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Petter Nielsen
Honest Christopher Kimaro
(Eds.)



Information and Communication Technologies for Development

Strengthening Southern-Driven Cooperation as a Catalyst for ICT4D

15th IFIP WG 9.4 International Conference
on Social Implications of Computers
in Developing Countries, ICT4D 2019
Dar es Salaam, Tanzania, May 1–3, 2019
Proceedings, Part II

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Preface

This book is a collection of papers presented at the 15th International Conference on Social Implications of Computers in Developing Countries (IFIP WG 9.4 2019 Conference) held in Dar es Salaam, Tanzania, May 1–3, 2019. The theme of the conference, “Strengthening Southern-Driven Cooperation as a Catalyst for ICT4D,” sought to stimulate and encourage critical discussions on the different facets of Southern-driven cooperation, its promises, potential for creating a better world, and the challenges we face in achieving the promised potential.

With the proliferation of ICT-related projects to support development, countries from the south are now emerging as important innovators and actors in the global development and adoption of ICT for community and economic growth. A good example is how Kenya and Tanzania have been leading the world with mobile payments for several years. The mobile payment services have supported micro financing and transformed economic activities and lives within the local communities and beyond. Such impacts offer an exciting setting for reverse innovation whereby lessons learned in ICT4D could offer rich insights for information systems research in general. Furthermore, strengthening a southern-driven cooperation promotes ICT initiatives and research carried out in and by developing countries. The conference, therefore, aimed at offering context-rich theories, methodologies and practical guidance on the use of ICTs to empower local communities.

Toward this goal, a request for track proposals was issued. After the evaluation we arrived at 11 tracks and two workshops, namely, Early Feedback to Early Career Researchers and the PhD Day Workshop. Only the research papers (97 full papers and two short papers) are included in this collection. The paper tracks were: Digital Platforms for Development; FinTech and Development; ICT4D for the Indigenous, by the Indigenous and of the Indigenous; Recognizing African Expression of Tech; Harnessing Agriculture; Land Administration and Public Financial Management for ICT4D; ICT for Displaced Population: How it helps, How it hurts; Communities, ICT-Enabled Networks, and Development; Pushing the Boundaries—New Research Methods, Theory and Philosophy in ICT4D; Southern-Driven Human–Computer Interaction; Locally Developed Process and Method Innovations in ICT4D; Sustainable ICT; Informatics, Education and Learning in a Turbulent World—“Doing the Safari Way.”

We received a total of 185 qualified papers from 46 countries, which were then sent for peer review. A double-blind peer review process was followed with each paper receiving an average of two reviews. The rigorous review process comprised 328 reviews, 248 of which came from 171 external reviewers. Of the 185 reviewed contribution, 99 were accepted and presented at the conference and are thus included in this collection.

For a large event like this conference to happen, a considerable effort by numerous individuals is required. We begin by thanking all the Program Committee members, the

local arrangements chairs, and 171 additional reviewers for their enormous efforts in reviewing the submitted papers. We also express gratitude to all the sponsors: the IFIP WG 9.4 (ifipwg94.org), International Network for Postgraduate Students in the area of ICT4D (IPID, ipid.se), University of Oslo (UiO), College of ICT (CoICT) of the University of Dar es Salaam, Tanzania Telecommunication Corporation Limited (TTCL), UNICEF Tanzania, and several others. It was a great pleasure to hold the IFIP WG 9.4 2019 Conference in Dar es Salaam, Tanzania.

May 2019

Petter Nielsen
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**Pushing the Boundaries - New Research
Methods, Theory and Philosophy in
ICT4D**



Southern Theories in ICT4D

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Abstract. This paper suggests that the dominance of northern research paradigms in ICT4D may be viewed as a continuation of colonial sway over the endeavors of the global South. The notion of Southern Theory - as introduced in the work of Raewyn Connell, the Comaroffs, and others - may be a route by which researchers in the global South can reclaim the intellectual territory of ICT4D, with indigenous and regional research paradigms and theories rather than those simply absorbed from the global North.

Keywords: Southern Theory · Research paradigms · Theory · Philosophy

1 Introduction

As pointed out by Heeks and Wall, “There is little overt engagement with research paradigms in ICT4D research but what there is shows a dominance of positivism and interpretivism” [1]. There is no reason why this should be so, nor, as this paper will argue, that the research paradigms to replace them should themselves derive from the scholarly traditions that brought us positivism and interpretivism in the first place. One route being explored by some ICT4D scholars is the Critical Realism inspired by British philosopher Roy Bhaskar [1, 2]. Rather than reiterate the possibilities of this route, this paper seeks to show that there are in fact many possible routes ICT4D researchers might take, in their search for alternative research paradigms, philosophies, and the theories that rest upon them. In this paper, we suggest both the philosophical backdrop and theoretical approaches of the global North originate and remain in the vein of colonial imposition, and that there is now an opportunity for philosophical underpinnings and theoretical tools more in keeping with the pre- and post-colonial global South to be unearthed, developed, and deployed, much to the enrichment of ICT4D as a discipline.

In the context of Avgerou’s three theoretical dimensions for ICT4D research - (i) theories of technology, (ii) theories of action, and (iii) “foundational theory that problematizes the notion of ‘development’” [3], this paper concerns most closely the third theoretical dimension, but with strong implications for our understanding of “the socially embedded capacity of people to act” [3] in the second dimension. As such, its arguments are closer to the realm of the highly influential ‘capabilities approach’ of Amartya Sen [4], focussing, however, rather on the local theoretical capabilities in development contexts, than on development per se.

ICT4D has a history of absorbing philosophical approaches and theories from outside of its own discipline. Despite this, the majority of ICT4D research seems to

prefer the safe territory of certain established paradigms, rooted in “a distinct academic, US-centric, business school-oriented, private sector focus, interpretive research method, systems development bias” [5]. Much research in ICT4D, according to two notable studies, among others, follows this path [6, 7].

In the absence of any alternative histories, embracing a different focus, many scholars in the developing world interested in theory are perhaps left wondering whether there is a place for them in a discipline dominated by such North American and European parochial concerns. However, there are rich seams of philosophical tradition all over the world, and potential theoretical models that could rest upon them, and a discipline dedicated to the fostering of what people living outside of the ‘developed’ world consider to be ‘success,’ can turn to scopes and measures of such achievement that, like the innovations they seek, are rooted in local context, rather than handed down from former colonial or contemporary economic masters.

In this paper, then, following a brief presentation of our research methods, we introduce the opportunity for the development of Southern Theories, and suggest a few alternative theoretical paths ICT4D scholars might wish to explore. We illustrate our new theoretical perspectives using a case study of cloud-hosted software service adoption in sub-Saharan Africa. Finally, we present some concluding remarks.

2 Methods

This research adds a new perspective to theoretical debates within the ICT4D community. Following our theoretical discussion, in order to apply our perspective and ground our thinking in an empirical context, we use a case study on cloud computing adoption in sub-Saharan Africa. The case study comprises secondary evidence, which we reinterpret for the purposes of our theoretical exploration.

Case studies enable the investigation of phenomena in a real-world setting, where it is not possible to manipulate variables [8]. We review published accounts of evidence collected, notably in the form of semi-structured open-ended interviews conducted with technology practitioners and executives in enterprises in Ethiopia and Nigeria.

3 Theoretical Context

Rather than simply apply one or more of the many already available philosophical paradigms and theoretical models from the global North to our Case Study, we offer a rationale for a search for something different – in regional and local guises - that might provide a fresh and more contextualised theoretical lens through which to understand the case.

The idea of ‘Southern Theory’ originates in Frantz Fanon’s classic 1961 book ‘The Wretched of the Earth,’ [9] and Edward Said’s 1979 ‘Orientalism’ [10], and 1993 ‘Culture and Imperialism’ [11], that together spawned the field of postcolonial studies. These studies are arguably right at the heart of Avgerou’s third theoretical dimension for ICT4D: foundational theory that problematizes the notion of ‘development’ [3]. They have concentrated, in the main, on the nature and effects of colonialism, and

postcolonial cultures in areas previously colonised, and the continuing legacy of the European colonial ‘expansion’ of previous centuries, and the more contemporary economic imperialism of the US, and China. The notion of social and critical theories originating and reflecting the concerns of the global South, as distinct from studies turning the social and critical theories of the north back upon themselves - what one might describe as indigenously ‘southern theories’ - is, perhaps, a more recent development, possibly as recent as 2007’s book of the same name, by Raewyn Connell [12]. Jean and John Comaroff, in 2012, have added to it with their book, ‘Theory From The South,’ [13] and de Sousa Santos in 2014 with his ‘Epistemologies of the South’ [14], along with a range of papers and other work highlighting the possibilities of a different view.

Raewyn Connell, introducing the notion of ‘Southern Theory,’ describes it straightforwardly as “a term I use for social thought *from* the societies of the global South. It’s not necessarily *about* the global South, though it often is.” [15]. ‘Theory,’ for Connell, in this context, does not refer to any specific theory, but to the broad spectrum of social thought and its range of different theories. Stressing the diverse nature of such thought, we like to think of it, for the purposes of ICT4D, as ‘southern theories,’ in the plural, and have titled our paper accordingly.

What, the reader might then ask, is the difference between theories from the global North and theories from the global South? The answer, for Connell, is in the ‘gaze.’ In her book, Connell outlines how classical sociology, as it is known in the ‘metropole’ of Europe and North America, is founded upon a creation myth cooked up in the 1950s, based upon a canon that distorts the history of sociology rather than faithfully depicts it. The backdrop of the ancient-medieval-modern sequence in European history, and the theories of progress which arose from it in the 19th century and came to define the new academic endeavour of social theory, had, by the end of the 19th century, in fact, as Connell tells us, settled upon the contrast between metropolitan and colonised societies as the central proof of ‘progress’ - the key motif of all social study at that time. The ‘imperial gaze’ of sociology ever since is one that Connell says ultimately “directs... attention away from analyses of the social world that come from intellectuals beyond the metropole.”¹ The ‘gaze’ of Northern Theory, for Connell, thus, is one tainted with colonial attitudes infused with notions of ‘progress’ in which the material culture and values of northern capital cities are the highest good and goal, and the more rural and colonised one’s culture the further one has yet to progress. Southern Theory – or theories - by contrast, would, therefore, perhaps be less concerned with such ‘progress’, less enrapt with city life and the needs and concerns of northern metropolitan living, and represent the needs and concerns of a more rural, agrarian, village-centred world-view, closer to the rhythms of the natural world. Connell is not suggesting that southern urban life would be excluded, but that southern rural life would not be excluded either.

The work of Vandana Shiva comes immediately to mind, the Indian scholar, environmental activist, and food sovereignty advocate, whose life’s work (including over twenty books) has been in the defence and celebration of biodiversity and indigenous knowledge, especially in the promotion of ‘seed freedom’: a rejection of

¹ [12, p. 25].

corporate patents on seeds. She is a key supporter of the notion of ‘alter-globalisation’ – an alternative approach to global economic cooperation that runs counter to the more established economic globalisation [16, 17].

According to Statista, in 2018 some 82% of North Americans lived in urban areas, and 74% of Europeans, compared to only 49% of those in Asia, and a mere 43% of those in Africa. Latin America and the Caribbean confounds this divide with 78% in urban areas – the sprawling urban conurbations (or megacities) of Sao Paolo, Buenos Aires, Rio de Janeiro, Bogota and Lima accounting for much of this high percentage. [18]. A focus on the more rural concerns of more than half the populations of Asia and Africa, then, could be one definition of what ‘southern theories’ could offer.

But the notion is perhaps even deeper than this, revealing broader assumptions at the heart of Euro-American thought concerning universality. As Comaroff and Comaroff succinctly capture it, in their introduction:

“Western Enlightenment thought has, from the first, posited itself as the wellspring of universal learning, of Science and Philosophy, uppercase; concomitantly, it has regarded the non-West - variously known as the ancient world, the orient, the primitive world, the third world, the underdeveloped world, the developing world, and now the global south - primarily as a place of parochial wisdom, of antiquarian traditions, of exotic ways and means. Above all, of unprocessed data.”²

Sociology and social theory as academic endeavors, in other words, are rooted in a very North American- and Euro-centric worldview. The sociological project to seek always to be able to make universal statements - to summarise experience in a way that can apply anywhere, at any time - is one that Comaroff and Comaroff roundly reject as a strategy for theory-building. Finding such an imperial gaze in the work of Coleman, Giddens and Bourdieu, each in their different ways, Connell shows how all of them rest their ideas fundamentally on experience and research in developed-world contexts, leading ultimately to what she describes as the utter ‘northernness’ of general theory. Comaroff and Comaroff likewise highlight how Euro-American social theory “has tended to treat modernity as though it were inseparable from... the rise of Enlightenment reason” and “a distinctively European mission to emancipate humankind from its uncivil prehistory.”³ The counter-history of European critical theorists who have spent their careers contesting aspects of or the very notion of the ‘Enlightenment,’ - for example Karl Marx, Hannah Arendt, Michel Foucault – seems, if anything, to underline this point.

For the world of development, it is important to recall, moreover, that sociological attention paid to the phenomenon of globalisation, began with the proclamation of ‘a new form of society’. The emergence of new sociological theories of that new ‘global society’ were based around the idea that boundaries were breaking down and new linkages were being created. The progress motif, of course, however, continued, expressing the spread of ‘global society’ as being the spread of this same Euro-American modernity. This sociological theory was paralleled by the neo-liberal

² [13, p. 1].

³ [13, p. 2].

ideology of the universal market, with all the imbalances of economic imperialism that accompanied it, so heavily critiqued by Vandana Shiva.

British sociologist Mike Featherstone was one of the lone voices sounding caution: “The process of globalisation, then,” he wrote, “does not seem to be producing cultural uniformity; rather it makes us aware of new levels of diversity. If there is a global culture it would be better to conceive of it not as a common culture, but as a field in which differences, power struggles and cultural prestige contests are played out” [19].

Connell’s project, then, is to foreground thinkers from beyond this metropolitan northern world. De Sousa Santos throws the oppositions of globalisation into sharp relief by positing a new ‘universal’ gaze from the south. Such ‘southern theory’ is thus not a branch of the northern social sciences wherein one is allowed to study non-northern contexts, such as anthropology. Nor is it development economics, or Area Studies, international relations, or the kinds of political economy which have spawned such ‘world-system’ approaches as Wallerstein’s. That globalisation “involved from the start a differentiated multistate economy” was a “great contribution,”⁴ but Wallerstein’s generalised analytical model for the concept of a social system was as fundamentally ‘northern’ as other globalisation theories. The geo-political logic of all such systems is to treat the majority world as the object of theory; theory undertaken by the subjects in the northern metropole.

By contrast, theorists based in and reflecting a truly southern gaze have an exceptional and extremely valuable - and pivotal - role to play in what ought to be a global intellectual project to approach an unbiased perspective. Perhaps, after Featherstone, such a perspective must inevitably be one that will, perforce, admit of a multiplicity of views, celebrating diversity for intellectual health as biologists celebrate biodiversity as a key determinant of the health of ecosystems.

Connell, Comaroff and Comaroff, and de Sousa Santos identify a fantastic range of thinkers from Australasia, Africa, the Islamic World, the Indian sub-continent, and South America, and we might also add that China and South-East Asia ought also to be considered in this light. There is not space in a conference paper such as this to cover even a representative sample of this incredibly diverse material.

For all that both authors of this paper, of course, are products, and denizens of the West, we are struck by how the more recent and diverse counter-history of Western (anti-Northern?) philosophy – e.g. Marx, Arendt, Foucault - seems to be crawling slowly, or as Jean and John Comaroff would say, *evolving* towards, a more (pre-colonial) African approach to personhood and social organization. One might equally point to Indian and Chinese pre-Western epistemological, philosophical and social positions and practices. These pre-colonial positions—the Confucian ethics of kinship and loyalty, the compassion and consensus building in Buddhism, the Shinto, Hindu and Bantu attention to how dynamic forces work through ancestors, places, and communities—all seem to share in common a sense of relationality, context, and contingency as foundational conditions of possibility for self-concept in ways those of us brought up in the context of the West’s ‘autonomous individuality’ find quite difficult to conceive. (Working with Chinese and Japanese businesses has required

⁴ [13, p. 67].

some interesting education for American businessmen!) The diversity, variety and difference between all of these non-Western positions around the world seems more in the manner in which this relationality is played out: the sense of connectedness is shared.

Alongside the contrast between northern capital cities and southern rural living, then, another fundamental difference between Northern and Southern Theories, we argue, is in the foundational philosophy of individualism that permeates in particular the Anglo-American model of Western dominance and universalism, in comparison with the far more relational and contingent philosophies of the global South. Theories resting upon each philosophy are likely to be completely different. The methodological individualism of the North, “a doctrine about explanation which asserts that all attempts to explain social (or individual) phenomena are to be rejected... unless they are couched wholly in terms of facts about individuals” [20] is bound to produce fundamentally different theoretical models to a relational and contingent philosophy. The belief that common ownership of a resource inevitably causes its demise, prompted by biologist Garrett Hardin’s flawed 1968 paper published in *Science*, famously entitled, ‘The Tragedy of the Commons,’ has been challenged and debunked [21]. As Locher describes it, such a ‘tragedy’ was “a misconception with no concrete basis, skewed by a highly ideological perception of social systems.” [22] The tragedy of the commons has been their disenfranchisement and impoverishment by corporate forces, not some half-baked theory that common ownership and control is always, and by definition, less successful or efficient than private ownership and control.

Southern Theories, in this sense, then, would be models based upon a philosophy of connectedness, of human kinship, and our responsibilities to one another. Doubtless the most famous such has to be the work of Amartya Sen, who wrested neoclassical economics from its methodological individualism and re-centred it upon a concern for the distribution of opportunities within society, upon non-materialistic calculations of human welfare such as health and education, and upon human freedoms far wider than the mere utility of income, such as participation in political activities, and living to old age. Sen’s individuals are connected, contextualised within a society that either supports or hinders them, both in simple monetary terms and in terms of other freedoms [4].

3.1 Southern Theories for ICT4D

So, if Amartya Sen and Vandana Shiva are to be considered exemplars, alongside a need for a focus upon more rural concerns and upon relationality, then there is already a clear guide to what Southern Theory is, and how to practice it. We could probably identify quite a few other writers in the field who are already (mostly) there. Prakash and De, for example, critiquing the meaning of ‘development’ through reference to dependency theory, and the neoliberal focusing of a great deal of such development on the interests of a Euro-American ‘centre’ around which the rest of the world must spin, rightly conclude that the findings in their study “should encourage ICT4D policy

makers and project designers to broaden their perspectives of what constitutes development and explicitly acknowledge the importance of development contexts in influencing the outcomes of ICT4D projects.”⁵

It is not the contention of this paper that the approaches of scholars in ICT4D who are not using what have we described as ‘southern theory’ are in any sense ‘wrong,’ or even ‘misguided.’ Yet, echoing the concerns of Bai [24], whose three-journal study wonders if the global South has “become a playground for Western scholars in information and communication technologies for development,” this paper nonetheless respectfully suggests that new theoretical directions for understanding the ICT4D context, and underpinning philosophical paradigms that might help it to flourish in continually changing circumstances, might best be sought for in traditions other than those of North America and Europe. “IT implementation projects” as Krishna and Walsham pointed out, “are not episodes disconnected from historical, organizational and economic circumstances from which they emerge” [25], and nor, necessarily, this paper argues, should be the theories and research paradigms through which they are analysed and understood.

Nor, importantly, is it our place, as northern theorists ourselves, necessarily to define what is or isn’t a ‘southern theory’, beyond the exemplars and the broad themes that we have tentatively outlined above. Our wish, in this paper, is rather to point out the opportunity that exists for scholars in ICT4D to seek out and to create theories rooted in southern values and philosophical paradigms, rather than northern ones.

4 Case Study – Cloud Adoption in sub-Saharan Africa

Cloud computing is a utility approach to providing computing services (such as storage or computation) using internet technologies. Cloud computing is characterised by providing essentially limitless access to scalable computing resources, often using a pay-as-you-go contract model [26]. Cloud computing has had a dramatic impact on the provision of computing applications and services to the public. Business start-ups, in the digital sector, can avoid the need to establish computer server infrastructure by purchasing pay-as-you-go computational services. A new server can be made operational within 5 or 10 min. The use of a free and open source operating system, such as Ubuntu, provides industrial strength services with long term support commitments, while eliminating license costs. The cloud reduces up-front capital costs for new business entrants. The elasticity of cloud services means that computational resource provision can be more accurately tuned to actual demand than is often possible when establishing in-house server provision. Software applications, in the global North, are increasingly accessed through a user-interface rendered using a web browser rather than downloaded or installed from disk.

Considering the adoption of cloud technologies in sub-Saharan Africa, there are obvious impediments in rural areas due to the lack of internet access (and telecommunications in general). However, the case study found evidence of awareness and

⁵ [23, p. 276].

adoption of cloud-hosted software services in urban areas notably in Nigeria, Ghana and Kenya. In these countries business owners valued the reliability of foreign data centres. Local server infrastructure is highly prone to damage from local power outages. Power outages come in the form of black-outs where power is lost but also brownouts where voltage is unexpectedly and arbitrarily reduced. Brownouts can be more damaging and are more difficult to manage for business consumers.

One key case study finding was the surprising difference in attitudes to cloud services between SMEs in the global South and global North. In the global North, the two issues of “security, privacy and trust,” and of “data loss” are considered impediments to cloud adoption. Businesses are reluctant to commit their data to a third-party. In contrast, the case study revealed that African SMEs are more concerned about local risks to security and data loss. The fear of local employee data theft meant that foreign cloud providers are perceived to be more trustworthy. Whilst US tech giant Microsoft now deliver cloud services across Africa from Cape Town and Johannesburg, Chinese company Huawei, notably, have won the contract to build Kenya’s government cloud infrastructure.

In this sense, cloud computing can be seen as the latest incarnation of colonisation and globalisation by powerful foreign commercial enterprises, with goods and services, in the form of computational and storage resources designed and implemented abroad and flows of payment finance out of Africa [27]. But an evolution toward China is visible, too.

In the case of Ethiopia, cloud technology adoption is much less common than the other parts of sub-Saharan Africa in the case study, impeded by lack of awareness, the history of state-run nationalised industries in the telecommunication sector and fear caused by the uncertain legal status of exporting local data to foreign server storage infrastructure [28]. Arguably, state monopoly ownership of the telecommunication sector has meant Ethiopia is much less open to these new forms of commercial colonisation.

So, what form might an alter-globalisation perspective take on a technology trend such as cloud computing? At a time when we might be concerned about centralising technology trends towards “Surveillance Capitalism” [29], we might instead focus on the indigenous African cloud hosted software services that have now started to emerge. For example, locally designed cloud hosted financial service products, notably pension portfolio investment products, have been developed in Ghana [30]. These fintech products are developed and marketed in Ghana for Ghanian and Nigerian consumers. Such providers benefit from low capital investment requirements and draw on the elastic and pay-as-you-go characteristics afforded by cloud-server hosting. Here the technology is supporting new, indigenous, entrants into the fintech market.

Initially, these indigenous services are hosted by foreign cloud service platform providers, though the financial service products are more closely aligned to local needs. However, we can also see evidence of indigenous cloud service platforms emerging. Specialist providers, based in the global South and serving local or regional markets, focus on the provision of high availability servers and use virtualisation to enable resource sharing and support elasticity. For example, cloudafrica.net is located in Johannesburg which, for South African consumers, eliminates the risks of undersea

cables through local hosting, keeps client data within their legal jurisdiction and mitigates foreign exchange costs by charging in local currency.

Hence, cloud hosting has the potential to create opportunities for “southern” improvisation and digital innovation. In commercial settings, reduced costs of (market) entry, eliminating capital expenditure for start-ups and pay-as-you-go models that can allow self-funded growth without significant investment funding create a uniquely level playing field for new entrants against (likely foreign) incumbents. We can predict that such benefits will eventually provide benefits to the co-operative and non-governmental sectors – the ‘sharing’ economy where the relationality of southern Theory might have much to teach us. We are already seeing cloud hosted open source not-for-profit applications in areas such as disaster management. We expect this trend into community-based initiatives will grow as knowledge about the benefits of cloud deployment become more widely disseminated.

Theoretical models that help us to understand trends outlined in the Case study, above, we conclude, might usefully turn both to the alter-globalisation and to the capabilities approach features being displayed, rather than, say, to maximising shareholder value for northern corporates. Further theoretical models – developed in the south – may tell us much more.

5 Conclusion

The power of the West has begun to decline, and the rise of both China and India as economic powers heralds a newly ‘multipolar’ world. But it is in Africa that the world’s population is growing at its fastest. [31]. By the mid-2020s India’s population is expected to have grown larger than China’s, and by 2050 Nigeria will have become the world’s third most populous country, behind India and China [32]. With a growth rate in 2017 of 3.2%, Tanzania is expected to be the sixth of the nine countries in which half of the world’s population growth will be concentrated over the coming decades. No fewer than 26 African countries are expected to at least double their current population by 2050.

In this newly ‘multipolar’ world, then, where if only by sheer weight of numbers the West’s decline will be accelerated, the Enlightenment project of general theory, expanded globally through colonialism, and then through neoliberal globalisation, will undoubtedly begin to find that its voice is not only not alone in trying to set the epistemological and philosophical agenda of global intellectual endeavour, but an increasingly contested voice, at that.

This paper, then, is a call to the community of ICT4D researchers to look further, in their search for methodological paradigms, theoretical lenses, and philosophical approaches in the various theoretical dimensions identified by Avgerou, than the canon of Euro-American academe, and to discover, explore, develop and promote ‘southern theories,’ indigenous sociology, African philosophy, Chinese philosophy, Indian philosophy, and more, in its analyses of what development is, and how information communication technologies – such as cloud-computing services - in development contexts can, should be, and are deployed.



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Combining Pragmatism and Critical Realism in ICT4D Research: An e-Resilience Case Example

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Abstract. ICT4D research is strongly oriented to practice but hardly ever explicitly uses the research paradigm of pragmatism. We argue that, though highly-relevant to ICT4D, pragmatism suffers some shortcomings in terms of its philosophy of the world, explanatory power, truth-testing, and values. We suggest that “pragmatist-critical realism” – a novel research paradigm combining pragmatism and critical realism – can address these shortcomings and provide a valuable foundation for ICT4D research; particularly action-oriented research. We outline a four-step operational methodology for pragmatist-critical realism based on a research project that created an “e-resilience” action plan applying ICTs to strengthen resilience of farming communities in Uganda. We hope other action- and design-oriented ICT4D researchers will be encouraged to assess whether pragmatist-critical realism could form a useful basis for their future research.

Keywords: ICT4D · Pragmatism · Critical realism · Methodology · Resilience

1 Introduction

The application of information and communication technologies to development (ICT4D) is highly practical. It involves real-world actions in the design, construction, implementation and use of digital technologies for the furtherance of development goals. ICT4D research is thus heavily engaged with practice since it must generally study, and sometimes directly involve these real-world actions.

While ICT4D research is thus often pragmatic – meaning oriented to practice – it is rarely pragmatist – meaning guided by the philosophy of pragmatism. Lack of engagement with research philosophies is a general characteristic of ICT4D research [16]. However, there are particular challenges with pragmatism: its dissimilarity to other paradigms, the diversity of views it contains, and its emergent shortcomings when applied. Our aim in this paper is: to explain one view of pragmatism; to argue that it may fruitfully be combined with the philosophy of critical realism in an attempt to

address its shortcomings; and to describe – as a set of methodological steps – an initial example of applying this “pragmatist-critical realism” in ICT4D research.

In the section that follows, we review key features of pragmatism and its combination with critical realism. We then explain the focal research case: an action-oriented research project seeking priorities for application of ICTs to improve resilience of a farming community in Uganda. The application of pragmatist-critical realism in the research is described before conclusions are drawn.

2 Pragmatism, Critical Realism and Pragmatist-Critical Realism

Research paradigms can often be understood as a kind of continuum. At one end is positivism: “The key idea of positivism is that the social world exists externally, and that its properties can be measured through objective methods rather than being inferred subjectively through sensation, reflection or intuition.” [8: p. 51]. At the other end is interpretivism: “the view that ‘reality’ is not objective and exterior, but is socially constructed and given meaning by people in their daily interactions with others ... [it] focuses on the ways that people make sense of the world especially through sharing their experiences with others via the medium of language.” [*ibid.*: p. 52]. In between are a number of middle-ground variants including critical realism: “the philosophical stance that what we experience are some of the manifestations of the things in the real world, rather than the real things” [30: p. 714] which combines positivism’s view that there is an objective reality with interpretivism’s view that our knowledge of that reality is socially-constructed.

A first challenge in explaining pragmatism is that it does not readily sit on this continuum because its fundamental interest is orthogonal to the continuum. The other research paradigms differentiate themselves around metaphysical questions of ontology: what the paradigm understands to be the nature of reality; and epistemology: what the paradigm understands about how we construct and evaluate knowledge about that reality. But pragmatism remains rather uninterested in such issues, “it is ... aimed at producing useful knowledge rather than understanding the true nature of the world” [21: p. 297] and “argues that concepts are only relevant where they support action. It considers research starts with a problem, and aims to contribute practical solutions that inform future practice” [30: p. 724].

A second challenge is the many varieties of pragmatism that exist, with variation along multiple dimensions including the shortcomings discussed below. To take just one example, when analysts have sought to extract a metaphysical position from the writings of pragmatism’s key thinkers, Dewey has been argued to be a positivist, Peirce a realist, and Rorty an anti-realist relativist [1, 25].

A third challenge is lack of engagement of ICT4D research with pragmatism. A search for literature identifying itself as ICT4D research and mentioning pragmatism found relatively few items overall, mostly using the term in its lay sense: asserting the

practical nature of ICT4D but not linking this to the philosophy. Of the remaining 11 items¹, seven make just a brief assertion that they are guided by the philosophy of pragmatism but without further explanation or exploration; and four provide only a little more detail identifying pragmatism as a relevant frame for ICT4D action and/or design-science-based research seeking to construct knowledge of practical utility. This very limited depth and breadth – without direct reference to the works of pragmatist philosophers – provides little basis for an understanding of what pragmatism means in ICT4D.

Within the limits imposed by these challenges, we identify three criticisms of pragmatism [3, 10, 20].

First, that its ontological and epistemological agnosticism means it can place anywhere on the continuum described above – as just noted, pragmatist “research may have considerable variation in terms of how ‘objectivist’ or ‘subjectivist’ it turns out to be” [30: p. 143] – or it can place nowhere; simply not engaging with ontology or epistemology. But having no set or defined position on ontology and epistemology is inconsonant with the actualities of research: as researchers, we all have a position on this, even if implicit, that guides our analysis. And that position is relatively invariant: we cannot jump back and forth between being a positivist and an interpretivist just because that proves differentially useful for different research; any more than one can flip-flop between being a Christian and a Muslim. So it will be appropriate for any research paradigm to include a metaphysical position or at least require researchers to clarify their beliefs about “the true nature of the world”.

Second, while pragmatism aspires to “transferability” of knowledge from one context to another [23], it provides no necessary explanatory foundation for this. It can demonstrate that a particular solution has worked in a particular context, but it cannot explain why the solution has worked; e.g., thus severely limiting the confidence with which solutions can be recommended for other contexts. Put another way, pragmatism’s belief that the truth of any knowledge lies in its practical utility provides a very shallow basis for that truth: a house built on sand that is easily washed away; particularly as utility can only be proven or disproven post-hoc by implementation.

Third, pragmatism is relativist in its judgement of practice, despite the strong engagement of many of its founding fathers with questions of ethics [*ibid.*]. It orients itself towards “what works” but has no inherent values or guidance about the implications of this. Issues of whose problems are attended to, of who wins and who loses from practice, may be addressed but pragmatism provides no inherent judgement on the answers.

2.1 Pragmatist-Critical Realism

In this paper, we argue not merely that critical realism is commensurable with pragmatism but that explicitly recognising their intersection as a variant research paradigm – pragmatist-critical realism (PCR) – will help address the shortcomings of pragmatism alone. PCR would be defined as a research paradigm based on our socially-constructed

¹ Notably eight of the eleven items linking ICT4D research to the philosophy of pragmatism were from South Africa-based authors.

experience of the manifestations of an external, independent reality that aims to provide practical and emancipatory solutions to problems of inequality.

Generally, we argue commensurability of critical realism and pragmatism on three grounds. First, philosophically that pragmatism’s orthogonality to the metaphysical paradigm continuum – e.g. its agnosticism about ontological issues – means there is no barrier to combining it with a paradigm on that continuum. Second, teleologically, that pragmatism and critical realism can be seen to share a similar purpose as a “third way” between positivism and interpretivism: critical realism in an ontological and epistemological sense [31]; pragmatism in a methodological sense [23]². Third, developmentally that 21st century writings on pragmatism – including attempts to respond to the three shortcomings through some reinterpretation of pragmatism – are actually fusing the ideas of critical realism and pragmatism; up to the point where a very few writers have now made explicit this potential fusion [6, 19].

Specifically, in terms of the three shortcomings identified above, PCR would assert a stable ontological and epistemological position: that of critical realism³. This adopts a three-level stratified ontology (see Fig. 1). The real domain has an objectivity independent of human thought and includes generative mechanisms: “causal structures that generate observable events” [17: p. 911]. The actual domain contains events: “specific happenings resulting from causal mechanisms being enacted in some social and physical structure within a particular ... context” [33: p. 939]. The empirical domain

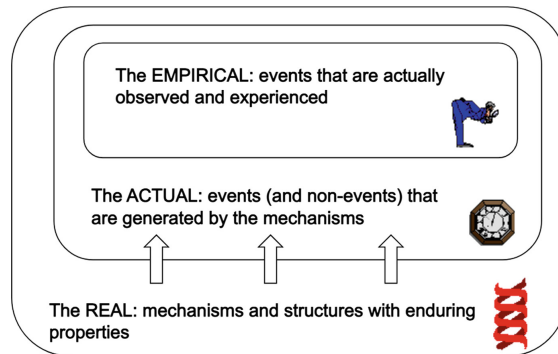


Fig. 1. Stratified ontology of critical realism [22]

² Some authors go further and interpret this as a metaphysical commensurability e.g. “Dewey [7] describes pragmatism to be based on both realist and idealist metaphysics. Pragmatism accepts things and events as existing independent of any observers, but at the same time emphasizes reason and thought as originators of elements in the external world. Goles and Hirschheim [13] describe pragmatism as taking a middle or dual position between positivist and interpretivist ontologies.” [12: p. 141].

³ Material here on critical realism summarises from Heeks and Wall [16], which should be referred to for further detail.

encompasses human experiences and observations of the events generated within the actual, with those experiences being not objective but shaped by their context.

PCR would look to the causal mechanisms of the real domain to provide a stronger foundation for explanation of the practical outcomes observed from any intervention. The posited existence of such mechanisms would more-readily allow a convincing basis for cross-context generalisation of those outcomes, and a greater credibility for building a consensus around the value of particular interventions (consensus-building being a key test of validity within pragmatism⁴). Phrased differently, PCR integrates two bases for truth-testing particular knowledge-claims – which could be a concept, idea or intervention (see Fig. 2). From critical realism, validity is strengthened by a gradual accretion of triangulated evidence in different contexts that supports the existence of proposed mechanisms. From pragmatism, validity is strengthened by gradual accretion of practical applications of knowledge in different contexts that achieve the intended practical purposes. Together – both sides of Fig. 2 being active during action research – validity is strengthened by gradual accretion of triangulated evidence in different contexts that proposed mechanisms achieve intended practical purposes.

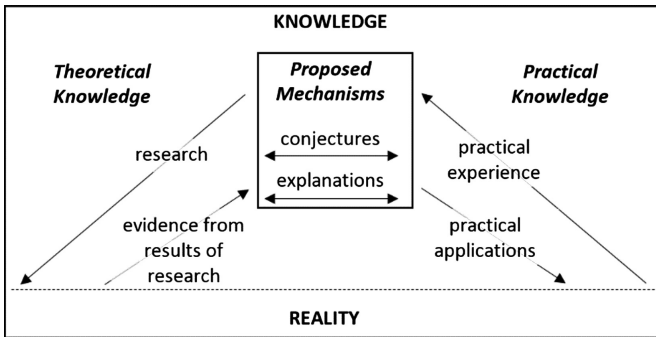


Fig. 2. Knowledge-building under PCR (adapted from Johnson and Duberley [19])

In terms of the third shortcoming, PCR moves pragmatism away from its relativistic view of purposes by drawing on the axiology of critical realism: what it does and does not value in research. Critical realism is “specifically driven by the values of emancipation. This means recognising the way in which the social structures and mechanisms of the real domain can sometimes serve to generate events and processes that are oppressive and outcomes that are unequal” [16: p. 4]. PCR thus delimits its purposes and judges practice on the extent to which it generates events and processes that counter oppression and on the extent to which it generates pro-equity outcomes.

⁴ We also believe that a realism-based approach to ICT4D work is more likely to build consensus within the ICT4D community than a constructionist approach given the great bulk of publication in the field adheres to some form of realism [14], suggesting a preponderance of realist worldviews within the ICT4D research community.

Finally, we can flip the main line of argument, and look for ways in which pragmatism addresses shortcomings within critical realism or, at least, adds value to critical realism. More work is needed here but one dimension to this is critical realism's link to practice. While the philosophy is sympathetic to and engaged with practice [28], it is not always applied in a practical way – for example, being applied to retrospective analysis of projects [24]; and sometimes applied to theory-oriented research [32]. The integration of pragmatism strengthens this engagement, and strongly encourages that ICT4D research be action research. This practical action would also be the only way to deliver on critical realism's axiological aspirations to emancipate those afflicted by structures of oppression and inequality.

3 Pragmatist-Critical Realist Methodology Overview

There are a number of potential starting points to provide the structure for a pragmatist-critical realist methodology. These are relatively easy to identify for critical realist methodology with the recent appearance of operational guides including:

- Four-step methodology: Description of events, Identification of entities and associations, Abduction (theoretical re-description), Retroduction [4].
- Six-step methodology: as four-step plus Analysis of mechanisms (affordances), and Assessment of explanatory power of mechanisms [5].

“Pragmatist methodology” as such is rarely identified but it is associated with three threads:

- Mixed-methods methodology [9], combining qualitative and quantitative methods in some way⁵.
- Action research methodology [29], such as the action research cycle Plan – Act – Observe – Reflect [34].
- Design science research methodology [18], such as the three-cycle approach of Relevance – Design – Rigour [*ibid.*] or the six-step approach of Problem – Solution – Design/Development – Demonstration – Evaluation – Communication [27].

In this case, we have chosen to use the action research methodology as the skeleton into which to integrate elements from the other methodologies but we acknowledge this as just one possible approach that could be taken.

We operationalise this in Sect. 4 through a case study relating to resilience-building; a topic that has risen sharply up the international development agenda in recent years; particularly in terms of strengthening the resilience of communities [35]. We define resilience as “the ability of a system to withstand, recover from and adapt to short-term shocks and longer-term change” [15: p. 75], and undertook action-oriented

⁵ Though arguably the association of mixed methods ought to be stronger to critical realism – where they can be seen as a requirement for validation of mechanisms [16] – whereas under pragmatism, methods are judged on their practical value rather than there being some inherent requirement to mix quantitative and qualitative [2].

research on resilience-building in Uganda and Costa Rica with a particular focus on community resilience to climate change.

The project reported here was based in the Uganda coffee-farming region of Mbale; around Mount Elgon. This has been particularly affected by climate change manifestations: more frequent droughts, a rise in average temperature, and increase in heavy rainfall and consequent floods and landslides [26]. Coffee farming is especially susceptible to climate change and so increasing resilience of farming communities to this and other wider shocks and change is seen as a development priority [*ibid.*].

We worked with farmer cooperatives in four areas around Mount Elgon: Bukalasi, Bumayoga, Busamaga and Konokoyi; those cooperatives belonging to the Gumutindo Coffee Cooperative Enterprise (GCCE). GCCE was set up in 1998 to try to improve the incomes and wider livelihoods of smallholder farmers. At the time of our project, it had 7,000 farmer-members and was being supported by Lutheran World Relief (LWR). LWR and GCCE both had strategic concerns about climate change and resilience. But they also saw opportunities based on the growing use of ICTs, mobile phones particularly, in the Mbale region. It was for this reason that we were engaged with the project described next, with what we identified as a pragmatist-critical realism-based approach.

4 Application of a Pragmatist-Critical Realist Methodology

Below, we explain the steps of an applied PCR methodology both in general and then case study-specific terms.

1. Plan

1a. Clarify Generic Problem and Emancipatory Purpose

In this step, researchers specify some emancipatory purpose for the action research project relating to a broad problem – e.g. lack of freedoms, equality or justice for a group – including details of for whom and in relation to what the problem exists. For the Uganda project, the generic problem was lack of resilience of low-income farming communities, hampering their ability to cope with environmental and other changes. The overall purpose was thus to increase community resilience. As with later steps, this could often be a participative, even bottom-up activity. In Uganda it was determined as part of a pre-existing and wider project of work that had engaged the community.

1b. Identify Specific Problem and Purpose of Intervention

In this step, the researchers identify a specific problem currently seen as hampering the overall emancipatory purpose. In the Uganda case, this was the increasing impact of climate change and variability on farmer livelihoods and, alongside this, the growing role of ICTs. One could either interpret current limited use of ICTs to support resilience as a problem, or flip this to see potential greater use in future as an opportunity. The specific purpose of the intervention then became to create an “e-resilience action plan”: a set of priorities that would make best use of ICTs in order to increase community resilience, especially resilience to climate change.

1c. Identify Proposed Mechanisms for Solution

PCR favours an abductive approach: iterative combination of inductive and deductive reasoning moving back and forth between data and theory⁶. The starting point for iteration could be data (an inductive-first approach in which mechanisms only emerge out of action research) or theory (a deductive-first approach in which mechanisms would precede and guide action research)⁷. For the Uganda project, we chose the latter, conceptualising resilience as a set of eight attributes known as the RABIT (Resilience Assessment Benchmarking and Impact Toolkit) framework⁸. Three foundational: robustness, self-organisation, learning; and five enabling: redundancy, rapidity, scale, diversity and flexibility, and equality. Attributes are understood as synonymous with mechanisms: “potentials of a system which, if enacted, would lead to events that would in turn impact the system” [15: p. 78].

Our primary purpose of PCR-based research would not be to verify the presence of the proposed mechanisms (that would be a secondary purpose) but to understand their nature in the specific context in order to guide practical action. With that in mind, we operationalised each of the attribute-mechanisms as a set of three illustrative markers: “observable characteristics for each attribute again derived from the ecological literature on resilience” [ibid.: p. 78].

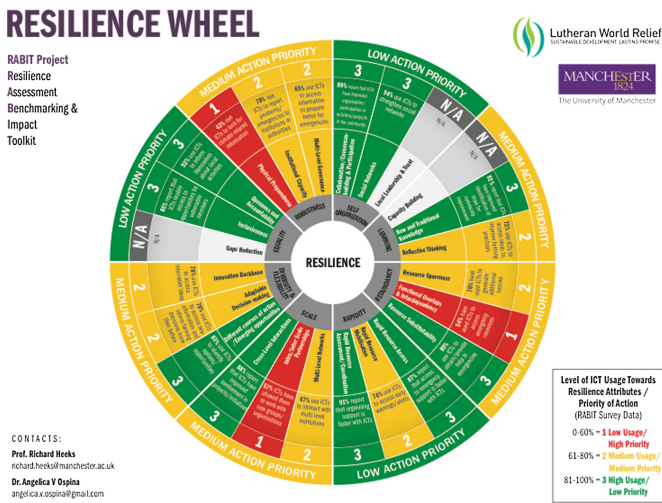


Fig. 3. Example visualisation of findings [26]

⁶ The emphasis on iteration is slightly different from the interpretation of abduction by some critical realists [e.g. 4, 11] which emphasises induction more than iteration, seeing abduction as an activity after fieldwork that moves from the empirical data to the re-description of that data “using theoretical concepts” [ibid.: p. 188].

⁷ In the terminology of critical realism, the former is a retrodiction-first approach, the latter a retrodiction-first approach [36].

⁸ Material here on resilience summarises from Heeks and Ospina [15], which should be referred to for further detail.

1d. Design Intervention and Methods

This step involves the design of the mechanisms-based action intervention, including any associated research methods for implementation and evaluation. Consistent with the tenets of both critical realism and pragmatism, PCR would favour mixed methods action research. In the Uganda case, and in order to build the e-resilience action plan, we designed a two-part process:

- First, benchmarking the current state of community resilience generally (i.e. the strength or weakness of resilience attributes) and then e-resilience specifically (i.e. the current level and nature of impact of ICTs on the attributes of community resilience). Data for this part was to be gathered through: (i) a questionnaire survey undertaken with a cross-sectional sample of farmers; (ii) semi-structured interviews with a purposive sample of farmers, community knowledge workers and cooperative staff; (iii) focus groups with farmers and with cooperative staff.
- Second, analysing, visualising and reporting back these findings to the community to enable the action plan to be developed. This was to be undertaken through two participative workshops: one in Kampala intended to identify national-level actions; one in Mbale intended to identify local-level actions.

2. Act

In this stage the intervention is enacted. In the Uganda case, we surveyed 54 farmers, undertook 16 interviews and five focus groups (three with farmers, two with cooperative staff). Findings were then visualised (see Fig. 3), and presented to the two participative workshops.

3. Observe

In this stage, the outcome of the action research intervention is observed and evaluated – both its research and its action components – with the evaluation of the latter potentially requiring additional research. In the Uganda case, alongside many interim outcomes such as the visualisations of findings, the final outcome was the e-resilience action plan. A sample of this is shown in Table 1.

Table 1. Part of e-resilience action plan

Attribute/Marker	Intervention
Rapidity/Rapid resource mobilisation	Develop effective early warning system combining diverse communication methods and technologies (SMS, radio, etc.)
Scale/Resource access and partnerships	Foster farmers' ability to make use of external weather information from broader-scale organisations such as FEWSNET

4. Reflect

In this stage, the validity of the knowledge-claims is assessed using the two-part approach shown in Fig. 2: via iterative cycles of abductive reasoning between data and mechanisms, and also through evaluation of the intervention outcomes against emancipatory purposes. This latter would orient towards measures of freedom and equality, and to the “*cui bono*” question of who benefits (and who loses) from the intervention.

In the Uganda case, the former was the stronger of the processes. Findings from this and the parallel Costa Rica case suggest that the framework of attributes does “provide insight into aspects of the system (i.e. community) that all in some way relate to withstanding or recovering from or adapting to short-term shocks and longer-term change. ... The findings show that each attribute identified at least some element of life within the community and some use of ICTs that was not found by any other attribute. Since all relate to coping with shocks or trends, this suggests all are necessary to a resilience framework. There is some evidence that they are sufficient: the more open-ended group interviews did not throw up anything that could not be related to one of the RABIT framework resilience attributes.” [15: p. 89]. The validity of the proposed mechanisms is further strengthened by the demonstrated transferability of the framework between two different contexts.

In practical terms, our overall emancipatory purpose was to increase the resilience of low-income farming communities beset by climate change. The intervention did not do that because, of course, this would require enactment of the e-resilience action plan; something which post-dates our particular package of work. However, the plan did identify and prioritise a series of practical resilience-strengthening actions. Some of these were incorporated into the strategic plans of both LWR and Gumutindo Cooperative, and implemented.

5 Conclusions

Pragmatism has much to recommend it as a research paradigm for ICT4D research because of its congruity with ICT4D’s practical orientation. However, it has some shortcomings. These can be addressed in various ways but our proposal in this paper is that combining pragmatism with critical realism provides a valuable new philosophical foundation for ICT4D research.

Pragmatist-critical realism is something of a chimera⁹, combining a pragmatist orientation, a realist metaphysics, and a critical axiology. No doubt one could readily fall down a rabbit hole of arguments about logical congruities and exact interpretations. But those joys can be postponed for a later day: here we provide an initial outing for PCR; identifying how it might be operationalised by illustrating its use on a project linking ICTs to community resilience-building in Uganda.

Ideally, that project would have had a stronger action component – putting our action plan into practice rather than just creating the plan – and we acknowledge this limitation. We also acknowledge that recognition of our PCR approach was emergent from and retrospective to the project rather than shaping it from the start. Our work thus provides a first pass at a PCR methodology; something to be refined in future through *pre hoc* application to other action research projects.

We have linked PCR strongly to action research; seeing action research as a preferred element of PCR; conversely, seeing PCR as an appropriate foundation for action research. For those undertaking ICT4D action research, we thus recommend they

⁹ A mythical beast that combined parts of a lion, goat and snake.

consider pragmatist-critical realism as an underpinning paradigm. We do likewise for those entering the ICT4D field from related directions, e.g. those embracing a design science approach and those for whom mixed methods research is their starting point.

We look forward to further applications, revisions and critiques of the pragmatist-critical realism paradigm.

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Digital Development: Elements of a Critical ICT4D Theory and Praxis

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Abstract. In recent years, critical research literature in ICT4D has grown. It is widely accepted that theory is to inform practice. However, the inverse directionality, practice informs theory, is much less present in ICT4D, including in critical research. In this paper, we discuss ways how ICT4D research and theory may be better informed by practice—in terms of (i) recognizing praxis-oriented research paradigms and integrating their results, (ii) development of foundational theories, (iii) critical analysis of ICT4D emerging policies, and (iv) positioning ICT4D in the wider development debate. This suggests several elements or directions in which critical research has the potential to push current boundaries of ICT4D in terms of content as well as relevance.

Keywords: Principles for Digital Development · Critical research · Action research paradigm · Network complexity theory

1 Introduction: Critical ICT4D Research

Recent years have seen a growing stream of critical ICT4D research. It is broadly compatible with suggested guiding ‘Principles for Critical Research in Information Systems’ (IS), as proposed in [1], and applied to ICT4D in [2]. The first principle formulated is: ‘The principle of using core concepts from critical social theorists’.

Recent ICT4D research references a variety of critical social theorists, including Habermas [3], Bourdieu [4, 5], Freire and Sen [6], Escobar and Spivak [7], other postcolonial theory [2], and Foucault, who is a key reference point for many postcolonial authors themselves (*e.g.*, Escobar [8]). The general pattern in this literature can be characterized as: (i) *selecting* a specific critical perspective (in particular, a critical theory author); and (ii) *applying* this to ICT4D empirical case studies so as to provide a critical interpretation of an ICT4D practice case - usually with a local focus.

In view of recent discussions of the future ICT4D research agenda, calling for a stronger inter/transdisciplinary approach and for increased relevance and impact [9, 10], and in view of the above-noted apparent one-perspective and one-directionality of theory to practice in current literature, this paper suggests some directions for critical research to push the boundaries of the ICT4D state of the art.

In particular, we discuss ways how ICT4D research and theory may learn from and be better informed by practice – in terms of (i) recognizing praxis-oriented research paradigms and integrating their results (Sect. 2); (ii) development of foundational theories (Sect. 3); (iii) critical analysis of emerging ICT4D policies (Sect. 4); and (iv) positioning of ICT4D within the wider development debate (Sect. 5).

2 Praxis: The Action Research Paradigm and Its Principles

Experiential Knowledge, Including from the South. A first element suggesting a direction to strengthen critical ICT4D research consists in forging a stronger exchange between theory and practice. It is widely accepted (even taken for granted) that theory is to inform practice. The inverse directionality, practice informs theory, is however much less present in ICT4D research.

Admittedly, many insights from ICT4D practice are not available in the easy format of (rigorous, peer-reviewed) scholarly publications as ICT4D theoretical work is. If practitioners publish at all, their work is rather considered as contributing specific case studies (*i.e.*, having no or limited bearing on general scientific theory), or as ‘popular’ (*i.e.*, non-scientific) contributions such as one finds in the wide-ranging, relevant and interesting (also for scientists) ICT4D practitioners blog *ICTworks* [11].

It would be severely limiting, however, for ICT4D research to ignore or play down such sources of knowledge. For example, whereas in theory of ICT4D discourse the contextuality of IS and ICT4D systems is often stressed *in abstracto*, in accounts of practice one finds ample examples of real-world contexts *in concreto* and, moreover and highly importantly, how one can actually deal with such *contextuality on-the-ground*. Moreover, much practical knowledge is action-oriented, experiential and often tacit in nature (phronetic, to use Aristotle’s terminology), as is indigenous knowledge relevant to big societal domains (*e.g.* agriculture, medicine) where ICT4D purports to make a difference. In general, as forcefully argued by Boaventura de Sousa Santos [12], the Global North may learn a lot from *epistemologies of the South* (see also [13–20]). We submit that this also definitely applies to ICT4D and IS.

Action Research as a Distinct ICT4D Research Paradigm. A step forward would be to recognize that there is a broader range of research paradigms that are valuable in IS and ICT4D, where to date positivist, interpretivist/constructionist, and critical research paradigms have met with ‘official’ scientific recognition, witness [1, 21, 22].

However, this does not at all exhaust the range of research paradigms that are valuable. In particular, there has been already for a long time a small but steady stream of action research [23]. In ICT4D, published action research comprises, *a.o.*, long-standing work from Oslo in Health Information Systems in several countries [24], in South Africa in a variety of domains [25–27], and from Amsterdam related to rural development (regreening [14]) in the Sahel [28, 29]. Action research represents a family of approaches, but in development (the D of ICT4D) it has a clear genealogy dating back to the work of (critical social theorists in their own right as) Fals Borda [30], Freire [31], and Chambers [32].

Participatory action research in IS and ICT4D constitutes a different and separate research paradigm, as it has underlying guiding principles that are significantly different from those of positivist [21], interpretive [22], and critical [1] research, as concisely shown in Table 1. The various points made there can easily be illustrated by the referenced action research literature in ICT4D in this paper as well that outside this domain. Comparing action research with the guiding principles of critical research [1], similarities (Principles 1, 2, 6) as well as differences (Principles 3, 4, 5) are noted.

Table 1. Guiding principles of the action research paradigm (Source: authors).

No.	Principle
1	Principle of Critical Investigation of Concrete Situations (field, professional practice)
2	Principle of Value : Developing/Taking a Value Position (democracy, emancipation, autonomy, social and economic betterment)
3	Principle of stakeholder Collaboration (involving Co-Investigation, Co-Design, Co-Creation, whereby goals and interests as seen by stakeholders themselves are central)
4	Principle of Dialogue (between multiple actors and stakeholders (to be) involved)
5	Principle of Action : Discovery and subsequent Realizing Change for the Better
6	Principle of Reflection and continuous Learning in Action

3 Foundational Theory: Network Complexity in Sociotechnical Innovation

ICT4D Action = Sociotechnical Innovation. ICT4D research has an important role in doing critical groundwork leading to a better theoretical understanding of the many real-world phenomena and their interactions that together are constitutive of the field of ICT4D and Digital Development. Learning from practice delivers new insights also for general theory. A key starting consideration that we put forward here is that any ICT4D action and any form of Digital Development – even if it employs established, so-called ‘non-advanced’ ICT technology (*e.g.*, radio, GSM mobile) – unavoidably entails fundamental and strongly interlinked processes of sociotechnical innovation.

Overseeing the research (as for example cited above) that has a long-term connection with practice on the ground, one finds a general and acute awareness of this key point. A recurring theme is that change is not a linear and direct effect caused by introduction of new technology, which can be measured and evaluated in terms of predetermined goals, (ideally) by means of straightforward pre/post randomized controlled trial quasi-experiments (as simple-minded policies but also positivist science would like to have it, even today).

Instead, basic research needs to theorize the deeply intertwined social (overlapping local *and* global, communal *and* policy/political) aspects as well as technical aspects. This involves ICT/IS *design and engineering*, but also the associated specific ICT technologies *affordances* and the subsequent much broader struggles over the pathways of innovation that are to lead to betterment of people’s lives and livelihoods.

Network Complexity Theory. Related reflective work in ICT4D action research repeatedly (and independently) points to ‘nonlinear’ (sociotechnical) network complexity theory as a fruitful foundational theory. For example, Braa *et al.* [33, 34] invoke complexity theory to achieve a better understanding of the ‘networks of action’ involved in health IS in developing countries. As another example, Bon [29] employs network complexity theory and discusses smallholder and family farmer innovation in the Sahel [14] and the roles of ICTs in scaling communication and knowledge sharing between smallholder farmers *both* as a Complex Adaptive System (CAS).

It is worth noting that complexity theory is proposed as a fruitful foundational theory also elsewhere in the field of development, and moreover by authors that are very differently positioned in the critical social theory debates. Ramalingam [35] offers, based on complexity theory, a book-length critique of the still predominantly linear thinking in development circles. Chambers, in recent work, *e.g.* [36], regularly refers to complexity theory, in the setting of sustainable livelihood analysis in an extended sense (also *nonlocal*, and ‘*bringing politics back in*’) as recently discussed by Scoones [37], and long ago already by Bernstein *et al.* [38]. Postdevelopment author Escobar refers to complexity theory at length in his very recent work [19], especially in relation to the struggles of indigenous and Afro-descendant peoples in Colombia and other Latin-American countries. Struggles, we note, that are actively supported by academic researchers through various forms of action research (here, Fals Borda’s influence is clearly visible), called ‘collective research and action’ (*investigación y acción colectiva* (IAC)).

Finally, the name of Rogers, through his famous Diffusion of Innovations Model (DIM), has for a long time been associated with the linear technology transfer and diffusion models that were (and still are) *en vogue* also in development policies. Historically this is not unjustified (as reflectively acknowledged by Rogers himself in later editions of his DIM book), but it does not do proper justice to the later DIM theory. In fact, in a (posthumously published) article Rogers *et al.* [39] discuss the DIM model in the light of Complex Adaptive Systems theory, and reach the conclusion that DIM and CAS can be very well brought into a co-theoretical model, with a pivotal conceptual role for heterogeneous and differentiated social networks and the associated ‘*strength of weak ties*’.

Complexity vs. ANT. It is interesting to ponder why so many different authors with significant participation in practice independently come to refer to complexity theories as a useful framework. One may flesh this out also by comparing it to features of another theory that has gained some traction in recent ICT4D and IS theory [9]: actor-network theory (ANT). What is appealing across the board is the notion of mixed, heterogeneous social and technical networks. For ICT this is even more obvious as it is a network technology itself, but evidently it is not limited to such cases. We note that taking as central the network viewpoint is an important conceptual step. Namely, it implies that individuals are not in the first place taken as entities (object classes in UML or database terms) with (locally held/owned) identifiable individual properties or attributes, or privately holding utility functions as in mainstream economic market theories. Instead, already in formal-mathematical network theory, an individual or node is (in the limiting case) simply the nexus of its relations (links, ties) to other nodes.

Thus, network theory implies an inherently *relational* ontological view on the human species and also on its technologies, a point elaborated by Escobar in [19].

Directly relevant to ICT4D, there is, by the way, an interesting (and even explicit) link here with early groundbreaking work from computer science – in particular at the intersection of Artificial Intelligence (AI), knowledge engineering and systems (KE/KBS), and Human-Computer Interaction (HCI) – regarding systems Design Thinking [40]. Given current trends in ICT4D donor programs to launch cutting-edge Digital Development initiatives concerned with the latest ICT technology advances ('Big Data' 4D, 'IoT' 4D, 'Blockchain' 4D, 'Drones' 4D, 'AI' 4D, *etc.*), renewed reading of Winograd and Flores's (1986) seminal work would be insightful also for today's ICT4D and IS research.

Where complexity theory and ANT depart is foremost in two specific assumptions made by ANT (see also the discussion by Walsham, *cf.* [9]). In a sort of putting postmodernism (that celebrates the notion of 'difference' as against essentialism and 'totalizing') on its head, it ontologically erases all differences between agents, human actors and technologies, and moves everything into a flat world of 'actants'. This sounds indeed extremely 'radical' and potentially theoretically innovative. But, for many it begs the question what interesting analytical progress can be made as a result of such an assumption. In ICT4D and IS many (practitioners as well as researchers) would tend to say that paying careful attention to differences is actually key to doing justice to the diversity of contexts in which systems have to function to benefit. Secondly, ANT has strongly the flavour of a purely microscopic theory. It does not want to allow in or recognize pre-existing larger structures (*e.g.*, of power or other field-like social theories). Rather, it expresses the ambition to generate them dynamically (when it is said that power is the variable to be explained). But to date it has not been very successful here, as it lacks a clear proposal what the generating mechanisms are. It is worthwhile to quote here a critical comment (referring to postmodernism, constructionism, poststructuralism) by Mbembe, a postcolonial author 'writing Africa':

"On the pretext of avoiding single-factor explanations of domination, these disciplines have reduced the complex phenomena of the state and power to 'discourses' and 'representations', forgetting that discourses and representations have materiality" ([41], p. 7).

Complexity theory does in our view a much better job here. It does not have a problem to recognize that there are initial conditions that represent the pre-existence of power and other structures and, unlike ANT, it does propose ways to generate macroscopic structure from what appears to be randomness or even chaos at the microscopic level. It is *precisely* the interaction between (local) microscopic behaviour and (global) macroscopic structural features that can trigger specific forms of emergence and self-organized structures (something completely overlooked by ANT). This is very visible especially in the many bio-ecological models of complexity, but it is already present in the early (1960's) complexity theories in physics and chemistry (cooperative 'synergetic' phenomena in lasers (Stuttgart, Haken *et al.*) and emergent macroscopic structure in chemical reactions ('order out of chaos', Brussels, Prigogine *et al.*). Very recently, like-minded Web Science research has emerged concerning the digital sphere, thus directly relevant to ICT4D and IS, such as on the World Wide Web as a complex adaptive system [42].

Thus, network complexity theory appears to much better than ANT correspond to the everyday realities (including structures and power residing in-between as well as emanating from various above) as felt on the ground by ‘the poor’ and ‘the unconnected’, and also as experienced by practitioners and researchers in the field.

4 Policy and Practice: The 9 Principles for Digital Development

Implementation Principles. If ICT4D research would like to escape the harsh verdict by Harris [10] that much of it lacks relevance and fails the poor, there is a pressing need to address policy issues as to what the ‘4D’ in ICT4D is supposed to mean. Also here academic research may be informed by and learn more from practice.

As a specific recent policy relevant to ICT4D, we refer to the emergence of the notion of ‘Digital Development’ [43, 44] and the associated so-called *9 Principles for Digital Development* [45]. Importantly, there is an evident aspiration here to acquire some sort of canonical (normalized, naturalized) or even hegemonial status with respect to defining and implementing ICT4D-related policies –witness the explicit push by especially USAID for development organizations to officially express and even sign formal adherence to these principles.

This should be all the more reason for ICT4D research and its hoped-for relevance to critically analyze such tendencies. Whether the orientation is toward academic scholarship, real-world research, practice, or policy, ICT4D has no choice but to reflectively position itself in such debates [46].

Key Principles for Digital Development are formulated as “*Be Collaborative*”, “*Design With The User*”, “*Understand the Existing Ecosystem*”, “*Build for Sustainability*” [45]. They are presented (by USAID) as new and as a radical break with conventional development policy. Abstracting from ICT technologies, one is reminded of earlier periods (1980/90’s) where conventional development policies were intellectually and politically challenged in different ways [32, 47], studies to hear the bottom-up *voices of the poor* were commissioned, and grassroots livelihood approaches entered the scene at the policy level. Collaborative work, putting the poor, the marginalized, the unconnected at the centre, were then, and are now, undoubtedly highly desirable Principles, also for Digital Development and ICT4D.

Statements of principle as indicated above obviously express good intentions. Good intentions alone, however, do not yet settle the matter. What ultimately matters is how they are translated into meaningful action on the ground. Current ICT4D academic literature is not of much help here. It has a tendency to relegate ICT4D practice on the ground to matters of ‘implementation’ ([48], Ch. 3; [49], Ch. 11), mistakenly suggesting that practitioner issues are of a derivative nature and/or relatively straightforward. Academic ICT4D research has a tendency to stay at the level of principles; even critical research does not get beyond high-level statements of principle such as that ICT4D implementation ‘can often be done most effectively in a series of carefully moderated workshops at the start of any intervention’ ([49], p. 364). It is then quite surprising that even in self-described critical literature one finds support ([50], p.1061)

for the Base-of-the-Pyramid strategy [51] where already a superficial reading makes clear that western capitalist profit motives, rather than the interests of the poor, are at the centre. In contrast, the ICT4D practitioner community itself has pointed out that principles alone are not enough: there are significant obstacles to putting the good intentions of the Principles for Digital Development into real practice [52], adding that some obstacles reside in conventional development policy itself.

The General Gap Between Developers and Users. If one takes the Principles for Digital Development as a starting point, a primary ICT4D question that comes up is: *how can one come to know what 'the unconnected' actually want, need or have an interest in, such that this can be turned into a basis for building valuable information systems?* Even adopting a collaborative user-centered philosophy, this primary ICT4D question is highly non-trivial. An important general difficulty across ICT is the gap between technology developers and end-users, the supposed beneficiaries of new technologies. Already in the Global North, in western (advanced) contexts, this gap has a proverbial status both in IS engineering research and in the software industry: 'users never know what they want'. In Global South contexts this gap is evidently even bigger, witness a community radio program maker interviewing our ICT4D team in rural Mali (Radio Moutian, Tominian, Mali, 16 January 2011): "First tell me what the World Wide Web *is*, my listeners have never heard of it."

Under such conditions, answers and solutions to the above primary ICT4D question are not pre-determined, but can only *emerge on the ground from a dialogical IS design and lifecycle development process*. Here, however, state-of-the-art academic ICT4D/IS research has as yet not succeeded in providing concrete handles for such collaborative and dialogical processes in the field. In our work (*e.g.*, [28, 29]) we have therefore endeavoured to bridge this gap between theory and practice, by providing practical ICT4D methodologies that work and have been tested in a way useful to ICT4D practitioners and students new to the field.

As pointed out by Sahay *et al.* [53], explaining why ICT4D is a big challenge, mainstream IS research is typically focused on (Global North) managerial and business concerns regarding ICT in organizations. (M)IS research is best viewed as social studies of information systems (with commonly a business school bias). Just as writing about architecture is different from doing it, being an observer of IS phenomena is notably different from being actually involved in Information Systems design and engineering (as IS and ICT4D practitioners are). Thus, mainstream IS research covers only a part of the whole IS field (albeit that its self-image seems to be different).

Here, we touch upon a point also made by Walsham [9]: ICT4D and IS research need to take up a more interdisciplinary outlook. There are outside bodies of knowledge that offer significant contributions as to how one may construct answers to the above-mentioned primary ICT4D question in collaborative and dialogical practice ways. IS engineering literature (with commonly a bias toward informatics and computing sciences: 'techne', including requirements and software engineering) has quite something to offer, but this goes largely unnoticed in much IS and ICT4D research as a result of monodisciplinary bias. In particular, state-of-the-art concepts, theories and

methodologies from so-called *agile* engineering can be adapted and extended to work in challenging and demanding development contexts, throughout the full IS lifecycle (as elaborated by Bon *et al.* [28, 29], see also references therein).

IS Engineering Bodies of Knowledge. This should not in fact come as a surprise. As pointed out above, the gap between ICT/IS developers and users/customers is a significant problem in western ‘advanced’ contexts already for a long time. Systems engineering in the Global North has also been dominated by linear models (known as the *waterfall model*) of ICT/IS technology transfer and software project management for most of the 20th century. The many resulting big IS project failures (so, ICT4D is certainly not alone here) triggered the development of alternative models. Accordingly, the linear waterfall model in IS and software has gone into decline, and agile engineering has emerged around the turn of the century as an explicitly *iterative, adaptive and collaborative* alternative. Today, one may even say that agile IS engineering has become the de facto industry standard in the West, especially for those ICT and software industries that have their customers in non-ICT industries, government and societal organizations. Apparently, this fact has not yet fully established itself in the mainstream IS and ICT4D research and policy consciousness.

So, perhaps there are also some epistemologies of the North that may be useful to the Global South. State-of-the-art technical engineering IS bodies of knowledge provide, or can be adapted to provide, many practical solutions to implementing collaborative Principles of Digital Development (which is not to say that these Principles themselves shouldn’t be critically investigated) [29].

In addition, along these lines one also finds some more concrete ICT4D answers as to the question of the often-claimed contextuality of IS. This is a scholarly issue that cannot be decided upon *in abstracto*. Instead, it has to be substantiated by extensive field research and co-operative inquiry on the ground in development contexts, *i.e.*, from critical praxis. Judging from evaluations of the authors’ own ICT4D courses students, contextuality, rather than functioning as an IS theoretical concept, is first of all to be *experienced*.

From our own action-research empirical and theoretical work we can offer some hopefully useful observations here. In ICT4D and also in Digital Development policy, ICT is often first of all conceptualized in terms of infrastructure and devices (access to internet, Web, social media, Internet of Things, *etc.*). We believe this is the wrong way to go. If one talks about, say, rural development in the West-African Sahel, one is not in the first place talking about ICT, but about possibilities for betterment of livelihoods by people—and ICTs may have some (but maybe none) role. Thus, contextuality of IS means in the first place thinking from and about the (extended) livelihoods of people [14, 37, 38]. Accordingly, in on-the-ground ICT4D field research work, there will be an emphasis on the early stages, because they are the hardest, and they happen to be the ones where ICT technologies themselves play yet no role or only in the background.

5 ICT4D 3.0: The Missing 10th Principle for Digital Development – “Putting the Last First”

A Critique of Development as Interventionism. In analyzing the Principles for Digital Development and their value, one has to cut deeper. Collaboration is an important value, or Principle, but just on itself it can also be employed in exploitative, profit-centered or harmful co-optation ways in a neoliberal ‘flattening of the world’ [54]. In discussing the implementation of the Principles for Digital Development, the ICT4D practitioner community itself has noticed [52] that there are obstacles in still dominant Global North-led conventional development policy.

The key point that we want to put forward here is that development has been framed for decades in terms of ‘intervention’. The term intervention is widely, loosely, but unreflectively used in development circles (in policy, practice as well as research (such as in [55])). In Foucauldian terms, it has become a normalized and naturalized concept. But it is not at all a normal or natural concept, it is a fundamental framing concept that needs to be unpacked. ‘Intervention’ evidently has strong connotations of medical curation, laboratory experimentation, and exercise of political and military power. These all have deep implications for thinking about development and how it is becoming biased. Intervention, therefore, is not at all an innocent concept.

Intervention thinking (even if well-intentioned) runs counter to working in a truly Southern-led collaborative partnership way. (The Taiwan ICT4D critical case study presented in [2] could very well be re-interpreted as an example of intervention thinking and action, as outlined above). The problem is that such a policy unavoidably tends to lose sight of the lifeworld, livelihood, *own goals and interests* of supposed beneficiaries (in our case, smallholder farmers in the Sahel). Practice projects often (have to) provide ‘donor satisfaction’ instead of user/customer/beneficiary satisfaction. Thus, in our view, intervention thinking presents several current policy obstacles that are in the way of collaborativeness and putting the user in the centre:

- i. The rather directive ways how big funds are programmatically spent (*e.g.*, spread internet, with access posited as the key issue, often set in a neoliberal market frame, see the US and UK digital development content frameworks [43, 44];
- ii. The imposed operational framework for project and program management (linear waterfall model, logframe, see for example the USAID ADS Chapter 200 implementation rules [56]);
- iii. An associated hegemonic discourse whereby intervention from the outside is framed [57] as the ‘natural’ way of bringing about desirable change.

This critique applies to development in general, ergo, also to ICT in development.

ICT4D 2.0 Derailed? “Like railways and roads before it, the ongoing digital revolution is unleashing waves of innovation.” (www.usaid.gov/digital-development/digis/2018). The 9 Principles for Digital Development pointed at above are process-oriented principles. They are principles intended to govern *implementation* of policy. They do not state the content of this policy itself. The above quote does. Was ICT4D 1.0 the policy whereby the roll-out of telecentres was thought to be the key to ICT4D

development, the above quote shows that ICT4D 2.0 [58] in its appearance of Digital Development first and foremost is the roll-out of network digital infrastructure, including internet, Web, and Web 2.0, social media, as is also apparent from the very recent digital policy documents [43, 44].

What is striking is that ICT4D and the new ‘Digital Development’ is foremost conceptualized content-wise as the rolling out of current Western ICT infrastructure of connectivity to the Global South. Then, Digital Development is not at all a radical break with previous conventional development policy, it is a continuation of it. The metaphor of railways and roads used by USAID itself is an appropriate one. It reminds one of western movies and what happened to native peoples in the US in the 19th century, and it positions the roll-out of internet and Web as a next phase of infrastructural intervention. The benefits of this are rather simply proclaimed in general terms (see the continuation of the above USAID quote at the indicated website). Moreover, it is carefully avoided to consider the ‘powers that be’ that are the dominant commercial market forces behind the current internet and Web infrastructures, even if this is a very contested issue these days also in the Global North. Again, in ICT4D 2.0 as in ICT4D 1.0, the supposed beneficiaries, the poor and unconnected, are not really asked for their opinion as it comes to the content and priorities of the new ICT4D policy of Digital Development. This is why ICT4D 3.0 is needed: a 10th goal-oriented Principle is missing in Digital Development: Putting The Last First.

“Decolonizing Theory, Practicing Solidarity” [20]. We have discussed ways how ICT4D research and theory may be better informed by practice, in terms of (i) recognizing praxis-oriented research paradigms such as participatory action research and integrating their results, (ii) development of foundational theories, (iii) critical analysis of ICT4D emerging policies such as Digital Development, and (iv) positioning ICT4D in the wider development debate. A case has been made for *ICT4D 3.0* as an approach that is collaborative throughout all phases of the IS lifecycle, and that includes collaborativeness not just in the development implementation process, but also in *agenda setting and goal construction* and associated decision making. Strengthening Southern-driven cooperation thus requires turning away from intervention thinking and putting Southern goals and interests central in research and IS design from the very beginning. And there exist practical ICT4D methodologies for doing so [28, 29].

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Identifying Generative Mechanisms in a Mobile Health (mHealth) Project in Sierra Leone: A Critical Realist Framework for Retroduction

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Abstract. This paper examines an ongoing mobile health (mHealth) initiative in Sierra Leone. The objective is to describe the ontological perspective and methodological approach used which relies on critical realism and Archer's morphogenetic approach. Such a critical realist-based approach addresses many of the concerns associated with the interpretivist and positivist philosophical duopoly that has dominated the ICT4D field for many years. The approach allows the mechanisms that determined what caused the events associated with the mHealth case to be hypothesized, thus making clear why this mHealth case has sustained through many challenges.

Keywords: ICT4D · mHealth · Critical realism · Morphogenetic approach

1 Introduction

Over the last decade, information and communications technology (ICT) has become more important and ubiquitous across developing countries. This is particularly true of mobile phones which are pervasive in many developing countries. Mobile technologies are also key to meeting the Sustainable Development Goals, and have thus become an integral part of many projects in a variety of fields such as healthcare, emergency management, and food and water security (Masiero 2018). This makes it easy to understand why the number of mHealth implementations around the world has been increasing dramatically (e.g. Purkayastha et al. 2013; Cameron et al. 2017; White et al. 2016; Sundin et al. 2016). However, while mHealth has the potential to transform health services and to increase access to healthcare (e.g. Hurt et al. 2016; Latif et al. 2017; Agarwal et al. 2016; Beratarrechea et al. 2017), the design, implementation and adoption of mHealth in developing countries is beset with wide-ranging challenges and many mHealth projects have been unable to sustain or demonstrate any significant impact at scale (e.g. Chigona et al. 2012; Manda and Msosa 2012; Kahn et al. 2010; Latif et al. 2017; Sundin et al. 2016). This is because any mHealth implementation in such environments is bound to be shaped by a variety of social, cultural, political, environmental, technological and ideological factors. Failure and underperformance of

mHealth projects in these fields has a direct impact on human lives (Masiero 2018), making it important to understand the reasons why so many ICT4D and mHealth projects underperform and fail to scale and sustain.

The ICT4D literature does provide guidance on this and numerous studies have produced insights into what goes wrong (e.g. Avgerou 2007). However, this body of work is dominated by interpretivist and positivist approaches (Gomez 2013; Walsham and Sahay 2006), and each of these paradigms has a number of limitations that constrain ICT4D research (Heeks and Wall 2018). The limitations and weaknesses of interpretivist and positivist approaches have been subject to much debate within the information systems and ICT4D communities over the last decade, and the space constraints imposed by this paper prohibit any in-depth discussion. Suffice it to emphasize that the research paradigm chosen is important as it guides research direction, methodology and conduct. In addition, it determines the way that research questions can be asked and answered and the manner in which findings can be presented (Hughes and Sharrock 2016). Research paradigms therefore determine what we as researchers see and do not see, and what we do and do not do in ICT4D research (Heeks and Wall 2018).

In an attempt to address both the generic and specific concerns associated with the philosophical duopoly that dominates ICT4D research, this paper adopts a “third way” research paradigm: critical realism (Bhaskar 1975, 1979). This philosophical approach is adopted for a variety of reasons, not least of which is the claim that there is a generic ability of critical realism to address issues seen as concerns for ICT4D research (Heeks and Wall 2018). Also, it has been suggested that the field of mHealth in developing countries is better researched by using approaches involving the use of critical theory and critical realism (Lemayian and Omwansa 2013).

This philosophical approach guided the development of a critical realist-based research framework which is applied to an ongoing mHealth case in Bonthe District, Sierra Leone. The aspiration is that the research framework will contribute to providing insights on why this mHealth case sustained through a variety of challenges. The mHealth case is briefly introduced in the following section, with the theoretical framework and methodology presented in Sect. 3. Results are presented in Sect. 4 before the paper concludes with a brief summary.

2 mHealth in Sierra Leone

In an effort to improve the public health systems, the Ministry of Health in Sierra Leone introduced a policy of integration of voluntary community health workers (CHWs) into the health system in 2012. In an attempt to leverage and aid the work of the CHWs, the Access to Infant and Maternal Health (AIM-Health) Programme (World Vision 2015) was initiated in 2012. AIM-Health contained an mHealth component which commenced as a pilot in Bonthe District, Sierra Leone in January 2013. Nokia Java based mobile phones with an mHealth app preinstalled were given to the CHWs. The mHealth app allowed the CHWs to view which household visits were due, register pregnant women, make emergency referrals to their affiliated health centre, track their own

progress, and collect household data for transmission to the health facility to support clinical and managerial decision-making (Wall et al. 2013; Vallières et al. 2013).

The mHealth project continued after completion of the pilot phase in April 2014, with ambitious plans in place to scale across Bonthe District and the whole of Sierra Leone by the end of that year. These plans were thrown into chaos when the Ebola virus epidemic struck in May 2014. The epidemic impacted the mHealth project severely with many key people leaving, scarce resources being redeployed, and government restrictions on the movement and association of people. Sierra Leone announced that it was Ebola free in March 2016, but the cost of the epidemic had been immense. According to the World Health Organization (2016) the total death toll in Sierra Leone was 3,955 with 11,308 deaths in total attributed to Ebola across the affected countries in West Africa. It is also estimated that there had been a 23% decrease in health services delivery in Sierra Leone during that time, with the country losing 7% of its healthcare workers (Evans et al. 2015).

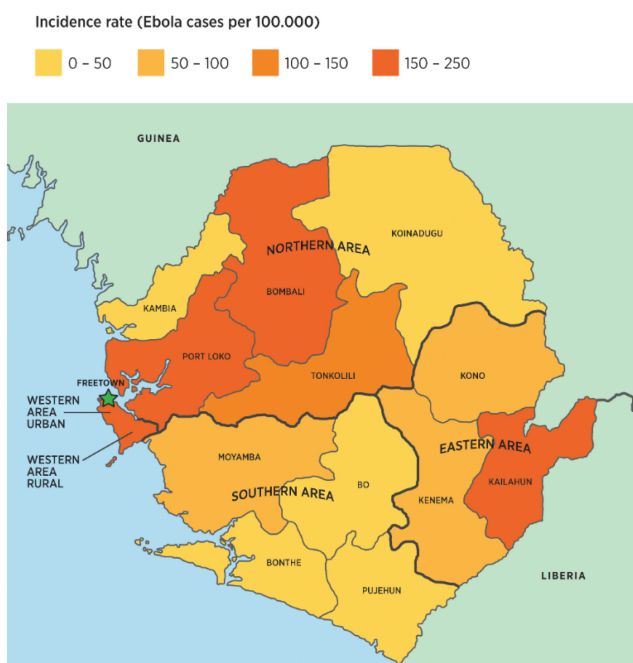


Fig. 1. Ebola incidence rates in Sierra Leone (Ribacke et al. 2016)

As can be seen in Fig. 1, the incidence of Ebola in Bonthe District was not as high as other areas in Sierra Leone at 0–50 cases per 100,000 people (Ribacke et al. 2016). Despite this, the capacity of the mHealth management team in Bonthe District was greatly reduced during the course of the Ebola epidemic (e.g. the AIM-Health project manager was redeployed, and the digital health M&E technical specialist left the project), many of the CHWs continued to use the original Nokia mobile phones and

mHealth app as part of their work. In addition, a different cohort of CHWs were given Nokia ASHA mobile phones as part of an Ebola community mobilization project. This Ebola project trained the CHWs to use the mobile phones to provide information on Ebola to the community, take sick people to the health centre, and report suspected Ebola cases. Although the activity of the CHWs was restricted during this time, data continued to be collected on the original Nokia C2-01 phones that still existed and had a functioning mHealth app installed. This happened even though many of the original phones had been broken, damaged or stolen. Also, the original mHealth app had stopped working at some time during the Ebola crisis as it had ceased to be supported on the Java platform.

3 Theoretical Framework and Methodology

This section presents the research question and outlines the theoretical framework adopted. The research adopts a qualitative, longitudinal case study methodology combined with a critical realist ontological perspective. We do not attempt to provide a detailed and comprehensive account of critical realism nor to contribute to the many ontological debates that exist on the relative strengths of various philosophical and ontological approaches to research. Instead, what is presented is an account of critical realism sufficient to provide an understanding of the philosophical and methodological approaches used.

Research questions in critical realist-based research should take a certain form. According to Easton (2010, p. 121) the most fundamental aim of critical realism is explanation, or answers to the question “what caused those events to happen?”. In other words, critical realist-based research questions should be of the form “what caused the events associated with the phenomenon to occur” (Easton 2010, p. 123). Taking this into account, the primary research question asks why the mHealth project in Sierra Leone evolved the way it did, and what were the mechanisms that determined this outcome? An alternative way to ask this question is why did the mHealth project in Sierra Leone turn out the way it did, and what caused the associated events to occur? The question is designed to provide mechanism-based explanation which will indicate how the interaction of different structural, social, cultural, and agency factors have influenced this particular mHealth case.

Put simply, critical realism asserts that general elements of an independent reality exist, but our knowledge of specific structures and mechanisms is limited because of the difficulty of accessing them directly through levels of stratification. This stratification is represented as three nested domains as proposed by Bhaskar (1975). Researchers seek mechanisms, but mechanisms reside in the domain of the Real and are thus independent of human knowledge or our ability to perceive them. The Actual domain contains events which are generated from both exercised and non-exercised mechanisms. The domain of the Empirical contains the events that we as humans are able to experience (Fig. 2).

It is important to have a clear understanding of what is meant by “mechanisms” and “events” in this instance. Mechanisms are “causal structures that generate observable events” (Henfridsson and Bygstad 2013, p. 911). An example of an ICT4D-related

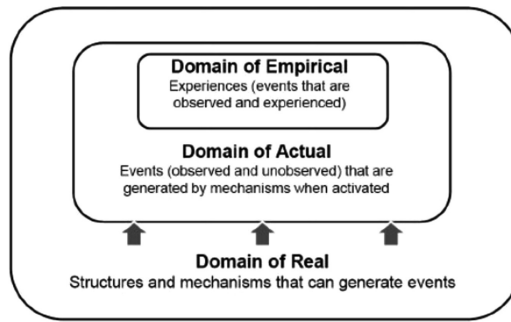


Fig. 2. Three overlapping domains of reality in the critical realist ontology (Mingers 2004)

mechanism would be an information infrastructure of technology and people in a country that attracts digital service providers, who create new services and thus attract more users, thereby strengthening the information infrastructure and creating a virtuous circle (Bygstad and Munkvold 2011). Events are “specific happenings resulting from causal mechanisms being enacted in some social and physical structure within a particular ... context” (Williams and Karahanna 2013, p. 939). An example of ICT4D-related events might be the appointment of an ICT4D champion, formation of an ICT4D strategy group, or design of an ICT4D app. It is important to mention that critical realism rejects linear notions of causality between mechanisms and events. Instead, it takes an open systems view of the world in which multiple mechanisms intersect, thus creating a “contingent causality” that is context-dependent (Smith 2010).

Retroduction is key to any critical realist-based methodology (Bhaskar 1975), and requires the researcher to take some unexplained phenomenon and propose hypothetical mechanisms that, if they existed, would generate or cause that which is to be explained (Mingers 2004). It is suggested in the literature that the process of applying such retroductive reasoning in an attempt to identify causal mechanisms is challenging (Williams and Karahanna 2013), as well as being difficult, time-consuming and resource-intensive (Reed 2009). However, retroduction is the essential methodological step in all critical realist studies (Mingers et al. 2013) and is required in order to answer our research question.

Our research relies on Margaret Archer’s morphogenetic approach (Archer 1995) for retroduction. We do not have the space here to provide detailed explanation of, and discussion on, the morphogenetic approach. Put simply, the morphogenetic approach prioritises agency; it recognises that agents create causation which has the potential to alter structure. This approach is particularly suited to the study of ICT4D as it provides a way to gain better understanding of complex ICT4D contexts (Njihia and Merali 2013). As such, it provides a tractable, comprehensive approach within which we can model and theorise ICT4D change in complex contexts (Njihia and Merali 2013).

For theorization of the mechanisms to occur using the morphogenetic approach, we looked for causal influences and relationships in social structures, interactions and relationships. Such causal influences and relationships result in either morphogenesis

(change) or morphostasis (no change). To achieve this the 4-step methodology as proposed by Radulescu and Vessey (2008, p. 12) was used as follows:

1. Identification was made of the internal and necessary relations within and between social structure. This was done by asking questions about what needs to be the case, and what needs to be present for X to be such it is, and not what people think, tell, or believe it is.
2. We then sought causal influences exerted by social structures on social interaction.
3. We then looked for causal relationships between various types of agents.
4. This allowed us to identify how social interaction elaborated upon the composition of social structures by modifying the current internal and necessary structural relations and introducing new ones.

Step 4 identifies morphogenesis which results in transformation. Alternatively, if the social interaction reproduces the existing internal and necessary structural relations then the result of the 4-step methodology is morphostasis which will mean that change does not occur.

The main sources of data used were gathered from semi-structured interviews and focus groups. Over one hundred documents relating to the mHealth case were also analysed. This data was analysed using NVivo software. It is only after the data analysis stage that theoretical reflection can take place. This involves consideration of structural and cultural configuration, and the interactions of the various agents involved and associated outcomes. This research framework allowed us to hypothesize ten separate generative mechanisms. One of these mechanisms is now discussed in detail in the following section.

4 Results, Analysis and Discussion

As previously stated, the objective of this research is to identify why the mHealth project evolved the way it did by hypothesizing mechanisms that may have determined this outcome. In other words, we are asking what caused the events associated with this mHealth case to occur. In order to answer this question, we followed the research framework as presented in Fig. 3 and outlined in the previous section.

Firstly, data was collected by semi-structured interview, focus group discussion, observation and document analysis. This data was then used to construct a factual case study description and a detailed chronological account of events. These documents give rise to the identification of discrete time periods called morphogenetic/morphostatic (M/M) cycles which are identified empirically from the factual case study description and the chronological account of events. Three distinct M/M cycles were identified as follows:

1. The mHealth planning and pilot cycle (2012 to April 2014). This cycle includes planning for the implementation of mHealth as part of the AIM-Health project. It also includes the mHealth pilot itself up to May 2014, where the CHWs were using the original Nokia C2-01 mobile phones and mHealth app.

2. Ebola virus outbreak cycle (May 2014 to March 2016). This cycle includes the loss of key staff from the mHealth management team in Bonthe District, and the retraining of the CHWs as part of the Ebola community mobilization project. It also includes the CHWs use of both the original mobile phones and the Nokia ASHA phones during this time.
3. Post-Ebola cycle (March 2016 to 2018). This cycle includes the use of the mobile phones by the CHWs in the post-Ebola period.

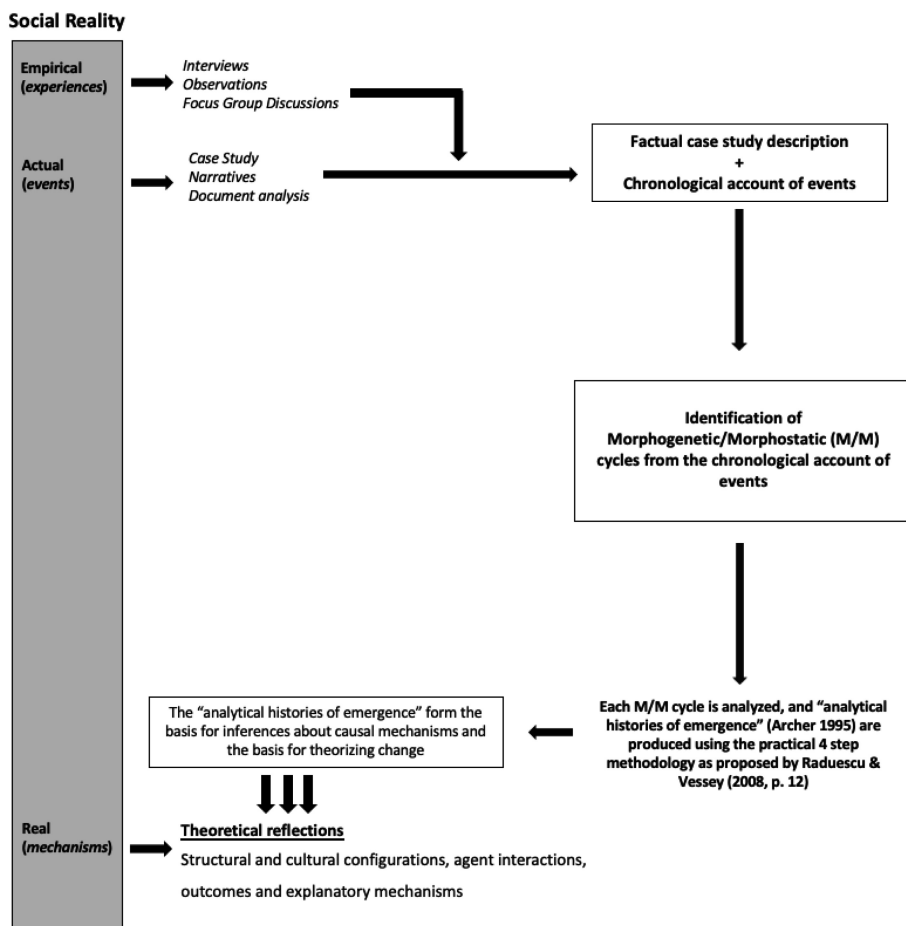


Fig. 3. Diagrammatic representation of the theoretical framework adopted for this research.

Each of the distinct M/M cycles were analysed using the 4-step methodology as proposed by Radulescu and Vessey (2008, p. 12) to produce analytical histories of emergence. These analytical histories of emergence then formed the basis for retro-reduction. This allowed us to retro-reduce a total of ten generative mechanisms. Examples of the mechanisms retro-reduced are the communications and technological infrastructure

built around the mHealth project mechanism; the self-reinforcing adoption of mHealth mechanism (which includes mHealth policy, good governance and supervision structures, inclusivity, and participatory design and decision making); the establishment of the CHW hub and the eHealth hub by the Ministry of Health in Sierra Leone; and the monitoring and reporting capabilities of the mobile phones and mHealth app.

The space restrictions imposed by this paper allow us to discuss only one of the mechanisms in any detail. The mechanism now discussed is the communications and technological infrastructure built around the mHealth project mechanism. This infrastructure consists of technology, people and monitoring and reporting structures.

An important component of this mechanism is the two-way communication structures that operate between the CHWs at community level, the district health management team at district level, and the Ministry of Health at national level. CHWs attached to each of the health centers in Bonthe District have monthly meetings where they raise issues that they see as important, and they can also expect to receive feedback on their performance. These monthly meetings may be attended by a variety of stakeholders including the health staff, various NGO representatives, local politicians and citizen representatives. These meetings will then be reported back to the district health management team in Bonthe District. This allows the concerns and performance of the CHWs to be communicated directly to the district health management team. A report from this meeting is then given directly to the Ministry of Health in Freetown. This communication system also works the opposite way, i.e. from national level back to district level and then to the CHWs at community level.

We suggest that this mechanism contributes to attracting and maintaining CHWs for many reasons. This is because the CHWs know they will be monitored and trained in an efficient manner, and as a result they can do their jobs more effectively. They also have access to an effective channel for communicating their concerns and ideas. This allows problems to be addressed and the work of the CHW to be completed more effectively. This has the effect of strengthening the health systems as well as making the job of the CHW a more desirable one.

5 Summary

It is both challenging and ambitious to attempt any level of understanding of mHealth in a severely resource constrained environment such as Sierra Leone. This research adopts a critical realist perspective to identify why the mHealth project evolved the way it did by hypothesizing mechanisms that may have determined the outcome of the project. The hypothesized mechanisms explain how the interaction of different structural, cultural and agency factors have influenced the project. All mechanisms hypothesized by this work are equally important and go towards explaining why the mHealth project evolved the way it did. Our belief is that such mechanism-based explanation allows a theoretically informed and empirically rich account of how context and mechanism interact in this specific case.

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Capabilities and Affordances in the ICT4D Context

Similarities, Differences, and Complementarities

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Abstract. The paper examines two concepts that have been frequently used in Information and Communications Technologies for Development (ICT4D) research, capabilities and affordance. We seek to delineate their similarities, their differences, and their accurate application in ICT4D. Both concepts connote a space of opportunities, both are relational between artefact and human agency when applied in ICT4D, and both entail potential rather than actualisation of possibilities. By comparing the two at some length, we hope to generate a more refined understanding of both capabilities and affordance, as well as how they could be more accurately applied in ICT4D.

Keywords: Capabilities · Affordance · Agency · ICT4D

1 Introduction

A debate is ongoing in Information and Communication Technology for Development (ICT4D) research regarding exploring the link between ICT and some kind of development (Walsham 2012, 2017). There has been extensive discussion of development in ICT4D, namely, what is the end goal of ICT4D (Kleine 2010; Thapa and Sæbø 2014; Walsham 2017; Zheng and Walsham 2008; Zheng et al. 2018). Another question concerns how to unfold the black box of ICT in ICT4D (Hatakka et al. 2016). After all, ICT4D requires us to take the technological artefacts seriously.

In this paper, we compare two theories—affordance theory and Sen’s capability approach (CA)—and seek to delineate their similarities, differences, and accurate applications in ICT4D. These specific theories are compared because both concepts imply a space of opportunities, both are relational between artefact and human agency, and both entail potential rather than actualisation of possibilities. Both concepts have been widely used in the ICT4D literature, albeit for different purposes. It can be confusing at times because the concepts often are understood as a set or as subsets of each other given their similarities, and various attempts have been made to merge the two (Hatakka et al. 2016; Faith 2018). By comparing the two theories, we seek to

present a more nuanced understanding of both concepts, especially for those unfamiliar with one or both.

In subsequent sections, we first introduce the origin and definition of the two concepts, followed by their similarities and differences. We then also discuss their limitations and how they might complement each other.

2 Sen's Capability Approach

The CA originates from the field of development economics (Sen 1992, 2000) with a focus on the agency and well-being of individuals and a concern for social arrangements that can enable individuals to live lives they have reason to value. In the ICT4D context, the CA has been used to theorise a human-oriented development paradigm (Thapa et al. 2012; Zheng 2009). One's capability set can be understood as a space of opportunities that constitutes a valuable life to an individual. The external boundary of the space is defined by structural conditions, such as social, institutional, and cultural conditions, that shape the availability of opportunities.

In the CA, capabilities and functionings are the two main concepts. *Capability* is defined as "a set of vectors of functionings, reflecting the person's freedom to lead one type of life or another" (Sen 1992, p. 40). Capabilities refer to the set of valued choices an individual has (e.g. to be educated, to be healthy, or to be respected). *Functioning* refers to an individual's actualised capabilities. Individuals are active agents who shape their own lives and help others shape theirs (Sen 2000). The focus of the CA, therefore, is on the expansion of individuals' well-being and agency freedom, as well as how individuals' agency and social arrangements can improve their quality of life.

The conversion of a commodity (e.g. ICT) to capabilities is contingent on three types of conversion factors (Robeyns 2005): personal (e.g. age, literacy, and health), social (e.g. norms, policies, rules, regulations, and cultural issues), and environmental (e.g. geographic location and climate, as well as infrastructure). These factors influence the availability of capabilities, i.e. valued opportunities, and the ability for people to actualise available choices.

When applied in ICT4D, one major weakness of the CA is that it does not explicitly theorise on technology. Instead, technology is likely to be treated as a commodity in the CA (Zheng 2009; Thapa and Hatakka 2017). Thus, ICTs are often "black-boxed" and seen as neutral, which can lead to positive outcomes (Zheng and Stahl 2011). Furthermore, the CA has little to offer when considering the process through which capabilities could be generated from ICT.

3 Affordance Theory

The concept of affordance, on the other hand, originates from the field of ecological psychology and is concerned with the action possibilities afforded in the relationship between individuals and their environment (Gibson 1979). According to Gibson (1979, p. 127), "[t]he affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill. It implies the complementarity of the

animal and the environment”. Gibson’s ideas moved from the natural environment to artificial objects such as tools. He also insisted that artificial affordances are no different from naturally occurring affordances. This focus on the tools makes the theory of affordance relevant for information systems (IS) research (Thapa and Sein 2018).

We derive the definition of affordances from IS because of its focus on people, technology, and organisation. In IS, affordances are defined as “the possibilities for goal-oriented action afforded to specified user groups by technical objects” (Markus and Silver 2008, p. 622), in which action possibilities depend on the relationship between systems and users in the context of the kind of ICT used. The affordance perspective suggests that people are more concerned with the action possibilities enabled by the technology than they are with the properties of the technology itself (Majchrzak and Markus 2013). For example, visibility, editability, persistence, and association could be considered functional affordances for social media (Treem and Leonardi 2013), whereas commenting, accessibility, viewability, and validation are associated with wikis (Mansour et al. 2013). Some scholars also suggest group-level affordances; for example, Majchrzak et al. (2013) argue that an online knowledge-sharing platform affords the following possibilities: metavoicing, triggered attending, network-informed associating, and generative role-taking.

Affordances can provide a relational middle ground between technological determinism and social constructivism (Faraj and Azad 2012; Leonardi and Barley 2010; Robey et al. 2013), in the sense that affordances do not determine how people will use a technology. At the same time, however, technology’s potential uses are not fully opened due to material limitations (Thapa and Sein 2018).

A criticism is that the affordance concept has often been stripped of relational character and reduced to properties of the object matched to the “effectivities” of the subject (Bloomfield et al. 2010). This could be called a *realist* view of affordance (Robey et al. 2013), which often refers to actions closely associated with functionalities of artefacts and often implies a linear causality in the sequence of existence-perception-actualisation (Bernhard et al. 2013). In comparison, a *relational* view of affordance (Robey et al. 2013) suggests that technological affordances “are inextricably bound up with specific, historically situated modes of engagement and ways of life” (p. 415; Bloomfield et al. 2010). For example, the affordances of a pair of chopsticks may be obvious to a native Chinese person but hardly perceivable to someone who has not encountered them before. Indeed, in this case, affordances to pick up food only become available when an individual acquires the skill of using chopsticks.

Therefore, affordances are not always directly perceivable, and the actualisation of the affordances depends on the interaction between the artefact and the actors situated in the context (Bernhard et al. 2013), including social and cultural contexts (Thapa and Sein 2018). However, affordance theory itself offers little explanation as to how affordances are actualised and how different sociotechnical factors enable or inhibit the actualisation process. Moreover, affordance theory pays no attention to the consequences of actualisation.

In ICT4D research, where we are more concerned with the process and impact of technological adoption in broader social life, i.e. beyond the immediate interaction between artefact and users, it may be more useful to discuss socialised affordances (Zheng and Yu 2016) rather than only functional affordances. Socialised affordances

explicitly take into account conversion factors, such as personal, social, and environmental factors (Bloomfield et al. 2010; Hausvik and Thapa 2017), as emphasised in the CA, as well as social practices and processes as conversion mechanisms. Zheng and Yu (2016) provide an example in their case study of affordances of social media in mobilising a charity programme for rural children in China. Similarly, what Thapa and Sein (2018) identify as affordances of telemedicine, including virtual co-localisability, volunteerability, and educability, are arguably closer to socialised affordances rather than functional affordances.

4 Similarities

Capabilities and affordances have the following similarities: both signify action possibilities, both are relational, and both are contingent on conversion factors. By definition, capabilities and affordances signify possibilities, i.e. opportunities or choices of being and doing, but not the actual outcome or achievement. These possibilities are not essential to the subject, i.e. do not pre-exist in an individual or an artefact and cannot be determined by only assessing the characteristics of an individual or properties of an artefact. Both capabilities and affordances are context specific, i.e. embedded in a specific sociocultural and historical context. As a result, the nature of capabilities and affordances is not deterministic but dynamic, as they change over time. In the absence of contextual information, it can be difficult to identify capabilities and affordances.

It follows that the CA and affordances are arguably ontologically relational (although there are alternative stances on this; e.g. see Lanamäki et al. 2016). Capabilities, as a space of opportunities, can be understood as relational effects emerging from the configuration of social structures and individual capacity and agency, which is influenced by the relative position of the individual in the social environment (Smith and Seward 2009). Technologies, or material artefacts, can be incorporated in this configuration but are not essential to the CA (see Sect. 6).

In comparison, affordances are action possibilities arising from the perception and interaction of users with artefacts—conditioned by the functional properties to the object and the individual capacity—situated in a particular social context (Volkoff and Strong 2013). The same object may provide different affordances to different people in different contexts. Similarly, the same person may enjoy different capability sets if situated in a different social environment, whereas people with different individual capacities and relational resources usually have different sets of choices under the same social structure (Kleine 2010).

Therefore, both affordances and capabilities are contingent on conversion factors. For Sen, this is why it is crucial to differentiate capabilities from commodities. For example, a computer may be perceived to offer a range of technical affordances to a person, e.g. to process documents or to browse the web. The actualisation of those affordances, however, is contingent on the person's capacity, attitude, and social conditions.

There are occasions when capabilities and affordances might overlap, especially when affordances are socialised beyond functional affordances through social processes and practices (Zheng and Yu 2016) and are converted into functionings that an

individual considers valuable. For example, given the conversation factors of individual skills and roads in reasonable conditions, a bicycle may be considered to provide the affordance of mobility, which could also be a capability that a person values.

5 Differences

Despite the similarities, there are some fundamental differences between these two concepts as described in the following three aspects.

The CA is philosophically anthropocentric and humanistic, which focuses on an individual's well-being and agency. Capability reflects the real opportunities that a person has to lead a life that he or she has reason to value (Zheng 2009). It should be noted that Sen explicitly differentiates “value” from “desire” or “happiness” as follows: “valuation is a reflective activity in a way that ‘being happy’ or ‘desiring’ need not be” (Sen 1992, pp. 29–30). The emphasis on human agencies and their values is one of the reasons that the CA is considered a normative approach with a fundamental interest in the ethics of development, which is distinct from other evaluative approaches to development that focus on income, utilities, or happiness.

In contrast, affordance is a concept of materiality that centres on the potential utility of objects. Affordance arises from the properties of an artefact in relation to its design and functionalities. While affordance is relational to human agency, in its original sense, its interest in human values, social conditions, or ethical evaluation, if any, mainly serves the purpose of understanding user behaviour and designing relevant affordances for particular purposes. In particular, functional affordances are mainly concerned with the immediate outcome of human interaction with the artefact (Seidel et al. 2013) rather than broader implications for the individual, communities, or society. Often these implications are outside the scope of consideration or assumed to take place automatically.

Consider e-learning systems, for example. A functional e-learning system may afford the possibilities to access information and educational material that may not otherwise be available and to have virtual interactions with tutors and fellow students (Gros and García-Peñalvo 2016). A capability related to such a system is to be educated, which is a much broader and more abstract notion that can be achieved not only through the e-learning system but through years of studying and learning via other means. There is no absolute causality between using the functions of an e-learning system and getting educated, as an individual could use the system but not engage with the learning process. In other words, actualisation of an e-learning system's functional affordances does not directly translate into the achieved capabilities of receiving education.

The most critical difference between the two concepts lies in their relationship with social structures. As discussed previously, capability is inherently conditioned by social structure and a person's relative position in his or her social network. Although the CA has been criticised for the lack of theorisation on social structure, Sen emphatically argues that “the removal of unfreedoms. . . is constitutive of development” (Sen 1992, p. xii). In other words, the expansion of an individual's capability set requires not only the enhancement of the his or her well-being and agency, but, more importantly, the

removal of deprivation and restrictions that often result from structural and environmental conditions. In contrast, the affordance theory largely remains on the agency level and tends to focus on interventions related to individual skills, aptitudes, and resources (although socialised affordance may allow some conceptual space to take social structures into account).

In the context of ICT4D, affordances seem to be more associated with the “means” (i.e. adoption of ICT) but say little about developmental outcome, which is the “ends”. In contrast, the CA is directly concerned with the outcome (e.g. individual well-being), is value-driven, and is normative. Therefore, the affordance theory is very useful in guiding the design of technologies, whereas the CA is often used as an evaluative framework for the social outcome of ICT4D projects.

6 Complementarities

Various attempts have been made to integrate the concept of affordance with the CA (Hatakka et al. 2016; Sein et al. 2018), but that is not the intention of this paper. The aim of this paper is to clarify the distinction between the two, which may shed light on their relationship and how they can be used appropriately either separately or together.

Building on Smith and Seward’s (2009) relational ontology of Sen’s CA (discussed in Sect. 4), Oosterlaken (2011) argues that technological artefacts should also be recognised as constituents of human capabilities, in addition to human agency and social structures. She does so by drawing upon Lawson’s (2010) conception of technology as an extension of human capabilities, which in turn is derived from the philosophy of technology and science and technology studies (STS). It should be noted that by “human capabilities”, Lawson (2010) is not referring to the CA but to capabilities in its common sense. For example, technological artefacts may extend an individual’s senses (vision, hearing), abstract thoughts, language functions, or memories.

Lawson (2010) argues that material properties of technical objects, when being enrolled into “particular networks of social and technical interdependences”, may possess capacities and powers, which, like social structures, operate with certain causal mechanisms that human agents have to work around and respect when trying to “harness the causal power of such objects” (p. 215). Meanwhile, technological objects embody and extend human intentions, values, and social relations “through a process of human interventions” (p. 214). Of course, this is nothing new for those familiar with STS or actor-network theory. These causal powers or mechanisms are exactly what the notion of affordance entails—they are not deterministic but generate certain causal effects when enacted. In other words, it is reasonable to argue that technological affordances, when enrolled in a sociotechnical network in a meaningful way, have the potential to extend human capabilities, which may ultimately enhance or diminish valuable choices.

Therefore, building on Oosterlaken (2011), technological affordances could be conceived as a relational component of one’s capability set (in the sense of the CA), the actualisation of which affects both the achieved functionings and capabilities (valued opportunities) that an individual enjoys. Not only do technological affordances

condition the action possibilities of human agents, they are also often entangled with existing power relations and social structures that set a boundary, albeit in flux, for individuals' substantive freedom (Zheng and Stahl 2011). On the other hand, the actualisation of affordances may also affect the positionality of human agents in relation to social structures, thereby transforming or reproducing their capability to lead valuable lives. For example, the technical design of computers presumes a certain literacy and way of working stemming from industrialised societies, which have often been imposed on users and organisations in other contexts. The actualisation of these functional affordances must rely on the cooperation of users' practices, which then changes their access to information, connectivity to social networks, and capacity to perform certain tasks, thereby possibly contributing to their valued choices to be active members of a community, to participate in public affairs, or to build a livelihood. It is important to reiterate, however, that actualised affordances do not automatically translate into higher functionings or capabilities.

7 Applications in ICT4D

Table 1 shows the comparison of the two theories as discussed above. By exploring the similarities and differences of the CA and the affordance lens at some length, it is clear that they focus on different aspects of ICT4D and serve different purposes. For example, the CA is more focused on the evaluation of individual choices (ends), whereas affordances centre on the direct interaction between technology (means) and goal-oriented actors. The CA sees artefacts as neutral resources and puts an emphasis on conversion factors, which conditions how ICTs might or might not lead to capabilities. The affordance lens pays less attention to broader social contexts that actors are situated in and is completely silent on how actualisation of affordance may give rise to any developmental outcome. Using both theories together may offer a better understanding of whether and how human technology interaction actually advances an individual's pursuit of a valuable life by enhancing his or her well-being and agency freedom.

For ICT4D researchers, it should be noted that the affordances lens, especially functional affordances, entails a narrow focus on technology adoption in the immediate context of the interaction. This may be useful if the objective of the research is to design an artefact or to explore how different designs give rise to different behaviours and consequences. However, care must be taken when making assertions about developmental outcomes based on a study of functional affordances. Nevertheless, by socialising affordances, namely, focusing on the practices and processes that convert functional affordances to affordances-in-practice (Zheng and Yu 2016), ICT4D researchers can avoid technology determinism and shed light on the complexity of ICT actualisation processes in different contexts. Moreover, affordances can both enable and constrain someone's goal, making it particularly important for ICT4D researchers to be sensitive to both effects of technologies. By connecting with the CA—especially in terms of what users' value and aspire to—and with the three sets of conversion factors, the affordances lens could provide better design guidance which generates possibilities that contribute to sustainable development.

Table 1. Juxtaposition of capability and functional affordance

Dimensions	Capability	Functional affordance
Origin and focus	<p>Originates from the field of development economics; Centres on the valued opportunities and choices available to an individual; Focuses on well-being and agency of individuals as the end goal of development Considers social arrangements that enable individuals to lead a life they have reasons to value; Emphasise conversion factors (e.g. individual, social, and environment) possibly acting as enablers or inhibitors Can be understood as space of opportunities with the upper limit of the space defined by structural conditions Concerned with the removal of unfreedom ICT often “black-boxed” and seen as something neutral that can lead to positive outcomes</p>	<p>Originates from the field of ecological psychology Concerns the action possibilities afforded in the relationship between individuals and the environment Focuses on the effectivities and utility of artefacts, given the sociocultural context and resources available, and individuals’ abilities to perceive affordances that lead to goal fulfilment Does not consider the effect of the outcome of the actualisation of action possibilities (can be for good or ill) Associated with artefacts—affordances of an object Perception and actualisation of affordances dependent on the relationship between the system and the actors in the context in which ICT are used Perception and actualisation of affordances influenced by personal, sociocultural, and historical contexts</p>
Similarities	<p>Space of possibilities enhanced by structural arrangements and individual agency Both dispositional and relational: contingent on and human agency and aptitude as well as individuals’ positionality within a social structure Context specific Potential not actual achievement Dynamic and could change over time</p>	<p>Action possibilities afforded by properties of an artefact Both dispositional and relational: contingent on properties of an object and the agency of goal-oriented actors Context specific Potential not actual achievement Dynamic and could change over time</p>
Differences	<p>Vectors of choices that can be turned into achieved functioning Human-centred: capabilities are defined by a person or a group of people Value-driven, concerned with the freedom to lead a life that one has reasons to value Normative and focus on ends of development Concerned with a person’s life as a whole (well-being and agency)</p>	<p>Action possibilities that may or may not be actualised A notion of materiality associated with design and functionalities Concerned with immediate action outcome, directly associated with artefacts Value-neutral and focus on means of development Could be arguably conceived as extending ‘human capabilities’ in its common sense,</p>

(continued)

Table 1. (continued)

Dimensions	Capability	Functional affordance
Limitations	Does not include artefacts explicitly, but talks about commodities; Not explicit with how, i.e. the process where capabilities could be generated; Insufficient theorisation on social structures	Does not consider end results (good or ill), and also how conversion factors enable or inhibit action possibilities Limited understanding of contextual factors (e.g. social, political, personal, and environmental), which can influence the actualisation process No theorisation on social structures
Complementarity	Can be used to evaluate the development outcome of technological adoption Can complement affordances by identifying conversion factors that can enable or inhibit the process of actualisation of affordances	Can be conceived as a constituent of capability, which interacts with human agency to shape social structure and to change the level of functioning and space of opportunities
Examples	Opportunity to be educated	Accessibility to online educational material

For ICT4D studies that use the CA and would also like to take technology more seriously, it should be noted that technology is not neutral, and its affordances are bundled with human agency. By examining the opportunities and barriers to actualise technological affordances, we could better understand, in a given social and physical environment, what type of ICTs to use or how to design ICTs that are sensitive to actors' attitudes and skills and how to facilitate the conversion from action possibilities to the expansion of substantive freedom.

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A Framework to Explain the Relation Between ICT and Development: Combining Affordances and the Capability Approach

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Abstract. In this paper, we suggest a framework to better explain the relation between ICT and development. The framework combines two theories: The Capability Approach and Affordances. The capability approach defines development as freedom of choice; and the affordances explains the relational aspects of people and technology. These two theories complement each other by connecting the means (technology) to the ends (development). A case study of ICT and study-circle education in rural areas of Kenya is used to illustrate the framework. Using the framework, the study revealed how actualization of affordances of internet-cafe enhanced income capabilities of marginalized people; however, at the same time, shows perception and actualization of affordances were contingent on the availability of resources, skills, socio-cultural norms, and infrastructure.

Keywords: Affordances · Capability approach · ICT4D · Education · Kenya

1 Introduction

Information and communication technology (ICT) is becoming more and more ubiquitous (Walsham 2012), being part of a developmental process that is moving the world forward toward a place “with universal literacy. A world with equitable and universal access to quality education at all levels, to health care and social protection, where physical, mental, and social well-being are assured” (United Nations General Assembly 2015, p. 3/35). Although the field has made noticeable progress in understanding the role of ICT, a key challenge remains in understanding the process by which development “happens” as a result of ICT implementation.

To understand how ICT can contribute to a better world, we need to understand what development is. In recent ICT4D literature, the concept of development is often understood in terms of human development (Andersson and Hatakka 2013), related to freedoms and individuals’ capabilities to choose to live a life that they have a reason to value, known as the capability approach (CA) (Sen 1999). The core focus of CA is the expansion and assessment of individuals’ well-being and how individuals’ agency and

social arrangements can improve their quality of life. CA, however, does not explain how ICT can make capabilities possible.

One potential theoretical lens to complement this lacuna is affordances. In the information systems context (closest discipline to ICT4D), affordances are defined as “the possibilities for goal-oriented action afforded to specified user groups by technical objects” (Markus and Silver 2008, p. 622), and suggests that people are more concerned with the action possibilities enabled by the technology than they are with the properties of the technology itself (Majchrzak and Markus 2012). Following this argument, we propose that integrating the affordances (e.g., Leonardi 2011; Marcus and Silver 2008) into CA can provide better explanations as to why and how people interact with ICT, and enhance individuals capabilities. The framework is illustrated using a case study of ICT use in study-circle education on the Kenyan South Coast. The purpose of introducing ICT in the study-circle groups was to give them access to digital learning content, increase members’ ICT literacy, and support their study-circle activities and projects. The framework captured the complex process of ICT intervention and development, furthermore identified challenges that can hinder the process.

Rest of the paper is organized as follows. Section two elaborates more on CA and affordances, thereafter, we present the proposed framework that combines the two theories. Followed by research design, and case analysis. Finally, we concludes the paper with discussion on implication for research and practice.

2 Theoretical Background

2.1 Capability Approach

CA defines poverty as the deprivation of individuals’ capability to live the kind of life that they have a reason to value (Sen 1999; Zheng 2009). Individuals are not seen as passive recipients of development, but as an active agent of change. CA further argues that individuals who are provided with opportunities have the power to shape their own lives and help others shape theirs (Sen 1999). Two main concepts in CA are capabilities and functionings. Capabilities are a person’s freedom to achieve and represents the various combinations of functionings that the person can choose from. Functionings are a person’s doings and beings, e.g., his or her participation in political discourse or education. Functionings represent a person’s realized achievements and include various aspects of how individuals live their lives (Gasper 2002; Hatakka and Dé 2011). The conversion of a means such as ICT into capability is determined by three types of conversion factors (Robeyns 2005): personal (such as age, literacy, and health), social (which include norms, policies, rules, regulations, and cultural issues), and environmental (such as geographic location and climate, as well as infrastructure). These factors influence the realization of potential functioning, and the ability of people to act on that potential functioning.

In ICT4D, CA has frequently been used to explore the link between ICT and development (see e.g., Hatakka and Dé 2011; Zheng and Walsham 2008; Madon 2004). However, to improve the applicability of CA for ICT4D research, we need to address the following issues. First, ICT in CA (within ICT4D research) is often seen as

a neutral commodity (Zheng and Stahl 2011). Implementing ICT does not automatically lead to increased capabilities. We need to be able to explain under what circumstances the action possibilities of ICT lead to individual improvements. Second, to explain individual and contextual factors that affect the development process, we need to include an individual's characteristics, preconditions, and the context in which he or she interacts.

An individual's context consists of his or her resource portfolio (which constitutes her agency) and the social structure (Kleine 2013). The social structure includes e.g., formal and informal laws and social arrangements for policies and programs. Likewise, agency, defined as "agency-based capability inputs", refers to an individual's resource portfolio (which includes assets such as material, financial, and cultural resources), which also includes an individual's personal characteristics, such as gender and age. Agency, together with "structure-based capability inputs" (seen as the structures that aid or constrain an individual's agency), determines how resources can be converted into capacities (Kleine 2013).

2.2 Affordances

We derive the definition of affordances from IS perspective. In IS, affordance is defined as the potential for behaviours associated with achieving an immediate concrete outcome, arising from the relationship between the properties of an object and characteristics of a goal-oriented actors (Volkoff and Strong 2013). From this perspective, affordances are an ever-present potential for action, while the details of their actualization in a specific instance are contingent on aspects of the techno-organizational context. Thus, the outcome is indeterminate (Volkoff and Strong 2013). Affordances need to be perceived by an actor before being actualized (Bernhard et al. 2013; Strong et al. 2014; Volkoff and Strong, 2013), however, perceiving an affordance does not necessarily mean that the actor realizes the offered action possibilities (Stoffregen 2003). The perception and actualization of the affordances depend on the relationship between the system and the actors, in the context in which IS are used (Bernhard et al. 2013; Leonardi 2011).

Our analysis shows that all affordances are not necessarily perceived or actualized. Sometimes people may not understand the complexity of the technical functionalities, or they may lack proper information or some intermediaries who can explore the action possibilities of the technology, which can result in the affordances being hidden from the individuals, or they may perceive them falsely. In some situations, the affordances are actualised without the outcome being achieved. In such conditions, goal-oriented actors would try to actualize the affordances they perceived, but the outcome would differ from the actors' expected goals. It is also possible that in the absence of appropriate information, the affordances may remain hidden or latent (Gaver 1991).

3 Proposed Framework

In this section we provide the rationale for integrating CA and Affordances, thereafter we present the integrated framework.

CA originates from the field of development economics. Focusing on the agency and well-being of individuals as the end of development, it is concerned with social arrangements that can enable individuals to live the kind of lives that they can value. In ICT4D, CA is most often applied following a step-wise process, in which ICT is seen as a commodity that leads to new opportunities for individuals (Hatakka and De' 2011; Zheng and Walsham 2008). However, ICT in itself is often "black-boxed" and seen as something neutral that can lead to positive outcomes (Zheng and Stahl 2011). Since CA does not include ICT explicitly, we argue that another conduit for understanding ICT's role in development would be beneficial. The affordance theory could be such a conduit. Affordance theory originates from the field of ecological psychology and is concerned with the action possibilities afforded in the relationship between individuals and the environment (Gibson 1979). It focuses on individuals' perception of what is possible, given the context and resources available, and individuals' abilities to perceive actions that can lead to goal fulfillment.

While it has been argued that affordances and capabilities can be seen as synonymous, we argue that affordances precede capabilities and are on a different "level". A capability is a much broader concept compared to affordances (Zheng and Thapa 2019). If a capability is to be able to make a living, the affordances are than the action possibilities that enable the capability.

Combining these two theories has previously been attempted (Hatakka et al. 2016; Faith 2018) to help explain the phenomenon in which people interact with technology (from affordances) to achieve an increase in agency and well-being (from the CA). The affordance conduit can complement the CA through an enhanced understanding of how the relationship between ICT and an individual lead to perceptible or hidden affordances, and how that may influence the actualization of affordances. But at the same time, while affordances center around action possibilities of an object and goal-oriented actors, the theory pays less attention to the outcome of an actualization and on the different socio-cultural and individual factors that can enable or inhibit the affordance from being perceived and actualized. Hence, we also need to understand the factors that influence the interaction between an individual and ICT, as well as the process and conversion of a means (a commodity) to an end (a functioning).

CA includes the concept of conversion factors (Robeyns 2005). However, the concept is underspecified and only provides us with a limited understanding of the conversion process. Here, we instead argue for the inclusion of resource portfolios, agency, and social structures from the choice framework (Kleine 2013). There is an assembly of various factors, both in an individual's resource portfolio and in the social structure, that determine whether an individual will perceive and actualize an affordance or not. In addition, when an individual lacks agency, or when the social structure is inhibiting, the result can be that the affordance will be hidden. Our study shows that even in situations when there are seemingly no results due to limitations related to agency and structure, something may still happen, e.g., affordances may be perceived, but not actualized, or the affordances may be hidden.

Affordances can exist without users' perceptions, whereas capabilities depend on making affordances perceptible and providing a conducive social structure and resource portfolio. For a capability to be available for individuals to act on, they first need to be able to perceive the affordance based on their goals. This provides us with a more

nuanced explanation of the process of moving from ICT to a capability. Therefore, we argue that to better understand the interplay between ICT and people, and its effects on societal change, we need to examine how interactions between ICT and actors in a specific context affect actors’ ability to perceive and actualize affordances, consequently, enable or inhibit individual capabilities.

The integrated framework is presented in Fig. 1. The framework shows the process and relation between ICT and development; depending on the actor’s goal, the actor’s ability to perceive affordances of ICT; and the context of the actor such as resource portfolio and social structure. The actor may perceive an affordance and actualize it, which can lead to new functionings. The actor may perceive an affordance, but cannot actualize it, or an actor may be unaware of the affordance, if it is hidden or latent.

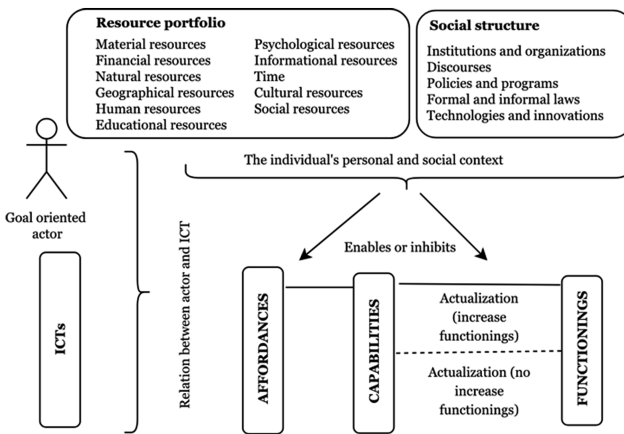


Fig. 1. Integrated framework

4 Research Design

In this section, we describe the case, data collection, and data analysis as follows.

The case concerns the use of study circles to improve the livelihoods of rural communities. The study-circle project took place in the Kwale district, on the South Coast of Kenya. The area is diverse, with most of the population sustaining a livelihood through fishing, agriculture, or forestry. The project was implemented by Coastal Oceans Research and Development – Indian Ocean (CORDIO) and aimed to address the educational needs of rural poor to help support their livelihoods and other income-generating activities (Wamala 2012). The overall objectives of the project were to introduce ICT into poverty-alleviation activities to support environmentally sustainable livelihoods by introducing adult education that follow the “folkbildning” concept of education. “Folkbildning” is the use of self-organized study circles where the groups decide on topics to discuss and activities to conduct.

Given this study’s emphasis on understanding the phenomena investigated within a real-life context through a rich description of particular instances (Yin 2009), it is appropriate to adopt an explorative case-study approach (Kirsch and Beath 1996).

Our study is based on a single case-study approach that aims to establish patterns of relationships among the constructs and identify their underlying logical arguments (Eisenhardt and Graebner 2007), retrieved through recursive cycling among the case data.

The data were collected during two field visits to the Kenyan South Coast in 2012 (in May and October). Most of the field work was done in rural areas, visiting study-circle groups, local governments, other ICT actors (e.g., people in local Internet cafés), or with the project-management team. A trip to Mombasa also was taken to conduct interviews with system developers and personnel from the company that handled the technical ICT support for the groups. During our field work, we conducted focus-group discussions (FGDs) with study-circle participants (12 FGDs with 109 participants), government officers (two FGDs with six respondents), and project managers (one FGD with six members of the CORDIO staff). Furthermore, we conducted individual interviews with nine people and observations of the groups' activities.

Based on the proposed framework, we started the analysis by identifying affordances and capabilities that had resulted from ICT use in the study circles. In this paper, we select one capability "to improve the livelihoods by launching Internet cafés" as an example. It was one of the frequently mentioned capabilities by the respondents as well. Next, we identified the affordances that were directly related to the selected capability. For example, "accessibility to various service using ICT." After identifying the affordances, the focus of the analysis was to find the structural and agential factors that either enabled or inhibited participants from perceiving and actualizing the affordances. In the next section, we discuss the case analysis.

5 Case Analysis

The case analysis shows that with the introduction of computers, printers, Internet and basic computer training, the groups perceived several affordances with the ICT that could help them gain the capabilities needed to improve their choices on how to make a living. The groups perceived the affordances of using computers to offer access to the communities, to learn basic computer skills, to virtually communicate and market their activities. All groups had previous experience with technology (mainly smartphones) and the cities in the areas had Internet cafés that several of them had visited. However, none of the study circle group villages had public access to computer and Internet so the groups saw an opportunity to launch Internet cafés and let the rest of the communities use their computers, printers, and Internet for a small fee:

When we started this program, we know that people were poor so we ask of them a very little amount to learn and take the studies. If it is a member, he will pay 100 KES for enrolling per month and then 200 per month, but that is also sometimes impossible. For non-members, it is 500. Because if you take the classes in the center instead to learn, it's more than 500 because going there and returning home, but here we made it cheap so that people will learn how to use the computer (a study-circle member in a group offering computer lessons in their Internet café).

When the groups perceived affordances relating to starting Internet cafés, the individuals needed to have the required skills, and the context needed to be enabling for them to actualize the affordances. The individuals needed the education required to start

a micro-business; knowledge about the needs in the communities; material resources, such as access to technology and facilities to start the cafés; and the financial resources to cope with the start-up costs until the cafés become financially sustainable. The social structure that they needed to navigate includes identifying a market need for the services, infrastructural programs that provide the communities with electricity and access to the Internet, and the required ICT needs to be affordable for the groups. Furthermore, there should be educational programs available so that members can gain necessary IT and other skills.

The success of the groups' Internet café businesses varied greatly. Although the groups were able to start a business that offered public access to computers in these communities, different factors regarding group members' agency and the social structures restricted some groups' ability to profit from the businesses. For example, lack of Internet access severely restricted the usefulness of services offered, the members' own IT skills limited what services they could provide, and the high cost of ICT-related supplies meant that group members were unable to afford maintenance expenses:

The printer cartridges are very expensive, and the printers are very slow. And the cartridge can only produce very few copies. So, if they use it for a business, they see that the cartridge is finished, but whatever they have paid, they cannot pay for the cost of the printing. There are other printers that have cheaper cartridges that they could use to earn some profit (study-circle member in a women's group).

Hence, they tried to actualize the affordances, but the resulting outcome did not correspond to the goals they had for their action. In addition, some groups overestimated the community's ability, or willingness, to pay for these services:

The committee (study circle) members decided the fee. We have to see the economic abilities of the community members. That's why we set the fee of 200 KES for registration and 200 per month. Now, from experience, because of the (economic) environment, still the low fee could not be met. The economy is a problem, and the fear is that the finances will be problematic (study-circle leader in a group focused on forestry and eco-tourism).

The groups also faced difficulties regarding the Internet infrastructure. One group, for example, tried to access the Internet by using mobile Internet service provided by Safaricom, but there were no mobile towers nearby. Therefore, the group was unable to connect. The group did not have the financial resources to acquire satellite Internet service, and affording it would have required external funding. Along with infrastructure problems, the group's lack of financial resources, and low community demand, the group was unable to navigate the restrictive social structure and enable any functionings when they tried to actualize the affordances. The group tried to offer a service that the context and ICT did not support, and the result was that the expected results from the affordance of improving group members' livelihoods by generating an income from the Internet café was not achieved.

Table 1 summarizes the process by which the groups could perceive and actualize the affordances, and the resulting functionings from the actualization, as well as an example in which the affordances were actualized without the achievement of the expected outcomes, and the Internet cafés did not result in increased functionings for the groups.

Table 1. Summary of findings

Affordance	Resource portfolio	Social structure	Capabilities	Functionings
Accessibility to various services and communities	<p>Enabling resources <i>Educational resources:</i></p> <ul style="list-style-type: none"> – Individuals in the groups have basic training in ICT and management <p><i>Financial resources:</i></p> <ul style="list-style-type: none"> – The groups have collective financial capital to start the Internet cafés <p><i>Material resources:</i></p> <ul style="list-style-type: none"> – The groups have the facilities (space) for Internet cafés <p><i>Time:</i></p> <ul style="list-style-type: none"> – Individuals in the group have time to devote to managing the Internet cafés <p><i>Information resources:</i></p> <ul style="list-style-type: none"> – The groups have collective knowledge about public access and community needs 	<p>Enabling structures <i>Policies and programs:</i></p> <ul style="list-style-type: none"> – There is a market need for the service – There are sufficient infrastructure programs (electricity and Internet access) <p><i>Technologies and innovations:</i></p> <ul style="list-style-type: none"> – The groups have access to ICT for the services they aim to provide – The needed ICT is affordable for the group 	<p>The capability to start Internet cafés to:</p> <ul style="list-style-type: none"> – Generate income for the group members – Support a community need – Offer computer training to the community 	<p>By choosing to actualize the perceptible affordance, the choice leads to:</p> <ul style="list-style-type: none"> – Financial support of their families (through added income), resulting in an increased standard of living (although minor) – Increased ICT skills in the communities (through computer training)

(continued)

Table 1. (continued)

Affordance	Resource portfolio	Social structure	Capabilities	Functionings
<p>Accessibility to various services and communities (with no increase in functionings)</p>	<p>Enabling resources <i>Educational resources:</i> – Individuals in the group have basic training in ICT and management <i>Material resources:</i> – The groups have the facilities (space) for Internet cafés <i>Time:</i> – Individuals in the group have time to devote to manage the Internet cafés <i>Information resources:</i> – The groups have collective knowledge about public access Restricting resources <i>Financial resources:</i> – The groups lack the financial capital to provide the services that the communities request <i>Information resources:</i> – The groups lack knowledge about the community’s willingness to pay for ICT access</p>	<p>Enabling structures <i>Policies and programs:</i> – There is a market need for the service <i>Technologies and innovations:</i> – Individuals in the group have the skills to provide the services Restricting structures <i>Policies and programs:</i> – There is a lack of infrastructure programs (electricity and Internet access) <i>Technologies and innovations:</i> – There is a lack of access to ICT that they aim to provide – The needed ICT is not affordable for the group</p>	<p>They have a false belief that they can start Internet cafés to generate an income and support a community need</p>	<p>While the groups try to actualize the affordances, the actualization does not result in increased functionings for the group members</p>

6 Discussion

The CA is frequently used in ICT4D studies and has, to a certain degree, changed the focus of ICT4D research from mainly looking at economic development to more human-centered development (Andersson and Hatakka 2013). Affordances, however, are rarely used to understand the interplay between ICT and goal-directed actors in fostering development. We argue that affordances allow us to examine how individuals interpret the material properties of ICT, with the objective of enhancing capabilities for individuals' agency and well-being. This distinction is important in the context of ICT4D because it allows for the specification of how ICT contributes to changes in developmental practices, which, in turn, constitute human development.

In this paper we propose a framework to explain *how* ICT affordances leads to increased capability sets for the individual, and *how* individuals' resource portfolios influence the perception and actualization of affordances. The affordances also need to be in line with the goals that users have, since people do not use a form of technology if they do not see any action possibilities to achieve their goals (Leonardi 2011).

Combining theoretical conduits may have the negative impact of adding complexity to our framework. However, we argue that the positive aspects outweigh eventual negative effects. In the analysis, our framework increases our understanding of the impacts, and potential impacts, of ICT for development. In our evaluation of the case, we go beyond describing the interplay of structure and agency, and add to the explanation of how agency and social structures, interacting with ICT, influence an individual's ability to perceive and actualize affordances, as well as what happens when the affordances are hidden. By applying the proposed framework, we explain what needs to be changed (in individuals' resource portfolios or in social structures) to increase individuals' choices from an ICT intervention in which the resulting outcomes are not as expected. It further enhances our understanding of why the same technology interventions result in different outcomes when implemented in different contexts or among different individuals; how contextual factors can limit (or enable) individuals' ability to perceive affordances and expand their capability sets, and why ICT interventions do not lead to perceptible affordances or increases in individuals' choices.

The analysis also shows that ICT-enabled capabilities can be converted into functionings only if perceptible affordances are actualized. In some situations, individuals may choose not to actualize affordances, or be unable to actualize them. For example, while most of the groups perceived Internet cafés as a means to increase their livelihoods, not all groups had made the choice to, or was able to, actualize it. For some there were contextual factors (e.g., infrastructural issues, or lack of computer skills) that prevented them from actualizing a perceptible affordance. Depending on which factors in individuals' resource portfolios and in the social structure that hinders the achieved outcomes, there are different ways to change the situation. Changes might be made to material properties to align with affordances, or their expectations may need to be changed to align with the material properties, e.g., by providing the groups with more cost-effective printers (which were suggested by the groups themselves), or by getting them to offer services in their Internet cafés that are available to them.

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Method of Research in a We-Paradigm, Lessons on Living Research in Africa

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Abstract. This paper paints a picture of how a method of research in an African *we-paradigm* looks like. The paper describes *living research*, where the researcher is an integral part of a community, being a recipient of communal grace and partaker in, and reporter of, the communal development of embodied knowledge.

Keywords: Africa · Method of research · We-paradigm · Values

1 Introduction

Renken and Heeks [1] argue that the complexities in the social realm succinctly demand diversity in research methods in ICT4D. They posit that the social sciences in general, and sociology in particular, harbour a resource pool of techniques from which researchers can glean approaches that could diversify the theoretical and methodological methods used. This paper presents such a diversification, albeit without adhering to key assumptions that Grosfoguel [2] shows are considered commonsensical in settings informed by a Euro-Western genealogy. The method of research presented conforms to paradigmatic and value propositions deduced from research at the intersection of technology and society in rural communities in Southern Africa, since the year 2000. The underlying line of inquiry emerged after embodied experiences in the communities in which the author reside(d) show that ICT4D is uncannily Eurocentric. The discourse often fails to recognise local, African ways of knowing and to, subsequently, navigate the clashes of paradigms [3–5].

2 A Fundamental Problem: Alien Framings and Foreign Methods

ICT4D research often appear to hold a technocentric gaze set in Eurocentric framings [6, 7]. Such framing is managed from academic strongholds aligned with Eurocentric worldviews [8–10]. Africans living in Africa have had little chance for participation in constituting discourses [5, 11]. Such framings inculcate coloniality [9, 10, 12, 13]. Dominant philosophy, constructs, theories, methods, and interventions are conceptualised within a logic set in systems of thought aligned with a Eurocentric meaning-making [14–17]. Coloniality obscures the local meaning arrived at through the

epistemology of those that are experiencing technologies in their daily lives, outside of Western settings [for example, 18, 19].

Methods set the way researchers claim the validity of perceptions and, subsequently, set the base from which theories are proposed. Methods include epistemic filters that frame reality and provide a base of interpretations of what constitutes reality [20]. Western epistemes, however, are mostly foreign to the understanding non-western value orientations [21]; In the poignant words of Alik Shahadah [22]: “You cannot measure an African success with a European ruler.”

The South African Cornel du Toit [23] calls to recognise and value subjectivities when assessing scientific integrity. He put this in historical perspective: “[In pre-modern Africa] the person and what she says is one. This contrasts with the Western notions that the inner world of consciousness and thought is separate from the way the person presents herself in the world” [24]. Research in Africa using imported methods undervalues much that is relevant in the local societies [25]. In an effort to provide alternative perspectives and ways to a conversation, I introduce an embedded method of research for unearthing community driven-perspectives, deduced from dynamic and integrative engagement in African communities. Such a method of research, I argue, aligns with the realities in the ‘we-paradigm’ where an entity exists integral to the whole [5].

3 The We-Paradigm

Being full time embedded in African communities since 2000, I noticed incompatibilities in the views of those indigenous to rural African realities and those being introduced to such realities from the outside [5, 11]. Underlying intricacies I observed through paradigmatic perspectives. In previous work, I conceptualised three distinct paradigms between which my African interlocutors switch voluntarily: the I, we, and it-paradigms [5]. A fundamental difficulty in this paper is to describe a *we-paradigm* in a possibly incommensurable *I-paradigmatic setting* of a Western-framed academic audience [9].

In the I-paradigm, an individual is a unit of analysis. Roest [26] argues how this paradigm is dominant in western belief systems; Life is seen as being lived in an age-of-authenticity seeking a self-consciousness that regards the individual (and, therefore, individualism) as the primary agent interacting within society. Roest paints the analogy of likening people to billiard balls, bouncing off each other. In this realm, an individual is urged to seek human power and agency, freedom and fulfilment in self-sufficiency, self-reliance, autonomy, through self-cultivation, and immanent prosperity and security [26]. The individual is the center, placing the *self-acting* in the world to the exclusion of others.

In the We-paradigm, there is no view of an individual in an existence in that way. Reality, in this worldview, is embedded in a myriad of relationships within a community that contain performers including humans, non-humans and other beings [27]. Community is given primacy where situations arise on who to prioritise between the community and the individual, summed up in: “I am because we are, we are therefore I am” [28]. These words link to the idea that human beings cannot live in isolation.

Many African cultural settings foreground the primacy of community over the individual from the understanding that humanity depends on community, interconnectedness, conviviality and interdependence [29].

I-paradigm-embedded theories of knowledge and their enactors, I experience daily, have great difficulties to facilitate and recognise the intellectual practices in a we-paradigm. Spivak [30] argues that it might be impossible to know what lies outside of one's perception. However, the IFIP 2019 conference seeks to facilitate South-North cooperation and therefore could be sensitive to different ways of knowing. I disagree with Kuhn [31] who argues it to be impossible to identify a different paradigm, as in previous work I have shown paradigm switching to occur in African communities [5]. Gioia and Pitre [32] argue that insight in different paradigms is possible when we apply transdisciplinary meta-perspectives, a technique used by many African authors when they reflect on coloniality in Africa. For instance, Nkrumah [33], an influential philosopher and political leader in Ghana, in response to his experience with Western theories provided an intellectual framework on social conscience founded in the African values of communal solidarity and presented these in his book *consciencism*. Other philosophers of note, giving indications of how the epistemic justice could play out in Africa are Kenneth Kaunda, Reuel Khoza, Patrice Lumumba, Munyaradzi Mawere, Lovemore Mbiqi, Julius Nyerere, Francis Nyamnjoh, among many others. From these writers, one gleans that in a we-paradigm knowledge is embodied in an ever becoming social personhood, in a universe of coherence [29, 34]. The Burundian Bigirimana [35] shows this embodied knowledge to be a dynamic and integrative *knowing*. Thus, in the we-paradigm, life unfolds itself as a holistic *doing through being*, with knowing being part of community engagement, conversation, and representation.

Research in the we-paradigm is to be understood in terms of its meaning and relevance for the communities in which it is performative. Knowledge divorced from a local sense, local knowing or expressed in isolation is void to the local community [35, 36]. When *knowledge* is represented in manners foreign to the community [for instance, in textuality, see 36], such declarations of intellectual faculty speaks solely about the researcher's encapsulation in a particular (geo)political agenda [9]. Of course, subsequent interventions ensue uphill battles for their local uptake and might even derail development [for a poignant example from Liberia, see 37]. Except, maybe, during a disaster, it is perverse to talk *about* local communities and make (research) plans and (research) strategies without authorised representation and engagement of such a community from the very start of deliberations, conceptualisations, planning, and activities.

4 Virtues and Values Orientation, Examples from Southern Africa

Many communities in Africa maintain an alliance to so-called indigenous, non-Western values. These values express themselves in convivial cultures like Ubuntu, espousing communal love [29]. The academic equivalent of such a convivial worldview is a philosophical approach that values positive character traits dubbed *virtue epistemology* [38, 39]. Such an epistemology necessitates a convivial understanding of local values.

Virtue epistemology seeks to share forms of understanding with others in a conscious and intellectual carefulness realising that perception intertwines with matters of attitude, beliefs and morality and *knowing* benefits from the acknowledgement of a multiplicity of knowledge systems.

Table 1 presents a working-scheme of five African values with some keywords describing their contents. These values do not match with I-paradigmatic propositions as exposed by Roest [26], cited earlier. There is no overlap with neo-liberal ideals of independent markets [cf, 40] or dominant theories of human motivation like those espoused by, for example, Abraham Maslow [41]. Of course, cultures and values are dynamic, shift, and hybridise over time. However, as I argue in my book *Reflections* [5], this toolbox is productive in view of the conceptualisations regarding philosophies, methods, and theories concerning research in many African communities.

Table 1. A working-scheme of African value orientations [source: 5].

Value	Description	Keywords
Ubuntu	Communal love	African cosmology & philosophy, morally <i>good</i> behaviour, conviviality, affirmation, compassion, solidarity
Oratio	Communicating embodied knowledge	Orality, narrative, knowing, inclusive, collaborative, conversation, community deposits
Relatio	Relational resource allocation	Sharing, needs orientation, relationship building
Animatio	Continuous present moment	Here-and-now, constituting history, emerging future, connectedness, rhythm, belonging, humaneness
Dominio	Seeking maturity	Reconciliation, continuity, covenant

5 Living Research

The philosophical grounding of *living research* in Africa relies, of course, on African philosophy. Mawere and Mubaya [42] describe African philosophy as meaning “the contextualised critical thinking, articulation of ideas, and attempts to seek solutions to problematic situations by Africans.” African philosophy, in the sense of Mawere and Mubaya, presupposes plurality and the participation of all in communiversity (*ibid*, 46). The articulations of African philosophies and related ontologies, epistemologies, ethics, and metaphysics are relatively recent as self-exploration of African thought by African researchers was actively suppressed till the end of settler colonisation in the 1960s and 70s. The initial propositions about such a philosophy, of course, are not settled and leave much room for debate, exploration and contributions [43, 44].

The outset of *living research* is to push the method of research beyond ‘the usual suspects’ where normative epistemologies dominate, silence, objectivise, and normalise [35, 45, 46]. Beyond what is pre-set in the researchers’ Eurocentric academic vocabulary, the approach to research seeks sensitisation and training to discover consciousness from within the locally active paradigm. The method of research seeks

priority for attaining an appreciation of the local understanding of local expressions of phenomena, in local manners. Living research depends upon one's inclusion and living-the-life, being part of the structures, practices, hopes, aspirations and fears in a community [47].

Focus on community is pivotal in a decolonised research [12]. Both the source and clients of research are embedded in communities. Any interaction involves communications within communities and derivatives are subject to communal processes. In the case of Macha Works in Zambia [48], I distinguish seven steps that facilitated the living research in that community [12]:

- (1) the community prioritises research and asks for its execution [for example, 49],
- (2) community members introduce research to the relevant authorities [for instance, in the House of Chiefs in Zambia, 50],
- (3) development of research concepts, proposals and execution processes take place within and with the community in the methods of co-creation [5],
- (4) any development and any communication is instantly interacted upon in the (geographical) location of the communities concerned [36, 51],
- (5) community members disclose embodied knowledge first and continue to be preferred presenters on research progress (for example, Macha's Fred Mweetwa at SXSW, USA, in 2014, and the Community Networks Summit, South Africa, and African Internet Forum, Sudan, in 2018),
- (6) any presentation or write-up concerning the research is co-developed, discussed and shown in the community first, after which representation could be granted for its dissemination outside of the community [52],
- (7) the community has veto rights to cancel or stall external propagation [for example, 53].

In living research, the researcher is an integral member of the community and visible as such, being a participant in interactions that affect embodied knowledge. The researcher, in my experience, mostly receives culturally-framed, implicit invitations to contribute to the dynamic and integrative processes that constitute communal knowing and, subsequently receives explicit requests to represent theoretical understandings that interact with broader social phenomena or extant theories.

The communal inclusion of the researcher in a community is an act of communal grace. Such grace is common in the sociology of ubuntu where "everyone exists by the grace of the other" [cited in, 5, 54]. Grace unsettles oriental, imperial, and colonial frames. Living research, therefore, acts within the parameters of the grace received from a community based upon a confession of character [5]. Such grace is remarkable as it is not necessary for a community to enable a researcher to be part of communal life.

The validity of living research links in with the means of entrance, the introduction. Also, such research is subject to local authority and thus reporting to local governing bodies. In this, *being* a researcher and *doing* research is not a removed activity nor confined to the academic art of writing of papers; It is a *vocation*, an identity [cf, 45]. Any breath and action in a community has moral and scientific consequences. Such an outlook surpasses artificial dichotomies, for instance, in being and doing by blending role performance, authority, and observatory virtue in continuous communal learning and growing in knowing and becoming [55]. Such a stand might very well need

measures of faith as to the materiality of the learnings to be acquired and a hope that it is possible to know.

Communities have distinctive authorities over what happens at the sites of enquiry. Gaining the necessary trust through tests of character and consistency of interactions and, subsequently, receiving the invitation to become an embodied part of the collective knowledge base takes many interactions in every facet of ones living [47]. Depending on the context, for instance, it took me at least five years of active waiting to be allowed access to local ways of knowing in various communities in Zimbabwe and Zambia [5].

Living research and its exploits are about understanding in relation with others, through covenants between people [56]. Through such covenants, the community is both sovereign and bound while remaining empowered as what and how to reveal whenever and however the community wishes to act and position any proceeds. Anything outside of such a covenant, for instance, appropriated data and uncollaborative write-ups, the community can consider manipulative, embezzlement, and/or projection [cf, 57]; “If the end product of foreign academic research is a takeaway text written in academic English, then the foreign academic appropriates local culture for private and foreign profit, leaving the local community objectified and exploited” [36].

The primary drive for living research is to get to know people and practices embedded in conversation in communities. In practice, this involves a never-ending and continuous interaction with anyone in any setting, 24 h a day, seven days a week, 365 days a year. Only death or expulsion can end such a connection. Research, thus, involves transparency and intellectual commitment in any encounter where one lives and works and where one meets. The researcher relies upon an outward-looking posture and attitude, with continuous attention and interest in those around: actively *getting to know* interests, believes, dreams, and fears, in a metaphysical world.

6 Discussion

Burawoy [45], among others, elaborates on the existence of various sciences. He positions one side focusing on positive sciences that rely on rationality, logic, and facts (which he shows, convincingly, to be unattainable). The other side, Burawoy positions reflexive sciences involving a presence and agency of the person *looking*. Living research is a paradigmatic response to the fundamental questioning of methods of research and how they relate with power. Hlabangane [9] provides insights into how methodologies issue from and adhere to a particular knowledge system: Eurocentric research issues from the I-paradigm. In this manner, for instance, living research differentiates from various forms of group-/collective-/network-oriented ICT4D research, especially where the latter thrives on aspects of individualism, seeks delineations or bifurcations, aims for textualisation, or insists on categorisations set outside of the community. With its orientation towards dynamic and integrative/embodied knowledge and conviviality, living research is ever emerging and changing and can only give an indication of temporary status. Also, living research differentiates with autoethnography, as the latter links in with the researcher’s individual self, as in a Cartesian conversation with oneself considering one’s own nature. Living research, however,

seeks the local epistemology as the frame of reference, seeking to align with a communal-self, inclusive of meaning contained in congregating beings and non-beings, for instance in Ubuntu [29].

The outcomes of research in the I-paradigm appear quite incommensurably with research in the we-paradigm. The I-paradigm is perpetuating as texts, written out of context, becoming pretext in subsequent research. Proceedings in the we-paradigm cannot be judged from the I-paradigm. Often, knowledge and judgement from the I-paradigm are irrelevant and a nuisance to an African community and their knowledge keepers. I experienced that such knowledge and judgement could generate damage in the form of the arrival of unsustainable electronic artefacts [58], broken relationships because of exclusion criteria, or a general feeling of inferiority or exploitation [36, 59, 60].

Being privy to, and included in, local ways of knowing involves moral obligations for constant communal reflection on any aspect of the research. Power issues are a prime subject for discussion as are matters of means of colonisation hidden in the practice of research (example: vendor lock-in). Other items are how to deal with the bifurcating presence of individualism (a particular trait and ideal in the I-paradigm) or questions about why perceived deductions were unavailable and why they should become embodied (example: the issue of taboos).

Living research involves periods of *imagination*. As Kahneman [61] shows, the human mind starts with assumptions and reflects information against those assumptions. In living research, the community challenges the pre-set assumptions and engages to reconcile history and contemporary contributions into embodied knowledge [34]. For this, the researcher has to assess evidence and ‘knowledge’ with a reflective mind’s eye, recognising what Nyamnjoh [62] called the conviviality of knowledges, celebrating incompleteness, and prioritising fluidity against fixedness of prescriptions, standardisations or routines.

Communal processes that sustain *knowing* involves the oratory art of *articulation* [36]. Co-production, in the communal setting, is the construction of deductions in manners that are recognised by the local community, the wider community, and the world (in that sequence). This articulation is not necessarily in writing (first) but involves a whole range of ways in which to express thought. The result, an emerging reconstruction, is subsequently embedded and embodied in the researcher as part of a local system of knowing, ongoing conversation, and, when expanding beyond what is known so-far, on improvisation [63].

7 Conclusion

This paper calls out at the Eurocentrism in ICT4D research by providing insights into a method of research embedded in the we-paradigm. The paper has drawn on extensive experience and African scholars to show the value of African scholarship to discuss phenomena in words and language set in context and associated with African place and positionality. Through living research, the paper offers directions forward that can inform method of research in ICT4D, although it appears far removed from practices as

trained and executed in Western epistemology-based research practices. In daily practice, living research is all-consuming, with the researchers entirely being engaged with the lived-life of the research in community.

Living research resonates with African contexts and worldviews. Of course, it needs stamina, to continue even when confronted with discomforting truths, confronting opinions, cognitive dissonance or even emotional dissonance appear. The presented paradigmatic approach, its practice, and a supporting set of communal values, I hope, can be helpful to both native African researchers and those visiting from foreign contexts.

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Unpacking Empowerment in ICT4D Research

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Abstract. Information and communication technology is said to provide paths to empowerment, yet the current ICT4D literature weakly conceptualises how this occurs. This article questions the conceptual alignment between the empowerment concept and the actual empowerment outcome attained through technology. We use Alsop and Heinsohn's measuring empowerment framework and Zimmerman's individual empowerment framework to analyse the missing links between empowerment and technology within current ICT4D research. We argue that research on empowerment in ICT4D needs to (1) be more specific about what type of empowerment takes place; (2) take into account both agency level changes and socio-institutional structures, (3) consider the dual effect of both empowerment and disempowerment.

Keywords: Empowerment · Disempowerment · Structure · Agency · ICT4D

1 Introduction

The term empowerment is frequently used in ICT4D studies, but often without a clear conceptualization. In some cases, there is a misalignment between the concept of empowerment and the actual findings. Empowerment, as a concept, can entail a wide range of elements that are interconnected and dynamic. A more refined understanding is necessary to unpack the meaning of empowerment and use it not as a sticker but a conceptual or evaluative framework. This paper reviews the current state of the ICT4D literature in the understanding and application of the concept of empowerment as linked with technological adoption. A categorization of empowerment is applied to a core set of ICT4D literature with the objective to firstly, identify how the empowerment concept has been used, in which contexts; and secondly, to review the linkages between claims of empowerment and the actual developmental impact of ICTs in various contexts. We also seek to identify what is missing or underdeveloped in our understanding of empowerment within ICT4D studies.

The various empowerment and technology studies and conceptualizations cited in this paper are from specialist journals on ICT4D, namely Information Technology for Development, Information Technologies & International Development, and Electronic Journal of Information Systems in Developing Countries; the proceedings of the series of conferences on ICT in developing countries organized by the IFIP WG9.4 and the African Journal of Information Communication and Technology.

The next section gives an overview of the different categories of empowerment and examples from the ICT4D literature. This is followed by a discussion of areas that require disambiguation. The paper concludes with recommendations for future research on empowerment in ICT4D.

2 Categories of Empowerment

In order to provide a theoretical guidance to the literature review, we apply six categories of empowerment, drawing upon Alsop and Heinsohn's [3] formulation of the empowerment indicators and Zimmerman's [43, 44] conceptualization of the empowerment theory from an *individual/psychological* level of analysis.

Alsop and Heinsohn give a detailed analysis of the different categories of empowerment; *community, political, economic, and cultural* and *gender* and their respective measurement indicators through various developmental projects conducted in Mexico, Ethiopia, Nepal and Honduras. They present an analytic framework that can be used to measure and monitor empowerment processes and outcomes. Their measuring empowerment (ME) framework, rooted in both conceptual discourse and measurement practice, illustrates how to gather data on empowerment and structure its analysis.

Zimmerman gives a nomological network of empowerment at an individual level of analysis. He states that individual empowerment is an open-ended construct that is not easily reduced to a universal set of operational rules and definitions. The measurement of individual or psychological empowerment may be especially difficult because this kind of empowerment '(a) manifests itself in different perceptions, skills, and behaviours across people; (b) different beliefs, competencies, and actions may be required to master various settings; and (c) and may fluctuate over time' [43]. Therefore, the development of population and milieu specific measures of individual empowerment is exigent but crucial to further develop empowerment theory, learn more about how different settings maybe empowering and disempowering and see how empowerment processes change over time.

Alsop and Heinsohn's formulation of the indicators of empowerment comes from a group level analysis such as the family, community or household level. Whilst that helps us recognize differential changes in power at a structural and organizational level, it does not give us a clear direction for an individual or agency level analysis of empowerment which has been seen to occur in most ICT4D empowerment cases we reviewed. Hence Zimmerman's individual empowerment framework fills the missing piece of understanding power changes that take place at an individual level and how it affects not only the individual but also, how it over time brings about larger structural or organizational changes.

In the rest of this section, we briefly introduce the six categories of empowerment. Examples from ICT4D studies are provided in each category. It should be noted that often more than one type of empowerment is discussed in a paper, so the papers are categorized based on the claims made and evidence presented in the paper.

2.1 Community Empowerment

This type of empowerment is defined as expanding the assets and capabilities of poor people to participate in, negotiate with, influence, control and hold accountable the institutions that affects their lives. Studies conducted in the development and other social science fields connote community empowerment with community mobilization and cohesion wherein communities gain the capacity to do things that they want to do and go beyond political or legal permission to participate in the national political system [3, 24, 34, 39]. Within ICT4D studies, studies conducted around micro-entrepreneurs and GIS technologies have shown to create a certain degree of community empowerment. A study by Corbett and Keller [13] in Indonesia explains how the effects of technology in the form of GIS led to community engagement and mobilization within two communities.

In particular, the results of the study showed that the aspect of being involved in the community mapping process brought about certain levels of community mobilization. Observed indicators of increased (and in some cases decreased) community empowerment capacity included heightened (and lowered) confidence, stronger community cohesion (between old and young) and an improved sense of cultural identity. Individuals appeared to have felt empowered by the skills learned during the routine use of the GIS; some learnt more about their community, some learnt language skills while some got a chance to collaborate with different members of the community. The skills that the individuals acquired also helped alter their social role within the community.

Another example is the case of micro-entrepreneurs in Morocco, where there was an increase in mobilization within communities to work together on their local businesses. ICTs in the form of mobile phones, helped maintaining the network of contacts of buyers by cutting out the middleman and selling traditional handicraft products directly to them [14].

The notion of community empowerment generally involves changes that occur at an individual and organizational level leading to an increase in inclusion, participation and organizational capacity within communities. Technology here becomes a channel through which community mobilization and participation can be achieved. The different functionalities offered by technology create changes through which the community eventually starts to mobilize which leads to a stronger integration of the community. ICT applications that have shown to create a certain degree of community mobilization are geographical information systems, telecentres and internet cafes [3, 14, 26, 36].

2.2 Psychological Empowerment

This type of empowerment is broadly defined along the lines of enhancement of capabilities, agency and well-being at an individual level. Most studies of individual empowerment are connoted with psychological empowerment that incorporates the cognitive elements of the individual agency such as intrapersonal and behavioural factors of self-esteem, self-perception, self-efficacy, participation and perceived control [1, 3, 43, 44].

According to Zimmerman [44], psychological empowerment is defined as “a cognitive state characterized by a sense of autonomy, competence, and goal internalization”. Hence, individual empowerment then becomes a multifaceted construct reflecting the three dimensions of being psychologically enabled [43]. Zimmerman’s constructs of psychological empowerment theory that includes, interpersonal, interactional and behavioural components can be used as a conceptual model for evaluating psychological empowerment in ICT4D studies. According to Zimmerman [32], the process of empowerment enables individuals to gain control over their lives and master their issues which are important to them and is often associated with developing interventions and creating social change. This would then have further effects on their community life and general lifestyle.

ICT4D studies on empowerment often highlight how technology is able to create individual level changes to the user during its routine use. For example, in the case of Singapore, foreign Vietnamese brides felt an increase in confidence and autonomy through the use of mobile technology. As immigrants from another country they were able to navigate through their transnational identity and accustom to a life in Singapore. Despite the difficulties of acquiring language skills by themselves from home, the mobile phone engendered a sense of autonomy. Certain informal learning channels, such as YouTube videos with English language lessons and beauty tutorials, proved useful. Here we see mobile phones engendering a sense of psychological empowerment for these women. Empowerment came in the form of enhanced capabilities such as English-speaking skills, personal grooming and other educational tutorials, leading to their ability to settle into a new life [31].

Technology here becomes a medium of capability enhancement at an individual level. ICTs in the form of computers, mobile phones or telecentres create changes at an agency level through which individuals feel a change at an interpersonal and behavioural level. This then helps them become capable to navigate through the existing norms and rules to achieve what they want for themselves.

2.3 Gender Empowerment

This type of empowerment is achieved when there is a provision of equal rights, voice, freedom of expression, spaces for political and social change and a greater independence/agency to act on one’s opportunities and choices for both women and men. This again boils down to having a greater control over one’s resources, independence and agency at an individual level. In most ICT4D studies, gender empowerment refers to women having a space for creating social change and being enabled to pursue their choices [6, 16, 19, 20].

ICT4D studies that focus on gender empowerment mainly highlight how women are able to have a higher sense of freedom through technology use. Technology here becomes a medium through which women attain skills and capabilities that offer them with an opportunity or choice set that was not available before. For example, a study conducted by Wheeler [40] on the use of internet cafes by women in Egypt showcases how women in strict authoritative states were enabled to create changes in their lives through the access to computers. For women in the Arab world, several obstacles stand in the way of their enablement through ICT, including illiteracy, censorship lack of

access, IT knowledge, and lack of technical training. In the case of Egypt, women felt that access to technology in the form of computers and internet-use helped them with their professional development, expand their social network and transform their social and political awareness. Women living in strict authoritative states were able to make friends and connect with people across gender lines and national borders through social networking [6]. Such studies explicate the role of technology in enhancing women's capabilities. Technology here becomes an artefact that creates a space for creating social change for women to gain equal rights and opportunities as men.

2.4 Cultural Empowerment

Cultural empowerment seeks to juxtapose narratives, languages and diverse cultural identities, as part of a broader social and educational change that wishes to undermine the hierarchical social divisions and classifications created by the modernist mentality. Empowerment indicators for cultural change include freedom of expression of different cultural identities, narratives, traditions and languages and social and political acceptance of different cultural identities, rituals, traditions, languages and narratives [3, 27, 36].

ICT4D studies that explicate cultural empowerment explain how technology helps bring visibility to the excluded narratives and diverse cultural identities. For instance, in order to bring out the relevance of forgotten indigenous Australian communities, computers and kiosks showcasing the history of such indigenous populations were installed in libraries and museums in order to educate city-dwellers of their presence and importance [28].

Most ICT4D focusing on cultural empowerment use the technology artefact as a medium through which education and knowledge about excluded or forgotten communities, cultures and practices can be imparted to the current population, in order maintain the heritage and importance of such communities. Technology here becomes a conduit through which forgotten narratives and cultural heritage can be brought in the current discourse and dialogue of modern communities.

2.5 Economic Empowerment

This type of empowerment ensures the increase, availability and widening of the distribution of basic life-sustaining goods such as food, shelter, health and protection. Economic empowerment highlights the expansion of the range of social and economic choices available to individuals and nations by freeing them from servitude and dependence not only in relation to other people and nation-states but also to the forces of ignorance and human misery [3, 12, 18].

Alsop and Heinsohn [3] in their choice framework attempt to highlight a sub-domain of economic empowerment titled as 'labour'; wherein, opportunity or agency enhancement indicators such as increase in literacy levels, acquisition of job specific skills, access to information are assumed to create economic empowerment. Technology here can be assumed to be a channel through which citizens can be given access to education and other world information through computers, which can then prepare them to be eligible for employment which is then assumed to enhance their basic livelihood.

Many ICT4D studies explore how technological adoption enable citizens to achieve an availability of basic goods or an improvement in livelihood, e.g. by using the sustainability livelihood framework without using the concept of empowerment. In the literature review, economic empowerment is often an assumed outcome based on technology adoption. For example, the provision of telecentres in Cape Town helped individuals with access to world information and helped them acquire basic literacy skills but the study did not further investigate if having acquired those skills did actually help them get employed, with a wage that helped increase their livelihood [32]. In order to attain actual economic change where one is able to create a higher accessibility to life sustaining goods, technology needs to integrate through people's existing livelihoods so as to assist them in their day to day struggles of bettering their lives.

2.6 Political or Structural Empowerment

This type of empowerment is concerned with civil society mobilization in which citizens' voices are amplified; a mechanism for vertical accountability is created for holding state institutions and service providers accountable for their actions. Political or structural empowerment is etymologically based on a structural shift of power between the state and the citizen. It is about giving power to the citizen to have a transparent relationship with the state wherein the citizen gets to participate in service delivery and policy processes. An actual outcome of political empowerment would inculcate organizational-level change where there is a structural shift of the power that the citizen holds [3, 4, 5, 11, 38].

Most ICT4D empowerment literature does not take into account the existing power structures that envelope technology use. While individual level changes are accounted for, broader socio-structural changes are generally not. For example, if a farmer in India chooses to take out a bank loan to finance a lift irrigation system, but the process for obtaining the loan required that he - an illiterate person - complete 20 forms, offer all his land as collateral, and obtain a lawyer to verify that he owned title to the land. The question that arises here is whether the provision of ICT enables the farmer to navigate through these institutional structures in order to attain what he wants, or whether these ICTs further reinforce the existing institutional structures which render the farmer even more powerless than before. Thus, empowerment changes are often considered at the individual level but rarely touch upon how ICTs could help navigate around and shape existing socio-institutional structures [22].

The next section examines in greater detail the missing links within current ICT4D studies such as the lack of emphasis on existing power structures and the disjointment between the empowerment concept and the actual empowerment result.

3 Empowerment and ICT4D: Clarifying the Links

The review of the empowerment literature in ICT4D reveals that the term is sometimes used merely as a sticker to indicate a vague developmental outcome. To have more meaningful discussions on empowerment, there is a need to disentangle the concept and its linkages with ICT adoptions. In this section we discuss two areas of concern from the literature review.

3.1 Misalignment Between the Empowerment Concept and Outcome

Out of the 23 papers that make an attempt to conceptualize the link between empowerment and technology, a majority of studies have shown a certain degree of individual level empowerment taking place through technology use. Whether it is the use of mobile phones by Vietnamese brides, or the use of internet cafes by women in Egypt; users of technology tend to feel a change in their self-confidence and self-perception due to access to technology or to the information through technology. While the findings of these studies reveal agency level changes, the theorization of the particular empowerment type appears to be disjointed with the actual result of empowerment achieved through technology. For instance, out of the studies that engaged with an individual level analysis, only two studies theorized the various facets of individual empowerment where specific psychological empowerment ‘indicators’ such as perceived control, self-efficacy, self-confidence, participation, problem solving, coping, and self-determination were explained and analysed in the findings. While in the other studies, either the definition of empowerment was missing, or even if the term was defined it was not distilled within the results of the study.

For instance, in the Ghanaian study of the provision of farming information through radios to farmers [23], empowerment was defined as an increase in autonomy. The study was done to understand how access to farming information affected female farmers in rural Ghana. There were traces of individual empowerment noticed, as the male farmers now had better access to farming information, but the finding of the study mostly focused on women’s lack of involvement in the household decision making (or willingness to invest in information delivery technologies). Here the concept of empowerment used was autonomy, but the outcome focused more on the aspect of women’s involvement, while there were certain linkages between the two, the evidence and result mostly appeared misaligned.

The literature review shows that ICT4D empowerment studies could benefit from a more refined analysis of empowerment indicators. For instance, in the Egyptian internet cafe case [40], the results revealed that women having access to information and ICTs helped them achieve literacy skills, connect with people from different parts of the world and for some, even gain employment. The findings would be more insightful if explicitly linked with the different indicative factors of psychological empowerment or even economic empowerment, such as the behavioural or intrapersonal factors or percentage of increase in livelihood, types of employment gained etc.

By clearly conceptualising and identifying the types of empowerment, and evaluating empowerment with specific indicators, ICT4D studies could move beyond general and superficial claims of “empowerment” and acquire a deeper understanding of the links between ICT adoption and empowerment.

3.2 The Dual Effect of Technology: Empowerment and Disempowerment

The literature review presented in this paper also indicates the lack of attention to structural conditions. Bar two, the reviewed ICT4D studies failed to address the enveloping structures that permeate ICT use. While agency level changes have been observed to take place not a single study addressed how the existing socio-cultural and

socio-institutional structures that envelope ICT use affect the level of empowerment taking place. Furthermore, these studies reveal an undertone of a disempowerment effect that often accompany the empowerment findings. Yet this is rarely reflected upon.

For instance, the installation of computers in the libraries at the University of Zimbabwe were intended to provide computer literacy to students [8]. But due to the first come first basis rule on the use of computers, female students faced reluctance by their male classmates on the use of computers. When asked about their perspectives and experiences around access, the female students spoke about their duties as wives and mothers at home—which they had to fulfil exactly during the same time at which the computers were free—and about the fact that, when they lined up, they ran the risk of being pushed out of the line by the male students. The first-come, first-served rule, which was undoubtedly established by the university management with the intent to guarantee as much “universal access” to both genders as possible, instead became a tool of gender discrimination within the existing system [8]. While the study does reveal the unintended effects of ICT use, it does not however, discuss how the existing patriarchal system was further reinforced with the installation of these computers. Instead of maybe providing a separate time slot for women to use the computers which takes into account of their existing responsibilities, the existing system in which the computers were installed further reinforced the patriarchal structure. Women now were either harassed by men for using the computers or completely missed out the opportunity to use the computers because of their female role as a wife or mother.

In another case, of the GIS use by local communities in rural Indonesia [13], being able to participate in the map making process through the GIS technology did indeed create certain levels of individual empowerment. However, it was also recorded that some informants appeared to lose status through making unwarranted recordings of information. A village elder in one of the communities recorded information about the location and extent of his fruit tree garden as proof of ownership that might be used to insure its inheritance by his descendants, which caused dispute from others in the village. Others in the village contested the truth of his claim. They disputed that the elder used the GIS to try and authenticate a controversial land dispute for his own family’s gain, and as a result, his recording from the GIS was deleted; thereby invariably dismissing his right to participate in the GIS.

The GIS project appeared to reinforce, rather than change, the pre-existing power structures of the community. While agency level changes did occur, they were only felt by those who were already elite and powerful in the community. Due to their existing high status in the community they felt that they had the right to have higher access and participation in the use of technology, thereby excluding the already marginalized groups such as the elderly, minor castes and women even further by not giving them enough space to participate in the GIS. What is observed here, is that while there is individual empowerment taking place for the elite, there is also a simultaneous disempowerment taking place for the marginalized. The installation of mobile phones or computers is taking place in the existing structures of society, so ICTs seem to be reinforcing rather than changing the existing structure.

Marginalized individuals in Indonesia appear to be more powerless than before due to the GIS technology, women studying in the university in Zimbabwe feel more disempowered than before while the elite and powerful individuals in Indonesia and men in Zimbabwe tend to feel psychologically empowered due to the access to technology. Women in Egypt feel psychologically empowered due to access to new information through the internet cafes, but, within the existing authoritative state of rule in Egypt. Vietnamese brides feel an increase in self-confidence due to increase knowledge attained through YouTube tutorials, but that increase in confidence is again grounded on the social approval of their husbands.

Here we see technology creating a dual effect, i.e., within the same community of users, due to existing power structure, we observe parallel effects of empowerment and disempowerment taking place. This is transpiring due to the existing socio-institutional structures in which ICTs are implanted. The trajectory of ICT use then, is shaped by the very structures of that setting. The dynamics of institutionalized power, such as those vested in systems of political, state and patriarchal control, need to be studied with more depth in order to understand the causes of the parallel disempowerment which takes place alongside the empowerment gained through technology use.

Ibrahim and Alkire [18], in a review of different interpretations of empowerment, argue that all interpretations have an underlying concept of gaining power in some way, which is dependent on agency and the social structures. Kabeer [20] sees empowerment as being fundamentally about power – about the power of people to redefine possibilities and to act on them and providing them the courage to do things they never thought themselves to be capable of. She further adds that “one way of thinking about power is in terms of the ability to make choices: to be disempowered, therefore, implies to be denied choice and the ability to act on that choice” [19]. Empowerment is thus inescapably bound up with the condition of disempowerment, referring to the processes by which those who have been denied the ability to make choices acquire such ability, implying a process of change.

The process of disempowerment is rarely addressed in ICT4D studies. It then becomes crucial to understand how technology not only empowers people but also in certain cases, becomes a medium where the already disempowered become even more powerless.

4 Conclusion

The paper provides a critical literature review on ICT4D studies that use empowerment as a keyword and argues for a clearer and more refined application of the concept in ICT4D research. Empowerment does not take place in a power-free or structure-free space. It is important to address the conceptual chains that link agency and structure to technology use, to gain a holistic perspective on how technology creates a space for empowerment? This will not only help in understanding the relationship between technology and empowerment but also help ICT4D researchers question these chains in terms of coherence and ensure that, the empowerment concept is aligned with its actual technological outcome.

Furthermore, empowerment often comes with the shadow of disempowerment that is neglected in ICT4D research. It is imperative to identify to whom power is getting transferred to, and whether empowerment occurs in a way that reinforces the existing power structure that institutionalizes inequality and marginality. This will help researchers further distil the processes of empowerment and disempowerment occurring through technology use.

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Adopting a Theory of Change Approach for ICT4D Project Impact Assessment - The Case of CMES Project

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Abstract. A compendium of impact assessment (IA) frameworks are available to understand the impact of ICT4D initiatives in Low Income Countries. However, existing frameworks do not adequately address the unique challenges of IA for ICT4D, especially the multi-level and time variant characteristics of the IA. To address these challenges, we propose the use of Theory of change (ToC) as a generic framework for IA of ICT4D projects. Based on the seminal work by Weiss [8], we argue that ToC can be viewed both as a methodology and a deep critical reflection process. We demonstrate the ToC approach for IA using a case study of an ICT4D project for LICs.

Keywords: ICT4D · CMES · Theory of change · Impact assessment

1 Introduction

The importance of information and communication technologies (ICT) for the Low Income Countries (LICs) is well recognized by the United Nations (UN). The UN 2030 Agenda for Sustainable Development states that “the spread of information and communications technology and global interconnectedness has great potential to accelerate human progress, to bridge the digital divide and to develop knowledge societies” [1]. Billions of US dollars are invested each year in ICT for Development (ICT4D) projects across different development sectors such as agriculture, health, education, environment, and natural resources. Yet, the question of whether these projects have achieved their intended development goals remains largely unanswered. The evaluation of development impact of ICT4D projects is thus a principal concern [2].

As a multiple-level and time-variant concept, impact assessment (IA) of ICT4D projects face many challenges. First, although the immediate outcomes (e.g., micro-level behavioral changes associated with the ICT4D project) are often easier to measure, the macro-level contributions and long-term development goals of ICT4D projects are arguably more difficult and costlier to assess. The difficulties are due to the challenges in establishing a direct link between the ICT intervention and its actual contribution towards the project’s development goals [3]. Second, the scope and focus of assessment changes over time [2]. Many intermediate changes take place within the ICT4D project cycle. Therefore, longitudinal studies are the better way to conduct IA

of ICT4D projects [4]. However, undertaking long term IA requires adequate resources, funding, time, and staffing capacities, which may not be readily available. Third, although ICT4D projects center around technological artifact, their impact may have great social, economic, and political implications. Resulting implications could be so complex that any related social and behavioral change needs to be assessed against a moving baseline [4]. Additionally, in many cases the impact is intangible, making it difficult to develop appropriate indicators for the IA of the ICT4D intervention.

A compendium of IA frameworks have been used by ICT4D practitioners, policy-makers, and consultants to understand the impact of ICT4D initiatives in LICs. Heeks and Molla [2] reviewed 11 popular IA frameworks, among which only two frameworks are generic in the assessment of ICT4D projects. The rest of frameworks have more specific focus on a particular development issue (e.g., gender equality), a particular ICT4D technology (e.g., telecentre), or a particular academic discipline (e.g., communication studies). Among the two generic IA frameworks, the cost-benefit analysis (CBA) approach focuses only on the financial performance of the ICT4D project, and does not address the more complex social, economic, and political implications. However, CBA adds rigor to IA by explicitly linking inputs and outcomes along with the underlying assumptions [2]. The other generic IA framework, project goals approach, simply assesses the ICT4D project against its goals by identifying indicators and appropriate methods to measure indicators to assess the goal achievement. While this approach clearly focuses on ICT4D project impact, and offers greater flexibility in its implementation, it only focuses on ICT4D project goals which may be in danger of techno-centrism. Both generic frameworks do not consider the multiple-level and time variant characteristics of the IA.

The theory of change (ToC) approach has been adopted by many NGOs to manage international development programs [5]. It has been used for strategic planning, communicating change process to internal and external stakeholders, monitoring programs, and IA [6]. In the last area, ToC has been used in inferring causal relationships between changes that have taken place and the activities that the program undertook, tracking changes, and demonstrating the impact [7]. ToC requires the articulation of the impact and assumptions underlying the impact, elaboration of development context, identification of interventions and outcomes, and determination of the causal links among interventions, outcomes, and impact. All these are crucial for the long-term IA of ICT4D projects. In an attempt to adopt ToC in ICT4D impact evaluation, Flor [3] used ToC as a tool to establish links between ICT interventions and Millennium Development Goals (MDGs). Guided by ToC, he drew a pathway to change map for different development sectors that used ICT to achieve one of the many MDGs. However, as a process tool, Flor [3] only presented a partial view of ToC. He acknowledged that the output of the study, the change pathway map, can serve as the basis for evaluating impact of ICT interventions, but that alone does not address IA.

In this research, we propose the use of ToC as a generic framework for ICT4D project IA. Based on the seminal work by Weiss [8], we argue that ToC should not be viewed only as a tool and methodology to map the sequence of changes of an ICT intervention from its outputs to outcomes. It should also be viewed as a deep critical reflection process in IA to help ICT4D researchers and practitioners to make their assumptions more explicit, and understand how and why change might happen as an

outcome of an ICT intervention. We assume that the ICT4D project has followed best practices in its implementation, such as involving all stakeholders and key project champions, designing ICT interventions for a specific development goal and adapting it to the social context, involving end-users in the iterative design process, and focusing on impact and sustainability throughout the project's life circle [9]. In addition, we assume that the project has completed implementation and is in the monitoring and evaluation phase. The rest paper is organized as follows. We first review ToC and discuss the rationale for adopting ToC for ICT4D project IA in Sect. 2. We then describe the key elements in adopting ToC for ICT4D project IA in Sect. 3, followed by a case study to demonstrate on how ToC can be adopted for IA in Sect. 4. In Sect. 5, we present the conclusion and future research.

2 Theory of Change

2.1 What Is Theory of Change?

Theory of change (ToC) emerged in mid 1990s as part of theory-based evaluation of community development programs [8]. Since then, ToC has been widely adopted by non-governmental organizations (NGOs), international foundations, and evaluators in the development sector [6, 7]. Weiss [8] defines the theory of change as a theory of how and why an initiative works. In practice, it has been viewed as a process mapping methodology that describes a sequence of events that lead to a particular desired outcome [10]. It has also been viewed as a deeper reflective process to explore why and how change happens [5]. Yet, these different views and definitions are all grounded in the idea that the beliefs and assumptions underlying an intervention can be expressed in terms of a phased sequence of causes and effects such as a program theory [11].

ToC is not a fixed methodology. It allows flexibility for people to work with it according to their needs. However, there is consensus on the basic elements that make up ToC [7]. These elements include: (1) desired long-term goals; (2) the context for the change initiatives; (3) interventions that are used to bring the change; (4) a path way of change that illustrates the relationships between immediate and intermediate change outcomes that are necessary and sufficient to reach the long-term goals; (5) assumptions that explain the change process, (6) indicators as means to measure the success at each step in the pathway of change; and (7) narrative summary.

2.2 Rationale for ToC for ICT4D Impact Assessment

Since its conceptualization from the fields of community development and program evaluation, ToC has increasingly become mainstream in the international development field because it enables organizations to explore and represent changes in a way that reflects the systemic understanding of the complex program development process [5]. It fits the same aim of ICT4D IA, which is to explicitly describe how and why ICT interventions produced by the ICT4D project contribute to its development goals.

In fact, ToC has been recognized as an important part of the theoretical foundations of ICT4D [9]. Additionally, methodological credentials of ToC has been tested and validated from two long-standing areas: program theories and development practices [5]. It is simple and easy to follow with substantial guidance and literature available on the best practices related to ToC.

Adopting ToC addresses many challenges associated with the multi-level and time-variant ICT4D IA. First, it explicates the context of the ICT4D project including social, political, institutional, and technological issues. A desired attribute of IA is that it takes into account the complexity of social setting and context for which the intervention is designed [4]. An IA that is based on ToC avoids the trap of technological determinism, and at the same time inclusive of the social and behavioral changes brought by the technological intervention. Second, ToC requires laying out the pathway of change in as much fine detail as possible. Thus, it divides the complexity of change into multiple levels and allows the creation of direct links between the ICT intervention and the project's development goals. Third, ToC requires making all assumptions that underlie the ICT4D program explicit, defining methods to measure the change, and clearly articulating the goals [8]. It enables the ICT4D researchers and practitioners to not only strengthen the monitoring and assessment of the ICT4D project's progress or success, but also to report to external funding agencies, many of whom now require a ToC analysis. As the scope and focus of IA changes over time that longitudinal studies are often necessary along the pathway. For identifying indicators and designing methods to measure the change, ToC favors both quantitative and qualitative data with a strong focus on the triangulation of different research methods [7]. Such a research design allows researchers and practitioners to measure the intangible impact of the ICT4D intervention, along with the tangible outcomes.

3 ToC for ICT4D Project Impact Assessment

In this section, we describe how ToC can be adopted as a generic framework for ICT4D project IA. As mentioned previously, we assume that the ICT4D project is in the stage of monitoring and evaluation. As an antecedent, it is assumed that an ICT4D project is initiated to target clearly defined long-term goals, and that the project followed best practices in the design and implementation of the project outputs (i.e., the ICT solutions). Because a generic IA framework should be flexible to different situations and adaptable to the different context, we do not consider the ToC for ICT4D IA as a fixed sequence of process that one should follow. Instead, we use the ToC to guide the IA planning and implementation based on the seven elements mentioned previously. Within each element, ICT4D researchers and practitioners can reflect and learn from their own experience, or bring in IA methods or best practices that are shared by other international development or program evaluation studies. Next, we elaborate each element separately. It should be noted that although these elements are presented in a sequential order, they are often interweaved in the IA process and may not be separated in the narrative summary.

3.1 Long-Term Goals

There should be clearly stated long-term goals. Within the context of ICT4D, the long-term goals should be associated with achievable project-based goals [3]. The long-term goals are not micro-level behavioral changes associated with the introduction of ICT initiatives, but related to broader development goals. The SDGs represents the single most important agenda shaping many ICT4D interventions [9]. For the ICT4D project to reach a broader impact in the developing world, it should suit and align with the SDGs.

3.2 Context for the ICT4D Project

The context for the ICT4D project and its related ICT interventions are explicitly described, including the problem statement, all social, political and economic conditions surrounding the problem space, and different actors that would influence a change. As highlighted in many evaluation studies, it is important to gather all contextual knowledge about the project to ensure that the ToC is built around the accurate local context [12]. This ensures plausibility (i.e., the extent to which the goal outlined in the ToC is realistic) and do-ability (i.e., the extent to which the goal is achieved within the project's scope, resources, and time), two important attributes of a good ToC [13].

Because we assume that the ICT4D project engages key stakeholders and project champions, there exists opportunities for partnerships among the multiple stakeholder groups to refine ToC based IA. Stakeholder partnerships will help to ensure the efficiency and effectiveness of IA when resources and interests are shared [14]. Below are some of useful guiding questions from the literature [5, 9].

First find, "who is the project aiming to support, and why?" If needed, prioritize key issues faced by the target group. Next set of questions should be related to identifying groups or stakeholders that would influence the expected change leading to desired development goals. It will also be beneficial to rank the groups in their importance to determine who would influence change positively, negatively, or both. Third, ask: "what problems are the project trying to solve?" A clearly stated problem statement identifies issues and challenges that can be solved by an ICT intervention. Fourth, questions should focus on the social, political, institutional, and economic conditions around the problem space. These conditions serve as important inputs for constructing the ToC, especially in defining assumptions and developing indicators. Finally, questions should also be asked to understand the internal and external factors preventing change, and how these risks may be mitigated.

3.3 Interventions

Academically speaking, ToC is not a general theory on how change occurs, but a "theory" specified to an intervention [3]. Within the ICT4D context, the interventions are the ICT solutions that are designed to achieve desired outcomes. The IA process will likely discover problems or unintended outcomes that are caused by some of the interventions and not specified within the ToC. In such cases, the ICT4D project team may have to go back to the analysis and design phase to redesign the ICT solution or create a new solution.

3.4 Pathway for Change

This element is the mapping between a phased sequence of causes and effects underlying the ICT interventions. It connects preconditions necessary to achieve a long-term goal and explains why the preconditions are necessary and sufficient. An ICT intervention produces a set of products or services, which can be referred as ICT outputs. These outputs may lead to an immediate or intermediate outcome, an effect that is caused by the intervention. These outcomes may be linked to a long-term goal and show positive or negative impact of ICT intervention on the goal. The mapping process should take into consideration impacts of the project in the immediate short term and in the long term; context and conditions that would lead to the outcomes; sustainability of the outcomes; who and what needs to change to achieve the outcomes; and factors, relationships, or approaches that may potentially influence different level of outcomes [15].

There are several useful approaches to facilitate the construction of the change pathway. Outcome mapping, a methodology for planning, monitoring, and evaluating social change initiatives, provide a set of tools to design and gather the outcomes, define and presents changes, identify actors that influence the change, and stakeholders roles related to participation and accountabilities [16]. Although outcome mapping approach does not explain why and how changes occur, it complements ToC as a useful tool to formally involve stakeholders and strategic partners when creating the pathway for change [5]. Backward Mapping is a process in ActKnowledge’s approach to ToC¹. The process begins with a long-term goal and builds the change pathway “backwards” by identifying preconditions, and ends at the earliest changes (i.e. the immediate outcomes). A more generic process mapping approach can also be used to build out the change process by repeatedly asking “when what happens” from the start of the ICT intervention, till the project’s long-term goals are reached. All assumptions in the process should be documented, discussed, and sorted [7].

The output of this element is usually a change pathway map. The map provides a visual representation of the logic model of ToC and is useful to communicate the conceptual analysis of the change process. Creating a map of how different types of outcomes relate to each other can help clarify what the project intends to do [17], and guide those engaged in the change process to see big picture quickly without having to read through a complex plan [18].

3.5 Assumptions

In the ToC literature, assumptions come in a variety of meanings. In its original definition, assumptions are about what to change and how change would take place [8]. It is similar to the ‘hypothesis’ in the general theory in academics, where the ToC is to test whether the assumptions will hold in the change process. Weiss [8] argues that not all theoretical assumptions of ToC are possible to test because some statements of ToC may be too general for testing, and an alternative explanation may arise from the data collected.

¹ www.theoryofchange.com.

Another type of assumption explains why one outcome leads to another in the pathway for change, or specific choices of activities along the pathway. Some assumptions can be "... accepted as true or as certain to happen, without proof."² These assumptions are not testable. Another type of assumptions is related to the broader operational context of a program or project [6]. All assumptions about how an ICT intervention would lead to the long-term goals should be explicated. The quality of the ToC rests on explicit, realistic, and transparent assumptions [7]. Because assumptions are deeply held perceptions that are taken for granted in the context of the intervention program, explicating assumptions can be challenging and requires a critical thinking approach that involves interacting with stakeholders and past experience with ICT4D projects. Since different assumptions are likely emerge from the study context, discussing the different structures of belief among the participants and stakeholders will ensure consensus among them [8].

3.6 Indicators

In addition to mapping all immediate and intermediate outcomes, ICT4D researchers and practitioners need to develop research plans and indicators to measure the extent to which each outcome has taken place. The change pathway map created in the previous section should include specific indicators at each level of change [5]. They not only provide evidence on the extent to which each outcome is achieved, but also ensure that a ToC can be tested if wisely chosen.

There are many challenges and issues associated with developing indicators of impact. To the extent that ToC presents the change in a causal-effect structure, there is inherent propensity to develop quantitative indicators that can be measured and analyzed statistically, especially when sponsors and participants also find quantitative data more credible than qualitative data [8]. This is a key problem of measurement in the ToC implementation. Qualitative analysis can be equally compelling, since it allows not only rich narratives that documenting intangible changes, but also the modification of assumptions in the assessment process [8]. Additionally, quantitative indicators have limited capabilities to capture complex relationships and reasons behind social changes that may be brought by the ICT intervention [4]. Therefore, we argue for a balanced set of quantitative and quality indicators when using ToC for IA.

Choosing indicators as measurable evidence of change is a unique notion. Many learning and monitoring processes and development frameworks use indicators as evidence-based measures of the success. For example [15] uses indicators as an integral part of IA strategy in the Communication for Development (C4D) framework. International development studies have always used indicators to measure the impact of development interventions [19]. Developing and implementing indicators for ToC can benefit from the cumulative knowledge of these different processes and frameworks. For example, the ActKnowledge's ToC process (see Footnote 1) recommended including four components for each indicator: population (i.e., who or what is to reach

² Assumption. In *oxforddictionaries.com*. Retrieved from <https://en.oxforddictionaries.com/definition/assumption>.

the goal), target (i.e., how many among the population are needed to reach the goal), threshold (i.e., how much percent of the target population needs to change or to what level), and timeline (i.e., by when the goal needs to be reached). These predisposed recommendations may be good guidelines in elucidating ToC indicators, but they lack the flexibility and richness to explain the multiple-level and time variant impacts within the ICT4D context.

Once defined, indicators need to be operationalized so that a research plan can be developed to gather data for the measurement. ICT4D researchers and practitioners can choose from a variety of methods and techniques to operationalize the indicators. For example, if an assumption of change in ToC fits within other existing theoretical or conceptual frameworks, such as the widely used technology acceptance model in Information Systems research, existing quantitative scale instruments can be adapted to measure the change. If the assumption is related to that a person's behavior change is influenced by their attitude, where the attitude is influenced by their knowledge, the KABP (knowledge, attitude, behavior, and practice) approach [20, 21] may be used, usually including standardized written questionnaires. Experimental design can be carried by comparing changes of the pre-and-post intervention. There are also commonly used qualitative and mix-method approaches that can be adopted to operationalize indicators. Examples include participatory communication appraisal [22], rapid rural communication appraisal [23], ethnographic action research [24], and most significant change technique [25]. It is out of scope of this paper to provide details on the strengths and weaknesses of these methods and how to design the measurement instrument. Nevertheless, the examples provide give a variety of means to operationalize indicators to measure the success of the ICT intervention in ICT4D studies.

3.7 Narrative Summary

While change pathway map is useful to communicate the logic of change process, it only represents one aspects of ToC. A narrative summary of a ToC should explain the change pathway map and underlying assumptions succinctly, as well as the contextual background of the project. In the ICT4D IA process, the narrative summary should help the ICT4D project team to present a convincing case of how and why the ICT interventions are expected to achieve the project's long-term development goals. A well-written narrative summary can help convey the major elements of the ToC easily and quickly to external and internal stakeholders, and is an important documentation on the IA process.

4 Case Study – CMES Project

CME on Stick (CMES)³ is a project that utilizes novel ICT interventions to deliver free and high-quality continuing medical education (CME) content to medical practitioners, including community health providers, nurses, midwives, first-year interns, residents, and physicians in LICs. The CMES project is guided by a Citizen-Centric Capacity

³ www.cmesworld.org.

Development (CCD) Framework (see Fig. 1), including the design of two ICT solutions [26]. One of the key strengths of the CCD framework is that utilized citizen-centric requirement engineering to involve end-users and key stakeholders in the solution development. The second strength lies in its goal-oriented design and evaluation process, where achieving ICT-enabled development goal was targeted through the integration of social and technical constructs in the ICT-solution design and evaluation.

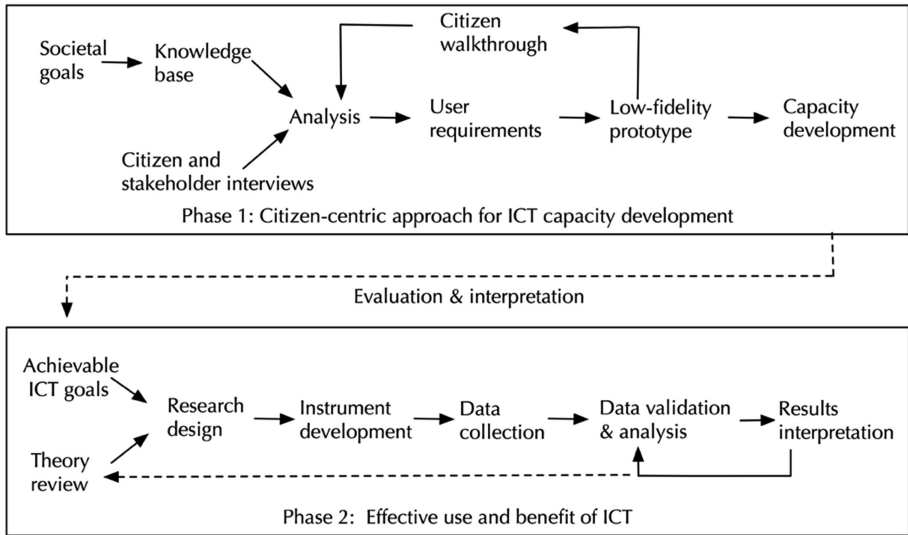


Fig. 1. Citizen-centric Capacity Development (CCD) framework

The project was first deployed in Nepal in 2016. Since then, it has stepped from one continent to another by simple word-of-mouth as participants reach out to their global colleagues. It is currently active in seven LICs (i.e., Nepal, Dominican Republic, Guatemala, Ecuador, Antigua, St. Lucia, and Nigeria) across three continents. There are over 100 rural medical practitioners presently enrolled and a patient population base of 386,000 impacted. Expansion is scheduled to Uganda and South Pacific Oceania in 2019. While the doctors have acknowledged the usefulness of CMES solutions in improving their knowledge, the evidence is largely anecdotal. Although simplicity and low-cost of the solutions make CMES project easy to deploy, the project’s long-term sustainability requires systematic monitoring and evaluation of actual impact towards the long-term goals. In this case study, we demonstrate how ToC can be used as a framework for the IA in the CMES project.

4.1 CMES Project Goal, Context, and Intervention

Continuing Medical Education (CME) activities draws from various academic disciplines such as adult learning, practice-based learning, continuing professional education, organizational change, development and behavior, and health services research [27]. Although there are different CME methods (e.g., printed or recorded materials, clinical practice guidelines, and interactive or online education) and activities (e.g., mentoring and opinion leaders, case-based training, audit and peer group discussions, educational outreach visits, etc.), attending conferences and reading printed materials are CME activities most commonly undertaken by medical practitioners. Unlike many developed countries, CME is particularly challenging in LICs as there is no external enforcement (from government bodies such as the National Board of Medicine) of the quality, standards, and participation in CME activities.

Medical practitioners in LICs fall behind on CME, not from lack of initiative but due to financial and infrastructure constraints. Interviews with medical practitioners worldwide indicate mentor shortages and unregulated CME requirements; lack of funds to attend conferences or buy CME programs; and lack of reliable electricity, up-to-date technology and internet connectivity as key challenges to CME. These challenges are further accentuated in rural parts of LICs. This results in localized medical practices with great disparities between urban and rural areas.

Within this context, the CMES project aims to provide local access to updated CME for medical practitioners who work in rural hospital and clinics in LICs, thereby enabling them to overcome many of the above-mentioned CME challenges. As part of the SDGs to be achieved by year 2030, the United Nations (UN) identifies healthy lives and well-being as essential to sustainable development (Goal 3 of the SDGs)⁴. Towards achieving this objective, the long-term goal of the CMES project is clearly articulated as “improve medical practitioner knowledge and skills, particularly in LICs.” Correspondingly, the ICT intervention of the CMES project is a content management system for best practice medical education of medical practitioners.

The outputs of the intervention are two innovative ICT solutions - CMES and CMES-Pi, both allowing CME content to be downloaded at locations with intermittent electricity or Internet. CMES is a thumb-drive based application, enabling access to content on a charged device without the need for Internet. CMES-Pi is a raspberry-pi based offline server that provides real-time access to CME content at locations where it is installed. Medical practitioners access CME content stored on CMES-Pi through their mobile phones using an iOS or android CMES-Pi App, or through web browser on a computer. This means that implementation is possible at health clinics, primary health care centers, hospital emergency rooms, and medical colleges in rural and remote locations. The solutions are low cost (initial set up at each site is \$10 per thumb drive, and \$80 per CMES-Pi) and easy to maintain. CMES provides multiple media of learning (pdf and mp3 audio) and available in English and Spanish. It caters to the specific needs of health professionals in LICs, and serves a broad range of topics for all levels of health practitioners.

⁴ <https://www.un.org/sustainabledevelopment/health/>.

4.2 CMES Change Pathway Map, Indicators, and Assumptions

Process mapping is used to delineate the immediate and intermediate outcomes of the intervention. ToC suggests that at least one or more observable and measurable indicator should be identified for each immediate and intermediate outcome. CMES project engaged participants and stakeholders early in the project who helped to explicate assumptions based on experience, practical knowledge, intuition, and intrinsic familiarity with the context of the study. Weiss [8] argued that underlying assumptions should also be clearly articulated, short of which outcome evaluation may not be credible or useful. The assumptions may be expressed in phrased sequences of cause and effect [11].

A ToC change pathway map can be used to present the outputs of ICT interventions along with the immediate and intermediate outcomes leading to explicitly stated long-term goals. It presents a big picture view that connects assumptions to outcomes, and identifies necessary and sufficient pre-conditions. The change pathway map also specifies indicators to measure the outcomes and long-term goal. Figure 2 shows the outcome map for CMES impact assessment. It is structured with a vertical logic upwards, starting with the intervention (at the bottom of the outcome map). The intervention is designed and implemented to achieve the long-term goal (at the top of the outcome map). As stated previously, the long-term goal of the CMES project is to improve knowledge and skills of medical practitioners in LICs, and the ICT intervention is a content management system which includes two outputs: CMES and CMES-Pi.

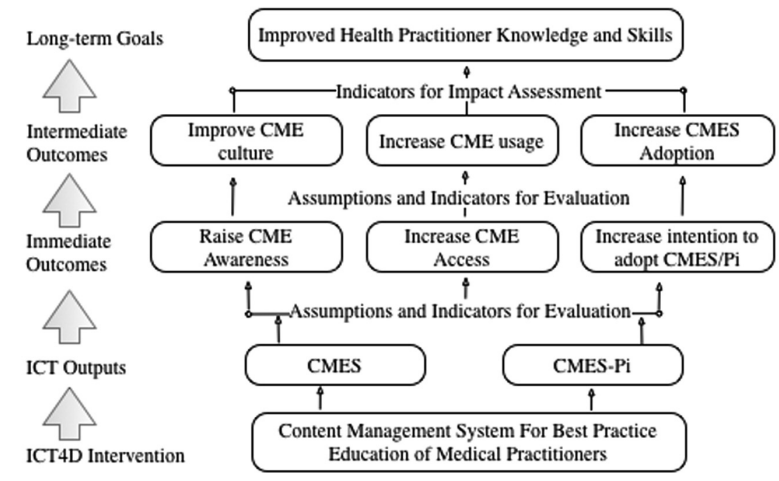


Fig. 2. Change pathway map for CMES impact assessment

Process mapping identifies three immediate outcomes - raise awareness, increase CME access, and increase intention among medical practitioners to adopt the CMES solutions. Due to the complexities of socioeconomic and infrastructural problems,

CME represents an overwhelming challenge in LICs. There exist few useful tools to effectively bridge the paucity of resources and access to CME, and little knowledge about how CME might be used to improve rural medical care and population health. Therefore, an immediate outcome targeted by the project was to raise awareness among medical practitioners about CMES solutions and they may enable assist in overcoming financial and infrastructure barriers to CME. A key assumption that forms the epistemological basis for immediate outcomes is - there is intrinsic motivation among participants to improve EM knowledge and skills.

To increase access to CME, an active on-the-ground campaign was undertaken in various LICs to identify clinics, primary care centers, and hospitals that are interested in CMES. Through rigorous effort of the project team members and with the assistance of various non-profit organizations in the medical field, the CMES solutions were deployed at 18 medical facilities across Asia, Sub-Saharan Africa, Latin America, and the Caribbean. Prior to deploying the solution, the team worked with the hospital administrator or person of authority at the location to thoroughly whet their interest in CMES, identify CME needs, determine the state of IT infrastructure, and their long-term commitment to improving CME culture. All doctors at participating locations are required to complete a screening survey before the site is finalized for CMES deployment. Researchers in the CMES project would then conduct on-site visits at most locations to implement the solution and provide training to the medical practitioners. The CMES team is available via Skype or WhatsApp to answer any questions, and visit locations for follow-up on a regular basis. The engagement of the CMES team aims to achieve the immediate outcomes of raising awareness of CMES, increasing access to CME, and increasing intention to adoption the CMES solutions.

Furthermore, we identified three intermediate outcomes that include - improve CME culture, increase CME usage, and increase adoption of CMES. Developing CME as a discipline specific culture requires nurturing and mentoring of junior medical practitioners by their seniors. In the absence of mandates established by governing bodies, as is the case in many LICs, medical practitioners have little or no incentive to pursue CME. Unless they are willing and able to engage in CME, the “Good Health and Well-being” goal of the SDG will remain distant. Thus, a significant intermediate outcome is the social goal of developing CME culture among the practitioners at the participating locations. This outcome is closely linked to the outcomes of increased CME usage and increased adoption of the CMES solutions. The key assumptions for intermediate outcomes are - increasing CME awareness will improve CME culture; increasing access to CME will increase CME usage; intention to adopt CMES will increase CMES adoption.

The outcomes may be measured in relative terms or as absolute numbers. Indicators for practitioner mentoring include the frequency and number of CME content accessed by the practitioners, extend of education and training sessions undertaken by the medical practitioners at the location, and the nature of engagement of the participants with the CMES team. The CMES solution includes extensive logging features to track usage patterns (e.g., frequency of application launch, content synchronization, content views, and search behaviors). The logs are uploaded to a remote server whenever the

CMES software determines the availability of Internet access. The logs provide varying degrees of assessment of CMES usage. CMES adoption will be assessed using a survey instrument. The instrument will be designed to analyze factors that influence the use and adoption of the CMES solutions.

In a synthesis of systematic reviews on CME effectiveness, Cervero and Gaines [28] concluded positive impact of CME on physician performance and patient health outcomes. The CMES project scope established the long-term goal as improving practitioner knowledge and skills. Patient health outcomes were not included as a long-term goal as it is a highly contentious topic and heavily debated in the medical discipline. The key assumption for achieving the long-term goal of the CMES is that – the extrinsic motivators for CME use include normative (arising from relationships where other professionals share information about benefits and advantages), coercive (formal and informal pressure exerted by organization on practitioners to pursue CME), and mimetic (tendency to imitate the action of others) forces.

Both qualitative and quantitative methods can be used to evaluate the adoption, effective usage, and benefits of CMES for improving practitioner knowledge and skills. A survey instrument can be developed and sent to each participant. Narratives and comments can be solicited from the users to gauge whether the CMES program met expectations and CME needs, whether the intervention helped to develop and sustain CME culture, and how well the ICT solution served to overcome CME barriers. Qualitative in-person interviews will also help to determine whether and how the ICT intervention impacted practice, professional identity, and quality of patient care.

5 Conclusion and Future Research

Social benefits of ICT interventions are hard to evaluate for many reasons. Primary among them are misclassification of evaluation program by grouping it with other control variables, difficulty in disaggregating outcomes that can directly be linked to the intervention, and the highly intangible nature of the social benefits [3]. These challenges equally apply to the CMES project. Similarly, the social benefits of the CMES project may not be outwardly visible for a length of time, just as is the case with most ICT4D projects. Nevertheless, a systematic approach to continuously monitor and assess whether the immediate and intermediate outcomes are what were intended, and make timely corrections if they are off course. In the regard, ToC provides a sound framework to guide the IA planning and implementation of ICT4D projects. This research demonstrates the flexibility and adaptability of ToC for the IA of an ICT4D project in an LIC context.

The research makes many contributions. First, we highlight the challenges of conducting multi-level and time-variant IA of ICT4D projects, and propose the use of ToC as a possible solution. We provided rationale for how ToC can enable researchers to clearly articulate the context of the study and inherent assumptions, generate a change pathway map highlighting immediate and intermediate outcomes as a phased sequence of causes and effects, and develop indicators to assess the extent to which the outcomes are achieved. Second, we used a case study to show how ToC enable researchers to critically investigate how and why change might happen as an outcome

of an ICT intervention. The approach identified indicators to measure outcomes while fully acknowledging the possibility that the scope and focus of IA may change over time. We are not aware of any other framework that provides the flexibility to conduct IA against a moving baseline, a crucial and overlooked fact in ICT4D research that has direct implications on the credibility and usefulness of the related findings.

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Participatory Video, Giving Voice and Respect to the Epistemic Sovereignty of Communities in Rural Zimbabwe

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Abstract. To inform program development in health in the rural areas of Masvingo Province in Zimbabwe, Ministry of Health and Child Care authorised cooperating partners to execute participatory video projects in rural districts in Masvingo Province. The Participatory Video process was a result of the desire to go beyond prescribed, non-participative or cultural insensitive data gathering methods. Two videos were produced that significantly shaped thinking of stakeholders being informed on health-seeking behaviours and utilisation of services. This use of Information and Communication Technologies proved a fruitful way to engage, interact, and develop public conversations, giving a voice to formerly disenfranchised groups (e.g. ostracised religious groups or ‘closed’ communities’). Participatory Video is recognised as a culturally aligned method appropriate for a setting other than the West.

Keywords: Participatory video · Health · Zimbabwe

1 Introduction

Health research in the context of African rural communities in sub-Saharan Africa often uses extraneous approaches that leave little space for indigenous, rural perspectives [1, 2]. Long established and prescriptive methods tend to pre-organise and regurgitate topics and practices. Most data gathering methods used are not participatory, with limited community involvement. Further, data collecting procedures observe a distance between the researcher and the researched. In practice, such approaches can be perceived as alienating, as the methods rely upon normative epistemologies that obscure local, dynamic and integral ways of knowing [3]. The authors engaged in an effort to push the boundary of the established ways of information gathering for health, utilising Information and Communication Technologies in the form of media. The engagement aimed to unlock local knowledge and indigenous perspectives to provide evidence on

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possible contentious subjects to inform health planning. In this paper, authors represent groups of community members and present the background, the context, and the cases and lessons learned from utilising participatory video in a health context.

Although Participatory Video (PV) already emerged in the 1980s, its existence and employ were unknown to the communities and cooperating partners in health care in Masvingo Province. PV utilises ICTs to facilitate community members to express themselves in ways they are used to: in orality. Some of the authors were sensitised to the existence of PV, having been involved in the method in Macha, Zambia, years ago. Activating the method in health became possible after hearing about activities in PV by a group of women in Zimbabwe. Cooperating partners agreed to trial the technique for matters related to maternal and sexual reproductive health care; to gather evidence on local perceptions on family planning and care surrounding deliveries, and for exploring the practical experiences and barriers to related health care in their geographical areas.

This paper uses the extended case method to study the PV cases presented here, by valorising the intervention, process, structuration, and theory as they live in their extra-local and historical context [4]. We explain how PV was applied ethically and fruitfully to create a community-led information base as a repository for change in the quality of care by presenting two consecutive cases of the use of PV in 2016 and 2017.

2 Participatory Video, a Theoretical-Practical Overview

Participative Video was proposed as a tool that respects self-determination across connected identities and dimensions within community life. It represents a method that allows disenfranchised people to be the authors, architects and arbiters of their development [5]. The method provides means to access narratives and content that *communities* ascribe to their situation. Shaw and Robertson [6] situate participatory video “as a social and community-based tool for individual and group development [...] to develop their confidence and self-esteem, to encourage creative self-expression, and to develop a critical awareness”. The first documented participator film process, at Fogo Island, Newfoundland, in 1967, used an iterative process of production and multiple screenings to an aggregated audience of 3,000 persons in isolated communities [7].

Participatory processes provide means for communities to communicate among themselves and with other communities of practice, in this case in health care. It allows community members to be collective prosumers – being both producers and consumers – in the production and incorporation of data, analysis, and knowledge. PV was considered a method appropriate for settings other than the West [2]. PV allows for community engagement [8], the first step in a three-step strategy for access to services, with the others being workforce development and thought leadership [9]. The developments emerging from community engagement are distinctly different from most empowerment approaches that target the economic situation of individuals using externally, non-African developed schemas [10]. With outcomes in the form of recorded narratives, PV unearths collective knowledge - that what is integrally *known* in a community in embodied formats [3, 11, 12].

The participatory video method aligns with Freire's [13] arguments that disadvantaged people groups must be the principal protagonists to engender transformative change. Participative Video is participatory in that those involved are actively engaged participants and actors rather than 'objects of observation' and 'sources of data' [14]. It avoids extractive research, where the primary target is the increase in knowledge in an external researcher [15]. Participative Video represents a form of transdisciplinary, multilevel action research that is respectful of ecological and psycho-political aspects [16]. It seeks out human-centred conceptualisation of development in line with the position of Tanzanian President Julius Nyerere [17] who argued that "people can't be developed, they can only develop themselves."

As a technique, Participatory Video was approached as a process and not an event. The lengthy process empowers communities, facilitating ownership of the activities and the outcomes. Contemporary reports of PV practices mainly discuss cases where cameras are being provided or used by people of the community. This situation allows community members to produce works from local agency 'reading reality through the camera'. For instance, Tony Roberts [7] describes such a PV process applied by Asikana Network in Zambia. In the cases presented in this paper shows that PV is not necessarily a technical process. It is a social one, where the complex role-plays with stakeholders, communities, and national authorities interface with the use of technologies.

3 Two Cases of PV in Masvingo Province

The first case in this paper is "Khuluma", a documentary film that highlights the causes of unmet need for family planning in Bikita District, Masvingo Province, Zimbabwe in 2016. A second film was produced to determine the reasons why some women deliver at home. This PV took place in the neighbouring Zaka District in 2017.

The facilitation and resourcing of the PV process were facilitated through a Public Private Community Partnership. The partners are a national organisation with PV facilitators and experts (Africa Women Filmmakers Trust, AWFT), the Ministry of Health and Child Care, and a Private Voluntary Organisation (SolidarMed). AWFT is a Trust and Arts Organization registered with the National Arts Council of Zimbabwe. The collective of women pioneered the use of participatory video in Zimbabwe during the 1990s [5]. SolidarMed a Private Voluntary Organisation (PVO) in Zimbabwe with a supporter base in Switzerland and Liechtenstein. The organisation cooperates with the Government of Zimbabwe for over 50 years. In daily practice, the PVO focuses on the support and execution of Zimbabwe's National Health Strategy through activities in HIV and TB care, Maternal and Newborn Health, Non-Communicable Diseases, and eHealth. The Ministry of Health and Child Care is the government ministry responsible for health in Zimbabwe.

In an effort to gather fresh evidence beyond enshrined methods of informing health care planning, Participatory Video was selected because of its engagement in community dialogues and community conversations, right where community members live. PV captures conversations on health that can include cultural, social, economic, religious and service provider aspects which are difficult to obtain through other means

and cannot be found in spreadsheets. By amplifying the ‘local voice’, the partners hypothesised that PV allowed for epistemic sovereignty to all stakeholders in the cascade of health care provisioning and access to the vocalised communal and embodied knowing [11].

After several months of preparation and stakeholder engagement, the community interactions for the first case using PV took place during September and October 2016. The women of AWFT facilitated both process and content when they recorded focus group discussions, non-structured interviews with community members in Bikita district, and semi-structured interviews with health care professionals at the local, provincial and national levels. The second PV process took place the following year, with recordings being done during September and October 2017. This PV applied the lessons learned during the first PV process. Instead of a focus in one area, contributions were gathered from a wider area, at selected sites scattered over Zaka district and, consecutively from academia in Zimbabwe providing a precise framing. Consent was sought for the videos to be used as a pinpointed facility to inform communities, stakeholders and policymakers, respecting the sequencing and hierarchy of stakeholders [18]. Therefore, the results are not made generally available or put on the internet.

3.1 Process

Although a Participative Video process is theorised as ‘free-flowing’, the complex networking of stakeholders and partners and cultural codings necessitates a purposeful embedding of activities. To ensure ‘all aboard’, both in the health chain (e.g. government agencies at the national, provincial and local level) and the communities (e.g. chiefs, headmen), the process focused on the incorporation of all guidance and the securing of all appropriate formal and informal permissions. This lengthy and involving process focused on:

- involving all service providers and policymakers to include their considerations for the PV process, by seeking continuous guidance through visits and updates
- the extensive use of embodied knowledge in local leaders – e.g. traditional and religious leaders – to structure access, location, and invitations for involvement
- empowerment of communities and individuals to identify and challenge cultural, religious and societal norms, using PV’s iterative processes
- the creation of a collective of stakeholders and communities who act together along the way, for instance, through an all-inclusive and public launch of the video.

Africa Women Filmmakers Trust is, to our knowledge, the only organisation in Zimbabwe facilitating Participatory Video processes. They use PV as a development and intervention tool, facilitating the PV process and the production of the final video. AWFT facilitates community gatherings and the operating of the media equipment. Continuous attention is given to content decisions to be taken by the community and ensuring active community gatherings by monitoring of group dynamics in manners respectful to local culture and contextual governing structures. The results provide different evidence on how the community understands their domestic situation, often better than outsiders [5]. Hence, through PV, the community contributes their collective

knowing and their view on problems and challenges, therewith engaging in the health planning processes.

The PV process, in the two cases, presented, built upon three main pillars:

- (1) expository videos and written report on process and content, systematically drawing attention to the nature and extent of the subject matter
- (2) community participation and sensitisation, enabling other communities to use the videos to hold a mirror to themselves, and
- (3) skill and experience in operating both at the grassroots level and policy advocacy level, ushering the possibility of justice and change.

Receiving access to communities in rural Zimbabwe is laborious. Custom requires adherence to complex and reiterative protocols of respect and reciprocity. As mentioned, at the start of the PV projects, the use and the content of the method and its practices were unknown in the communities and stakeholders. Therefore, the projects took long periods of introduction and sensitisation on the method and process, involving many meetings with governing authorities and the communities involved. During these periods, the focus was gaining and establishing trust. At provincial and district levels, permissions were sought from government authorities as well so-called traditional leaders in line with their authority in their respective areas. In rural communities, informed consent does not necessarily relate to a project or a specific set of questions but is given for the people involved as a validation of their credibility [19]. In the process, the AWTF facilitators were required to obtain press cards.

3.2 Content

In the preparations leading up to community encounters, a basis of understanding about the PV method was established in all stakeholders and collaborators. Developments included extensive reading and preliminary research on the literature on the subjects' matter and learning extensively about the contexts. Semi-structured interviews were videoed with academic stakeholders at the national level. These interactive and elaborate preparation processes ensured a framing for the result. Broad cooperation and interaction proved crucial for alignment during communications with stakeholders and authorities [cf, 18].

Gender and age are critical factors that impact access to people groups and leaders, especially in rural areas in Zimbabwe. Therefore, process and execution were managed by Zimbabwean women. Female leadership is conducive for both female and male voices to be able to express their views, while the opposite might not be the case. The inclusive socialities of the rural Zimbabwean communities are embedded in Ubuntu/Unhu, the epistemology emerging from an African paradigm [20, 21]. The inclusive and convivial values of the communities led the PV discussions to gravitate to the subject matter studied by the cooperating partners involved.

After been introduced and getting to know people, local ways of knowing are revealed to those involved in and co-habituate in the community, over time and through the stories shared by others in the vicinity [11]. For instance, in one of the cases, during familiarisation in the communities, some women belonging to African churches brought up how some religious groups seem to discourage 'modern' (Western-constructed) health care

seeking. As a result of this sensitisation, the AWTF strove to include members and leaders from religious groups in the PV process. The targeted inclusion of apostolic religious groupings ensued previously unrevealed evidence of neglected perspectives. For instance, in the case of the PV on family planning, apostolic women explained how they were accessing family planning services creatively. From the same group, in the case of PV on why women deliver at home, women told how they would mediate their health care by periods of geographic separations, especially near the period of delivery. The process and inclusion provided unique insights into how community members manage their multiple identities, for instance, being community members, members of religious groupings, and being travellers. They narrated about switching paradigms, aligning with local realities in, for example, religion or secular concepts of health care in the demanding context of rural community members in Zimbabwe.

During the process, Participative Videos were produced involving discussions during both large community gatherings and in smaller group settings. The setting up and execution of such meetings were done following the local, cultural practices and protocol. In the two cases, the PV method was applied during church meetings, gatherings of women at sheltered waiting areas, at men discussion meetings, or during meetings in the community or with spiritual leaders. Also, the PV process involved the governmental health care providers, officials, and academic stakeholders wherever they were positioned, at a local, district, provincial or national level.

No representatives of any of the cooperating partners were present during introductions and PV recording processes in the rural communities. The AWTF facilitators positioned themselves as Zimbabwean compatriots and as experts in the operations of media equipment like the video camera or light sources. The absence of outsiders was intentional to minimise sources of influence to the community deliberations. Assimilation of PV in the community was to alleviate, as much as possible, external control and cultural biases affecting the language, content and form of deliberations [cf, 12]. All conversations were made in the first language in the community: Shona. The expert team stayed in the community and was included in the daily routines and rhythms of community life.

Participatory Video captures both the content and the interactions in manners set by the community. The subjects that are discussed are the subjects that the community has reason to value. PV allows for multiple approaches, ranging from communities determining both the themes and questions to pre-set themes or questions. In the two cases described here, the context was proposed by a cooperating partner to align with its planning for work in support of the Ministry of Health and Child Card in Maternal Neonatal Health support. However, beyond this meta-frame, the AWTF experts and the communities were given no guidance as to what or how to discuss. Therefore, the PVs were developed within the communities according to conventional, local practices. Subsequently, the content addressed issues of shared concern. In the second PV on home deliveries, the framing of the final video was synced with inputs from academics in the national university, aligning the content with academic models gleaned from national research by African researchers. The final product, therefore, provided scientific veracity that bolstered acceptance at the stakeholder level.

The videos triggered lively dialogues during the numerous screenings of the resulting video at community meetings, just like was reported in Fogo. These public conversations were lively due to a recognition of the views expressed in the videos. During sensitisation meetings, communities build upon the work by adding specific views, insights and expand on the issues triggered upon by the videos. PV thus accelerates the processes of learning by providing evidence at different levels of consciousness of the various stakeholders. Such differentiation of views came out emphatically during the official launch of one of the videos. This video provided evidence that few health service providers were trained in long-acting reversible contraceptives. The necessity of such training was taken up during the launch, and included in future health program planning, indicating how ‘community knowledge’ became ‘stakeholder knowledge’.

4 Discussion

The Participative Video method aligns with observations from communications professor Francis Nyamnjoh. In his assessment of *Journalism in Africa, Africa in Journalism*, Nyamnjoh [22] cites Servaes and Arnst who argue that it is about time the poor and the illiterate became actively involved. They “have always been researched, described and interpreted by the rich and educated”. Servaes and Arnst argue the poor and the illiterate should take over the research on their predicaments, especially, as often, “they best know their situation and have a perspective on problems and needs that no outsider can fully share”. PV can be instrumental to such epistemic justice, where it relies upon local community dialogues and community conversations that are effusive, addressing broad subjects expansively. In the two cases, the inclusive process substantiated the local understanding of a variety of cultural, social, economic and religious causes of unmet family planning needs and home deliveries. The videos exposed how, according to the community, related issues interplay at a community level. Uniquely, it made the voice heard of (religious) groups in rural communities that are commonly not included in community dialogues.

The PV approach encouraged participants to share experiences, provide observations and relate narratives with insights on content and future scenarios. These insights could well remain undisclosed using other methods, and, thus, be overlooking in the planning of health care interventions. The public ways of information sharing that the PV method calls for are crucial to sustaining an embedded, unpressured way of evidence gathering. The process allows for involvement and scrutiny by all. The process, therefore, allowed for rural communities to discuss contentious and potentially sensitive health issues. This empowered communities to contribute to the professional discourse and pinpoint previously underrated issues that affect family-planning in Bikita district and why women deliver at home in Zaka district.

In the rural setting in Zimbabwe, we found that community members value a quality-of-the-interaction. Adherence to cultural scripts was essential. The process, therefore, supersedes addressing of content. Adhering to the convivial principles of appreciative inquiry – being asked ‘nicely’ – enabled communities to disclose ways and content of their *knowing*. Community members were remarkably free, in-depth and

open about their perceptions of social, cultural, religious influences and guidance. Also, they were open about their perceptions of behaviour and attitude of health service providers. In the process, poignant aspects and significant influences concerning the subjects' matter were put in the limelight. The PV process provided tangible and stark evidence on the content of beliefs, material realities and socialisations in rural communities. The videos sparked lively debate on the content of the videos both in the institutionalised health chain as in the communities. The videos proved to be a sensitisation tool on the subject matter in consecutive community screenings. The PV method, therefore, showed value in providing visible and readily accessible input for change processes. The tangible evidence offers a base for informed policy and subsequent potential change in programmatic areas.

As PV involves the rendering of a vast repository of video material into a relatively short video, its tangible outcomes provide both lean and thick descriptive evidence. Both forms of evidence proved substantial for ongoing change processes to improve local health care provisioning and systems continuously. The videos contain evidence from communities affirming their views on subject matters within the existing cultural realities. The method unobscuring the local view, showing individual community members display an appreciation of contemporary realities and indicate the perceived benefits of specific measures of intervention. At the same time, there is a useable source showing a local narrative and comprehension of particular interventions, indicating the local understanding of realities, as well as the local, cultural processes involved with health care decision making. For instance, the videos show bounded ambivalence about the reasoning and intended outcomes of specific interventions. The ongoing showing of the videos in communities in Masvingo province sparked inclusive debates along a continuum from 'closed' via 'arrested' to 'open' to conversion.

During the described PV cases, processing of the orally stored information within the community was done in a verbal equivalent of 'social networks' [cf., 12]. In the process of producing video compilations, community members and stakeholders interacted in the framing of the data. Outputs, therefore, were more helpful in communicating to both the local and the broader contexts of health care in (rural) Zimbabwe. The result provided input for subsequent community meetings in other communities, evoking a response to the subjects' matter. These screenings ensured continuous production of embodied knowledge and unearthing of a public *knowing*.

Participative Video bridges the insider/outsider segregation. Research methods, for instance, using surveys or the handling of aggregated data, position the researchers as outsiders. Such a position is, often, assumed necessary for objectivity and neutrality. However, in rural areas of Zimbabwe, communities engage in continuous, inclusive conversations, from which regularly tested conclusions are drawn [12]. Communities commented positively on researchers participation in community life and talks.

The tangible expression of the result of the PV processes is a product set in an oral format, albeit digitalised. The oral form aligns with how information is starting to permeate within a rural community. Oral culture relies upon continuous conversation, often in scripted manners. The conversation is the knowing [11] which structures restrict experimentations or adding new information without communities' involvement. The process of 'orally' processing new information' by itself is a tool for community engagement and acceptance [12, 23]. The ways of information and

knowledge conceptualisation align with the ways that Participatory Video processes deal with information. These emerge naturally through the process of verbalisation while, often, incorporating aspects of the immediate, familiar environment. As such, a ‘new world’ becomes assimilated into the ‘old world’. For instance, high-technology interventions, like the introduction of ICT or an aeroplane, are described in a context of events involving people [24]. This assimilation correlates with the fact that oral culture, in general, does not include counts, statistics or facts, but, instead, keeps track of activity or activities in which humans are involved [25]. The process of PV, recording the verbalisation of community perspectives, let to an opportunity to analyse and discuss the information with the community itself.

The resulting videos were intended to align partners and communities in their focus of health interventions and to promote advanced quality of care in the subject areas. The PV process provided affordances (allows and enables) for expressions in the local language, local ways of doing, without intruding external parties. Taking the six affordances of Tony Roberts [7], the movies allowed for:

- *Reflection.* Respectful to the primacy of the local community, PV created the space for local reflections on the subject matter and the valuing of local perspectives. Secondly, through the execution of ‘official launches’ of the videos, stakeholders and those involved in the video reflected on the content, openly. Thirdly, the broader health community in Zimbabwe use the videos to reflect and assess the potential to improve quality of care. The PV process in itself, brought conscientisation for all involved as this was unusual – though culturally aligned – manner of being confronted with information and bringing knowledge into a broader realm.
- *Engagement.* In one of the video activities, the PV process, unexpectedly, brought the views of a religious grouping to the fore. This development was appreciated as opening contemporary facilities to enhance communications. Previously, interactions with, especially, so-called indigenous African churches were strained in the context of ‘modern’ health care. Through the PV process, the engagement of all involved was appreciated, including members and leaders of African churches. Through these engagements, various views became accessible and became seeds to surmount barriers of institutional ignorance or incomprehension.
- *Dialogue.* Respectful to the primacy of the local language, the PV method allows for interactions in the vernacular language, Shona in these cases. Allowing the process to be in the local language from start to finish strengthened communications in a situation where ‘normally’ conversation take place ‘in translation’ [26]. Stories and words used in the videos allowed for proper depth and cultural consciousness that sustains an impact beyond the normal ‘text focused’ social-political-culture structures in healthcare research and dissemination.
- *Intent.* The PV method builds upon a shared intention to allow a collective voice to be expressed. Structuring processes in tune with local cultures brought to light local ways of dealing with the subjects at hand. Such input validated the complex and in-depth local knowledge and perceptions, its systems of knowing, and sets the scenes for change.

- *Voice.* PV alleviates the conundrum of how to accord ‘voice to the rendered voiceless’ [27]. In the process, due diligence is given to issues of language, the identification and categorisation of local problems and their articulation in context. Further, the videos provide insights into the contemporary and shifting local priorities, the critical, local questioning of common knowledge and the addressing of taboos.
- *Action.* The video output of the PV process travels quickly, allowing for its agency to be felt widely. Although controlled by stakeholders, the video ‘artefact’, can move on USB sticks, exerting influence in a fluid and helpful way.

The Participatory Video process was particularly compelling to engage the community. Engagement, of course, took much time and effort. The whole process took about half a year each. In that manner, it proved difficult to reconcile this fluid and qualitative method in the quantitative focused health care planning processes. However, the commitment to engage allowed inclusion and active involvement of what would be considered ‘closed communities’, where thinking is considered to be set in strict value systems without much agency for change [23]. Access to various religious groups is deemed very difficult as they are depicted as ‘closed’. Subsequently, their ‘underutilisation’ of ‘modern health care’ has been criticised [28]. However, the leadership of a large religious grouping in Bikita embraced the participatory video process, and, subsequently, contributed significantly. Through the inclusiveness and openness of PV, members of all groups in the communities could participate and engage in discussions.

5 Conclusions

This extended case study of the use of Participative Video shows its feasibility in rural Zimbabwe. In an environment where the method was unknown, it succeeded to provide input into health planning processes through a representation of the local voice and showing respect to the epistemic sovereignty of communities in rural Zimbabwe. The method unearthed collective knowledge and validated Zimbabwean academic models contributing material information in a new format for a health care development environment ‘set in its ways’. The method succeeded to carry input from a context in culturally appropriate ways to the stakeholders involved in (provincial) health planning in Zimbabwe. Community views provided inputs that were previously subalternised and, therefore, relatively unknown to those facilitating public health interventions and health care. From the two case studies presented, we conclude that Participative Video is a method that facilitates information gathering that increases social and political engagement of groups in rural Zimbabwe through a means of community engagement. The videos continue to raise awareness about the local views on the matter being discussed. They provide entry points in conversation through subsequent showing in other communities. By allowing the voice to marginalised communities, PV allows for social-emotional learning that expands beyond the ideas presented in the videos. Also, the videos have a transformational agency as they frame the follow-ups in the designs of the related health intervention program in rural communities.

The PV process facilitation was done by Zimbabwean women, allowing for the participation of all genders while embedding access control to tools and framing within the context of the areas involved. The cases show how Participatory Video is instrumental in improving and deepening healthcare practices in alignment with ‘local ways of knowing’ and the cultural and political realities of the Zimbabwean, rural context. The PV process, though, is extensive and caters for involvement instead of ‘token participation’. PV exposes local perspectives on complex social issues and reveals subjective, emotional and dynamic factors in rural communities, also on sensitive topics. It is a method to bring community voices to the fore, not to solve health issues there and then, and therefore provides for qualitative inputs. The process can engage local, rural communities, health care providers and decision makers at district, provincial and national levels in Zimbabwe to engage subsequent communities and inform policy and program design aligned with the realities in context.

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Mechanisms Fostering the Misuse of Information Systems for Corrupt Practices in the Nigerian Public Sector

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Abstract. The paper explores the misuse of information systems for corrupt practices in the Nigerian public sector as a phenomenon under study. Routine Activity theory, Model of Emergent IT Use, and Normalization theory were used as lenses. Danermark et al.'s six stage framework with a single case-study was adopted as the critical realist methodology. The anti-corruption and regulatory agency, the Economic and Financial Crimes Commission of Nigeria, is the case in focus. Semi-structured interviews, archival documents and press media were used as data sources. By analyzing the data, we identified motivated offender, suitable target, and the absence of a capable guardian as the entities/factors that characterized the phenomenon. Political clientelism patronage, socialization, embeddedness of corrupt routine into IT artifacts and rationalization were identified as causal mechanisms with culture as the enabling conditions. Dysfunctional structures of the Nigerian public sector were also identified as structures that breed the mechanisms. The study findings contribute to theory, practice, and the methodology of critical realism.

Keywords: Information systems · Misuse · Corrupt practices · Public sector

1 Motivation and Research Questions

The misuse of information systems (IS) for corrupt practices in the public sector is classified by IS scholars [e.g., 1, 2] as one of the “dark sides” of information technology (IT) usage. In this context IS covers e-government, business enterprise systems, computer mediated communications such as emails and mobile applications adopted by the public sector to deliver services to its citizenry. The revelation of Tarafdar, Gupta [2] coincides with the concerns of other IS scholars, who have observed that misuse of IS has enabled corrupt practices over the years [3–6]. Corrupt practices is defined as the form of financial crime that is skewed towards occupational fraud [7], involving the intentional misuse of organizational resources by employees. Financial crime described here could occur with or without IS in the public institutions. However, the focus of this paper is on corporate frauds that are facilitated with the use of implemented IS, which we conceptualize as misuse of IS for corrupt practices in public institutions.

IS has been touted for fostering development and contributing to citizens' right to freedom for better lives as well as fight corrupt practices in the public sector [8].

Despite the much anticipated expectations of IS to help curb corrupt practices, there is overwhelming anecdotal evidence that suggest that IS adoption has been misappropriated to enable corrupt practices in public institutions [3–5]. A typical example, is that of a Nigerian civil servant who was arraigned before an Abuja High Court by the Economic and Financial Crimes Commission (EFCC), "...for allegedly manipulating the Integrated Personnel and Payroll Information System [IPPIS] in collaboration with two of her sisters to enrich themselves. IPPIS is one of the functional systems [used by] the [Nigerian] Government [to pay] staff salaries" [9]. Such corrupt practices are seen as a "broad collection of 'negative' phenomena that are associated with the use of IT and that have the potential to infringe on the well-being of individuals, organizations and societies" [2, p. 161]. Following Heeks [5], we are of the notion that IS designed to function properly within an organization "have no innate property related to corruption except that of their imagery. They do not automatically provide a Panoptic model of control- this only comes if they are deliberately and systematically designed to do so" (p. 185). Therefore, the purpose of this paper is to explore and understand why misuse of IS for corrupt practices occur in the Nigerian public sector. Thus, we pose the following research questions: RQ1: What entities/factors characterize the misuse of IS for corrupt practices in the Nigerian public sector? and RQ2: What mechanisms are responsible for the misuse of IS for corrupt practices in the Nigerian public sector? The rest of this paper is organized as follows: Sect. 2 consists of the theoretical redescription of the context. Section 3 discusses the methodology. Section 4 presents the research findings and discussion. Section 5 presents the conclusion.

2 Theoretical Redescription of the Context/Research

To focus the research, we first consider RAT to understand and cluster what characterized the misuse of IS in our context as entities/factors. Given the multiple understandings of misuse of IS for corrupt practices, the entities help us to understand each perspective of corruption as a different frame of interpretation that triggers different program of actions. RAT proposed three terms/concepts - motivated offender, suitable target, and the absence of a capable guardian - stemming from the environment where the crime occurred. The theory argues that a crime is bound to take place at the convergence of the three concepts in time and space [10, 11]. The concepts represent *terministic clusters* that are used to group the dialectical negotiation of people's perceptions and experiences about the events. Such concepts have been adopted extensively in criminology research and when particularized to the context of misuse of IS for corrupt practices, RAT concepts can be used to cluster the entities associated with improper IS use. Motivated offender is a concept used to cluster occurrences of misuse of IS for corrupt practices that arise from IT employees conniving with their colleagues to compromise public sector IT infrastructures under their care. Suitable target is a

concept that represent IS that are loosely coupled security-wise or an easily compromised IS by employees, while the absence of capable guardians could result in poor IT governance, legal and policing barriers in the adopting organization's routines of operation.

To understand the structures and mechanisms at the real domain, NT [12] and the MEITU [13] were adopted. NT focuses on the normalization of corruption in an organization through institutionalization, rationalization and socialization [12]. When particularized to our context, institutionalization is the process through which misuse of IS for corrupt practices are enacted by corrupt individuals as a matter of routine without regard for their reputation. Rationalization typifies a self-serving ideology develop to justify and perhaps even valorise misuse of IS for corrupt practices. Socialization is where new IT employees are induced to view misuse of IS for corrupt practices as permissible if not desirable. The concepts are mutually reinforcing and equally interdependent. Once established in an organization, the concepts create a situation where misuse of IS for corrupt practices can be practiced collectively by employees and may persist indefinitely [12]. On the other hand, MEITU provides a model for explaining the interplay of distinctive sets of causal powers of embedding organizational structures, culture, routines, institutional and environmental contexts into IT artifact by human agencies through socialization and reflexivity [13]. The two adopted theories can be helpful in understanding the misuse of IS for corrupt practices within the organizational setting, especially where corruption has been illegally and surreptitiously institutionalized with the help of implemented IT artifact. The overlap of the two theories occur in socialization, where corrupt individuals socialize to enact their corrupt routines into IT artifact through reflexivity.

Since all theories presuppose a set of philosophical assumptions about the nature of reality (ontology) [13, 14], we draw from critical realism (CR) to posit that the event/phenomenon understudy is stratified into three domains – the real, the actual and the empirical. The empirical domain is the experienced and observed layer, where the misuse of IS for corrupt practices is mediated through the lens of human experience and interpretation. The actual domain is where entities that constitute the phenomenon under study reside. Such entities may or may not be experienced/observed. The third is the real layer that consists of interactive causal forces which produce the phenomenon understudy at the empirical level. Thus, the primary goal of the research is “to explain the misuse of IS for corrupt practices through reference to the causal mechanisms and the effects they can have throughout the three layers of reality” [15, p. 183].

Apart from the nature of reality, all theories presuppose a set of philosophical assumptions about how reality can be known (epistemology) and theories thus, are the epistemological objects of science used in the social practice of research [13]. Thus, we engaged the concepts of RAT to cluster the entities into factors and posit such entities as what exist at the actual domain, while NT and MEITU theories are used to mediate into the real to identify the causal mechanisms that could cause misuse of IS for corrupt practices in the Nigerian public sector. Such mechanisms “exist only in virtue of the activities they govern and cannot be empirically identified independently of them” [16, p. 41]. It then follows that such mechanisms can be explained ultimately through the study of the phenomenon at the empirical level. However, the misuse of IS for corrupt practices exist in the social world that is dynamic and unpredictably open, there are

social conditions inherent in causal mechanisms that could enable or constrain it from acting in certain ways [16]. In CR research, researchers engage in a retroductive reasoning process to identify such conditions for the actualization of causal mechanisms in the level of reality [16].

3 Methodology

To provide explanation of the process involved in conducting CR research, the present study follows the six stage methodological guidelines suggested by Danermark et al. [17, pp. 108–112]. When particularized to our context, the six stage includes: (1) description, which describes the misuse of IS for corrupt practices in the Nigerian public sector using everyday concepts and the interpretations of those involved; (2) analytical resolution which separates out various dimensions of misuse of IS for corrupt practices as factors that characterize the event; (3) abduction and theoretical redescription in which misuse of IS for corrupt practices are interpreted through theories that match the empirical situation discovered in stage one; (4) retrodution which identifies the structures and mechanisms and postulate them as what must exist for misuse of IS for corrupt practices to occur in the Nigerian public sector; (5) which can be included in stage four, compares various theories and abstractions to determine the relative explanatory power of the mechanisms and structures identified earlier, and; (6) concretization and contextualization, is the discussion stage of how the empirically identified mechanisms interact and manifest themselves in the concrete event under specific conditions in the same or different context.

3.1 Methods of Data Collection

The empirical data emanates from the EFCC as a case study research [18]. We adopted semi-structured interviews (i.e., face-to-face & focus group) as primary source of data, while archival documents, blogs, and press media were used as secondary data source [19]. EFCC is an agency of the Nigerian government that is saddled with the responsibility of combating financial and economic crimes, with headquarters in Abuja–Nigeria. The agency, the custodian of the evidence-based cases, also interrogates and prosecutes/investigates offenders of IS misuse for corrupt practices. Twenty-five EFCC cybercrime experts at the managerial level were used as proxies for the interview. They consist of 5 from forensic unit, 5 from legal and operations unit, 5 from IT unit, 10 from cybercrime unit. The choices were based on experience on the job, length of service at EFCC which we gleaned from long service awards received by staff and their technical expertise. Consent forms, guaranteeing confidentiality, voluntariness and ethical clearance as stipulated in the American university of Nigeria codes of ethics for research were given to each to complete. Getting access to interview the offenders directly proved to be difficult since most offenders are either in the prison or have fled the country for fear of prosecution. Besides, it is most likely that the offenders may not disclose information to researchers, rather, they can open up to EFCC operatives and the courts because evidences of their criminal acts have been established. Archival data such as court verdicts and interrogative documents on a case by case

bases were also looked into. We collected more than one hundred court verdicts and other interrogative documents, out of which twenty-five were usable for corroborating the interview data. For the focus interview, assemblage of the group arises from informants from cybercrime, legal, research, forensic, and legal and operations units of EFCC and they are ten informants in number. The group brainstormed towards providing answers to our questions such as “what do you think could cause misuse of IS for corrupt practices to exist? What characterized such a misuse?” Among others. We audio-taped the discussion and also observed their body languages. Besides, second rounds of interviews were conducted between February 2018 and May 2018 respectively as a follow up to the focus interviews. The interviews lasted for about 50 min in each case. We moderated the interviews and audio taped (with their consent) it as well on a non-threatening environment to avoid distractions. We then pass-worded the folder that contained the file for safe keeping.

3.2 Methods of Data Analysis

At first, we transcribed the audio taped data into a word document of sixty-five pages, we triangulated the primary data sources to corroborate the secondary data for more insights. Data coding process was done in two stages: (1) data coding process of searching for entities that characterized the misuse of IS for corrupt practices as factors; and (2) data analysis through abduction and retrodution as shown in Fig. 1.

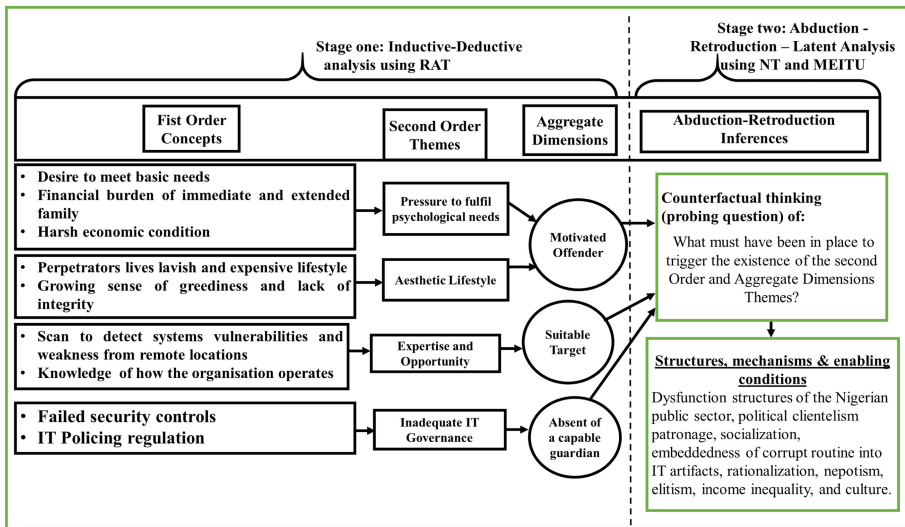


Fig. 1. Inductive-deductive semantic and abductive – retrodutive latent data analysis [Adapted from 20, 21].

During stage one, the cycles of the coding process followed the inductive-deductive logic via a flexible theory “directed” coding process [20, 21]. The theory here is the RAT, where three concepts - motivated offender, suitable target, and the absence of a capable guardian- are used as terministic clusters of entities [22, 23] or themes [20, 21] that are grounded in the data. The terministic clusters represent theoretical grouping of the verbalization of the multiple interviewees as entities. Such entities express different dimensions surrounding the occurrence of the phenomenon under study. It is more likely that there will be multiple perceptions and experiences about the occurrences of the phenomenon, and such will be expressed agonistically and consistently in the verbalization discourse. Indeed, we must exercise care to recognize and protect these terministic tensions as entities that reside at the actual domain within the social context that misuse of IS for corrupt practices occurred. Thus, the data coding process is guided by provisional codes that draw upon the RAT and the stratified ontological view of reality as endorsed by CR. Throughout the coding cycles, the most prominent codes are used as a foundation to identify the entities as factors that characterized the empirical situation.

After identifying the tendencies of the data, the second stage is the latent data analysis. This consists of abductive-retroductive reasoning to identify the misuse of IS for corrupt practices by engaging with the existing theories [12]. Abductive reasoning is the spotting of patterns and relationships in sets of data and matching them with theories or theoretical concepts, with a view to selecting theories or theoretical concepts with significant explanatory power or which offer better explanations [24, 25]. Thus, NT [12] and the MEITU [13] were applied not to mold the data to fit the pre-conceptions of the theories. Rather to identify the mechanisms operating in the empirical situation by choosing between a number of possible frames of theories to interpret particular empirical situation. The final stage of data analysis aims to ascertain the contextual condition for the causal mechanism to take effect and to result in what were seen from the empirical data. To identify the necessary contextual conditions, a retroductive reasoning process is applied by constantly moving from the empirical domain to the deeper levels of reality through counterfactual thinking and questioning (i.e., what must have been in place for the data to have been observed in the empirical domain) [26].

Again, NT and MEITU were applied to identify the specific context of the actualization of the causal mechanism as it relates to the social structures. Thus, analysis of the empirical data provides evidence of the observable outcome (i.e., misuse of IS for corrupt practices) that may enable plausible explanations of the generative mechanisms and enabling conditions that caused such an outcome to be hypothesized. Thus, empirical data analysis is not an end in itself but serves as a facilitation agent preparing the data needed to enable retroduction and abduction. It is an interim step and requires a combination of data from each of the three sources of empirical data described in Sect. 3.1. The raw material provided by analysis can then be interpreted using Danermark et al.’s framework to explain the entities and generative mechanisms giving rise to both visible outcome and causal inference as detailed next.

4 Research Findings

Stage 1 - Description of the context: In 1999, Nigerians adopted a constitution that empowered the public sector to exist and function. It encompassed over one hundred ministries, departments and agencies (MDAs) through which the government implements policies and delivers services to the citizenry. Such services spans health, security, education, utilities, and infrastructures among others. It is also categorized into Federal Civil Services, State Civil Services, Local Government Services, and the Public bureaucracy that includes the National and State Assemblies. Not long after inception, services to the citizenry have been characterized with intense corruption that have impeded good governance. Corrupt practices manifest in the form of bribery, misappropriation, embezzlement, and money laundering among others. To find solution to such corrupt practices the government of Olusegun Obasanjo in 1999 sought for the introduction of EFCC an anti-graft agency and the digitalization of the bureaucratic services across its MDAs via e-government initiatives. The EFCC Establishment Act of 2004 and the Money Laundering Act of 2004 legalized and governed its activities. Between 2004 and 2018 EFCC investigated/prosecuted several corrupt bureaucrats and politicians including state governors some of whom were convicted with jail terms while others are still facing trials in various courts as stated by one respondent, that “the cases are still ongoing in courts... there are many of them”. Interviewee #8.

To strengthen the digitization agenda, the government in 2000–2001 enacted the National Telecommunications (NT) and the National Information Technology Policy (NITP) to regulate and manage the telecomm and IT industries. To enforce the digitization process into the fabric of the public sector, the National e-government Strategies (NeGSts) was created in 2004. Despite such attempts, it is rather unfortunate that the impact of EFCC and e-government initiatives seem not to have attained expected goals. In fact, our data suggests that the e-government systems domiciled in the MDAs were misused by bureaucrats and IT vendors for corrupt practices. Among such systems were the IPPIS and the Government Integrated Financial Management Information Systems (GIFMIS). The IPPIS platform plugged out over 46,000 “*ghost workers*” when it was initially implemented. However, such *ghost workers* found their way back into the system due to misuse by a group of syndicates (i.e., corrupt IT official(s)) as commented by one of our informant: “A director in the IPPIS and the IT vendors... are responsible for compromising the systems, they introduce *ghost workers* into the government payroll illegally”. Interviewee #2. Another informant stated “...group of fraudsters recruited an IT staff in the office of the accountant general of the federation (AGF), now this guy connected the fraudsters to the network inside the AGF’s office, scanned the network and exploit its vulnerabilities to transfer funds into various bank accounts”. Interviewee #4.

Stage 2 - Analytical resolution: Misuse of IS for corrupt practices in the Nigerian public sector can be dissected into motivated offender based, suitable target based, and the absence of a capable guardian based dimensions. Such dimensions are entities that

exist as individual instances of things under study [27], which we classify as factors that characterized the phenomenon. The dimensions are discussed as follows:

Motivated offender-based form of misuse of IS for corrupt practices: Misuse of IS for corrupt practices as a long term problem in the Nigerian public sector is framed by most informants as an invasive corruption perpetrated by motivated top employees at managerial levels in collaboration with external IT consultants within the public sector. Being vested with powers and the responsibility for approving changes in systems, they collude with the external IT consultants responsible for IT governance and control to compromise the system to meet their psychological needs. The following brief excerpts illustrate this terministic screen as stated by one informant “A Director in the IPPIS and the private entity [i.e., IT vendor] in charge of managing the IPPIS infrastructures... are responsible for compromising the systems, and this is common to all the IT platforms that you see in the public sector, they do this to make ends meet”. Interviewee #2. Employees with pressure to fulfil the need of shelter, food and immediate need of families and acquaintances as stated by two respondents: “A syndicate confided in us that he perpetrated the act because his take home pay does not actually take him home. Besides, the pay he receives as salary does not meet the needs of the family”. Interviewees #2 and #10. Other bureaucrats, who misuse IS for corrupt practice, exhibit lifestyles of pleasure, ownership of many exotic cars and expensive houses as exclaimed by two informants “... what do they use it for [i.e., the stolen funds]? Lavish and expensive life-style!” Interviewees #4 and #14.

Suitable target-based form of misuse of IS for corrupt practices: By clustering misuse of IS for corrupt practices as suitable target, informants give strong, severe and very negative connotations to e-government IT platforms and the dishonest IT officials and managers that man such IT platforms. Thus, such a dysfunctional public sector environment becomes a suitable target for breeding misuse of IS for corrupt practices. Our findings revealed that the syndicates of corporate and state fraud are IT experts who had been with the affected organizations for many years and have expertise on operations of the systems and the organization itself. This provides them the opportunity to capitalize on and coordinate to erroneously manipulate the IS at will. One informant attests that: “The syndicates are experts in IT, and as such they focus on vulnerabilities . . . then they . . . take advantage of the weaknesses of the system to penetrate . . . and transfer funds into different accounts for selfish gains. Such actions are usually done after working hours or on weekends”. Interviewee #4. Suitable target refers to an opportunistic scenario where employees strive to use their IT skills to steal from national coffers.

Absence of a capable guardianship-based form of misuse of IS for corrupt practices: A third cluster of terms is absence of a capable guardianship. This type of misuse suggests that corruption is associated with deliberate relaxation of adequate control measures and IT polices to foster insider’s cooperation to compromise the system. Such an environment breeds willing offenders to do the “needful” as commented by another informant: “...it is not the case that the IT is not functioning, but there is lack of trusted people, so vulnerabilities of the system are exploited. A situation where a director is also the chairman of the IT steering committee is the head of the

corrupt syndicates, what do you do?” Interviewee #5. Absence of a capable guardianship is associated with distrust of the citizenry which becomes entangled in the culture of a given society.

Overall, the brief description and the elicitation of the three entities demonstrate the crucial elements for hypothesizing plausible generative mechanisms that produce the visible outcome, are explained further in stages 3–4 of the Danermark et al.’s [17, pp. 108–112] framework below.

Stage 3–4 - Abduction and Retroduction – identification of structures, mechanisms and conditions: We used theories of MEITU and NT to look in the data via abductive reasoning, while retroduction was used to identify the structures, mechanisms and the enabling conditions. With MEITU, we identified the dysfunctional structures of the Nigerian public sector as structures. Such structures manifest as: the quasi-democratic hijack of power by elites and their kleptocratic hijack of national sovereignty [28], a centralized economic decision-making and disbursement of funds, lawlessness in the administrative process, considerable lack of exemplary ethical leadership exhibited by politicians and senior public officials and deformed sociocultural norms that are skewed towards loyalty to friends, politicians, tribe and, superiors [28]. As commented by one informant: “Politicians highjack the institutions of government and make them to operate in their own way without observing the code of conducts guiding public service... institutions are centrally managed by corrupt politicians and bureaucrats who do not have conscience and morality...”. Interviewee #16.

The dominant presence of dysfunctional structures gave rise to embeddedness of corrupt routines into IT artifacts as one of the mechanisms. Such a mechanism exists due to activities of motivated offenders who inscribe their corrupt intent into the IT artifacts through socialization. One informant commented: “pay officers, directors of ministries, and IT vendors entrusted for IT governance.... collude to help one another and rewrite the sources codes of the systems to pay ghost workers, employees in the ministries will not even report, they take their share of the proceeds, he [the director] takes his cuts, so it is a win-win situation for all of them”. Interviewee #3. Thus, employees and IT vendors leverage socialization processes as a mechanism to normalize their corrupt tendencies. Cliques of syndicates with a common interest are formed to undermine IT governance and policies. An excerpt from an informant enlightens us thus: “...it is not that the IT controls are not functioning, it is the people that are compromising it, and they collude with one another. Where there is supposed to be a dual authentication, if the two people agree to help each other, the control is useless...” Interviewee #5. The long-term socialization process valorizes the misuse of IS as one informant attests: “... his bosses are busy making money on the basis of inserting ghost workers into the IPPIS.... he has to joyfully commit the act as well since there seem to be no consequences”. Interviewee #5. Thus, rationalization becomes another mechanism in the context.

Cliques of syndicates with a common interest in the socialization process are actually stooges or proxies of politicians in the ruling political party. Such cliques are strategically positioned in IT infrastructures in critical ministries for the sole purpose of fraud. Proceeds from the fraud are given to the politicians who put them there on a sharing formula based on percentages. Thus, political clientelism patronage is one of

the mechanisms operating in the context. Political clientelism patronage defined as “a more or less personalized relationship between actors... commanding unequal wealth, status or influence, based on conditional loyalties and involving mutually beneficial transactions” [29, p. 69] positions the politicians at a high level in the pyramid of loyalty, allegiance, and respect. Such a positioning breeds corrupt bureaucrats who collude with their cliques to embed corrupt routines into IT artifacts as stated by an informant: “one syndicate confided in us [the EFFC] that they are in government and wield power”. Interviewee #17.

The identified structures and mechanisms are seen as tendencies and liabilities, i.e., susceptible to the powers of other mechanisms. They operate, in our case, by the help of enabling conditions. The key enabling condition, identified in our context, by drawing from MEITU is culture. Culture, defined as shared beliefs, values, attitudes, norms, customs and tradition established to strongly influence human behavior and reveals basic assumptions of how things are done by a particular group of people [30], is deeply shrouded in corruption in the Nigeria context. The following excerpts from informants summarize it: “Corruption is so pervasive in this country that it would be nearly correct to say that it is a way of life”. Interview #11. “The reason why looting of public funds using IT is that Nigeria is morally bankrupt and IT has now become the facilitating agent. Despite our preference for anti-corruption set of rules, Nigerian governance culture is giving everybody the feeling of – “if you can’t beat them, then you join them”. Interviewee #18. “Our value system allows so much nepotism, impunity and lawlessness in the public sector and this is reflected in our national culture and the way we do things, even in using IT.” Interviewee #20.

Stage 5 - Compares various theories and abstractions: Arguably, other potential mechanisms might be at work in our context. For instance, one might hypothesize that nepotism defined as a form of undue bureaucratic favoritism enjoyed by friends, members of the same tribes, and families of those in power or that elitism and income inequality (i.e., misallocation of national wealth in favor of elites to enrich a few at the expense of the nation as a whole) might explain the misuse of IS for corrupt practices in the Nigerian public sector. However, they were eliminated because of their plausibility of lack of a strong explanatory power in the empirical evidence [31, 32]. Several alternative and rival mechanisms were empirically collaborated to be at work [33], including nepotism, elitism and income inequality. However, mechanisms consistent with the whole data material, including feedback from key informants seem offered strong explanatory power and were therefore selected.

Stage 6 - concretization and contextualization – Discussion: Beyond the realm of experiences, there is a polysemy of misuse of IS for corrupt practices identified as motivated offenders, suitable targets, and absence of a capable guardians residing as entities/factors at the actual domain as shown in Fig. 2. This polysemous condition of misuse of IS has both material consequences leading to the normalization of corruption. The three different terministic screens that informants use to construct misuse of IS for corrupt practices suggest distinct programs of action as material consequences. For instance, motivated offender perspective regard wealthy Nigerians as corrupt, which might not necessary be the case. Thus, terrace and luxury houses or exotic cars are under the watch of EFCC with a view of interrogating owners. Suitable target

perspective regards IT infrastructures in the public sector as an opportunistic artifact to steal, while absence of a capable guardians perceived IT employees as culprits and colluders with bureaucrats and politicians to defraud the Nigerian state. To give rise to such polysemous condition of misuse of IS are political clientelism patronage, socialization, embeddedness of corrupt routines into IT artifacts and rationalization mechanisms that interact to cause misuse of IS for corrupt practices. However, such interaction of the mechanisms would not have been fully possible without the enabling conditions of culture. The dysfunction structures of the Nigerian public sector were also identified as structures that breed such mechanisms as shown in Fig. 2 as the research model. Hence, our contribution.

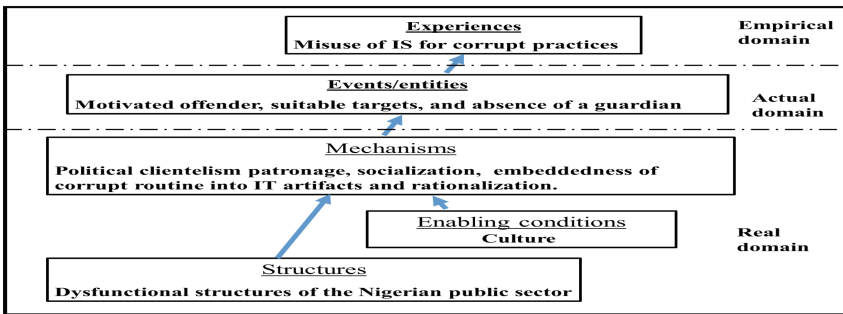


Fig. 2. A realist model of IS misuse for corrupt practices in the Nigerian public sector.

5 Conclusion

In this paper, we leveraged the CR single case-study methodology to identify the generative mechanisms and enabling condition in concerted interactive form to cause misuse of IS for corrupt practices in the Nigerian public sector. Such misuse of IS was identified to have entities/factors (i.e., motivated offenders, suitable targets, and absence of a capable guardians) which represent the different interpretations and meanings given to it by the Nigerian audience. The identified mechanisms (i.e., political clientelism patronage, socialization, embeddedness of corrupt routine into IT artifacts, and rationalization) breed within the dysfunctional structures of the Nigerian public sector, with culture as the enabling condition. Thus, the paper contributes to both theory, practice and CR methodology. In theory, the research model in Fig. 2 is first of its kind in literature to explain the cause of misuse of IS for corrupt practices and the various interpretations and meanings in Nigeria. In practice, EFCC can use the research findings for intervention purposes. Lastly, by using CR methodology, we further added to the application of CR methodology literature. Presently, this paper identified a few generative mechanisms at work, thus, future study can identify more generative mechanisms and enabling conditions and their interplay until closure is attained.

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Rethinking Theory and Practice of ICT4D. An Analysis of the Discourse Embedded in the 2016 World Bank Report

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Abstract. Although development studies/theory is critical in all areas pertaining to global development, Information and Communication Technology for development (ICT4D) studies have been argued to have paid little attention to the controversies around development. I argue that all ICT4D research uncover the meaning of development but this is often implicit; and this meaning can be revealed using techniques such as discourse analysis (CDA). The study is a CDA of World Bank Report 2016 on Digital Dividends (WDR16) to illustrate how CDA can be applied to expose implicit views of development embedded in ICT4D studies. The study is centred on the recent growing emphasis on ICTs for development focusing on contemporary processes of social transformation which are variously identified within the critical discourse analysis (CDA) by such terms as ‘neo-liberalism’, ‘globalisation’, ‘information society’ and ‘knowledge-based economy’. Although the report can be critiqued for over-emphasis of positive contributions of ICT4D, it needs to be applauded for taking development not as merely market related but as a holistic process covering other socio-economic development issues like poverty eradication, human development and human dignity. It resembled major shifts in ICT4D thinking from 2000 to 2010 which was a move from technocentric view.

Keywords: World Bank · ICT4D · Economic growth · Digital dividends · Globalisation · Development studies

1 Introduction

The rising poverty and inequality within and among nations and many other global developmental challenges have left many critical questions as to whether diffusion of ICTs can lead to development or whether they reinforce the divide and uneven development. This central argument is critical as the main debate in development policy and practice has been always on the disparities between and within nations. The assumption that ICTs adoption and use can contribute to reducing the massive inequity that exists between and within nations is questioned, as the gap is widening (Kondowe 2018). Furthermore, the observations that the poor will benefit from the development of ICTs was critiqued as too simplistic and abstract, vague, complex (Bongo 2005; Kondowe 2018). The question of ICT-enabled development remains a heated debate in ICT4D studies and the central critique has been that they do not tap into the central

discussions on the theory and practice of development studies. Though several studies have claimed that ICTs have a number of contributions to development whether implied or explicit, to date literature that integrates ICT4D debates into the mainstream development ideas is argued to be sparse. The central question as to what ICTs mean within the language of development studies is argued to be unanswered and in ferment.

It is critical from the onset to acknowledge a number of ICT4D studies that have explicitly argued about the contribution of ICTs in development through poverty eradication, economic growth, better health and education (Bankole et al. 2015; May et al. 2014; Miroro and Adera 2014; Levendis and Lee 2013). The field also recently witnessed the use of many derivative frameworks: for example, the capability approach, millennium development goals for example by Clarke et al. (2013) and Kleine's Choice Framework. Nonetheless a majority of the ICT4D sources are implicit about technology enabled development. Research and studies in ICT4D have been critiqued as flawed due to the lack of a unified conceptual grounding in development studies. Studies were described as complex, ambiguous, and often laden with conflicting and antagonistic views lacking clarity on how ICT is conceptualised in the context of development (Avgerou 2010; Kondowe 2018). Moreover, studies fail to come up with convincing arguments regarding technology-enabled development and how it can be achieved (Avgerou 2010). Furthermore, development debates occupy a lesser space in ICT4D debates (Wade 2002). In some contexts where there is an attempt to conceptualise, there is a lack of reference to important aspects surrounding development that can provide a more comprehensive explanation (Harindranath and Sein 2007). It is thus clear that scholars have expressed discontent regarding the progress within the technology-enabled development debates.

Although development studies/theory is critical in all areas pertaining to global development, ICT4D studies have been argued to paying less attention to the controversies around development (Avgerou 2010), hence lacking a solid understanding of development outcome (2001). In support of this, Heeks (2006: 1) argued that "we are changing the world without interpreting or understanding it". The process by which ICTs foster socio-economic development is argued to be unclear (Thapa and Sein 2010). Thus, although there is a growing literature on ICTs in developing countries (Walsham and Sahay 2006; Avgerou 2008), a number of researchers, for example, have argued that much of this literature does not address the question of what is meant by development (Heeks 2006; Thompson 2008). In an article in the policy arena recently published in the *Journal of International Development*, Richard Heeks argues that the development informatics community has been informed much more by academics with a technical bias (for example, those from the information sciences, information systems, communication studies, and computer science disciplines) than those with a development studies focus (Heeks 2010). It is clear that ICT4D as a discipline is found wanting in terms of conceptualising development.

Although studies have been critiqued for lacking a unified conceptual understanding of what development is, several studies have managed to imply what they mean by development. It is evident that many studies in ICT4D have done a great deal in pointing to the weaknesses; amidst this dark picture, "development" as a concept in ICT4D studies has been emerging as a cross-cutting theme. Scholars and researchers need to be applauded for thinking/rethinking and conceptualising/reconceptualising

development. It may be an under-specification, if the contributions to framing of development are overlooked. Amidst these critiques, however, a number of studies articulate the link between ICT, economic growth and poverty eradication (May et al. 2014; Miroro and Adera 2014). There has been progress in identifying a myriad of ways in which ICTs contribute to development. ICTs are argued to have made the world more inclusive (World Bank 2016a; b). ICTs are also positioned such that they have transformative potential in all spheres of the economy. ICTs in general are portrayed as a catalyst, a tool that can enable development and has many positive contributions to development (World Bank 2002; Acilar 2011). There is a bold stance that the question of whether ICTs can contribute to development has come to have an obvious “Yes” answer (Walsham et al. 2007). In this study, I argue from the outset that the fact that these studies make reference to development studies, does not in itself make reference to what they see development as. Although they may not be explicit in stating the nature and kind of development that ICTs pursue or contribute to, it is clear that they imply a set of principles which mirror orthodox and neo-liberal development.

1.1 Understanding Development Studies/Theory

Concern over development has been at the core of theory and practice for decades. Development studies is complex; there is no agreed way of analysing development. Scholars and practitioners thus face critical choices regarding focus, scale and expertise (Currie-Alder 2016). Conceptualisations of development have been diverse. Development studies is multidisciplinary and has, for several decades, been connecting different thinkers in different fields, such as economics, sociology and history, amongst others. Early conceptualisations have been based on development as purely economic growth within the neo-liberal school until recently when the field witnessed the nature of explanation shifting from merely economic growth to other aspects in socio-economic development and human development.

The field has been preoccupied with analysing the existence of poverty and inequalities in societies (Pieterse 2010). Recently, development studies is engaging with several issues around environment management, peace, and climate change, amongst other critical concerns. Moreover, it is seen as the improvement of human wellbeing, the human condition or welfare. Although there have been shifts in development studies from economic growth to human development as new developments and new frameworks forged consensus by prioritising reducing extreme poverty, they remained compatible with neo-liberal growth economics (Clarke et al. 2013). Development studies is thus embedded within orthodox and neo-liberal thinking. This study will discuss the orthodox approach which is mainly in the neo-liberal school.

1.2 Orthodox Approach to Development

The orthodox approach refers to the early conceptualisation of development which was primarily preoccupied with economic growth (Ranis 2004). This was the thinking that emerged after World War II, as independent countries sought advice for the acceleration of their development (Rapley 2007). At that time, the Western world was confronted with the challenge of rebuilding countries that had been destroyed by war.

Simultaneously, there was also a concern regarding the challenges alongside facing backward regions and countries, and the solution that was devised was that these challenges could only be overcome by the pursuit of economic growth through industrialisation. Capital accumulation was at the heart of development and was seen as the necessary requirement for development. The approach emphasised the importance of markets. The states were supposed to create an enabling environment which was market-friendly. The resulting growth theories assumed that wealth generated through economic growth would trickle down and eventually benefit all segments of society. This therefore primarily focused on the requirements for an increase in per capita real income. Development was considered largely synonymous with industrialisation and economic growth. Technologies, new inventions and innovations were idealised as a momentum to bring economic improvements to the less-developed and developing regions (Hwang 2006). The ultimate goal was to raise incomes and, in the process, give the poor people access to the range of goods and services. Industrialisation was seen as the path to raise incomes, and the benefits of economic growth were envisaged as if they would trickle down to the poor. However, development thinking should be applauded, with significant scholars propounding conceptualisations incorporating human development following Sen's (1999) ground-breaking capability approach to development that focused on empowerment, amongst other approaches. Moreover, millennium development goals and human development reports, which were adopted by the United Nations to track practice, were associated with human development. As positive as steps such as these appeared on the surface, these developments, according to Clarke et al. (2013), prioritised reducing extreme poverty; however, to date, development conceptualisation remains compatible with neo-liberal growth economics.

1.3 Technology and the New Capitalism Language

The Frankfurt School, arriving in the mid-20th century, was built on the work of Marx, Weber and Parsons around the interactions of technology and society. Within this school, technology was part of a critique of modernity and the developments and institutions associated with modern society (Richardson et al. 2006). Critical theory allied technology with modernity and viewed it as a tool of the modern state used for more perfect subjugation of both the masses and the individual (Richardson et al. 2006). The study is a critique of the neo-liberal explanations rendered for ICT-enabled development. Although critical research in information systems dates back to the early 1980s (Mingers 1980; Ngwenyama and Lee 1997), the discipline has been flooded with studies within the positivist paradigm with fewer of a critical nature (Richardson et al. 2006). The role of technology in society emerged from critical philosophers Marx, Weber & Parsons, who argued that technology has effects in society (Shields 1997). Technologies have been seen by the Marxists as a replacement of the traditional organisation of the "family-owned and -operated firm with that of the large-scale, centralized, hierarchical, bureaucratic corporation" (Kurz 1994: 245). The logic behind technology was with a view to maximising economic growth as measured by market share and profitability (Kurz 1994). Although the explanations that technologies contribute to economic growth may seem substantial, the Marxists, thorough analysis of the function of technologies in the sphere of production, bring clearly into focus an

underlying logic guiding the process of mechanical integration and organisation, a logic that the technology optimists failed to see. No doubt stemming from the Marxist thinkers, the integration of technologies into the sphere of production is associated with the economic growth logic of profits and capital accumulation.

Many research studies within the ICT4D discipline may not state the development discourse that they are assuming as guiding them and structuring the information sources and methodologies that they employ in justifying ICTs in enabling development; however, they share a language, vocabulary, common basis and generally agreed principles. This study draws attention to the fact that ICT4D discourses are built, maintained and rearranged in the context within in which any study is taken. The way in which ICT is positioned in development raises questions whether ICT is a panacea of development or economic growth. In this case ICT4D studies shapes development discourses as well. The methodological foundation of the research is based on critical discourse analysis, which draws particular attention to discreet language and the way narratives are formed and interpreted. The methodological framework applied specifically emphasises the role of language and identities in the formation and reproduction of discourses through the hegemonic institutions which are key stakeholders in ICT4D, such as the World Bank. I argue that the way that these hegemonic institutions view technology in development has been the underlying theme that has been transferred to ICT4D studies. Although there has been a major shift from market related and technocentric resemblance of ICT4D the language of orthodox approach to development witnessed minor changes, hence the results reaped within ICT initiatives targeting development have exhibited mixed results. The data analysis will investigate the argumentation and legitimisation strategies behind the discourses of ICT and development through these institutors.

2 Methodology

The study utilised the critical discourse analysis (CDA) methodology in its investigation of how the World Bank frames ICT-enabled development. CDA is not only a theoretical framework that explores the relationship between language use as discourse and unequal power relations, but also is an analytical method that analyses diverse linguistic features and discursive strategies by which a certain ideological bias is exercised in texts (Hwang 2006). The discourse analysis as a research tool can be used in exploration and analysis of various policy documents (Byungura et al. 2016). Accordingly, CDA was used in this study as a research approach that is methodologically based on the analysis of the WDR16 is supporting the rhetoric that ICTs are a catalyst that contributes positively to development. The intention to use a CDA approach for this study was to create a deeper knowledge about how development is conceptualised in ICTs and to unpack the implied and articulated concepts that are used in framing development in ICT4D.

I focus my discussion around the arguments in the report which refer to contemporary processes which are ICT-driven and are variously identified within the CDA by such terms as ‘neo-liberalism’, ‘globalisation’, ‘information society’ and ‘knowledge-based economy’. These terms and inferences in the ICT4D space have an extremely

huge bearing on how development is understood and conceptualised. A focus on these led to greater use, application and reference to the language of new capitalism, the language of globalisation of Fairclough (2003). These terms were used as the central focus to analyse texts that were extracted to discuss the implied meaning of development within the report.

The WDR16 is the data source for the study. The basis of the analysis is a description of new capitalism, written by Jessop (2000), which Fairclough (2003) constantly refers to. The capitalist mode of production has evolved in several ways to include issues such as re-articulation and re-scaling the relations between the economic, political, and social (Jessop 2000). The new capitalism encompasses new technologies and new modes of economic coordination (Fairclough 2003). The main terms which have entered this language are, for example: the information economy, the knowledge-driven economy, globalisation, the rise of regional economies, entrepreneurial cities, the network economy, strategic alliances, government without governance, turbo capitalism, space-time compression, flexibility, workfare, the learning economy, and the enterprise culture (Fairclough 2003). The above refer to capital accumulation as the main logic which has dominated the current economic state of affairs. ICTs and digital technologies are drivers of this new capitalism and occupy a dominant space in this economic era. It is from this background that this chapter focuses on the discourse of ICTs, economic growth and globalisation, which is portrayed by the WDR16.

The rationale behind selecting the WDR16 on digital dividends was purposive. I basically believe that policy reports are the most valuable resource to recognise the positions and arguments of certain stakeholders. I also see ICT4D as a power struggle for domination and the World Bank as the hegemony of ICT4D, having much control of the direction which it will take. Further, policy reports, in particular those produced by international organisations, are the most important discursive resource to investigate the way in which the discourse of development is being constructed, disseminated, and argued. The World Bank has had the predominant role in global development issues and now has taken a leading role in ICTs. The World Bank is seen as the custodian of development and shapes the direction of development. It is also seen as an institution with technical capacity and competency to deal with development. Although history has condemned some of the policy options that have failed the global South, to date the World Bank is the key institution sometimes referred to the hegemony of development as it provides policy options to development practitioners and shapes the terrain and landscape of global development. I thus analyse texts within the report to elicit what they mirror in development theory. The study utilised only the Part 1 of the report which contains three documents that summarise ICTs and economic growth, expanding opportunities, and promoting service delivery, respectively. I read the full report and purposively focused on Part 1 of the report as it forms the summary of the report. The texts which were analysed were purposively selected as they formed the summary or main argument of the section concerned. This study is part of the major PhD work in progress which analyses the full report and a wide variety of literature sources.

3 Findings

The Positive Contributions of ICTs in Development. The main title, *Digital Dividends*, introduces the main claim and the underlying assumption in the report which is that ICTs can provide digital opportunities or that they have positive impacts on the global development story. The title is rhetoric: “digital dividends” intends to justify and motivate a shift that would entail presenting ICTs as positive contributors to development. Rhetoric statements set precedence on how the social reality should be viewed, experienced and interpreted (Fairclough 2003; Guo 2013). It thus sets the underlying tone of positive contribution of ICTs in development, while choosing paying less attention to negative impacts of ICTs, which is digital divide. Unlike most literature and research in ICT4D, the report partially acknowledge the longstanding debate of the complex relationship between ICT and development from the outset. The report claims that the digital revolution is necessary and contributes to better business operational efficiency and productivity, amongst other benefits. ICTs are presented as drivers and catalysts to unlock digital opportunities and improve the lives of the poor. ICTs also transform the ways in which corporates operate, stimulating productivity, innovation and efficient ways of operating which, in turn, lead to profitability, which is the much-desired force to improve GNP and GDP. The report states that ICTs have positive contributions to economic growth and job creation.

<Extract 1>

We must take advantage of this rapid technological change to make the world more prosperous and inclusive. This Report finds that traditional development challenges are preventing the digital revolution from fulfilling its transformative potential. For many people, today’s increase in access to digital technologies brings more choice and greater convenience. (Foreword) [My emphasis].

The wording of the statement starting “We must take advantage of this rapid technological change...” is suggestive in nature. It glorifies ICTs and makes them a non-negotiable for organisations and countries to tap into it if development is to happen. This statement is accomplished by the metaphor “digital revolution”. Metaphors are used in a number of ways to create social realities and may thus be a guide for future action, which reinforces the power of the metaphor to make experience coherent (Guo 2013), thus underscoring a specific understanding of the reality while ignoring others. ICTs, in this narrative, are positioned as prerequisites for development, and should be taken advantage of. Although ICTs are important in the development story, there are other contributing factors which are also important, however ICTs remain catalysts and enablers of development.

Key Contents of the Report. As stated earlier, the report has three key policy contents. I discuss the narrative of the three key contents in the report which are the contributions of ICTs in: economic growth, expanding opportunities and promoting service delivery. The theme for ICTs and promoting economic growth inclusion and participation continues to solidify the legitimization of ICTs as a panacea for development. In this paradigm, these digital technologies are accelerating growth and helping businesses become more productive; ICTs expand economic opportunities for

individuals, for example, people find jobs and greater opportunities; and lastly ICTs can contribute to better service delivery where governments deliver better public services to all. The report thus shifted from traditional view on markets and techno-hype approach to development as economic growth is seen as a means and not an end of development. Better service delivery and quality of life is seen as an end of development.

Accelerating Growth. The report then reiterates the ways in which ICTs need to be discussed within the global development discourse. It is therefore significant to analyse the discursive formation by which economic growth is conceptualised and constructed within ICTs discourses. Discourses word or lexicalize the world in particular ways (Fairclough 2003). Due to the more abstract ways in which discourses construct meaning it was imperative to focus on semantic relationships between words and not only on individual words that were used in the policy report. According to the report, the three broad ways that ICTs can promote growth is through enabling inclusion, efficiency, and innovation of firms (World Bank 2016a; b). These three ways are important in expanding trade, increasing capital and labour utilisation, and intensifying competition and are argued to have direct positive impacts on growth. Better communication between firms is argued to contribute to better access to market information. This considers the continued and ever persisting debate of whether development is about economic growth or human development. Although from the surface the report legitimises an orthodox development where economic growth is primary, implicitly it covers deep critical development questions on inclusion.

<Extract 2>

Digital technologies have dramatically expanded the information base, lowered information costs, and created information goods. This has facilitated searching, matching, and sharing of information and contributed to greater organization and collaboration among economic agents—influencing how firms operate, people seek opportunities, and citizens interact with their governments. The changes are not limited to economic transactions—they also influence the participation of women in the labor force, the ease of communication for people with disabilities, and the way people spend their leisure. [My emphasis].

Texts set up dialogical or polemical relations between their ‘own’ discourses and the discourses of others (Fairclough 2003). Beyond supporting the technology, in this extract, optimists emphasise the role of markets/private sector in the development and importance of globalisation. The private sector is thus seen as the key vehicle to bring about development that is needed. If the firms can deliver on productivity, it is expected that these will result in improved GDP which, in turn, would benefit the masses. Development is thus mainly framed within the orthodox school. The rhetoric used in <Extract 2> (“information goods”) justifies and motivates a shift that would entail the information economy, which speaks to the importance of information in current economic relations and for countries and firms to be competitive in the global market. This rhetoric also furthers the understanding of the information or digital economy, which optimists argue are catalysts for development. Although optimists argue that ICTs are important for development, on the other hand, the pessimists argue that ICTs have reinforced inequality and poverty. The rhetoric is used to reinforce the former view. In as much as the report emphasises the role of ICTs in development it needs to be

applauded for taking development not as merely market related but took a holistic approach which encompasses other socio-economic development issues like poverty eradication signalling the shifts in ICT4D thinking from 2000 to 2010 which was a move from technocentric view.

Expanding Opportunities. Digital technologies are vested with the potential to improve overall welfare and reduce poverty; but without complementary investments, they can also worsen inequality. They are vehicles to enable employment of youth and other vulnerable groups, and assist innovation for farmers and fishermen, among other businesses which are mostly dominated by the poor. Connectivity is also seen as leading to inclusion of women and other marginalised groups into the mainstream economy.

<Extract 3>

Digital technologies can improve overall welfare and reduce poverty, but without complementary investments, they can also worsen inequality. In Africa alone, 11 million youth are expected to enter the labor market every year for the next decade. Born in the internet era, they live in a world full of new and exciting opportunities. Farmers use mobile phones to get price information and technical advice. Women facing barriers to work outside their homes can work online and better balance work and family. [My emphasis].

The use of ICTs is seen as having far-reaching positive contributions that go beyond the economic benefits discussed in the earlier section. ICTs are major contributors to poverty eradication. They have benefits that spill over to the general populace, for example, women's inclusion in the labour market. The report uses "depoliticisation and the common interest" (Ziai 2015: 13) strategy in order to position ICTs in development. The discourse employed by most development agencies assumes that 'development' is something that benefits everyone and therefore no one can object to it (Ziai 2015). The intention is that the poor will also benefit from this nature of development. The report assumes that, in a networked society, the poor will also benefit and that there will be opportunities that will be unlocked, and that technology has the power for socio-economic inclusion of the poor. Although the above is important as ICTs are catalytic in unlocking opportunities for the poor, however questions on the extent to which they benefit remain under ferment.

It is important to note that there is great controversy around opportunities that are created by ICTs. While, in the developed countries, technology has opened opportunities, the case is not the same with developing countries, as there are several challenges that are faced. Connectivity challenges due to data costs and skills continue to exclude a large number of the population from participating in the information society. Moreover, although this is widely contested, there is, however, an acknowledgement amongst several scholars that ICTs have brought with them the main challenge of cyber apartheid. There is evidence that ICTs have achieved positive results for developing countries, but the information economy has been critiqued by pessimists in that they reinforced exclusion of developing countries (Heeks 2008). Moreover, the extract negates analysis of the structural causes of poverty. Technology, at times, may exclude women due to culture; also, costs can exclude the poor while skills exclude the illiterate. The inclusive nature of technology portrayed in this statement can thus be questioned.

Delivering Services. ICTs are discussed in the report as important in enabling government's capability to empower citizens through accessing government information, and enhancing democracy and citizen participation, which, in turn, promote transparency and accountability. They are thus empowering tools for citizens. This is important as development is seen as transforming human wellbeing and for people to have voice.

<Extract 4>

Governments have invested heavily in digital technology over the past two decades, and these efforts have made it easier in many countries for businesses to file taxes, and for the poor to get an official identity allowing them to receive welfare payments and vote in elections. Digital technologies have also enabled governments to receive regular feedback from service users, improving service quality.

In discussing the importance of ICTs in delivering services, the report once again uses “depoliticisation and the common interest” which was used in the previous discussion. Technology is seen as contributed to improving the life of all citizens, including the government itself. It has become easy for governments to deliver and for the citizens to hold the governments accountable. This is a positive step and move from the market related and technocentric approach to development. It is important to note that this is a critical contribution of the report as it signalled a shift to realisation of development as about people. ICTs thus enable participation and for people to live the life they want which resembled major shifts in ICT4D thinking. One of the main propositions of neo-liberal development is the redistributive role of states when markets fail. ICTs have enabled accountability and open government, which is important for human wellbeing. On the contrary however, rural and remote areas have rather excluded the poor from participating due to affordability and access, although this is changing rapidly. Moreover, while the number of democracies is growing, the share of free and fair elections is falling (World Bank 2016a; b). This indicates that the role of ICTs in holding governments accountable should not be over emphasised.

4 Discussion

Whether ICTs promote development or perpetuate poverty, marginalisation and inequality is the major question that has caused ICT4D study to be in ferment. Although the WDR16 legitimates the discourse of ICTs and economic growth and neo-liberal development, the report needs to be applauded for moving from the mere technocratic and market related view of development which was the traditional thinking within ICT4D. It has uncovered issues of socio-economic development and has positioned humans as the end of development. It is important to agree that ICTs promote economic growth, provide opportunities, and increase democracy in developing countries (Acilar 2011). Although the report under specifies the fact that the poor are often unable to participate in the information society and the digital and global divide is widening. Moreover, poverty and inequality gaps between and within nations is increasing. The poor lack access due to cost, skills and other social factors that impact them. It is thus on this background, the report made clear that ICTs alone do not contribute to development unless necessary inputs are availed.

The three key policy contents and the theme in this report have not been haphazardly selected but have conveniently underspecified the challenges associated with ICTs in development and have supported the technology optimist's perspectives of technology as catalysts and enablers of development. It is clear from the narrative that challenges associated with ICTs are underspecified, while the report is clear on the benefits. Non-hegemonic discourses which are held by technology pessimists are marginalised, displaced and/or excluded within/from the report. Every hegemonic discourse is therefore political in the sense that it admits only one contingent fixation of meaning, excluding other possible meanings. It is thus clear that the report's exclusion of going into further detail around the digital divide and cyber apartheid may be intentional, reinforcing the dominant rhetoric that digital opportunities assume in the theory and practice of ICT4D.

It is within the optimist's perspective that the report, by implication, argued with the neo-liberal theme as the underlying tone of the understanding of ICTs and development (e.g., terms such as knowledge-based society, competitiveness, productivity, efficiency, markets, globalisation and trade); all these have economic growth implication and speak to the theme that development is about economic growth. Although, in a few instances, inclusion of women and the other marginalised groups is mentioned, however, the report implies that they are included in the labour market and employment opportunities are unlocked for them by technology. This shows that the language of economic growth as the goal of development is the underlying thread in this report. They create a hegemony of orthodox approach in development and maintain the underdevelopment and uneven development discourse offered by the orthodox approach. On the contrary however human development remained as central aspect of development as poverty eradication, participation and service delivery were mentioned which are central to development debates.

It is clear that there is overemphasis on the role of markets or the private sector to stimulate development within the ICT4D landscape. The firm or private sector growth is widely acknowledged to be a central institution to lead to employment creation, innovation, and profits which will lead to GDP and GNP growth, which, in turn, is a means for alleviation of poverty through the assumed trickle-down economics. The supreme role of markets in development has been the central theme of orthodox development thinkers. The private sector is also seen as a means of providing more and various economic opportunities in different societies. Although the analysis may be true, however, to focus on growth alone generates a risk of creating or exacerbating inequality. In many contexts the private sector is influenced by profits rather than development. The trickle-down economics can thus be questionable.

Globalisation, trade and the formation of world markets is also one key concept that is argued to be facilitated by ICTs. The main goal of globalisation is providing organisations a superior competitive position with lower operating costs, to gain greater numbers of products, services and consumers as well as access to the world market (Veseth 1998). It is a force for liberal economics where the main aim is the formation of one world market which is not restricted by state boundaries to enhance full participation of market forces. The report argued that globalisation is thus facilitated by the use of ICTs as tools which enhance dynamic trade, exchanges and communication through the production of networks and platforms. Although globalisation is seen in the economic

growth perspective as a positive move, there are often uneven and unjust outcomes of globalisation which the report underspecified. Globalisation positions markets as the centre of development, which is the language of orthodox thinkers, moreover, profits and capital accumulation are made to be the logic of development. Although this positions ICTs, as articulated by the report, as falling within the orthodox school of development, the fact that these processes are intended for benefiting and improving the quality of life for individuals is important as it takes into consideration the new frameworks in ICT4D like the capability approach and empowerment approach.

5 Conclusion

The way in which the report articulates the relationship between ICT and development depended a great deal on how development itself was understood: what it is and how it can be achieved. It may be that, on the surface, the report is silent about the development ideology it aligns with, but there are a number of inferences and implied assumptions as to the nature of development that they refer to. Development theory/studies is/are central to ICT4D narratives and research. Implied as it can be, the assumptions, values and logic around how development is conceived has been the overarching theme within this report and many other ICT4D studies. This supports that ICT4D debates are inseparable from the fundamental development ideas (Castells 1999). It is evident from the report that development as concept has been an emergent discourse in ICT4D studies and has been debated in theory and practice, albeit to a greater extent by implication. This is confirmation of its use and, in fact, it is a reflection of the understanding of what development is perceived to be.

This study argues that, in any development discussion, there are embedded ideological assumptions and value propositions; it is thus questionable to argue that ICT4D debates do not make reference to development studies. I argue that ideological underpinnings of development within ICT4D studies are not made manifest, however, they are implied, as indicated by the report that was analysed. Evidence from the analysis supported the fact that the role of ICT in development though has a strong basis within the market dominated and technocentric school, it has intensely shifted to encompass recent development paradigms of human dignity, capabilities, empowerment and socio-economic development. Although it furthers the idea of economic growth through free market, free trade, and globalisation targeting growth and prosperity these are viewed as only making sense if they enable human dignity and freedom.

The report acknowledges the ambiguity of the role of ICTs in development, however with a bias on the positive impacts of ICTs, which most studies fall victim to. Within this messy and tumultuous field, WDR16 should be applauded, as it took into consideration the recent developments in the field and use of many derivative frameworks: for example, the capability approach, millennium development goals for example by Clarke et al. (2013) and Kleine's Choice Framework. These frameworks are now increasingly adopted by researchers and international agencies (Mbarika et al. 2005). These frameworks have been essential analysing the role of technology to different contexts.

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**ICT4D for the Indigenous, by the
Indigenous and of the Indigenous**



Nexus Between Country Context and the Role of External Actors in the Formulation of National Information and Communication Technology Policies

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Abstract. This paper examines the nexus between the context of a developing country and external actors' influence in the formulation of a national Information and Communication Technology (ICT) policy. It questions whether context of a country affects the way external actors influence formulation of a national ICT policy following that external actors have mostly influenced policy formulation in Africa. Drawing on Bourdieu's concepts of field, habitus, capital and practice, the study uses eighteen interview transcripts, three draft policy documents, two copies of minutes of policy meetings and three reports to analyse the relationship. The paper finds that external actors overtly influence the formulation of a national ICT policy in developing countries with limited economic, social and cultural capital. This finding offers stakeholders of public policy and government important insights into how they can effectively manage external actors during the policy process in developing countries.

Keywords: National ICT policy · External influences · Malawi · Country context

1 Introduction

A national ICT policy is a specification of objectives intended to direct and control implementation of ICTs in a country [39]. National ICT policies are important towards realising a country's socio-economic goals such as enhancing democracy and the general diffusion of ICTs, among other applications [45].

Nearly 84% of countries in Africa have formulated national ICT policies [1], most of which have been influenced by external actors [35]. During policy formulation, however, these actors played other roles such as providing blueprints for developing national ICT policies [1] and setting priorities for policy and action [50]. In the process, the external actors either endorsed, undermined or actively facilitated "the entry of different actors and interests depending on their national ideologies or interests" [19, p. 6]. Influence denotes motivation, resources, expertise and power balance during a national ICT policy making.

Malawi, a country in Africa, has been overtly influenced by external actors in the formulation of its national ICT policy. The influences include provision of financial support [29] and technical assistance [16]. UNDP funded a pre-policy survey in

Malawi in 2002 to establish the levels of ICT utilisation at district and national levels [29]. UNDP also funded workshops in early 2002, which were aimed at soliciting views from stakeholders regarding the ICT policy framework that Malawi would adopt [34], despite literature discouraging imposing of policy ideas on a country [44]. Furthermore, the process of developing the Malawi policy was highly convoluted going through three different drafts over a decade before the policy could be adopted [33]. Malawi launched its first national ICT policy in 2013 [24].

Although there is a substantial body of qualitative research that has focused on external actors' influences in national ICT policy making in Africa [1, 10, 19, 33, 35], there is a dearth of research that has attempted to focus on the effects of the influences. This paper aims at extending previous research on external actors' influences by analysing how the context of a developing country affects the influence of external actors in the formulation of national ICT policies. An examination of the nexus between country context and influence of external actors in policy making may help unlock the mystery surrounding the reported poor ICT policy outcomes in developing countries. The analysis may also help stakeholders of public policy in developing countries to devise strategies for managing external actors during the policy process. The paper seeks to answer the research question: How does country context affect the way external actors influence formulation of a national ICT policy of a developing country?

Bourdieu's Theory of Practice was adopted because of its focus on aspects of domination and relative strength of agents within social space [5]. External actors' influences in the formulation of a national ICT policy are deemed to have resulted in some forms of domination [30]. Documents and interviews with policy actors from Malawi were used for the study. Malawi was selected as the case on the basis that it is heavily reliant on donors for foreign aid [48]. World Bank reports also show that poverty levels in Malawi are in excess of 70% of the population [47]. With this status, there is a possibility that donors may influence the country's policies given its context.

The paper is structured as follows. Section 2 outlines the literature that was reviewed for the study. Sections 3 and 4 describe the theoretical framework that was adopted and the methodology used for the research. Section 5 provides a description of the case study. Section 6 is an outline of the results. Section 7 discusses findings and concludes the study.

2 Literature Review

2.1 Policy Process

Nearly all public policy models suggest a stages approach to the policy process, which include agenda setting, policy formulation, policy adoption, policy implementation and policy evaluation [15]. The problem or issue of concern is identified in agenda setting [32]. Within the same stage, challenges and opportunities associated with the agenda are then defined. In most models, agenda setting entails local actors identifying problems that have to be addressed since they are conversant with the social problem to be addressed. Next, goals and objectives are formulated to address the challenges.

The third stage involves four steps: (i) formal consultation, (ii) risk analysis, (iii) undertaking pilot studies, and (iv) designing the implementation plan. The fourth stage deals with implementation of the policy and may include development of legislation and a delivery plan to support the implementation of the formulated policy [4]. The last stage deals with an assessment of the policy objectives to determine if they are effective in addressing the challenges [15]. This is one stage in which consequences of a policy are understood in a real life situation [11]. After this stage, the process may restart. Although the policy process is conceptualized as sequential, in reality it consists of iterative processes [32]. This study focused on the policy formulation stage because most forms of external actors' influences were identified in this stage [30].

2.2 Policy Making and Policy Actors in Africa

External actors mostly influence policy formulation in most developing countries. Research on *the political economy of ICT policy making in Africa* noted that most policies and ICT programme agendas are influenced by external actors rather than through participatory activities within the countries [1]. Similarly, [21] reviewed matters of ICT policy research and attributed poor ICT policy outcomes in Africa to the *scarcity of critical research* that considers political dimensions of policy reform and economic regulation. The review established that external actors initiated the policy reforms instead of local actors, a practice that has been discouraged in literature [44].

The idea to formulate national ICT policies dates back to 1993 when the first National Information Infrastructure (NII) was established in the United States of America [1]. By the mid-1990s, the NII initiative gave birth to national and regional information society initiatives around the globe. The African Information Society Initiative (AISI) was set up in 1996 with support from the United Nations Economic Commission for Africa (UNECA) and other international organisations [10]. Consequently, the AISI developed a National Information Communication Infrastructure (NICI) framework as a blueprint for formulating national ICT policies in Africa [1]. This is a form of external influence.

Public policies are the effort of a network of actors [4]. A policy network is a group of actors that are recruited to take part in policy making [37]. Policy actors can be classified based on whether they are visible or invisible [37]; official or unofficial [4] or based on their place of origin such as foreign or local actors [35]. The term *foreign actors* has been used interchangeably with *external actors* [35]. Policy actors have also been classified into local, domestic and external actors where domestic have represented actors that take part in regional policy making activities [10]. This study classifies policy actors as nationals that were appointed into a policy network to take part in policy making activities and external as those actors who were not nationals of a country (see Table 1).

In normal circumstances, government is the main actor in public policy making, even in situations where ideas come from other actors [4]. Government sets agenda by filtering issues and problems that are to be solved [37]. However, formulation of public policies in Africa, a stage which follows agenda setting, attracts external actors. The external actors in policy making activities in Africa have been either visible or invisible [10, 35].

Table 1. Classification of policy actors based on their position vis-a-vis the policy network [10]

Category of actor	Definitions	Examples of actors
Local actors	Nationals from a country appointed in a policy network	Actors from Public actors, Private actors and local non-governmental organisations
External actors	Bilateral donors, international organisations and regional groupings and other countries	Donors, international organisations and regional groupings and other countries

2.3 National Information and Communication Infrastructure

The NICI approach consists of a framework, policy, plan and structures [16]. The framework is a platform for setting the agenda to develop the policy, plan and structures [16]. The plan outlines details of programmes and initiatives for implementing government commitments while the structures deal with bodies or institutional arrangements that support formulation and implementation of the policies and plans [16].

The framework became a blueprint for developing national ICT policies in African countries and was created to fast track inclusion of Africa into the global information society through development of “national ICT policies, strategies and plans” [10, p. 10]. To date, 56% of countries in Africa have used the blueprint to develop their national ICT policies [1]. Despite this revelation, not much has been done to explore how country context is related to the influence of external actors in ICT policy making.

2.4 Influence of External Actors

External actors’ influences in the formulation of national ICT policies in Africa include the NICI framework, financial support, technical support and policy ideas [30]. The influences were categorised as direct where a local actor had direct contact with an external actor and indirect where there was no direct contact during policy making. [35] classified technical and financial support as direct influences and situations where external actors controlled policy formulation from behind-the-scenes in the case of Swaziland, as indirect influences. The influences together with their categorization do not reveal much about the effects of external actors on policy.

2.5 Country Context on Policy

Public policy studies in other disciplines present diverse findings on effects of context on policy. An evaluation on the effect of context on climate change adaptation policy found that contextual factors influence effectiveness of national energy conservation measures [43]. Another study on effect of context on family policy highlighted “both the potential of systematic interventions in parenting, peer relations, and social-cognitive skills training, and the problems that will be encountered in trying to bring these interventions to a community context” [14, p. 443] as factors that may affect policy. These studies appear to suggest that each discipline may have its own contextual factors that can determine the effectiveness of a policy.

The importance of country context in ICT projects has been discussed in research. A study on E-government implementation in sub-Saharan Africa found that institutional, cultural, and administrative contexts are prerequisites for the success of ICTs [41]. This study focused on the implementation and use of ICTs, which are goals of a national ICT policy [39]. However, there is a paucity of studies that have analysed the link between influence of external actors in the formulation of a national ICT policy and the context of a developing country. This paper is therefore intended to address this gap. In this paper, *country context* refers to economic, cultural, social and political status of a country at the time of formulating a national ICT policy.

3 Theoretical Framework

3.1 Bourdieu's Theory of Practice (ToP)

Bourdieu's framework focuses on aspects of domination and relative strength of agents (actors) within society [5], which was the interest of this study. Bourdieu understood domination in social space as primarily being prompted by unequal allocation of resources [5]. Examples of research that has adopted ToP are listed in Table 2.

Table 2. A summary of studies that have used Bourdieu's theory of practice

Author(s)/Year	Research title
Collyer <i>et al.</i> , 2015	Healthcare choice: Bourdieu's capital, habitus and field
Gunter & Forrester, 2009	School leadership and education policy-making in England
Lingard <i>et al.</i> , 2015	Researching the habitus of global policy actors in education

The concepts of field, habitus, capital and practice (see Table 3) are used to explain interactions of agents within a context [6]. Agents are distributed in the field based on the volume of capital they possess [6]. An *agent* is defined in the study as an individual, group of persons, donor or country who acts in a field such as national ICT policy formulation.

A field is a network of relations with a specific distribution of power and has a boundary, a purpose to be achieved within some time frame and agents [28]. These agents go into the field with their habitus, which outlines their behaviour, beliefs and values in the field [12]. Bourdieu argued that an explanation of social phenomenon can be theorized by examining the social space in which interactions and events occurred [7]. Practices describe the actions of actors that are repeated and patterned [40]. Agents occupy positions, which are structured in terms of power relations.

The Malawi national ICT policy formulation was the field of study in which habitus of the actors was identified. Positions of actors in the field were identified based on the capital actors brought to the field.

Table 3. Concepts of Bourdieu's theory of practice

Concept	Definition	Examples
Field	A network of relationships of policy actors and positions occupied as a result of different forms of capitals the actors possess [28]	A policy network and relationships within the group
Practice	Actions that policy actors engage in, or what they do. Habitus generates practice [8]	Over-dependence on foreign aid
Habitus	Behaviour, beliefs, values, expressions of policy actors and are identified through the practices that enact the habitus [28]	Seeking external technical support
Capital	Possessions of an actor [6]	Cultural: skills, knowledge Economic: funding Social: blueprint Symbolic: tacit power

Bourdieu classifies capital into economic, social, cultural and symbolic capital [12]. Economic capital is about resources such as income or property; social capital as in connections [6], while cultural capital as knowledge and skills [7]. Bourdieu refers to symbolic capital as a form of tacit power that an agent holds and all the different forms of capital are interlinked. However, economic capital can be more easily and efficiently converted into cultural, social, and symbolic capital than the other way round [6].

3.2 Limitations of the Theory

Despite its wide use, Bourdieu's theory has some weaknesses. Bourdieu's theory does not clearly show "where to draw the line, that is, how to find out where the field effects stop" [28, p. 78]. This limitation is associated with field boundary. This was addressed by specifying the time frame, purpose and actors that participated in the formulation of the policy within the context. Second, there is a problem of change in the field. Bourdieu theorized "fields as antagonistic, as sites of struggle. The game that is played in fields has no ultimate winner, it is an unending game, and this always implies the potential for change at any time" [28, p. 79]. To understand the existing form, Bourdieu stresses analysis of the way the field develops by showing how changes in the field take place over time [28]. The study analysed how policy formulation progressed within different sub-fields.

4 Methodology

4.1 Approach

This qualitative study adopted case study strategy to answer the research question, and used interviews and documents as the main methods of enquiry. Qualitative research provides an insight into some phenomenon of interest [42]. In addition, case study strategy was deemed necessary because it combines the phenomenon of interest and the context; and its aim is to provide an analysis of context and processes that may cause

events associated with the occurrence of the phenomena [49]. The study sought to analyse how country context affects the influence of external actors in the ICT policy making. A case study uses multiple data gathering methods such as interviews and documents [3], which were used in this study.

Although some scholars posit that one cannot generalise on the basis of a single case [18], [20] argues that choice of a case, not necessarily the number of cases, is central in case study research and can be used to generalise to theory. Walsham [46] cited in [31, p. 236] elucidates that with a “rich description of a case, the researcher can generalise to concepts, to a theory, to specific implications, or to rich insight. All four of Walsham’s examples involve generalising from empirical statements (reflecting the observations made in a case study) to theoretical statements (concepts, theory, specific implications, and rich insight)”. This study adopted the understanding of generalization to theory based on Walsham’s [46] citation and used a single case study.

4.2 Data Collection

Nineteen (19) interviews (see Table 4) of policy actors who directly took part in the formulation of the national ICT policy and secondary data from draft national ICT policy documents, minutes of policy meetings and reports from the policy proceedings (see Table 5) between 2001 and 2009 were used.

Table 4. Summary of respondents

Sector	Respondent
Academia	ACADEMIC-1 to 5
Non-Governmental organisation	NON-GOVERNMENTAL-1
Private sector	PRIVATE-1 to 4
Public sector	PUBLIC-1 to 6
Public sector	STATUTORY-1 to 3

Influence of external actors was studied within three nested policy making fields in the context. The first field constituted policy making activities that took place between 2001 and 2003, the second from 2004 and 2006 whilst the third field was the draft ICT policy between 2007 and 2009.

Table 5. Secondary data sources

Unit of interest	Primary data	Secondary data
Local actor	Semi-structured interviews with 18 respondents	Three workshop reports [17, 29, 34] and two copies minutes of policy meetings [22, 23]
National ICT policy	Three versions of draft policies (2003, 2006 and 2009)	None

4.3 Data Analysis

Thematic analysis was applied in an iterative manner to code the data using six phases [9]. (see Table 6). Informed by Bourdieu's concepts of field, capital, habitus and practice, an initial set of eight codes was developed and refined using the first three interview transcripts. The 8 codes were subsequently applied on the remaining 15 interview transcripts and relevant policy documents in a process that resulted in 23 codes.

Table 6. Phases of thematic analysis [9, p. 87]

Phase	Description of the process
Familiarizing yourself with your data	Transcribing data (if necessary), reading and re-reading the data, noting down initial ideas
Generating initial codes	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code
Searching for themes	Collating codes into potential themes, gathering all data relevant to each potential theme
Reviewing themes	Checking if the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic 'map' of the analysis
Defining and naming themes	Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells, generating clear definitions and names for each theme
Producing the report	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis

An examination of the codes revealed 4 overarching themes of context of policy formulation, interaction among actors, domination of actors and behaviour of policy actors. NVIVO 11 software was used during the analysis. The theme on context of policy formulation is the focus of this paper.

4.4 Limitations of the Methodology

The policy making process in Malawi took place more than ten years ago so memory lapses were a limitation as some policy actors could not recall some of the events of the policy process [42]. This was partly addressed by sending copies of the research instrument and draft policy documents prior to the interviews. This was done to assist the actors to recall some of the events that took place years back based on the contents of the draft policy documents.

Another limitation arose when the Ministry responsible for ICT could not trace minutes for policy proceedings. This was mitigated by contacting some of the policy actors who had kept few copies of the policy meetings. A third limitation arose when most of the external actors failed to trace individuals who took part in the policy

making arena. Snowballing was used to identify some roles that the external actors played during policy making. However, while some of the local actors presented their personal views about the roles of the external actors, their level of subjectivity could affect the accuracy of the findings since the local actors' views on the behaviour of external actors during the process could not be validated.

5 Case Description: Malawi Context

5.1 Country's Historical and Political Perspectives

Malawi, a country located in East Africa, gained its independence from Great Britain in 1964, the first national ICT policy for the country was only launched under Joyce Banda's presidency [24].

At the time of formulating the national ICT policy, Malawi had been facing challenges in most spheres of life such as illiteracy levels at 81%, population growth rate at 3.2% and lack of access to higher education for the vast majority [17].

5.2 Malawi Public Policy Making Process

Malawi adopts the standard public policy approach described in Sect. 2.1. This process starts with identification of an issue, followed by the development of a concept paper that would address the problem. Next, stakeholder consultations are held followed by formulation of the policy document, which is reviewed by cabinet. Once cabinet approves, the policy is ready for implementation. Beyond implementation stage, issues of monitoring and evaluation arise [33]. The policy process may iterate at any of the stages.

5.3 Malawi National ICT Policy

The first activities to developing a national ICT policy started in 2001 when UNDP funded a pre-policy survey [29] and pre-policy workshops in 2002 [34]. The workshops recommended adoption of a UNECA framework, which was used in developing the country's first draft policy. An Information Technology Task Force (ITTF) consisting of public and non-public actors (private and non-governmental organisations) led the activity while the second and third draft policies were led by a National ICT Working Group (NICTWG), which replaced the ITTF. In subsequent drafts, the country abandoned the framework and took a national approach to policy formulation. Although the name of the second draft policy was ICT4D, in the context it was the ICT policy. The three draft policies are summarised in Table 7.

Table 7. A summary of purpose and custodian of the policy

Version of policy	Purpose	Custodian of policy
First draft national ICT policy (2001–2003)	Contribute to the attainment of the aspirations of the Vision 2020, the objectives of the Malawi Science and Technology Policy, and the objectives of Malawi Poverty Reduction Strategy paper [25, p. 7]	ITTF
Second draft national ICT policy (2004–2006)	Provide a framework for deployment, exploitation and development of ICTs to support the process of accelerated socio-economic development in Malawi [26, p. 2]	NICTWG
Third draft national ICT policy (2007–2009)	Provide a framework for deployment, exploitation and development of ICT to support the process of accelerated socio-economic development in Malawi [27, p. 6]	NICTWG

5.4 Challenges Affecting the ICT Sector in the Country

Malawi is characterised by an underdeveloped ICT infrastructure, lack of skilled and experienced human resources in policy formulation, a weak information and computer use culture, high cost of telecommunications and unstable and unreliable power [17]. Given these challenges, Malawi has continued to rely on financial and technical support on most of its projects [48].

6 Results

The research sought to analyse the link between country context and external actors' influences in the formulation of a national ICT policy in developing countries using Malawi as the context.

6.1 Policy Formulation Field

Policy formulation constituted three overlapping nested fields (see Fig. 1), which were: (i) draft national ICT policy of 2003, (ii) draft Malawi National ICT for Development (ICT4D) policy of 2006 and (iii) draft national ICT policy of 2009. Each draft policy had a temporary boundary, a purpose to be achieved in a time frame and a policy network that occupied different positions in the field (See Table 8). Two additional fields shared relationships with the three policy making fields. These are political field, occupied by cabinet, and external actors' field, in which most of the external influences were located (see Fig. 1). While the political field was nested within the second and third draft policy fields; the other field was nested within all the three fields.

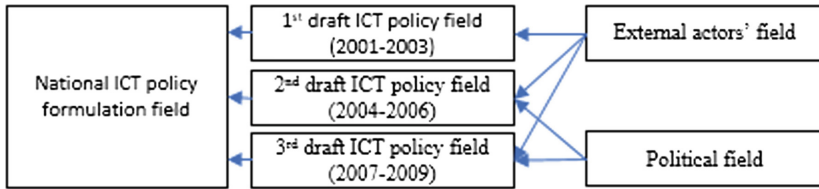


Fig. 1. Overview of overlapping and nested fields of ICT policy formulation in Malawi

Table 8. Roles of external actors in the Malawi policy field vis-à-vis traditional roles

Forms of capital	External actor(s)	Roles of external actors
Economic capital	UNDP, COMESA, the World Bank	Providing financial resources
Cultural capital	External consultants	Setting policy priorities
	UNECA, UNDP and the World Bank	Facilitating entry of external actors
Social capital	UNECA	Shaping of policy content
	UNECA, Rwanda	Shaping of policy formulation

With some level of autonomy and its own logics [7], a field generates “its own values and behavioural imperatives that are relatively independent from forces emerging from the economic and political fields” [38, p. 458]. The national ICT policy field was not completely autonomous. The control from the external actors’ and political fields reduced the autonomy of the field. This control created cross-field effects and affected the policy process: “... when the template was thrown out. ... and [the] policy approach changed from UNECA to [take a] national [stance], that’s what has worked [for the nation]” (NON-GOVERNMENTAL-1).

6.2 Context of Policy Formulation (2001–2009)

The theme on context of policy formulation revealed that the ITTF omitted challenges associated with country context in the first draft, which adopted the NICI framework. However, the NICTWG acknowledged the contextual challenges in the second and third draft policies. For example, in the first draft policy there was little mention of illiteracy as having an impact on access to and usage of ICTs. Although the draft policy mentioned literacy issues as in “Promote basic literacy and ICT literacy in Malawi” [25, p. 13], the policy was silent about the country’s illiteracy levels as a challenge relating to ICTs. Similarly, poverty was only mentioned in the context of another policy paper: “Furthermore, the conviction is demonstrated through Government’s prioritization of ICT activities in the Malawi Poverty Reduction Strategy Paper” [25, p. 6]. In addition, contextual challenges such as energy were also omitted in the first draft policy although one respondent felt that: “...energy [electricity] and poverty were not considered at the time of developing [the] policy” (PRIVATE-1).

Economic and cultural capital have the potential to affect policy outcomes [13]. Thus, the habitus of *omitting challenges of the country* shaped the policy making field. This could mean that the policy team was inexperienced and failed to appreciate the importance of context in policy formulation. Alternatively, it could be that the NICI framework was so over-powering, so they failed to customise it to the case of Malawi.

The NICTWG considered country context during the second draft policy:

“... Malawi faces a number of challenges that must be taken into account in order to achieve sustainable development processes and outcomes and promote the development and use of ICT. More often such challenges have affected and derailed the implementation of policies and strategies on one hand and intended outcomes, on the other” [26, p. 7].

Likewise, in the third draft policy, challenges in the context were acknowledged: *“socio-economic challenges which are associated, among other things, with inadequate communication infrastructure, very low utilization of technology and lack of information”* [27, p. 6].

Despite acknowledging the challenges such as over-dependence on aid, the local actors still considered donor support as a strategy to implement policy objectives: *“Encourage donor agencies, non-government organizations and other development partners of the country to help in ICT capacity building initiatives”* [26, p. 31]. In other words, an identified challenge becomes a solution at the same time.

External actors may have taken advantage of the practice of over-dependence on foreign aid, for example, and played other roles than the tradition of providing financial and technical support [10]. (see Table 8). The different pre-policy activities that were funded by external actors constituted agenda setting. Funding is classified as economic capital [6]. The importance of agenda setting as a foundation of policy making has been noted. Problems in agenda setting may bring forth undesired effects for the policy process and policy outcomes (Fox *et al.* 2006). The agenda for ICT policy making in Malawi was set by external actors: *“... a donor came and said there are issues of an ICT policy so a donor came and said we will fund it, hence Malawi did not own the policy”* (PRIVATE-1). This may suggest that the context was not ready for the policy. A summary of the capital, habitus and practices identified in the context is in Fig. 2. Donor dependency syndrome negatively affects realisation of policy outcomes [48].

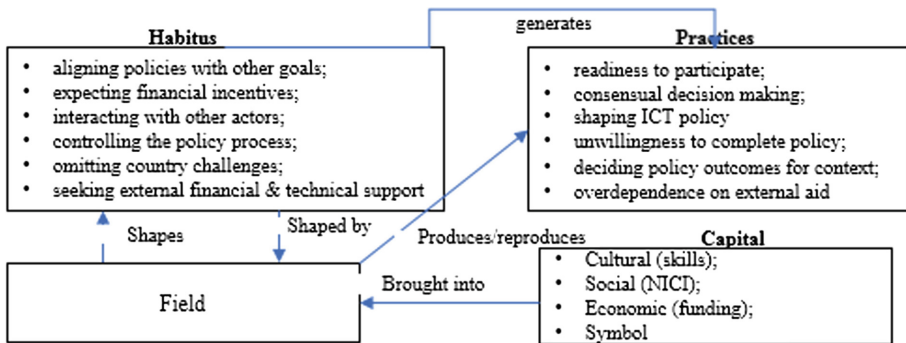


Fig. 2. A summary of the capital, habitus and practices in the context

Government requested UNECA to provide technical assistance in the context, which was in a form of customizing the NICI framework. Many respondents expressed lack of technical skills in policy formulation as the reason why government sought external support: “[there was] admission that the country did not have skills in policy formulation hence [government] called for assistance” (PUBLIC-5). In this case, the habitus of seeking external technical support shaped the policy.

7 Discussion and Conclusion

External actors played different roles in the context because of the capital they brought into the policy making field, which shaped the design and process of the national ICT policy (see Table 8). The context did not appear to have sufficient economic capital compared to the external actors’ financial resources. Bourdieu identifies economic capital as resources such as income or property [6]. Some respondents said that the habitus of expecting donor support pushed government to accept funding from external actors towards initiatives although these were not priorities of government at the time. For example, government received funding from the World Bank for formulation of a Universal Access policy at a time implementation of the policy could not be sustained. In this case, an external actor played the role of setting a priority for the context.

Acceptance of this funding may be attributed to the country’s *overdependence on donor aid*, a practice that is produced and reproduced in the context. This agrees with literature that 40% of the country’s annual budget year-in and year-out is supplemented by foreign aid [36, 48]. Some respondents said that an external actor partnered with a local actor through provision of funding and controlled formulation of the Universal Access policy. This supports literature that: “*Through these funding partnerships, donors can sometimes control policy agendas and project ideas*” [10, p. 94]. External actors’ actions may have led to abandonment of and delays in launching the policy. Indeed, the first draft policy was later abandoned in favour of local initiatives within the context. Furthermore, formulation of the national ICT policy was also prolonged as the final policy was only launched more than 10 years later.

At the time of formulating the national ICT policy, the country context was experiencing economic challenges such as severe poverty and heavy dependence on donor assistance [17]. This appears to suggest that the context had limited economic capital. Thus, setting priorities for such a country may overburden government to allocate financial resources, in this case economic capital, on projects that are not sustainable or cannot be implemented. Setting policy priorities in such a country may “contribute to policy fragmentation, overburden local administrations and tie up scarce professional resources” [2, p. 36] and contradicts literature that donors and partners should focus their efforts around “country-owned and defined objectives and expected results” [50, p. 9].

Some respondents observed that an external actor shaped the content of an ICT policy in the context through provision of a blueprint as a tool for developing a national ICT policy. The blueprint was a resource that was adopted in the context in the formulation of the policy. Bourdieu describes social capital as a resource that is connected with group membership and social networks but is also based on mutual

understanding and appreciation among agents [6]. Some respondents mentioned that they did not support adoption of the blueprint because they did not share the idea of using the blueprint. This is consistent with literature that imposing ideas on a country may fail to produce the desired output [44]. Other respondents accepted that the blueprint was useful as it worked as an eyeopener given that the context did not have the knowledge and skills to develop a national ICT policy. The different viewpoints may have resulted in unintended policy outcomes since decisions among the local actors were made through consensus. Indeed, after a while, local actors abandoned the blueprint and took a different approach to policy making. This was despite the context holding several sensitisation workshops seeking views of different stakeholders on the suitability of blueprint in the context. This may mean that the country context did not fully support adoption of the blueprint on account of limited social capital with respect to the blueprint.

Most respondents also acknowledged that the context did not possess sufficient knowledge and skills for formulating a national ICT policy. Bourdieu identifies knowledge and skills as a category of cultural capital [7]. So, as a starting point, government made a request to external actors to provide technical support in policy making. External actors also recruited consultants to offer technical support during policy activities in the context. In this way, external actors facilitated entry of other actors into the policy making arena through provision of technical support, which was in limited supply in the context. There was admission that the local actors did not have cultural capital at the time for developing a national ICT policy. The country's limited cultural capital in the field shaped the habitus of *seeking external technical support*, which in turn generated the practice of *overdependence on foreign aid*.

Because of the country's limitations, external actors brought economic, social and cultural capital during policy formulation field and played roles that contradict literature on the tradition of providing financial and technical support in projects [10]. The different forms of capital that were identified in the policy making space constituted the context. External actors brought sufficient economic, social and cultural capital in the country context at the request of government. This agrees with literature that all the different forms of capital are inter-linked [6].

This discussion leads to a proposition that:

- P1 *When the context of a country is characterised by limited economic, social and cultural capital during formulation of a national ICT policy then external actors play other roles in the context that result in unintended policy outcomes than the tradition of providing funding and technical support*

In summary, Bourdieu's concepts of field, capital and habitus have been used to illuminate the field in which formulation of a national ICT policy took place. The major tools used in this paper are field and capital. The study has found that when the context of a developing country has limited economic, social and cultural capital then external actors such as donors, international organisations take advantage of the context and play roles other than the tradition of providing funds and technical support. External actors shape policy formulation, content of a policy but also set priorities which are not on the government's agenda. These roles in turn affect other stages of the policy

process. A limitation in this study was that the research focused on a single case, which may give a narrow view. Future research may consider comparing contexts from more developing countries to broaden the view.

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Research in Africa for Africa? Probing the Effect and Credibility of Research Done by Foreigners *for* Africa

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Abstract. This paper probes research being carried out by researchers foreign to Africa. From an assessment of decennia of research, we address the many and varied ways in which the work of foreign researchers, often from countries with unresolved colonial baggage, cast their normalising shadows over African realities. From experiences in Mozambique, Zambia and Zimbabwe, among others, through the exposit of the complex and expansive array of influences and coloniality, we paint a picture how foreign researchers benefit from enshrined and ongoing practices that dominate research scenes. These practices depreciate African research and development done by Africans, in Africa for utilisation in Africa. We propose the need to mainstream decoloniality and communiversity as to affect the primacy of African researchers researching in, on and *for* Africa.

Keywords: Foreign researchers · Africa · Coloniality

1 Introduction

Research in Africa, as the production of knowledge itself, is political. It is political because more often than not, research in Africa is carried out by foreign researchers whose objectives are sometimes not only biased but nefarious. This situation renders research in, on, and for Africa by foreign researchers suspicious and problematic.

In this paper, we probe research *for* Africa by researchers flying in from outside Africa by reframing such research within understandings of stigmatisation and discrimination. These vices follow each other in social processes that can only be understood in relation to broader notions of power and domination. In this probing, we move beyond narratives of research collaborations being portrayed as mostly ahistorical, apolitical, and non-racial. Negating histories, power distances, and diverse epistemologies are part of a panoptical and normalising situation that Bert Olivier [1] shows to be part of an ongoing colonisation of universities by neo-liberal or capitalistic approaches.

The authors are members of communities in rural and urban areas of Southern Africa, involved in various research works in natural sciences and the humanities. The research incorporates the implementation and effects of Information and Communication Technologies in Mozambique, Zambia, and Zimbabwe, on a daily basis. In this

work, we engage with local, national and international communities and researchers (in that order). In this paper, we reflect on our experiences in operational research collaborations, conference visits, and academic-administrative communications encountered in over ten consecutive years of research practice in Africa.

We note that foreign researchers in Africa are often closely related to:

- countries or institutes that were benefitting from colonial power meddling
- countries that are still connected to colonialism, in fact, bolster neo-colonialism
- countries or institutes that never have said sorry for colonialism they initiated and perpetuated on Africa
- institutes and corporate businesses that, in fact, perpetuate super-colonialism, being the scaled-up colonial practice of subjugation of other people and groups for the gain of colonial agents [2]
- dominant normative epistemologies that do not align with the dynamic and integrative epistemologies that are common in Africa.

We recognise a stigma that affects work by African researchers. Often, their work is subalternised in processes where foreign researchers waltz in and impose what they want Africans to do. Tyler and Slater [3] call for the unearthing of the underlying conditions that create stigma – the ‘why’ and ‘for whose benefit’. There are (perceived) power distances, asymmetries and powerful framings that subjugate and label African researchers and their work [4]. Further, researchers from foreign realms have direct access to, and use, industries that are local to their environment. However, those non-African industries are practically unapproachable for African researchers. Subsequently to data-collection, foreign researchers often (mostly?) appropriate the data and take it abroad. Data is not only used in objectification of the African situation. It provides advantages to foreigners to harvest information and turn data into knowledge and, subsequently, seek rent. Wa Thiongo’o [5] and Nhemachena *et al.* [6], among others, show how such knowledge is deployed to work against the people that have been researched. The misappropriation of data and information has compromised the quality, validity and legitimacy of research on Africa by foreign researchers, especially those linked in with Africa’s former colonisers. Although the local decisions on research ethics must supersede any foreign body, in practice, local ethics may be omitted, ignored or overridden by ethics review meetings outside of Africa.

A persistent stream of research outputs presented by foreign researchers about Africa for Africa subalternates local, African researchers. This supports an epistemicide of African meaning-makings. Owusu [7] argues, “the validity of African ethnographies and researches by foreigners, have often been compromised due to an over-reliance on theoretical work from elsewhere. Actual evidence available in the field has frequently been disregarded, while the writing flair of the ethnographer has often been valued more than ethnographic evidence.” Similarly, Mamdani [8] laments that Africans are seen as harvesters of information only. He “urge[s] to examine the processes of power and profit”. We add here that these processes are complex and require intellectual rigour.

This paper critically interrogates the effect and credibility of research in, on, and for Africa by foreign researchers. We focus on communiversity counter to the dominance of university to destabilise a normative epistemology that bifurcates between subject-object and the researcher-researched narratives, paradigms dominant in academia.

2 The Coloniality of Research in Africa

Gonzales *et al.* [9] show that in HIV health research in Africa, foreign research institutions and international NGOs are responsible for almost 60% of the research. Being sensitised by their observation, we critically analysed the evidence presented at the prestigious International Aids Society meeting (IAS) in 2017 to quantify the African contributions. South Africa was responsible for 15% of the research while the input from African researchers outside of South Africa was a paltry 19%. These numbers show a clear dominance of foreign researchers presenting views, and normalising, a disease that disproportionately hits the African continent, affecting millions of people.

The unavailability of research outputs from Africa resonates with Geldof's (2010) observation on the dearth of literature on ICT in Africa by Africans on the continent. In her study on literacy and ICT in Ethiopia and Malawi, Geldof [10] noted how she found little literature that pays explicit attention to the positionality of foreign researchers compared to local researchers or how this impacts the research process as a whole. Her writings and similar research papers, however, seem to narrow down issues to language barriers and cultural misunderstandings only. For instance, in their review of 'non-technical aspects' of information and communication technology (ICT) in international development, Kempainen *et al.* [11] did not show any sensitivity towards 'who researches' what and where. Not surprisingly, they deduced that 'the alignment with international political and development agenda' is crucial for 'improving ICT oriented development projects', something we contest in this paper. Of course, there could be reports addressing issues we mention in this paper. However, when paywalls guard such documents, they are rendered inaccessible and void to African researchers like us.

ICT research in Africa appears to be Eurocentric, colonial and hegemonic. It remains undergirded and trapped in what Ndlovu-Gatsheni [12] and others regard as the snares of a colonial matrix of power and dominance. In this matrix, foreign researchers dominate the terrain of research even where research is on Africa, carried out in Africa, and framed to be *for* Africa. This domination of foreign researchers is coloniality at its best as it implies an illusion of freedom and perpetuation of colonial gestures.

We experienced that foreign researchers position themselves as the main actors and gatekeepers in connections with funding partners. Such partners often demand 'leadership from a Western partner' or 'technical assistance' with a push to involve Westerners for a benefit for their (non-African) industries. This appetite for foreign control is part of concepts like Public Private Partnerships (PPP), and a 'new normal' culture of universities forced to follow neoliberal schemes that demand marketisation. This marketisation relies on ideologies heralding the benefits of corporatisation, commercialisation, and privatisation of education and research [13]. In PPPs, Western-based corporate partners often look over the shoulders of researchers, seeking rent by leveraging market powers and first entry advantages. In this scramble, humanitarian aid or corporate responsibility programs are being used to facilitate market entry for companies [14]. These capitalistic processes result in weaponised research endeavours that

fuel the apparent insensitivity and power-laden manners in which foreign researchers interact in Africa. As a result, the outcomes, or research collaborations, mostly negate and defy the loud voices demanding epistemic liberation and research independence which have become recurrent in Africa and elsewhere since the beginning of decolonisation project in the late 1950s and early 1960s. Such observations warrant serious rethinking and reconsideration if research in and on Africa by foreign researchers is to pass the rigour and logic of social and epistemic justice in objective research. Therefore, we argue for a communiversity instead of the dominant university narrative where those at the latter are purported to be sole knowers, knowledge producers and custodians of knowledge.

3 The Powerhouse of Coloniality in Research Work for Africa

Quijano [15] presents coloniality as a system that defines the organisation and dissemination of epistemic, material and social resources in ways that reproduce modernity's imperial projects. To this understanding, Maldonado-Torres [16] adds that "coloniality refers to long-standing patterns of power that emerged as a result of colonialism, but that define culture, labour, intersubjective relations, and knowledge production well beyond the strict limits of colonial administrations." These patterns of power remain standing in contemporary African states in the name of the so-called modernity, which for many critical scholars is an extension of colonialism and a manifestation of coloniality. Grosfoguel [17], for instance, argues that "coloniality and modernity constitute two sides of a single coin. The same way as the European industrial revolution was achieved on the shoulders of the coerced forms of labour in the periphery, the new identities, rights, laws, and institutions of modernity such as nation-states, citizenship and democracy were formed in the process of colonial interaction with, and domination/exploitation of, non-Western people." Similarly, Zembylas [15] brings coloniality and modernity together. He regards coloniality as the underlying logic that places peoples and knowledge into a classification system such that all that is European is valorised while all that is non-Western is despised or condemned. The colonial matrix of power and knowledge, therefore, serves only a small portion of the global society – the elite – that benefits from the dominant and hegemonic Eurocentric belief systems that regarding epistemology implies a 'one size that fits all'. Coloniality, modernity, and capitalism thus go hand-in-hand – they have the same underlying philosophy.

The #Rhodesmustfall movement sparked a renewed interest in decolonising higher education (and thus research) in South Africa [18] and in Africa in general. In contemporary times, in line with political realities of interest in the continuing colonial meddling and the narrative of an African renaissance, a growing realm of African presidents are highlighting local agency. They advocate wholesomely rejection of foreign aid as an agent of geopolitical meddling. Former African statesmen like Mbeki (of South Africa) and Mugabe (of Zimbabwe) have, throughout their history as presidents, been critical of foreign aid which they consistently criticised as agents of imperial powers.

Nyamnjoh [19] links an ideology of modernism to research. He describes how the demand for modernism and its promises have been the main engine for methodological import from outside of Africa. He questions how, given its apparent result in decennia of underdevelopment, related research practices have continued in Africa. He states “modernisation has survived more because it suits the purposes of its agents than because of its relevance to understanding the African situation. Those who run international development programmes along the Western model inspired by Modernisation Theory, “are not interested in challenge, stimulation and provocation at any level”. They want their programmes to go on without disturbance and would only select as researchers or accept only those research questions and findings that confirm their basic assumptions on development in Africa.” [19].

The Africa failing narrative which appears persistent in literature has resulted in a discourse of deficiency and incompetence, framing African research and researchers as lacking academic and professional resource. Regarding research, it is a discourse that partly explains the situation in which Africa finds itself today.

Burawoy [20] shows how positive science tries to negate power influence, an effort that, in environments outside of the dominant power-that-be (and, most probably also within) can be considered futile. It was Fanon [21] who revealed the effects of colonial subjectivation. He describes psychological trauma being caused by the instilling of negative pictures. Such injury is caused early in a learning environment saturated by ‘white’ supremacy that does not value (and actively devalues) persons of colour. The result is *psychological colonisation* through an imposed racist phenomenology that seeks to imprint a sense of inferiority in the minds of people of colour. Further, Fanon shows how, through those interactions – with histories and within the material world as well as ideas – the source of the matter becomes acutely exposed. Fanon actively rejects the idea that amendments to the local realities should come from input from the outside. Such input, he argues, should be rejected.

4 The Decolonisation of Relationships and Common Sense

The African realities and their negotiations with non-African realities are set in structural narratives and structuring discourse and make their appearances through paradigms and epistemologies. They have been influenced, and are shaped, through perceptions of time, view on histories, geographies, religious, political and economic relationships. These are all social processes. Foreign research in Africa, with dominance and imperial gestures therein, has a long and questionable history. For example, African anthropologists discovered some gross mistranslations and misinterpretations of oral traditions in texts from accounts about African culture by Western anthropologists [22]. Others have pointed to the existence of a ‘white saviour’ syndrome.

African study centres in Europe started as research institutes to support colonial conquest in Africa and elsewhere [23]. However, it is not necessarily the social cognitive understanding that informs us why the contemporary situation is the way it is. The questioning of foreign researchers performing research in, on and for Africa is not a problem of a sub-set in ICT4D, nor limited to any field of study. Although the contemporary situation makes collaboration and cooperation difficult and lopsided,

these are not contentions between individuals. They are the result of structures in society that have grown to be super-colonial. They are the continuation of an orientalist, imperial academy that continues to benefit from the ongoing situation as the recipient of data, information, existing powers to create knowledge and to make a living out of it for its (Western) workforce. No wonder, that esteemed Ugandan researcher Mahmood Mamdani [8] cynically noted that in research collaborations Africa could only solicit for the crumbs as hunters and gatherers of raw data, as native informants who collect and provide empirical data for processing in West, and the empowerment of the elite.

The Burundian scientist, Bigirimana [24, 25] describes how a normative epistemology introduced from an externalised knowledge is presented as authoritative because it is positioned as indubitable, infallible and incorrigible. This positioning aligns with Burawoy's [20] assessment of a positive science that relies on the '4R's', being representative, reactive, reliable and replicable. Both authors problemise these approaches as harbouring dichotomies and removed from the complexity of power. The use of the amended methods as in post-positivism and constructivistic-interpretivistic and critical-ideological methods seem not to deal with the outset of regarding knowledge as existing separate of the knower, and thus as being available 'to be harvested'. The results of any of such method are further problematised by their dominant use, being focused on *the individual*, in line with a long history of objectifying Africa, Africans and African realities. A consistent framing of 'individuals' and reflecting on his effectiveness or self-actualisation have set how measures of success are being defined. Subsequently, in line with the Adagio of 'what gets measured gets done', conceptualisation of technologies and reports on their implementation are set to echo such a discourse of 'success'.

Indirectly, the Ghanaian Annan stood against such individualism. Preceding his passionate arguments for democracy, he commented on the politic of human beings stating that "Man is born, lives and dies as a member of a community and the affairs of that community are therefore his and vice-versa." [26] However, dominant neo-liberal anthropocentric approaches continue to put 'the individual' at the centre of attention. Such centrality supports divisions, as it pitches 'one-against-the-other' in a competitive world, allowing foreign researchers to research in and on Africa without being an integral part and member of the community in which the research takes place. Individualism, also, strives in dichotomies, where opposing and mutually exclusive positions are assigned to thinking and doing. Bifurcations undergird the dungeons of scientism or culturism. The resulting fights over boundaries have taken away the academic attention to the value of altogether different and integrated ways of knowing, although there are clear signals of their existence in non-Western literature or counter-narratives.

Is it, therefore, that the research cooperations in ICT4D have little to show as for societal impact? Do we apply the right lenses [27]? We highlight here that the socio-political context puts up severe challenges to accost inherited and super-colonial practices and structures that have been purposely planted to dominate. To make matters worse, the (mostly western-based) collectors of data get more and more powerful. Their platforms are regarded to have accumulated much value, their foreign based and led

research networks continue to measure and control. The relatively limited impact of ICT4D might well be related to these inherent flaws and the limitations because of theoretical and methodological scarcity leading to an echo-chamber of lopsided attention to foreign, Western epistemology. The subalternising of African researchers and their agency to study their environment (like Western researchers do in their Western environments), is part of what Bourdieu [28] called ‘symbolic violence’. Therefore, the effect of foreign researchers must be placed in meso and macro socio-cultural structure and power, especially as in the capitalistic scheming of ‘the market’. Western researchers are often well embedded in the rhetoric of (the Western rendering of) modernity as a means to salvation for development or poverty alleviation. This hegemony limits the potential of epistemic disobedience [29] that can shed light on African life, the varied ways of knowing and how to institutionalise them.

For fruitful research for Africa in Africa, there is a need to thoroughly understand the local epistemologies by living-the-life and gleaning inputs from local, African philosophies. Although put outside of the limelight, often tough to access, and relatively under-researched, among others, the studying of African cultural heritages provides narratives on how meaning-making is *lived* in a community. The vocabularies of *knowing* in African environments present a gateway to understanding how many Africans sustain their cultural identities against the (often technology enabled) onslaught of orientalism, imperialism, and colonialism that fuelled Africa’s disenfranchisements for over 500 years. There is little evidence of foreign researchers in ICT4D showing sensitivity to incorporate these perspectives. African epistemologies are dynamic and integrative, understanding knowing as an act of the knower and knowledge being a quadrichotomy of emotional, intellectual, evaluating and pragmatic forms [24]. Method, of course, is subject to the epistemic base and philosophy of knowing, and, in the case of the dynamic and integrative epistemology of the local community, methodological approaches must be aligned with the level of consciousness one is focussing on.

There appears a consistent undervaluing of local methods of research to unearth a dynamic and integrative (and thus evolving) local knowing in a community of inquiry [30] involving human and non-human inputs. In the meantime, researchers in African universities are between a rock and a hard place [31], as they are both stigmatised, or feel inferior. This situation disempowers the enactment of alternative views enlightened by African value systems as they are not (yet) accepted in the Western-oriented universities. Further, in international cooperations, often African researchers are supposed to align with neo-liberal motives of institutes and states that are, inherently, colonial from the African perspective: they shame, brainwash and meter out resources via them [2]. Those that wish to include methods set in African philosophies are mostly rejected because of such methods being typified ‘idiosyncratic’ [32]. Mainstream sciences generally marginalise the output of African research set in African philosophies. For instance, the African research work in TV White Spaces is overshadowed by the onslaught of information from Western institutes. Actually, in publications, reference of western authors or activities is seen as ‘compulsory, while Western publications do not necessarily cite the ground-breaking research taking place in Africa by Africans [e.g. in 33].

ICT4D cooperations and ICT technologies are relatively new. However, Dourish and Mainwaring [34] showed how the ubiquitousness of the information and communication technologies is inherently colonial. Therefore, the negation of local researchers, or keeping them as ‘suppliers of raw data’, remains a productive situation for foreigners in the African environment. It is a force that enables the structures, mechanisms, and justifications of power to function in the current, super-colonial fashion.

We have observed that research by Africans on the continent is stigmatised and often despised. This stigmatisation is devastating in its effects, as it isolates researchers in African universities, especially when they are not listed in (western) standardised and homogenised ‘quality’ criteria in global and national institutional rankings. Goffman [35] showed this attack on identity leads to passing and concealment. It acts as a means of formal social control. This social control is clear in work by Holm and Maleté [36] exposing the asymmetries of research partnerships from their experience in Botswana. When we regard the African researcher as stigmatised, the work of Graham Scambler [37] becomes productive. Scambler argues that ‘stigma’ is particularly weaponised in the neoliberal era. He observes (a) the distinctions between enacted and felt stigma (involving norms of shame) and enacted and felt deviance (involving norms of blame), and (b) the novel neoliberal dialectic between these two sets of norms, especially because of the dynamics of financial capitalism, which is ‘lord’ in research. The target is gathering of financial resources, and the vehicle is research. This focus on monetisation and extracting rent has led to a plethora of ‘training’ – part of colonialism as it brainwashes – where ‘education’ and ‘schooling’ to alleviate that ‘shortcomings’ (the stigma) is pushed for. However, we contend, there are more structural issues underlying this. It is in the assigned roles of power and structure. These power issues are many.

Possibly, what the reaction of #RHODESMUSTFALL movement might have shown is the ridiculing and encapsulation of the African territory ‘being different’ then what the forces of globalisation asks compliance with. Mass unemployment of graduates and non-graduates alike and the negation of African politics and needs for decolonisation are positioned as reasons of marginalisation. Through this typification and stigmatisation of the local demand for emancipation and epistemological sovereignty [38], African research is being excluded and made even less relevant by the ones ‘on top’. This negation keeps the ‘African failing’ narrative intact and perpetuates the thought that interventions from ‘the outside’ are justified and worth pursuing. This setting is part of the colonial ways, with shaming being a key element in perpetuating the structures of self-interest that support the unequal distributions of resources in society [39]. We must address the construction of the social structures of research ‘normalcy’ and how come that African researchers are considered different, or what causes (hidden) attitudes of prejudice. There is a clear need for the celebration of diversity in knowing, for the differentiation of attention, resource allocation, and focus.

5 Discussion

Foreign researchers are often complicit with the modernist narrative, steeped in philosophies conceptualised by Westerners in Western places [40]. They seem to thrive in normative epistemologies that do not align with the dynamic and integrated epistemologies prevalent in African settings. African epistemologies like, for instance, Ubuntu are widespread and well enshrined [41]. They are part of a long history, being present well before the advent of colonial control [42–44]. African means of knowing have led to embodied knowledge, often in response to various forms of oppression [45, 46]. The undeserved privileges of non-African researchers indirectly serve to delegitimise African ways of knowing. Thus, to question the primacy of foreign researchers to perform research in Africa *for* Africa (as shown in the example in HIV/AIDS research) is a question on cognitive justice that is inseparable from the struggle for social justice [45].

Examples of issues that are seemingly overlooked in ICT4D research are, for instance, understanding indigenous social structures, their relation to land, the meaning of technological artefacts, and the use of taboos. These aspects of life in Africa constitute a consciousness that opposes colonial systems and, subsequently, interventions that result out of foreign research. The overshadowing of the local ways of knowing is an existential struggle. The coloniality that influences the choices in research in and on Africa denies African researchers their voice, most especially their ability to use African and local epistemic frames, with severe consequences.

A transformation of research practices in Africa would involve the disrupting of institutional cultures that guide research, publications, and funding. An example is the resource contained in the papers presented at this conference. The texts are claimed exclusively, solely, and permanently by an organisation (IFIP) and a publisher (Springer) for the financial benefit of people outside of Africa. Neither of these organisations has a workforce in Africa. Nevertheless, they gatekeep the texts and their dissemination by demanding compliance of all authors while harvesting its value by the selling of the knowledge emerging from a vital gathering of researchers and specialists. This situation represents a poignant example as to how current research and dissemination structures are set in neoliberal structures that benefit a Eurocentric elite.

When we question the effect and credibility of research done by foreigners for Africa, we examine the systems of access and management to research projects. We pose that decolonisation means reversing the systems of Eurocentric research control. Such would address and attenuate the hegemony of Eurocentric normative epistemologies and processes of research management, the use of individualistic anthropocentric methodologies, the authority of Eurocentric classifications, reviewing means of command and control and dissemination, the dominant system of capitalistic accountancy and research assessment systems. Decolonisation implies breaking the barriers between the researchers and the researched, in the strengthening of *knowing in community* [23, 30]. Reform would involve assuring pluriversalism, reorienting ways of knowing and research transcending disciplinary divisions and orientalist, imperialist and colonial segregations. The master narrative that research is ahistorical and apolitical, and research practices and the dissemination of its outcomes are without

racism or stereotyping acts as a muffler on discussions on these issues. Being neutral means that dominant practices will continue, as the status quo of mostly foreign researchers researching *for* Africa is well enshrined. The continued dismantling of African agency, for instance by the established practice of inviting foreigners to research in African on Africa demands needs an academic push back. However, insisting on the primacy of African researchers for research in Africa will not go well with established partners but requires authoritative advocacy and well thought through policies.

6 Conclusions

Questioning the agency and effects of foreign researchers in Africa, in this paper is positioned as a profound shift of discourse towards decoloniality. The reality at hand is that the primacy of non-African researchers researching in, on and *for* Africa denies serious attention on the African experience and theories. They mask the complex entanglements between knowledge formations and ways of knowing. Although there is a clear need for transformation of research practices in, on and for Africa. Such a change cannot be seen outside the realm of decolonisation. This paper exposes of the dominance of Eurocentrism in research and its underlying philosophies, epistemologies and practices. Lifting the subalternising of African researchers will unearth unique ways of knowing that have been denied relevance due to a hegemonic and epistemic arrogance of long-established parties.

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Decolonising Neo-Liberal Innovation: Using the Andean Philosophy of ‘*Buen Vivir*’ to Reimagine Innovation Hubs

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Abstract. Innovation is increasingly portrayed as central to social and economic development. Models of innovation from the global North are often applied uncritically in the global South. Doing so may unwittingly silence indigenous knowledge, ways of knowing, and cultural values. Santos (2014) has argued that this form of epistemic violence is committed when actors from the global North are insufficiently mindful of ‘Epistemologies of the South’. Neither Santos nor the authors of this paper believe that there is nothing of value to be learned from the global North – only that there is as much to be learned from the global South – and everything to be gained from a skillful combination of different ways of knowing. This theoretical paper proposes a future line of research to examine in what ways Epistemologies of the South might inform innovation processes to produce different outcomes. We use the example of innovation hubs and although we might have used the philosophies of *Ubuntu* from Southern Africa or *Swaraj* from India, in this paper we use the lens of *Buen Vivir* (living well) from Andean and Amazonian communities in South America to suggest that *another innovation is possible*.

Keywords: Innovation · Epistemologies of the South · Decolonising · Buen Vivir

1 Introduction

Over recent decades we have seen income inequality increased in every region [1]. The number of African people living in poverty in 2018 is now 113 million more than it was in 1990 [2], and the dominant economic development model has proven to be ecologically unsustainable [3].

Innovation has variously been proposed as a way to reduce poverty, inequality and climate change [4, 5]. In the Sustainable Development Goals innovation is referred to as a ‘crucial driver of economic growth and development’ and is considered sufficiently important to feature explicitly in six different SDG targets¹ [6]. In the research

¹ Innovation is included in SDG targets 8.2, 8.3, 9.5, 9b, 17.6 and 17.8.

discourse innovation is often presented as an ideologically neutral ‘technical fix’ divorced from any industry interests or political aims [7, 8]. Despite attempts to portray innovation as politically neutral, several decades of evidence from Science and Technology Studies (STS) research demonstrates that innovation processes generally reflect the dominant political and ideological values of innovators or societies in which they lived [9].

From a development perspective innovation is defined as applying new tools or processes to address development challenges and unmet needs [10]. To achieve this, the World Bank, United Nations Development Programme (UNDP), the United Nations High Commissioner for Refugees (UNHCR) and UNICEF have been establishing their own Innovation Labs. Moreover, the Global Innovation Fund², the Global Challenges Research Fund and a range of other funding agencies provided funding to a wide range of innovation initiatives, including more than 300 ‘innovation hubs’ in Africa alone [11].

Innovation Hubs

Innovation hubs are places where technology entrepreneurs, experts and enthusiasts meet to collaborate on their latest apps, platforms and development projects [12]. The authors’ prior experience of long-term research based in innovation hubs gave rise to our research interest in whether hubs in the global South were too closely modelled on the global North template of Silicon Valley start-up culture, and if so whether this might lead to a lost opportunity to nurture indigenous approaches to innovation, as well as the risk of importing political and ideological values that drown out and silence local values and interests (See [13, 14]). Other authors have been exploring similar aspects (for example, [15]).

Innovation hub events in the global South often feature ‘masterclasses’ led by individuals or featuring methods from the global North – sometimes hosting venture capitalists or famous entrepreneurs such as Mark Zuckerberg [16]. Often, the hackathons and pitching events that they host, assess innovations in terms of whether they are patentable, monetisable, or scalable, and calculate the value of innovations as dollar return on investments. From this perspective technology and innovation hubs can be interpreted to be sites where the goal and measure is to become as much like the Silicon Valley (USA) as possible. This is evidenced by the label of Silicon Savannah, used to characterise the technology and innovation ecosystem in Kenya [17], thereby assimilating previous forms of mechanistic modernisation theory [18].

This paper addresses the concern that if innovation approaches from the global North are applied uncritically in the global South, they may unwittingly subordinate indigenous knowledge, ways of knowing, and cultural values. This paper also makes the political and ecological argument that smuggling in growth-orientated neo-liberal development under the guise of innovation can be considered to be both neo-colonial as well as environmentally unsustainable. We use innovation hubs as an example of innovation processes in this paper because of our prior experience but hope that researchers and practitioners with other innovation experience will find resonance in

² <https://globalinnovation.fund/>.

other innovation settings. In this paper we remain with de Sousa Santos [19] example of *Buen Vivir* (living well) from South America in order to argue that another innovation is possible.

2 Literature Review

Innovation is ‘the process by which novelty is taken up and circulated in the public sphere’ [20]. Scholars, practitioners and policy makers have focused on ways in which innovation can be improved, enhanced and diffused [21]. In the innovation for development literature authors often argue that innovation is central to economic growth and thus crucial to development [22] and innovation is promoted as a development mechanism [23]. Pansera and Owen [8] argue that innovation for development approaches embody distinctive political dimensions, cultural values and normative worldviews, and that they often leave unproblematized implicit neo-liberal, individualized and market-oriented approaches. The National Systems of Innovation (NSI) approach, for instance, has been a dominant discourse [24] emphasising the interrelation of different actors as fundamental to strong national innovation ecosystems. In this process, authors have often focused on economic actors and institutions, exploring the role of NSI in competitive advantage and economic growth. More recently, there has also been a proliferation of innovation concepts that attempt to describe phenomena happening in resource-constrained environments to explain innovation phenomena. Terms like ‘frugal innovation’, ‘reverse innovation’, ‘pro-poor innovation’, ‘Bottom of the Pyramid (BOP) innovation’, ‘grassroots innovation’, ‘inclusive innovation’ are most popular in the literature [25]. Although these concepts have expanded our understanding of innovation by focusing on the marginalised in society, they tend to still be framed within the dominant economic discourses albeit with some better focus on inclusivity. In this sense, even though these concepts advance our understanding of innovation in the global South, they still operate within a neoliberal paradigm.

Most innovation research is framed within an economic system that perpetuates growth [26] despite irrefutable evidence that perpetual growth is not possible on a finite planet [27]. The Sustainable Development Goals fail to address this inconvenient truth when they set continued growth as a key Global Goal (SDG8) and commit the international community to building innovation capacity (SDG 17) in order to achieve it. The next section shows how the underlying logic of neo-liberalism demands requires perpetual innovation in pursuit of the unattainable goal of perpetual growth.

2.1 Neoliberalism

Although there is no agreed definition of neo-liberalism, there is consensus that it “is built on deregulation, liberalization, privatization and ever tighter global integration” [28]. In this paper we rely on the more expansive definition of Harvey [29] that neoliberalism is an hegemonic ideology or a theory of political economy discourse that ‘proposes that human well-being can best be advanced by liberating individual entrepreneurial freedoms and skills within an institutional framework characterized by strong private property rights, free markets, and free trade’. In this respect, innovation is framed as key in improving efficiency and driving economies.

The neo-liberal paradigm also holds an underlying notion that economic liberalisation (freedom of market and trade) is a necessary step towards individual freedom. In this respect, Bourdieu [30] argued that the neoliberal project was ‘a programme of the methodical destruction of collectives’ (pp. 95–96). This implies that individuals have moral priority and ‘[...] may not be limited by the community, common good or interest’ [31]. Neoliberalism then, encourages the individualisation of the social and the collective [32].

In neo-liberal theory, economic growth is portrayed as self-evidently desirable [33], driven by the dynamism of individual entrepreneurs and by creative gales of technological destruction. Growth itself constitutes the goal of neoliberalism, overriding concerns for social equity or environmental sustainability [34]. Despite neoliberalism being founded on the idea of freedom, the globalisation of the neoliberal project demonstrated its imposition in countries of the global South through coercive programs of structural adjustments [18]. This took the form of ‘modernisation’ as the enforced adoption and imitation of economic and ideological approaches copied from ‘developed countries’. The social, cultural, and structural forms stemming from Western societies were idealised and compared to the ‘traditional’ societies, seen as backward and as such in crucial need of modernisation [35].

One devastating effect of this modernisation process has been the exploitation of natural resources to industrialise and urbanise societies. To counteract the negative consequences of climate change, there have been attempts to manage the environment without stopping growth, with the introduction of concepts like ‘green economy’ and ‘sustainable development’ [3]. Furthermore, in the current era there has also been an attempt to step away from mechanistic modernisation by highlighting economic growth in Southern contexts, with examples like the rise of Asia and the increasing influence of the East in the world. However, in other contexts like South America and sub-Saharan Africa there is still the contentious push for recognising their own voice, given the pressure of modernisation patterns still experienced [3].

2.2 Neoliberal Innovation for Development

This dominant neoliberal paradigm is also framing the way innovation for development is conceptualised and practiced. There are two main characteristics of this framing. Firstly, there is a strong emphasis on funding disruptive innovation to drive economic growth [36]. As such, innovation is often framed from an individualistic dimension, embracing the ideal entrepreneur as seeking profit maximisation. Secondly, innovation in the South is expected to mirror models and concepts from the North, following a path of uncritical modernisation. This amplifies the dominant worldview at the expense of other voices.

Rather than continuing to uncritically adopt and adapt neo-liberal concepts and theories of innovation from the Global North, this paper argues that it is important to also explore alternative conceptions of innovation, taking into account indigenous knowledges and values from the Global South. The next section details alternative frameworks known as epistemologies of the South [19].

3 Epistemologies of the South

In this section we introduce the overarching notion of ‘Epistemologies of the South’, this will help to explain how and why a concept like *Buen Vivir* becomes relevant in our understanding of development and subsequently, innovation. Ever since colonial times, certain kinds of knowledges have been privileged as valid, consequently prioritising certain kinds of activities, and by extension have de-legitimised and subordinated others [37]. This epistemic dimension has been referred by Quijano [38] as the “coloniality of power”, and later described by Mignolo [39] as “the less visible side of modernity” (As cited in Bruman 2017, my translation). Moreover, this epistemological dimension has followed through to current context, as explained by Tuhai-Smith [37], ‘[...] although in the reframed discourse of globalisation.’ (p. 92).

This practice, of imposing a foreign knowledge as valid and diminishing indigenous knowledges is labelled by postcolonial scholars such as Spivak [40] as ‘epistemic violence’, which actively obstructs and undermines non-Western methods or approaches to knowledge as the Other. As explained by Theo [41], epistemic violence happens when ‘[...] theoretical interpretations regarding empirical results implicitly or explicitly construct the Other as inferior or problematic, despite the fact that alternative interpretations, equally viable based on the data, are available’ (p. 298). Freire refers to a similar phenomenon as ‘cultural invasion’, where ‘[...] invaders penetrate the cultural context of another group, in disrespect of the latter’s potentialities, they impose their own view of the world upon those they invade and inhibit the creativity of the invaded by curbing their expression’ [42]. At the heart of this understanding of imposing Western knowledge into other contexts is the notion that such type of knowledge has become hegemonic and dominant, and other types of knowledges are subverted and portrayed as inferior.

In their substantive senses, epistemologies of the South replace the dominance of Western ideas by a notion of ‘interculturality’, from which Western knowledge is not rejected but seen as one among many options [43]. As a way to do this, Santos, suggests we engage in a plural dialogue between different systems of knowledge and between different epistemologies, without pre-established hierarchies [19].

The next section introduces one epistemology of the global South, which guides the framework for this analysis.

3.1 *Buen Vivir*

Buen Vivir is a discursive ‘work-in-progress’ resulting from the cross-pollination of traditional indigenous knowledges and the interpretive and articulating work by scholars and political leaders [44]. Indigenous ontologies and traditions do not involve an idea of progress as a linear unfolding of history, nor do they perceive that wellbeing is associated with ideals of individuation where humankind is separate from nature [45]. Rather they see the world as a plurality of stories happening alongside each other, with no single totalising narrative. *Buen Vivir* scholars and activists suggest that we reframe our understanding of the world from the existence of a ‘uni-verse’ to a ‘pluri-verse’, which is defined as “[...] understanding that reality is constituted not only by

many worlds, but by many kinds of worlds, many ontologies, many ways of being in the world, many ways of knowing reality, and experimenting those many worlds” [45].

Scholars saw an alternative to neoliberalism and the growth paradigm that was characterising the way development was implemented in Latin America, enhancing inequalities and destroying ecosystems. The consequence of discussions between indigenous communities and scholars has led to a definition on *Buen Vivir* as a concept under construction, shifting away from the mind-set of production and consumption and against growth-based development [46]. Instead, *Buen Vivir* values aspects that benefit the community, with strong environmentally-oriented ideas. This suggests that some indigenous communities would prioritise values of collectivism, environmental justice and reciprocity.

Buen Vivir introduces three novel ideas: first, it is elaborated by peoples who have been historically marginalised [46]; second, well-being is not conceived in its individualistic Western sense, but rather in the context of a community [47]; and third, the natural environment can be conceptualised as a subject of rights and therefore cannot be subjected to market logics [48]. In more practical terms, *Buen Vivir* suggests a transition from a capitalist mode of production to a social and communal economy. This economy would take consideration for the constraints of the environment and where surpluses would be invested back into the community [49].

Attempts to include *Buen Vivir* into policy have been proposed, even though they not existed without challenges and contradictions [50]. For instance, *Buen Vivir* was introduced to the Ecuadorian Constitution during the government of president Rafael Correa in 2007, mentioned at least 25 times in the Constitution and subsequently integrated into 3 national development plans [51].

Authors have discussed various challenges contradictions of this experience. Williford [51] summarises them into a continued reliance on extractivist methods, the centralising of power and silencing of indigenous voices, and the shift from depending on the World Bank and IMF to China. However, authors have also highlighted the positive effects this experience has, including rejecting a neoliberal definition of development, strengthening regional ties in Latin America and visibilising the voices of indigenous peoples. The experience of Ecuador demonstrated that *Buen Vivir* can become co-opted as a discourse, without much change. Authors explain that the structural preconditions for the implementation of *Buen Vivir* at a nation level are not in place yet [52]. However, other authors argue that the way in which *Buen Vivir* has been incorporated in government initiatives is dialogical, and as such the implications should be measured by its contribution to destabilising dominant existing cognitive and cultural templates, and by, most importantly, showing that it is possible to explore alternative ways of living than the neoliberal one suggests [3, 53].

Buen Vivir resembles aspects from other concepts developed elsewhere. For instance, it has been related to the concept of degrowth, developed mainly by European scholars to critique the growth paradigm, suggesting instead values of ‘sharing’, simplicity, conviviality and care [26]. Furthermore, they also share commonalities with indigenous concepts that have been historically part of other cultures in the Global South. For instance, *Swaraj*, developed in India which refers to self-reliance and self-governance [3, 53] and *Ubuntu* in Africa, which emphasises human mutuality [54]. Even though they stem from different contexts and are based on different traditions,

scholars have demonstrated the similarities of such concepts in terms of their rejection to individualism and growth without consideration of the environment. Furthermore, they also share in common the fact that they often arise from traditionally marginalised groups [3]. In this sense, *Buen Vivir*, as an epistemology of the South, recognises the need to account for the diversity of the world and the urge for more intercultural understanding, although it critiques the viewpoint that theories produced in the global North are best equipped to account for the social, political and cultural realities of the South [19].

In summary, *Buen Vivir* is a work-in-progress presented as an alternative to development. It does not aim to become a dominant, hegemonic ideology because it is based in the recognition of multiple perspectives coexisting. It proposes that we replace values of individualism and growth, without consideration of the environment, with values of solidarity, reciprocity, complementarity, harmony and interdependence.

4 Analysis

Having introduced the concept of *Buen Vivir* as an alternative to the dominant neoliberal view, this section will establish the distinctive elements of neoliberal and *Buen Vivir* philosophy; to then describe what features innovation would have under each paradigm. We distinguish three themes emerging from our review of both paradigms, the ontology, concerned with the nature of reality and what there is to know about the world; the ideology, understood as distinctive set of discursive themes and standpoints and finally, ethics, as what is considered to be good and valued. We recognise that these elements form part of a complex reality, yet for analytical purposes they are being separated here.

4.1 Neoliberal vs *Buen Vivir*

Table 1 presents a summary of the key aspects of a neoliberal innovation paradigm in contrast with a *Buen Vivir* innovation paradigm. In the neoliberal paradigm, the ontology functions around an individualistic worldview, that is the idea of individual freedom to set and pursue one's own goals. This type of individualism 'hence puts a claim on the nature of human beings, on the way they live their lives and their relation to society' [55] (p. 17). Furthermore, linked to the notion of individualism is the understanding that it is individual economic interests and overall economic growth. By adopting this worldview, material resources exist in function to individuals, and not the other way around. As a consequence, the environment is perceived to be at the service of pursuing individual freedom and therefore subsumed to an individual's path to achieving his or her own goals.

Given that this is the worldview adopted, then anything that benefits individuals constitutes part of the ideology. The environment becomes a commodity, that has economic value and that is subordinated to the advancement of human interests. This means that it is imperative to produce benefits for individuals in their quest to satisfy what they perceive as needs and desires. Furthermore, what is considered as ethical is that people perceive 'freedom' to achieve their own goals, being them the primary

point of concern. If the environment is an impediment for one's own perception of wellbeing, then it is subordinated, commodified, transformed and in some cases destroyed to achieve individual success.

By contrast, from a Buen Vivir's ontological perspective, the individual is only a part of a collective, of species, non-human and of different peoples in other contexts. In this sense, it is not possible to separate the individual from its interdependence with others, because everybody and everything is connected. This means that it is not possible to subordinate the environment and perceive it as a commodity.

This way of looking at the world is translated into an ideology that relies on strong environmental ethics, collective benefits and a strong spiritual and affective rationality. The main logic therefore looks out for what process would provide a better outcome for everyone, rather than an individual. It also rejects a market-based logic that may have detrimental effects in the environment and instead supports models that would benefit it. In this sense, it would support alternative ways to being, producing and obtaining resources, one that first and foremost is in harmony with the environment and with others. It would also imply that the earnings of a particular resource would be shared amongst everyone.

Table 1. Neoliberal Paradigm vs Buen Vivir Paradigm (Source: authors)

Neo-Liberal	Buen Vivir
<i>Ontology</i>	<i>Ontology</i>
Individual (others out there)	Collective, connected, related,
Independent	Interdependent, mutuality
Environment (out there) as resource	Environment as part of us
<i>Ideology</i>	<i>Ideology</i>
Market-based capitalism	Needs-based cooperativism
Private profit	Collective benefits
Market logic	Logic of shared interests
Environment as private resource	Environmental as part of us - Pachamama
Goal of economic growth	Goal of collective living well (de-growth)
<i>Ethics</i>	<i>Ethics</i>
Individual self-interest	Collective shared interest
Distribution according to means	Distribution according to needs

4.2 Neoliberal Innovation vs Buen Vivir Innovation

Following the neoliberal paradigm, innovation adopts an individualistic form, framed around the notion of individual wellbeing. Stories of individual 'innovators' becoming billionaires would be valued as a heroic achievement. An innovation would be considered a novelty that can be patented or privatised, and there is a need to promote more development of such novelties. Finally, scaling would be appropriate to reduce costs and promote value for money.

By following the Buen Vivir paradigm, then innovation takes a collective form that would support mutual respect for each other and the natural world. Collective processes

would be valued and innovation would be effectively benefiting the commons rather than individuals. Appropriateness would be valued over the costs and it would aim for producing positive effects for as many as possible.

4.3 Neoliberal Innovation Hubs vs Buen Vivir Innovation Hubs

As already mentioned, our previous research centred in understanding the role of innovation hubs in development. In such work we have argued that there is an expectation that hubs will promote economic growth. In this paper we present some characteristics of a hub, framed in a neoliberal context.

A neoliberal innovation hub would prioritise innovations that are patentable, for instance mobile applications that can be monetised. Furthermore, it will seek to promote innovations that are investable, to attract angel investors or other types of investors. It will seek to do this in a dynamic and efficient way, and often host hackathons and events that seek to develop cool/interesting ideas. As a result, innovations that are perceived to have monetary value would be framed to scale.

In contrast, a Buen Vivir innovation hub, if it ever existed, might reasonably be expected to have a strong focus on innovation for collective well-being. Such hubs might emphasise collaborative process and prioritise inclusive innovation. In this sense, rather than focusing on whether an innovation will be scalable and investable, it would prioritise innovation that is environmentally just, that include all voices and that contributes to living well, rather than making a profit. It is important to note that, just as the aforementioned example of Ecuador, an attempt to integrate Buen Vivir into practice will be confronted by several tensions and contradictions. Here, we do not intend to assume that this will be a smooth process, rather a dialectical one. More research is needed to see the feasibility of this.

5 Conclusion

In this paper we counterposed existing neo-liberal innovation with an imagined alternative approach to innovation informed by the values of Buen Vivir. We do so because we see value in imagining innovation otherwise and in reflecting the world-views of the people that they are intended to benefit. Furthermore, we explored alternatives around innovation which pushed a neoliberal agenda (of which uncontrolled growth is one element).

By adopting this alternative perspective, we have attempted to provide a starting point for problematizing neoliberal innovation and opening a thought-space for considering new possibilities. We have suggested that another innovation, one informed by the values and worldview of Buen Vivir might prioritise collective, ethical, ecological and culturally sensitive innovation that contributes to the common well-being.

We recognise how difficult it would be to actually transform the neoliberal ideas around innovation and development. The example of Ecuador show that we are far from achieving a real transformation with the adoption of indigenous knowledges. This makes us wonder, as [51] (p. 110) asks, “Is maintaining western notions of development in practice while investing in the social sector a first step in the process of moving

away from the modernist paradigm? Or is the commitment to *buen vivir* principles in this particular case only superficial?” The answers to these questions should encourage future research.

Future research should put this in action to see in what ways innovations/tech hubs can produce values of environmental ethics, collective benefits and a strong spiritual and affective rationality, thereby promoting an alignment with such worldviews. The inclusion of indigenous viewpoints (like Buen Vivir) should not just be instrumental, it should be epistemological and ontological. In our view, the Western (neoliberal) approach to innovation represents only one possible approach among others, and we should therefore accept the possibility of a plurality of legitimate paradigms around innovation and its impact in our societies. In this sense, in a world with increasing inequality, huge environmental and ecological risks, ‘Is another innovation possible?’.

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Incorporating Indigenous Perspectives in Provision of E-government Services: The Case of Tanzania

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Abstract. This paper reports on the gap on perceptions of e-government for indigenous inclusion in Tanzania. E-government provisions in developing countries are linked with the use of ICT4D to support development plans. Literature indicates that development issues, cultural context and consideration of local communities' requirements play a crucial role in facilitating adoption of e-government systems. Use of mobile phones in local communities and sharing mobile device facilities presents a unique phenomenon on utilizing e-government services in Tanzania. Drawing from in-depth interviews from government officials and citizens, the paper argue that perceived gap between central government and local communities is caused by a number of issues. The results indicate that even with few available e-government services, citizens are still keen to use them. It also emerged that there is a gap on computing facilities, central government was found to have all required minimum devices and support to access e-government services and the same was missing to the local communities. Among citizens, mobile phones were preferred way of accessing e-government services as compared to other means since they are convenient and are more personal and hence providing feeling of ownership. For the e-government services to benefits indigenous communities there is a need to address problems associated with the lack of available key e-government services in rural areas, lack of skills among government officials on public administration and development issues as well as underutilization of mobile phone for e-government services.

Keywords: Mobile phones · E-government · Local communities · ICT4D

1 Introduction

Provision of e-government services in developing countries is regarded as a critical aspects in ICT4D initiatives. To implement e-government projects, information and communication technology (ICT) is used to facilitate innovation and improve public service delivery [1]. However the key e-government services have concentrated on transactional delivery such as payment of central government taxes, local council collections, fines and other forms of government payments. This approach hinders the potentials of reaching many local communities especially those living in rural areas who may not have interactions with these systems [2]. In developing countries,

indigenous citizens mainly living in rural areas are more concerned with the provision of key social services such as health, education, food and water. However technology infrastructure in most of the rural areas is still a challenge. Technology infrastructure can support provision of basic services such as water supply, health facilities, education and communication [51]. However most of these services can take a while before they are easily available in rural areas [52]. Lack of these services can hinder indigenous citizens mostly living in rural citizens to realize access to basic needs and lead a meaningful life. Malecki [53] and Nandi [54] emphasize the needs to use information and communication technology (ICT) to address these challenges in rural areas. For example Malecki [53] emphasize the need to send people with skills on various technologies including ICT to support rural citizens in learning and acquisition of new technology [53] while Nandi [54] highlight the need to use affordable technologies such as access of ICT facilities for communication in rural communities.

The current practice in developing countries like Tanzania, central government is the one driving e-government projects and monitor the operations [3]. This approach tends to ignore how people are working on their day to day activities and lean more on high level issues. Moreover most of the donors who fund e-government projects prescribe the requirements and thereafter solutions to the targeted developing countries. This create a donor receiver relationship which is referred by Zheng and Walsham [4, p. 238] as “unfavourable inclusion”. As a result most of the local communities perceive central government approach as interference and therefore causes a number of e-government initiatives not to work locally [5].

In another context, mobile phones are currently known to provide a unique avenue for digital access by availing various internet and mobile services traditionally accessed through desktop computers and laptops. ITU reports that by 2015, there were 7 billion people connected to various mobile phone services [6] with 5.5 billion people representing 92% residing in developing countries. The figure can even be extrapolated to 100% as people in developing countries have a tendency to share mobile phone because of their culture and living style [7]. These statistics also show there is a potential for use of mobile phones services to support various social and economic activities. With more smart phones becoming cheaper, there is also an opportunity of mobile phone usage in many public services such as health, education and social care [6, 8–10] and even expanding participation of citizens in the government affairs [11]. Considering the above key issues, mobile phones have emerged as one of the key tools to engage local communities in provision of e-government services.

1.1 Tanzania Context and Use of Mobile Phones

Tanzania is located on the eastern part of Africa with a population of 47 million people with more than 70% residing in rural areas [12]. Kiswahili is a national language spoken throughout the country. It is still a developing country with most of the citizens depending on the agriculture as their main economic activity. Other key sectors of the economy include tourism, mining, finance and construction. Although the real gross domestic product (GDP) is growing at the rate of 7%, most of the citizens are still leaving below poverty line [13]. This may be explained in terms of the inequality in the society whereby few citizens in towns enjoy comfortable life as compared to the majority residing in rural areas.

The number of people who own mobile phones in Tanzania has increased considerably. Tanzania Communication Regulatory Authority (TCRA) reported that in 1995 there were only 2 thousand mobile phone subscribers. This number had increased to 8 million in December 2007 and as of December 2015, there were 39 million mobile phone subscribers [14]. Comparing these figures with the country current population of 47 million [12], this is equivalent to 70 mobile subscribers per 100 people with majority of citizens residing in rural areas [12]. This proliferation of mobile phones provides a good avenue for the government to interact with citizens. In fact private sector has utilized this opportunity through varieties of initiatives including mobile money as mentioned above, mobile internet and mobile business. There is therefore a need for governments in developing countries to investigate on how the use of mobile phones and their associated platforms to facilitate understanding of social gaps in provision of e-government services for local communities.

1.2 Need for a Study on E-government on Social Inclusion

The above discussion shows that e-government in development countries is linked with the ICT4D. However the literature reveals that most of the studies have been concentrated on the adoption of e-government on various sectors for transactional benefits [1, 15–18]. Others have identified trust technology, trust in government, psychology of citizens and risk factors as barriers to the adoption of e-government among citizens [19–24]. Yet, most of these studies rarely focused on the perception of social gaps between central and local government in adoption e-government services.

In this paper, we consider local communities and indigenous citizens as key factors for the success of e-government service delivery. We question the importance of understanding the social gap between central government and local communities for successful adoption of e-government systems.

2 Literature Review

2.1 E-government and ICT4D Context

Early literature has associated e-government with use of computers and automation of key public services functions such as finance and manpower [25]. With the wide spread of internet; e-government was later defined to include provision of online services using the web technology [26, 27]. E-government is nowadays considered to be more than online presence through websites and e-mails as it also includes various stakeholders and provides special interest to citizens' involvement and consideration of wider issues, social media and mobile phones [1, 28, 29]. However, these definitions puts emphasize on the use of various information and communication technology (ICT) tools to provide e-government services. As a result they ignore needs to consider various processes within the public offices and citizens before attempting to apply any kind of technology. For example citizens in rural areas may need only to know the prices of agricultural products they grow in the market. In this case, a mobile phone can serve the purpose better than constructing a telecentre. In some cases, a technology may not be needed at all, only a need to reorganise the existing processes in public offices to get the desired result.

World Bank report shows digital divide is still a world issue with African countries facing “access digital divide” while Europe is facing “capability divide”. The report also showed that, in Africa, the gap is double between rural and urban, mature and young as well as those with low income compared to those with higher income [30]. Digital divide is a challenge facing African countries and fails short of solution due to limited technological and economic resources. Example of this is the initiative by the some governments in Africa to rollout one laptop per child across all public schools. Most of these projects did not materialize [31] as they did not consider other components of development such as availability of teaching facilities, teachers training, food for the students and electricity availability in schools [32, 33]. This calls to link between social and economic issues when implementing ICT4D in developing countries where the social and cultural context are considered as opposed to the political ambitions. In order to link social and economic issues, the need of indigenous communities should be considered.

The other challenge on ICT4D initiatives is on the maintenance and sustainability. Once the donor fund is finished, these projects are rarely financed by a recipient government or benefited institutions. It is not strange to see a number of abandoned telecentres at the end of the ICT4D project left without any maintenance and thus jeopardizing their fundamental purpose of providing digital access to those in needs [34]. This raises a fundamental question; how can ICT4D fulfil the promise to provide digital benefits to the developing countries? Unless the needs of local communities are addressed, most of these ICT4D initiatives may end up not benefiting the intended local communities and remaining as white elephant projects.

2.2 Mobile Phones and Local Communities

In line with current context of e-government in developing countries, mobile phones have attracted attention of most governments in the world. These devices have multiple functions such as short messages (SMS), voice calls and simple calculations. With the spread of smartphones, there are even more added functions on top of those found in simple cell phones. While one can use smartphone for calls and SMS, the device can also be used with almost the same function as a desktop computer by connecting to the internet through Wi-Fi or using mobile network technologies (3G and 4G) [35]. It is possible nowadays to receive and send e-mails while travelling attend office work or purchase and make payment. With the widespread of mobile phone to more than three quarter of the world population [30], mobile phones provides an immerse opportunity for governments to provides services and link with citizens. This is crucial in developing countries where only 34% of the citizens have access to computers or internet access but 91.8% use mobile phones [36].

The use of mobile phones in providing government services has now become part of e-government [37]. The innovation and fast communication of mobile services is considered to be able to bring enormous benefits to the e-government services [37, 38]. The ability of mobile devices to be accessed anywhere can allow citizens in remote areas to access government services without a need to travel long distances. For example an SMS can be send to citizens as a reminder to attend school meeting, appointment to see a medical doctor and so on. The mobile phone services can also be

used in emergencies situations such as floods, fire [37, 38] and in protecting vulnerable groups like people with albinism in Africa. Despite these benefits, there has been few initiative and studies on how mobile phones can be used to enhance government services in developing countries [39].

Use of mobile phone for providing government services has its own obstacles. Acquisition of appropriate mobile device and the mobile charges are among the issues that can hinder wider adoption by local communities in developing countries. At first is the costs of using mobile phones. Gilwald and Stock [40] pointed the cost of mobile airtime top up hindering use of mobile services among women in Africa. There is also a tendency for some government agencies to charge higher fees on the use of SMS based services than the market rate and thus hindering people from using their services [41]. Unless the mobile based government services are provided with the incentive to reduce costs of usage or no payment at all, many local communities may run away from these services and therefore deprive indigenous communities access to these crucial services.

We therefore argue that consideration of local communities and their requirements is a key issue in developing and adopting e-government services in developing countries. The services when developed through local communities' perspectives, can facilitate local communities' participation and address most of the problems they are encountering in their areas.

3 Methodology

The study borrows tools from grounded theory [42] to conduct preliminary interviews aimed at identifying characteristics of the gap on e-government perception from the government and citizens as users. The study is making the ontological assumption that there is a gap between government agencies and the citizens when it comes to creation and utilization of e-government services in Tanzania. This relativist approach will lead to analysis of perceptions on how the central government on one hand and the local communities on the other side views related to e-government provision. As a result the study follows interpretive paradigm using in-depth interviews in order to understanding whether there is a gap between government and citizens and how the gap can be explained. The choice of interpretive approach as opposed to the positivism is based on the fact that analyzing perceptions and generate understanding of the gaps between different groups [43] can lead to the development of framework.

In selecting participants, snow ball sampling technique was used [44 p. 303]. The researcher used a contact person as a starting point and thereafter he was the one who pointed other people to participate in the interviews [45 p. 3]. This approach ensured participants are comfortable to participate in the study. The problem with this method is getting a sample of respondents who may have similar [44 p. 303]. However as this was a preliminary study, it was necessary to start with smaller sample to understand the kind of responses and themes before embarking to full data collection. Also four interviews, two with citizens in Arusha, a local town where researcher lives and the other two with public officers at the government in institution in Dar EsSalaam. These four preliminary in-depth interviews were used to collect data for this study and generate issues surrounding the research questions. In-depth interviews were used so as

explore how people view e-government and mobile government and how we can make meaning by analyzing the perceived gaps [44].

The interviews were recorded in a digital recorder after getting permission from the participants. They were later transcribed using oTranscribe web based application. The transcriptions were later analyzed manually to see the emerging coded by adopting grounded theory coding techniques and document the emerging themes [46].

4 Findings and Discussion

4.1 Support and Availability of E-government Facilities

In this aspect, the interviews demonstrated that most government employees have access to computers with internet access. These staff are also provided with training on the use of computers to support the office work. Respondents from government institutions did not describe other type training related to e-government services such as public administration, customer services and government processes. This is justified by one of the staff when describing training on the use of e-government:

“Our office has a very clear policy on training. When I was employed, I was given a basic training on the use of the existing systems. There after we tend to have training whenever we acquire and install a new system. This has helped us to understand the way can use e-government services and how can get the best from it. We also get support from our suppliers if we face any problem from the systems we are using. There are also a number of manuals available and help from the IT Services directorate on the use of each of the system. So to be frank we have all support to make us use the systems”.

Without key skills in public administration and citizen services, there is a potential of e-government to incline more on ICT than the whole spectrum of public administration. There is also a lack of training skills on development issues and this may lead of implementing e-government projects with a focus on ICT rather than development agenda [47, 48].

Respondents representing citizens said they only get some information concerning e-government services through radios and televisions as they have not been involved in any training or advocacy on the use and adoption of e-government services.

“On training, I did not get it. I think there is more to be done. May be myself but I think many people are not conversant on the use of e-government services. Even citizen are not clearly involved in this. Even this concept of e-government is a new terminology to most of us which needs a discussion and analysis for understanding. In this way people can understand what you are talking about. It needs more advocacy and elaboration before people can understand”.

The respondent also showed has never heard availability public access areas for computer and internet. Considering citizens as key stakeholders, the lack of government promotion to this group poses a challenge in managing the gap between government and citizens on e-government adoption.

4.2 Citizens Perceptions on E-Government Services

Respondents from citizens said that they would like to access or use e-government services in order to avoid unnecessary physical visits to the government offices, increase transparency in public services and easy access to health services. However they pointed hurdles in attaining these wishes. These include unstable e-government systems, lack of citizens' oriented e-government services and awareness of the available e-government services.

"I think the government is trying to provide these services although is still in a very small scale. They are also provided mainly in town areas. Also most citizens do not have access to the internet and they do not even know how to use these ICT technologies. For example if they could know how to use these services, there could have been no queues in the payment of electrical bills or water utilities. Most people know there is Mpesa but they still go and queue, that is because they not have skills on using these devices. So there is a need for more training on the use of e-government".

There is also a perception that these services are targeting urban areas. Considering most of the citizens in Tanzania are located in rural areas [12], this shows a gap between e-government services with the citizens.

4.3 Mobile Phone Use and E-government Services

Citizens and government officers showed that mobile phone is currently used not only for communication but also for accessing financial services. People use mobile phones to make payments for water and electricity bills. Affording life through mobile phone was also another key aspect as cited by one of the respondent.

"Eh it has assisted me a lot. For example myself it has assisted me to learn a lot that is happening in the country, social issues and many other issues. Mobile phone is now a fashion and everyone is looking to own it. In this way it has assisted people to know many things happening on the phone. So I can say I got some government services through mobile phone and not computers. For example yesterday I was checking results of form four students through mobile phone and I manage to see my young sister results through mobile phone. Also how to pay and running family, my mobile phone is assisting me a lot".

The same respondent also showed how he has used mobile phone to call someone to login to the internet and check the national examination results for his young sister. Although the respondent did not have access to the computer with internet access, he was able to get the results instantly. This demonstrates how mobile phone can mediate a communication with another person in order to get access to the internet based services. However the respondent was also concerned that government is not using mobile phone for providing services.

"You know let's be realistic. This issue of saying there is information from the government through mobile phones is not widely available. Say you can receive a text message about election but not that large extent. Even if you ask someone about last time has received information through mobile phone very likely they will not remember or know anything. This is different from the way people receive information from the televisions or radios. So in the mobile phone, I have not received anything tangible from the government rather than getting messages from those who are contesting for the post. So I got many messages from contestants and not the government".

There is still underutilization of mobile based services in providing e-government services. As mobile services can provide quick response to most of the developing countries problems, this creates a gap between the government and the citizens.

5 Discussion and Conclusion

The above analysis presented results on how gaps exists between central government and citizens. The notable areas of the gaps are in the areas of e-government facilities between central government and local communities. Central government was found to have all required minimum devices and support to access e-government services while the same was missing to the citizens. There was also a challenge in using e-government services as some services are yet to be available online and even those available are scattered across different government departments making harder for the citizen to access. This may have been caused by the lack of involvement of citizens as key stakeholders as pointed by the interviews participants. On the contrary, even on those e-government services currently used by citizens, most respondents showed they have accessed them through mobile phones. Mobile phones were preferred way of accessing e-government services as compared to other means since they are convenient and are more personal and hence providing feeling of ownership. While there is interest from the government to use of mobile phone for delivering services, the rate of adoption is slow and most citizens are not aware on these services.

This study has tried to provide explanation on the gap available in the use of e-government in Tanzania. The study showed challenges on using e-government for citizens and thus creates gap between citizens as users and e-government providers. The results also shows mobile phones provides an important avenue for citizens to access e-government services. However the government is yet to make use proper use of the mobile services. Additionally, the results showed there is currently no linkage between e-government services and development aspects. This can lead to the adoption of e-government services which are not aligned with the life of the people and thus a failure of the initiatives.

The study recommends the need to empower local communities can be empowered to use mobile phones to access key services (health, agriculture, education etc.) from various government agencies. This can be developed through the use of shared mobile phone facilities among local communities as well as providing training on the use of mobile phones to access e-government services for their own benefits.

The major limitation of this study is a sample size. The sample size used for both citizens and government officials was small to claim saturation of the findings [49, 50]. The sample did not capture the key areas both in the central government and citizens. As pointed above, citizens participants were selected using a contact person and therefore raises a potential bias in their responses. Likewise, there was also a need to translate interview guide into Kiswahili language for the citizens which may also contribute to the loss of meaning. These deficiencies will be used as input for the full study.

The study did not also incorporate the theory. This was done purposely as it was aimed to get a taste of responses in order to apply appropriate theoretical lens. Future research direction will be on the use of theories to define the key issues for research

framework and provide explanation for the gaps on e-government perceptions. In undertaking the full study, the researcher also aims to develop separate interview guides for the citizens and government official so as to analyze the gap between them.

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Smart City for Development: A Conceptual Model for Developing Countries

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Abstract. The present article addresses how smart city initiatives can positively impact development, with a special emphasis on developing countries. Extant definitions and maturity models on smart cities have a very strong focus on the mere use of Information and Communication Technology (ICT), thereby ignoring the special needs and factors to be considered in developing countries. Thus, by using the extant literature on Smart Cities and Information and Communication Technology for Development (ICT4D), a comprehensive Smart City for Development (SC4D) model is introduced. The article argues that a favorable ecosystem for SC4D is one that is backed by both national and local sustainability, infrastructure, human capital, services, apps, and data. Moreover, successful SC4D initiatives include bottom-up approaches, citizen participation, a fit with both the national and the local culture, as well as a fit with the United Nations' Sustainable Development Goals and the Capability Approach.

Keywords: ICT4D · Smart city · Capability approach

1 Introduction

While the study field of ICT has been receiving increased attention and significance throughout the past few decades, the conventional wisdom has become that, if they are conducted efficiently, ICT projects in the public sector enable citizens to access services of higher efficiency [8]. In developed countries, this translates into increased productivity, whereas in developing countries the impact of ICT4D is far more meaningful and may, for instance, help eradicate poverty, handle problems related to climate change or enable people's inclusion in economic, social and political life [20].

Recently, a topic closely related to ICT and ICT4D has emerged: the idea of making cities smarter to take advantage of the benefits of the digital age. As of 2012, there were around 143 self-declared smart city projects worldwide, most of which were located in Europe, North America and Asia [31]. These numbers show that the relevance and existence of smart city initiatives are higher in developed than in developing countries. Yet, at the same time, smart cities have a lot of potential to foster sustainable development in developing countries – a potential that is not being completely achieved so far - and worse, structural problems might even extend the gap between this potential and the reality [15].

In that context, the present paper aims to provide a framework that may support developing countries policymakers to recognize the potential of smart city initiatives to foster development in their respective developing country.

Thus, this article addresses the following research question: How can smart city initiatives impact development in developing countries?

2 Methodological Procedures

The methodology supporting this article involves three main research stages, namely:

1. Literature review: to identify and discuss the most significant research literature that treats ICT4D and the smart city knowledge fields;
2. Model development: built upon the knowledge taken from the literature review, a vision for SC4D and its conceptual framework are determined. Then, considering this vision, the structure of a conceptual framework for SC4D is created. This model aims to guide how smart city initiatives in developing countries must be designed by governments and supported by ecosystems in order to lead to the desired positive impact on development.
3. Synthesis: implications for public policies accrued from this work.

3 Literature Review

3.1 ICT for Development (ICT4D)

The United Nations Economic and Social Council emphasizes the potential impact on the social and economic development of a country related to ICTs that, if applied in a strategic manner, can lead to increasing growth, create income sources for poor people and reduce poverty [48]. In addition to such social and economic aspects, the European Parliament mentions the possibility of better outcomes in the areas of healthcare and education for developing countries that make use of ICTs [16]. Thus, in a wider sense, ICT4D endeavors intend to harness digital technologies in the service of the world's most pressing problems, addressing the needs of the poor [20]. In regard to the latter, it is argued that ICT4D initiatives should be inclusive – including the poor in improved services and opportunities –, enabling – supporting policies that improve the lives of the poor – and focused – aiming at the poor's rights, interests, and needs –, yet at the same time sustainable, scalable and effective [35].

While ICT initiatives have in the past mainly focused on tangible benefits of ICTs that are easily measurable and quantifiable, there was a shift in that focus towards intangible benefits, such as empowerment, self-esteem, and social cohesion, since these are more important from a developmental perspective [19].

A similar approach to the evaluation of ICT4D initiatives is offered by [29], who argues that instead of trying to make ICTs fit with a linear conceptualization of impacts and an often economic view of development, an ICT4D endeavor is a development process that needs to be analyzed in a holistic way based on Amartya Sen's capability

approach. Development should be seen from the perspective of individual freedom rather than as mere economic growth [41–43]. In this context, capabilities are factors that determine the freedom of choice regarding the question of how to live one’s life. They are therefore the central element to consider in the assessment of human development.

Eventually, the application of the capability approach to ICT4D has not only remained an academic idea but also been put into practice, for instance, with regard to the World Bank’s development strategy: instead of solely considering new technologies and the introduction of such, the focus of ICT4D projects increasingly lies on people and on how a meaningful use of ICTs enhances both the individual human capabilities and the collective social capabilities inside a community [18]. This focus on the people should also be considered in the initial design of ICT4D initiatives and the way in which they are directed: while top-down approaches may be necessary to create a favorable environment for the use and diffusion of ICTs, there is a need for more and innovative bottom-up approaches, since it is crucial to include and empower local stakeholders in order to create ICT4D projects that are actually sustainable [37].

3.2 Digital Inclusion

Digital inclusion means to provide opportunities for people to be included in the current digital society [14]. Yet, merely making ICTs available is not enough and the political, social, cultural and institutional environment needs also to be taken into account, since these are factors that influence the access to ICTs and the ability to make effective use of them [49]. In this context, [26, 27] provides a model that includes the key success factors and processes that should underlie the promotion of digital inclusion in a country (Fig. 1).

The Virtuous Empowerment and Participation Cycle

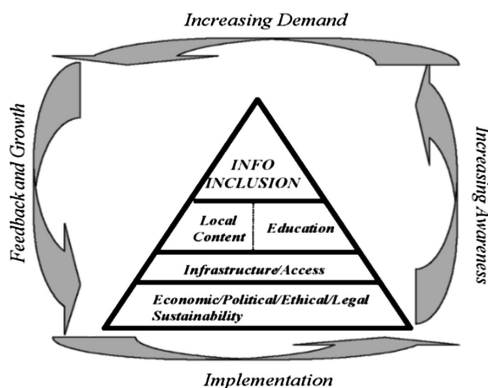


Fig. 1. The dynamic infoinclusion model [25]

According to that model, the primary requirement is economic, political, ethical and legal sustainability, meaning that the government's actions need to support a favorable ecosystem. Secondly, infrastructure and access need to be made available. Thirdly, local content and education must be provided, being same relevant and customized for the needs and interests of the local community or target group with the particular objective of empowering socially excluded groups. Lastly, the model emphasizes the digital inclusion as a dynamic process. Thus, the model features a so-called virtuous participation and empowerment cycle that includes four stages: at the first stage, an ICT initiative and corresponding tools are implemented; subsequently, at the second stage, people become increasingly aware of the possibilities and benefits connected to these tools; this ought to lead to the third stage, in which current participants increase their demand for the implementation of further tools, applications and IT infrastructure in general; consequently, at a fourth stage, those people that are already included in the process give feedback on it and, at the same time, have a feeling of involvement and empowerment, while the number of new users grows as well [45].

3.3 Smart Cities

According to the United Nations, nowadays the resources and energy consumption of cities are dramatically high [46]. Moreover, while more than 50% of people worldwide were already living in urban areas by 2008, this figure is expected to further rise to 70% by 2050; in Europe, about 80% of people are already living in urban areas, and both the mentioned changes and their impacts are going to be much more significant in regions such as Asia, Latin America, and Africa, where the diffusion of megacities of more than 20 million people is already a reality [46].

In light of this, cities worldwide are required to become “smart”, or in other words, to find intelligent and innovative ways to tackle the upcoming challenges effectively [9, 33]. However, the definition and purpose of a so-called smart city have led to controversy in Academia, having a variety of proposals on this matter [2, 11]. In fact, there is no one-size-fits-all definition, neither for the smart city term nor for the successful conceptualization of a smart city [36]. What is noteworthy is that while at the beginning, most of the definitions of smart city had a very strong focus on the diffusion of ICTs and tended to disregard the importance of other crucial factors besides technology, recent approaches have shifted towards the needs of people and communities [2], such as the quality of life [4]. Indeed, it is important to acknowledge that within the concept of successfully creating a smart city, ICTs are just one thread in the system as the deployment of such must follow an integrative and multi-dimensional approach [40]. In a truly smart city, adopting new technologies is not an end in itself as innovation in technology must be complemented by innovation in management and policy [34]. Besides, progressive smart city initiatives must start with the focus on human capital – people, their interaction, knowledge, skills, and participation – rather than with the blind belief that ICTs can automatically transform and improve cities [23]. Thus, some authors developed one of the most recent approaches for a unified definition of a smart city and came to the result that there are 25200 potential components of a smart city: the more components a city is composed of, the smarter it is [39].

4 The Vision for a Smart City for Development Model (SC4D)

As the concept of ICT4D was introduced in order to customize the concept of ICT diffusion to lead to a positive impact on development in developing countries [20], the idea behind the concept of SC4D envisioned by the present article is to adapt the concept of smart cities in order to create customized smart city solutions with the objective of positively impacting development in developing countries. This customization is important because responses to challenges in cities inside developing countries will need to be tailored and framed differently from those in cities inside developed countries, due to the fact that urban growth will be a bigger phenomenon and therefore a more present problem in the developing world [46]. Because of this and against the background of the vague and broad conceptualization of smart cities [39], it is first necessary to redefine and narrow down the term to make it appropriate for developing countries.

Due to its focus on development, a feasible definition might be one that has been introduced by the Inter-American Development Bank (IDB) [7]. According to that definition, a smart city is an innovative city that uses a holistic approach – including both ICTs and other means – in order to improve the quality of life, efficiency of urban operations and services, as well as competitiveness, while ensuring that it fulfils both present and future generations’ needs related to economic, social, urban and environmental factors, thus placing people at the center and implementing collaborative planning activities and citizen participation methods.

Yet, if the question is how smart cities can foster development, the term of development itself needs to be defined as well. The inspiration for this can be found within the process that the ICT4D movement has gone through: after initially focusing too much on technology, an increased shift towards other factors took place over time. Within the context of smart city initiatives in developing countries, this means viewing development as freedom [43] in a city context, such as an increase in a city’s citizens’ well-being, as well as in their capabilities [18, 42] – capabilities meaning the different ways of living a life that are possible to be achieved and freely chosen [29]. A shift towards SC4D also means acknowledging the significance of intangible benefits of smart city initiatives, such as empowerment, social cohesion, and self-esteem, as done for ICT4D [19]. The focus on bottom-up approaches [38] and the society’s poorest [35] should be further points, in which the modern approach within ICT4D may serve as a role model for the conceptualization of SC4D. With regard to the latter suggestion – targeting the society’s poorest – the vision of SC4D suggested in the present article is that instead of improving the lives of those citizens that are already highly privileged, relevant SC4D initiatives should aim at targeting those people that are most in need, namely the world’s four billion poorest people with an income that is too low to sustain a decent life [38]. Moreover, an additional guideline can be the Sustainable Development Goals (SDGs), which have been declared by the United Nations (UN) and include “no poverty”, “zero hunger”, “good health and well-being”, “quality education”, “gender equality”, “clean water and sanitation”, “affordable and clean energy”, “decent work and economic growth”, “industry, innovation and infrastructure”,

“reduced inequalities”, “sustainable cities and communities”, “responsible consumption and production”, “climate action”, “life below water”, “life on land”, “peace, justice and strong institutions” and “partnership for the goals” as facets of development [47].

In summary, any smart city initiative that targets the underprivileged citizens of any city inside any developing country, improves their quality of life, enhances their capabilities, and significantly and positively contributes to one or more of the 17 SDGs, is a smart city initiative that fosters development and may therefore be considered a successful SC4D initiative.

4.1 The SC4D Model Underlying Rationale

Considering the implications from the literature review and the defined vision for SC4D on the basis of ICT4D, a framework that effectively describes the nature and ecosystem of successful developing countries SC4D initiatives needs to comprehensively involve the success factors already discussed, be a dynamic model [25], involve participation [37], focus on development and capabilities [18, 19, 29, 35, 48] and also factor the indigenous contextual or cultural component in. Besides, the model should be based on academic rather than anecdotal, practitioner-oriented reasoning.

None of the extant smart city assessment models is able to fulfill all of the necessary characteristics that have been defined before [1, 10, 12, 42, 47]. Thus, the rationale for developing the SC4D model is based on the need of a very dynamic model that balances ICTs with other crucial factors and has a high level of visualization, comprehensiveness, development focus and academic background.

4.2 The SC4D Model

Based on the literature review and the vision for SC4D and taking the rationale for developing a new model into consideration, the SD4D model has been developed and is depicted below in Fig. 2. Most of the model’s components, especially the empowerment and participation cycle surrounding the pyramid, have been inspired by the digital inclusion model introduced by [25, 27], due to its comprehensiveness and dynamic nature. However, some elements have been adapted or added with regard to the topic of smart cities. Besides, the research areas of ICT4D and digital inclusion, as closely related to the research area of smart cities, served as sources of information for the development of the SC4D model. Thus, all of the SC4D model’s constituent components are further explained in the upcoming section.

4.3 The Components of the SC4D Model

Sustainability

An economic, political, ethical and legal sustainability is fundamental to a successful development project in the areas of ICT and digital inclusion [25, 44]. Nevertheless, there are different understandings of what sustainability actually means. In a developmental context, it is understood as meeting the needs of the present without

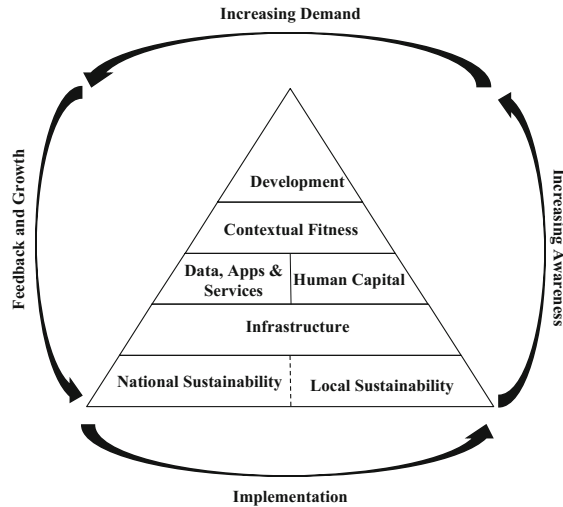


Fig. 2. The SC4D model

compromising future generations' ability to meet their needs, or more basically, something is sustainable if it is capable of being sustained [5]. Applying the latter definition to the before mentioned areas that need sustainability, an SC4D initiative requires a stable economy and a predictable political setting, as well as a legal system and ethical values that are coherent with the well-functioning of the project. This also implies that the situation in terms of sustainability might differ from city to city. Thus, in the assessment of a smart city project, both national and local sustainability play a role. Past failures of ICT4D initiatives have taught that a short-term focus on the initial investment can be fatal and instead, project managers must consider the sustainable viability of the respective initiative [30]. Apart from the financial aspect, a sustainable effect of ICT implementation can only be achieved if the ICT initiative also encompasses the creation of economic, social, political and cultural capabilities [18].

Accordingly, among the leading questions for the assessment of an SC4D initiative regarding this component must be:

- How economically, politically, ethically and legally sustainable is the country?
- How economically, politically, ethically and legally sustainable are the city and its region?

Infrastructure

This component addresses the ICT infrastructure, including available high-quality, high-security and privacy-ensuring wireless infrastructure and service-oriented information systems [9]. The implementation of ICT infrastructure may lead to economic growth and development and thus significantly contribute to the eradication of poverty [6]. Simultaneously, it gives low-income people the opportunity to partake in the digital society and to profit from it both economically and socially [12]. Thus, ICT infrastructure and access potentially offer the chance to increase citizens' levels of choice and

are therefore of crucial value from a capability approach point of view [29]. After all, infrastructure is a key input inside any ICT4D value chain and a necessary element to ensure the readiness for ICT4D projects [21].

Accordingly, among the leading questions for the assessment of an SC4D initiative regarding this component must be:

- How developed is the city's ICT infrastructure?
- Is the ICT infrastructure sufficiently developed for a smooth functioning of the smart city project?

Data, Apps, and Services

The significance of data for smart cities has been made clear in several of the extant smart city assessment models: a smart city should aim at achieving an ever more sophisticated and comprehensive [13] as well as centralized data analytics system [10]. And though highly developed data systems are more common in highly developed countries and cities, an effective usage and processing of available data is also a precursor [21] and likely to have a positive impact on SC4D initiatives. Indeed, advanced data systems should be complemented by apps and services for citizens. Modern and digital services that target the poor underlie the idea of inclusive innovation [22], which translates into the use of digital services to empower same – the core of the vision for SC4D.

Accordingly, among the leading questions for the assessment of an SC4D initiative regarding this component must be:

- How developed is the city in terms of data collection, integration and centralization?
- Are there services that facilitate citizen engagement with smart city initiatives?
- Does the local government support smart city initiatives through apps?

Human Capital

By definition, human capital comprises people's education, skills, competencies, and knowledge [28]. One emphasizes the importance of education within the context of digital inclusion, underlining however that education involves more than simply training the citizens and should be considered as more important than ICTs themselves [25]. Accordingly, the objective is that people become aware of the opportunities offered by ICTs or, in the present case, SC4D initiatives. A lack of skills and knowledge, however, might prevent any development initiative from achieving its purpose of inclusion [22]. One emphasizes other factors related to human capital apart from education, such as participation, quality of life and accessibility of ICTs for everyone [9]. Besides, what can be learned from ICT4D initiatives is that educating people about the initiative and its possible benefits for them is even more important than providing ICT infrastructure and access itself [17]. Relating this to the concept of SC4D, for a successful SC4D initiative, citizens need to be sufficiently educated and know about the opportunities the SC4D initiative brings about, while users should be skilled and competent enough.

Accordingly, among the leading questions for the assessment of an SC4D initiative regarding this component must be:

- How developed is the city in terms of human capital?
- Is the level of education in the city sufficient for a successful smart city initiative?
- What kind of training is offered in order to enable people to engage with the smart city initiative?

Contextual Fitness

The importance of respect for the local context has been emphasized before with regard to digital inclusion [25]. The same is valid for SC4D initiatives: those projects that are in line with the indigenous culture are more likely to be widely accepted and spread among the community. An example for this can be taken from the area of ICT4D: one found that in certain communities, certain individuals have influence and therefore play a decisive role during the process of popularizing innovative digital technologies [3]. There are several ways how ICTs and culture are intertwined: culture has an impact on the way ICTs are developed, adopted, diffused, used and managed, as well as on their outcomes, which may lead to vision, system or contribution conflicts [32]. Thus, the conclusion with regard to SC4D projects is that what works well in some cultural areas might not necessarily be appropriate for developing countries and what is in line with one city's local context is not necessarily applicable to all cities in the respective country.

Accordingly, among the leading questions for the assessment of an SC4D initiative regarding this component must be:

- Is the SC4D initiative compatible with the national indigenous context?
- Is the SC4D initiative compatible with the local indigenous context?

Development

This component of the SC4D model is the most important one, on the top of the pyramid. Development is the objective behind the concept of SC4D and all other components within the pyramid are supporting ones. The development component derives directly from the vision for SC4D. This vision is defined by three main ideas of development. Firstly, any SC4D initiative should work towards one or more of the SDGs [47]. In this context, the International Telecommunications Union [24] gives concrete examples regarding each of the 17 goals for ICT4D projects that had a significant and positive impact on development. Secondly, development means increasing people's capabilities and freedom [41–43]. The choice framework [29] involves a successful example taken from the area of ICT4D and serves as a role model for what an SC4D initiative needs to take into account to meet this second requirement. Thirdly, development means focusing especially on those people at the BOP [38].

Accordingly, among the leading questions for the assessment of an SC4D initiative regarding this component must be:

- Does the SC4D initiative contribute to the fulfillment of the SDGs?
- Does the SC4D initiative improve people's capabilities and levels of choice?

Empowerment and Participation Cycle

The dynamic way in which the SC4D model respects the integration of citizens in SC4D initiatives is one of its main differentiating factors compared to formerly developed assessment models for smart cities. This dynamic approach is adopted from [25] and – adapted here to the concept of SC4D – means that after the government implements an SC4D initiative, the targeted citizens should become aware of the initiative and the benefits for them related to it. They start giving feedback and feel involved and empowered by the SC4D initiative, consequently engaging more and demanding for an expansion of the SC4D initiative, while the total number of engaged citizens grows as well. It is expected that the government and project managers react and interact appropriately. Indeed, three of the stages of the virtuous cycle of empowerment and participation – increased awareness, increased demand, and feedback and growth – can be seen as capabilities inside the whole SC4D system [27]. When it comes to citizens’ freedom and their opportunities of choosing on how to live their lives [29, 41–43], said components of the pyramidal SC4D model have a direct and positive effect. At the same time, there is a direct link between the background of the empowerment and participation cycle and development.

Accordingly, among the leading questions for the assessment of an SC4D initiative regarding this component must be:

- Up to which extent does the SC4D initiative include bottom-up elements?
- Does the government take measures in order to increase people’s awareness and demand?
- Is the initiative open to receiving and implementing citizens’ feedback?

5 Conclusions

The SC4D model might be a helpful tool for governments and smart city project managers in developing countries to implement and/or evaluate SC4D initiatives. Governments might use this model because it offers a holistic approach that balances ICT with other needs. Smart cities have in a recent past been established with a bias towards the mere diffusion of ICTs. Yet, the SC4D model changes the focus towards further components, such as sustainability, infrastructure, data, apps, services, human capital, cultural and contextual fitness, and citizen empowerment and participation. Thus, governments of cities in developing countries might adapt their smart city endeavors accordingly in order to ensure that same are successful, targeting people most in need.

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Digital Technology for Preserving Cultural Heritage in Tonga

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Abstract. Cultural heritage embodies and carries the stories and values of our ancestors that define our understanding of who we are today. A society’s heritage serves an important purpose for educating people about their own culture and aiding in understanding their traditional values. In Tonga, where this research has been conducted, the historical knowledge and cultural values have been usually transferred orally from generation to generation. However, due to the pressures of globalisation, westernisation and migration, cultural heritage is under threat. These threats can potentially impede the transferring of societies’ idiosyncratic identity to future generations and erode cultural life. ICT as an option to preserve cultural heritage offers opportunities to not only capture and immortalise tangible and intangible cultural artefacts but also enables the accessibility of those artefacts to a wider audience through the internet. It is against this background that we explore how digital technologies are utilised in the process of preserving cultural heritage.

Keywords: ICT4D · Social embeddedness · Preserving cultural heritage

1 Introduction

Oral traditions have maintained the sea navigation skills and astronomy that asserted Tonga’s maritime chiefdom for over 2000 year [1]. However, this ancient navigation knowledge is now at risk of being eroded due to modernisation, globalisation and especially due to various technological developments such as Geographic Information Systems (GIS). This is just an example that illustrates that cultural heritage in Tonga is threatened. Other Pacific nations such as Fiji are utilising ICT to create a virtual museum that supports the safeguarding of cultural artefacts making it accessible to the community [2]. Fiji’s virtual museum has audio narrations, a zoom function, and descriptions on artefacts, such as Lapita pottery and even traditional Tongan weapons [2]. As such, information and communication technology (ICT) can play a role in maintaining cultural knowledge. In order to improve our understanding of the potential of ICT for the preservation of cultural heritage in Tonga we aim to answer the research question: How is ICT utilised in the process of preserving cultural heritage in Tongan?

In order to answer this question, we adopt an interpretive case study [3] approach which involved talanoa –a Pacific research method that focuses on relationship building and complying with the cultural protocols [4]. The interviews in the form of talanoa were conducted with Tongan individuals who consider the use of ICT to preserve

cultural heritage in their workplace. By doing so, we cater to the Tongan cooperative attitude and collaborative assumptions as opposed to relying on frameworks developed in other contexts. We argue that by investigating locally developed solutions for safeguarding Tongan cultural heritage by a Tongan researcher, we enhance the understanding of indigenous perspectives in ICT4D initiatives.

2 Background

Tonga has a rich history that tells stories of the thriving Tongan maritime chiefdom that was technologically advanced in its time. Additional cultural richness includes the Tongan traditional arts: *nimamea'a* (fine arts), *tufunga* (material arts) and *faiva* (performance arts). For example, the *lakalaka* is part of the *faiva* category and is a genre of music and traditional dance in which Tongans chant about the natural features, places and history of the more than 170 islands that make what is now known as the Kingdom of Tonga. Furthermore, traditional sports stories include the *sia heu lupe*, a circular, flat topped mounds related to an ancient sport – pigeon snaring reserved for chiefs [1] – that is linked to possible star constellations associated with ancient forms of Tongan navigation. The physical remains of culture in the form of historical sites conserves Tonga's rich cultural heritage which is essential to providing an understanding of who Tongans are, where they have come from – their past feats as traditional warriors and great navigators – and therefore, what they are capable of achieving – their future.

The use of ICT for preserving cultural heritage in Tonga is minimally adopted within organisations, whilst other Moana (Pacific) nations, such as Fiji [2], [5] have recognised the potential of ICT not only to conserve their cultural heritage but also to disseminate it. Different views exist in Tonga on how, what and why cultural heritage should be preserved, and the role digital technology can play in this process. For instance, the idea of a museum to preserve cultural artefacts is questioned in Tonga, whose citizens are proud of their living and breathing culture. The clash of traditional and modern views of cultural heritage preservation, is a process of tension, transformation and transitioning currently taking place in Tonga, which we want to investigate by adopting a social embeddedness approach [6]. This allows us to gain an in-depth understanding of the role ICT plays in preserving cultural heritage in relation to local cultural beliefs, values and norms from a local Tongan perspective. To explore the utilisation of ICT within the local context, it is essential to identify how local Tongans perceive ICT and the process of preservation. Furthermore, locating what cultural, economic and or political factors in Tonga may impact or inform these local perceptions can provide understanding into how ICT can be used in the process of preserving cultural heritage [6].

3 Literature Review

3.1 Cultural Heritage

The interpretation of cultural heritage has evolved significantly over recent decades. Abd Manaf and Ismail [7] define heritage as “our legacy from the past, what we live with today and what we pass on to future generations”. Cultural heritage embodies a former way of life and its transmission to the next generation is crucial to the longevity of the culture. Belhi et al. [8] argue that cultural heritage is the only vehicle that can trace the lifecycle of a society and promote the use of digital technologies for passing on cultural knowledge. Culture constitutes sets of core values, beliefs and understandings [7] and their embodiments are manifested in artefacts. Cultural heritage is not limited to just tangible artefacts such as archaeological sites and monuments, but also involves intangible artefacts, such as religious ceremonies, language, practices and oral history [9].

3.2 The Social Embeddedness Discourse in ICT4D Research

Heeks [10], defines ICT4D as “the application of any entity that processes or communicates digital data in order to deliver some part of the intentional development agenda in a developing country”. Heeks definition combines ICT as an entity that communicates or processes digital data, for example – smart phones, tablets, the Internet, computers etc.- and development as a means of focusing on a specific geographic and agenda development, “particularly progressive changes in a developing country”.

ICT4D studies suggest that ICT can aid the refining of socio-economic conditions in developing countries [11]. The assumption is that ICT4D entails the use of ICT innovations to help individuals or communities develop their potential. However, Walsham [12] suggests that within ICT4D, researchers should perceive themselves as co-contributors along with local actors rather than experts bringing top-down solutions. Furthermore, Walsham [12] highlights that views about development would differ in different local contexts. This aligns with one of Avgerou’s [6] three identified discourses occurring in ICT with regard to IS innovation: social embeddedness. The other two discourses are transformative information systems in developing countries (ISDC) and transfer and diffusion discourse [6]. The social embeddedness and transformative in ISDC discourses take into consideration the role of culture in ICT innovation [6]. In the context of this study we define ICT innovation as a process that involves the “development and implementation of ICT systems and concomitant organisational change” [6]. Therefore, applying a social embeddedness lens we looked at what cultural factors in Tonga contribute to how ICT is leveraged in order to preserve cultural heritage in Tonga. As such, the study of ICT innovations always requires understanding of the social context [6].

The social embeddedness discourse guides our study of the utilisation of digital technologies for preserving cultural heritage since it conceptualises ICT innovation as a local process that is comprised of organisational change and technology construction [6]. By applying a social embedded approach, we consider local Tongan perspectives

in a collaborative and co-creative partnership to explore and identify solutions for using ICT as an option to safeguard heritage. Local Tongans will better relate to and accept the solutions that fit to their local context and were developed with their contribution. We pay special attention to locally constructed meanings in the presence of digital technologies for preserving cultural heritage in Tonga. For instance, the online material about Tongan kupesi (patterns for printing onto cloth) [13] constitute examples of digital technology utilised to preserve cultural heritage. Although the technologies used may not be sophisticated, the local implementation experience constitutes an ICT innovation. As such, a social embeddedness approach places emphasis on investigating local meanings and exploring locally suitable techno-organisational change [6].

4 Research Method

We adopted a constructivist perspective [14] and used an interpretive case study approach [3] to collect and analyse data. The case study approach is suitable to gain an in-depth understanding and knowledge of how ICT is utilised in the process of preserving cultural heritage in Tonga, and what the implications are for those involved [3]. This approach is adequate for the highly stratified and hierarchical society of Tonga, where cultural information has been traditionally perceived as something to be guarded rather than to be shared openly [15]. Considering the scarcity of literature about the use of digital technology for preserving cultural heritage in Tonga, we took an explorative perspective and were open to the patterns that were emerging from the data as part of our thematic analysis [14].

4.1 Data Collection

In order to collect data, we used semi-structured interviews in the form of a talanoa. The talanoa were conducted in Tonga in September 2018 by the first author, who is a Tongan citizen. She was born in Tonga and raised in New Zealand in a conservative Tongan family. Her upbringing provides insider knowledge on the Tongan culture.

Pacific researchers have employed talanoa as a methodology [4] and a method, however, for this study we employ talanoa as a method that adheres to Tongan norms of communication. Talanoa encompass the Tongan worldview of communicating that involves debating, gossiping, reflecting, story-telling, joking, and sharing family connections [4]. The vigorous interactive form of conversating incite deep discussions and relationship. *Kepa* and *Manu'atu* [16] refers to the verb talanoa as a way of conversating, relating to experiences of every-day life and telling stories. *Vaioleti* [4] affirms that talanoa permits for more meaningful information to become apparent to the Pacific researcher. *Mahina* [17] advises that the word talanoa is commonly “used to mean a story and, occasionally, an account, an explanation or a description”.

Furthermore, due to her cultural background the first author was able to engage in the talanoa form which takes cultural protocols into consideration. For example, by complying with the appropriate dress code such as wearing a *kiekie* (traditional waist garment for women) in particular situations, the first author signaled her own Tongan roots and identified herself as an insider and part of the society. It was an important

decision to use the talanoa form in order to carry out communication in a manner that is ethical and familiar to the Tongan mode of conversating and its values.

The first author conducted face-to-face interviews, following the tenets of talanoa, with eight participants and informal interviews in talanoa form with four participants, for an average of 30 min to one hour and a half. The eight participants were selected from five organisations or initiatives in Tonga. The selection criteria were based on the level of expertise and knowledge on digital technology and their involvement in preserving cultural heritage. In a hierarchically structured society, interviewing a range of participants increases the probability of attaining honest, rich data reflecting different perspectives. A breakdown of all participants is displayed in Table 1. Please note that all participants and organisations have been assigned pseudonyms to ensure confidentiality.

Table 1. Participant demographics

Group	Participant	Position	Age group	Gender	Education
Heritage support group	Mele	Leadership	50 yrs+	Female	Tertiary level
Advocate group	Lupe	Leadership	50 yrs+	Female	Tertiary level
Government agent	Sione	Leadership	35 yrs–50 yrs	Female	Tertiary level
Royal heritage agent	Tangi	Ranked chief	35 yrs–50 yrs	Male	Unknown
Royal heritage group	‘Uasimoa	Office employee	18 yrs–34 yrs	Female	Unknown
Royal heritage agent	‘Ohai	Office employee	18 yrs–34 yrs	Female	Unknown
Government agent	Fusi	Office employee	35 yrs–50 yrs	Female	Tertiary level
Government agent	Leka	Office employee	18 yrs–34 yrs	Female	Tertiary level
Community-based interest group	Lisiua	Initiator/Director	35 yrs–50 yrs	Female	Unknown
Others	Kameli	Anonymous	51 yrs–65 yrs	Female	High school level
Others	Kapeta	Office employee	35 yrs–50 yrs	Female	High school level
Others	Kepu	Blue collar entrepreneur	50+	Male	High school level

Talanoa were recorded with the voice recorder of a smart phone. The smart phone was selected due to its unobtrusive, subtle and less threatening size, minimising distractions during a talanoa. Additionally, as approved by the participant, the researcher took notes during the talanoa to capture key points, Tongan concepts, and emotions that prevailed throughout the session.

4.2 Data Analysis

The transcribing of the audio tapes took place in New Zealand at the end of the fieldwork by the researcher and two paid transcribers. Transcripts that were not transcribed by the researcher were checked against the original recording, and notes taken in an attempt to read the data in an active manner [14].

A thematic analysis was undertaken to “identify, analyse, and report patterns (themes) within data” [14].

Applying an inductive approach [14], the coded key words, key points, experiences, ideas, and emotion(s) in order to generate an initial list of codes. The ideas were grouped in a table according to meaningful connections. Meaningful connections were constantly reviewed to organise the data into further meaningful groups [14]. For example, references by participants to a lack of funding, lack of policy and a lack of direction were collated under one group, lack of support. The systematic and consistent approach to identifying codes was applied across each data item.

The next phase involved searching for themes across the different codes. The researcher focused on a thematic analysis on the semantic level to generate themes [14]. On the semantic level, themes are found in the explicit meaning of the data as spoken or written by the participants [14].

The researcher utilised visual representations, in the form of posted notes and coloured markers, to sort the different codes into themes [14]. Each code was organised and rearranged to form connections and relationships. Some initial themes became main themes whilst others, sub-themes. For instance, lack of policy and direction initially grouped under lack of support along-side lack of leadership, became a sub-group of - lack of leadership. Important to note is that the analysis process was a recursive one as opposed to a linear [14].

The last phase of the thematic analysis process was refining, defining and naming the themes [14]. This led to the following preliminary findings which will be outlined in the next section.

5 Preliminary Findings

Three themes emerged from the data analysis: Awareness of the potential of ICT to preserve cultural heritage, existing challenges that affect the preservation of cultural heritage in Tonga and bottom-up initiatives for preservation of cultural heritage in Tonga. We found that despite the awareness of the potential of ICT to preserve cultural heritage, Tongans face various challenges that hinder their use of technology to safeguard their cultural roots. However, we also found that Tongans try to mitigate these challenges through bottom-up initiatives.

5.1 Awareness of the Potential of ICT to Preserve Cultural Heritage

Awareness of the Importance of Cultural Heritage

Amongst participants there is a strong sentiment that cultural heritage is important and all recognised its preservation as valuable and empowering to the Tongan society.

Lupe remarks, "I think...the most important thing I ever did was being included in the Tu'i Pelehake's ah political and reform committee. Because, I had then the opportunity to go and meet people in their own communities. And listen to them talk about, their passions, their desires, their visions for their future. And that was for me a very enriching experience. Which I don't think I will ever have again, but I was very grateful that I had that opportunity. Because it um, demonstrated and showed me the richness of our culture, and the richness of the Tongan language. When people use it properly. People who know the language and know the history and know the oral history. It was such an eye-opener for me to sit there and listen to these people, sharing their stories and their wisdom over the years. And ah the, the language they used and the example that they drew from it was just, so, empowering."

Fusi who specialises in geographical information system advised that technology can be utilised to identify, capture and create awareness of the importance of historical sites in Tonga. The digitisation allows the preservation and dissemination of knowledge about these tangible sites and its stories. In her work she mainly relies on satellite data, an internal open source software, a database and a scanner to identify and capture the historical sites.

As outlined above ICT is recognised and used as an option that enables, prolongs and supports the continuance, storage and disseminating of cultural heritage in Tonga. However, the participants also emphasised the importance of traditional methods of preservation such as traditional arts - for instance faiva and tapa making- memory and book form, kava circles and family storytelling which was highlighted by Mele, Lupe, Tangi, Kameli and Kepu, indicating that digital technology and traditional methods are not mutually exclusive. Therefore, from the perspectives of local Tongans ICT and traditional methods both play an essential role in safeguarding their heritage.

5.2 Existing Challenges that Affect the Preservation of Cultural Heritage in Tonga

Despite the awareness of ICT and its perceived value and benefits as an option to safeguard heritage, participants face the challenge of a lack of governmental ICT legislation to preserve cultural heritage. Inevitably, the lack of ICT policy on a national level impacts funding, vocational training, leadership and autonomy to act independently, disengaging participants from the preservation process.

Lack of ICT Policy

A significant number of participants commented on the lack of an ICT policy on the national level and therefore the missing direction on how ICT should be leveraged, also with regards to preserving the cultural roots. Three participants acknowledged the

existence of a national ICT policy, however, were unable to advise where it can be accessed or how it can be attained. Lupe explains:

“We have a national ICT policy which I’m sure is languishing somewhere. I have a copy but I don’t have a copy I can give you. Umm.. but umm.. that is supposed to provide the regulation for the service for that particular sector but I don’t think it has been activated. So it’s still languishing somewhere and ministries are still carrying on doing their own thing”.

Mele remarked that she had been advised by another Tongan member of the existence of an IT policy, however, herself was unaware of one.

Apart from these three participants, the remaining participants were not even aware of an ICT policy. Leka highlights, *“That’s one of the things they’ve brought up recently cause I don’t think Tonga has any IT policies”*. Fusi also comments, *“In everything there should be legislation, because then it is easier to do our job for example, like at the moment there is no policy only the Land Act that we hold on to”*. Fusi continues on the lack of policy and sharing or information on historical sites:

“We have the capacity, we can develop our own web service, but we don’t have a policy...We have started to develop a policy, but it is not yet completed. But this policy is only for data sharing, it’s almost completed. However, we don’t know an act that the policy can fall under and that can validate it”.

The absence of an administrative and legal framework to ensure the safeguarding of Tonga’s heritage, is a point of exasperation for participants. According to the participants, an ICT policy is needed to preserve Tonga’s heritage, provide protection from exploitation and empower local Tongan’s partaking in the preservation process within their workplace.

Lack of Leadership and Direction

The missing ICT policy on governmental level affects the leadership and decision making in public agencies like the Ministries. Due to the lack of clear processes and instructions from leaders in the institutions of how to leverage ICT to preserve cultural heritage, employees are often uncertain if and how ICT can be used in their daily work to safeguard cultural heritage, even if the necessary technology is available and cultural heritage is identified.

Governmental Level

Tonga is currently going through a process of political change with the democratic party being in power. The government is focusing on other topics like their new democratic model, and not prioritising the preservation of cultural heritage as outlined by ‘Uasimoa:

“With what Tonga is going through now with the change of politics and democracy, the priorities of um things for them is quite different and trying to push this whole piece and this idea into a government proposal is I think it would be probably a third or fourth issue to handle to draw their attention to. You can probably know by now that Tonga is just too focused on just the change in the democracy”.

‘Uasimoa, highlights that the leadership changes on government level affects strategic direction and therefore, results in continual policy variations. ICT direction depends on the party in power, and currently the development of an ICT strategy that can provide legislation and policies to guide preservation work is not a high priority.

This is in part due to Tonga's reliance on foreign aid, therefore, priorities are often centered on the agenda and priorities of the foreign nations. For example, the joint commitment for development agreement 2016–2018 between New Zealand and Tonga prioritised: energy, law and justice and education [18].

The lack of leadership and ICT direction means an absent frame work for organisations to prioritise and advance the preservation of cultural heritage. Therefore, ICT is utilised very minimally in the preservation process, as priorities of leaders are directed elsewhere.

Institutional Level

The lack of direction and guidelines on the preservation of cultural heritage in general and the use of IT to safeguard it is reflected in the management and operation of public agencies. Fusi explains that there is a disconnect between the department she works in, which collects and stores information on historical sites, and the office that administers and approves land ownership. Fusi uses satellite data to identify and register historical sites. However, if a potential land owner visits the front office, the front office personnel does not request further information from her department to check if a historical site is part of the requested land. There are neither instructions in place that the front office must request the necessary information from the back office nor are the two IT systems integrated so that the front office could easily access the information through a shared database. Fusi claims that this problem is mainly caused by not having a leader with technical skills who would understand the potential of technology and to integrate the two systems.

“Yes, what we are waiting for is someone on the level of Director so that our work can be managed properly, we need someone on that level who understands technology.” (Fusi). Furthermore, Leka explains, *“we have the capacity (referring to skills) to get the job done but like I said what we need is someone at the top”* (referring to a leader for the department).

The participants highlighted that the team leaders don't have a clear strategy and vision on how ICT can be utilised within the workplace. This is particularly frustrating for the participants as they value their own cultural heritage and would have the necessary technological skills to engage in the preservation process. However, they are disengaged due to a lack of direction and guidance from their leaders.

Lack of resources, the missing policies and leadership result in lack of funding, equipment and training of the participants. Without the required financial and technical support participants won't receive any training on how ICT can be used to preserve cultural heritage. Therefore, the capacity in which ICT can be utilised in the preservation process in Tonga is not realised. Despite their limitations, 'Uasimoa explains that they *“are trying to speak up and seek help from people for us here staff to be trained on how to handle the files and how to take them and convert them to technology, digital”*. Although there has been an effort to commence the digitisation of its historical records within' Uasimoa's workplace, she remarks that *“we are very far behind”*.

5.3 Bottom-up Initiatives to Preserve Cultural Heritage

In spite of the challenges experienced by participants, we found that small ICT initiatives are being implemented by individuals to preserve cultural heritage. Such initiatives are not bound to a hierarchy or a position, therefore, individuals can be proactive and take initiative without violating the hierarchical norms which are highly important in the Tongan culture. Tongans would not act against the instructions of their superior as they respect their authority.

In Tonga, there are grass root initiatives such as The Nuku'alofa Film Festival initiated in 2015, to recount Tongan and Samoan myths encouraging story telling through film making. Although the festival has evolved to include films on current issues for example climate change, it has provided a good platform for encouraging the use of video technology to preserve the cultural roots of the two countries [16]. Lisuia drawing on her personal experience of partaking in grass-root initiatives to preserve heritage comments:

“It has been difficult to sell the idea to locals for a variety of reasons. A lot have agreed that it is an important initiative to document our history and stories via films. One major hurdle will always be that there is no local funding that would allow these visions to happen. But nevertheless, we at the (pseudonym initiative) believe that it will take time. There are a few of us, working little odd jobs in films to make ends meet and at the same time plan to pursue this important vision”.

Other interactive bottom-up initiatives can be observed on social media platforms such as Facebook. For example, the Facebook page ‘Fale a Matapule’, with 14,495 members, disseminates traditional knowledge and ensures its accuracy through online discussions. Furthermore, the video sharing platform YouTube was recognized by the participants as a suitable tool to publish and broadcast their knowledge, their experiences and their handcrafts to a wide audience.

“There are so many ways I think we can use to preserve our culture digitally. Not only through films but also protecting them online. In the forms of website, on YouTube etc. I was lucky to have been funded by ICHCP (Intangible Cultural Heritage for Asia Pacific) in 2016 to make a short documentary on the making of our fine mats KIE. This short video is available on YouTube and I think it is important for students to learn about the knowledge developed by our people on how to make these beautiful fine mats. In 2016 I made a very short film with Coconet on “How to tau’olunga”, which shows some very basic tau’olunga movements. Again, it is available on YouTube”.

Also, families are actively engaging in the preservation process as identified by Sione. Often, their goal is to safeguard their own family roots so that, family members record oral stories of their family genealogies and traditional songs, dances and stories using video cameras. Kepeu explains during an informal talanoa that his daughter audio records conversations regarding genealogy and historical accounts passed down from previous generations. It seems that the local Tongans are engaging in the process of preserving cultural heritage using ICT. This highlights that Tongans are conscious of the need for preserving cultural heritage and are utilising ICT tools to do so.

5.4 Conclusion

The goal of this research project was to explore how ICT is utilised in the process of preserving cultural heritage in Tonga. Taking a social embeddedness approach and investigating the phenomenon in its local context we found that besides traditional methods such as orally from one generation to the next, storytelling in faiva, the talanoa around kava circles, and participating in traditional artwork such as ngatu making (tapa making).

ICT is considered a valuable option to preserve cultural heritage in Tonga. However, due to the lack of an ICT strategy on governmental level, institutions are unable to leverage ICT to its fullest potential to protect historical documents, traditional arts, traditional knowledge and significant historical sites in Tonga. Due to the absence of an ICT policy and therefore lacking legitimization there is no funding, vocational training, and autonomy to act. This missing support leads to frustration of the participants and affects innovation within organisations. However, out of this restrictive and confined environment positive IS innovation has emerged in the form of bottom-up initiatives. These grass root initiatives are occurring on an individual level stirred by hopes, concern and expectations to preserve one's heritage. Although, the goal of this study was to explore how Tongans use ICT to preserve cultural heritage, it is important to emphasize that the traditional methods have carried Tonga's rich culture for many centuries and are still the most common means to safeguard the cultural roots.

In line with the social embeddedness approach it is against this background that we developed the following recommendations that cater Tongan's appreciations for traditional means as well as the potential of ICT.

Firstly, the preservation of cultural heritage in Tonga is essential to the continuance of the culture in the face of globalisation, technological advancements and modernisation. Currently some archaeological sites such as the sia heu lupe, are at great risk of complete demolition and with the destruction of physical historical artefacts, cultural heritage is at risk of erosion. Therefore, we recommend the implementation of clear guidelines on a governmental level on how to preserve cultural heritage and to develop an ICT strategy to leverage the potential of technology to safeguard cultural heritage in Tonga. Secondly, processes and clear instructions especially within government agents and royal agents have to be developed in order to guide employees in how to preserve cultural heritage. These processes and instructions should factor in traditional methods of preservation and the potential of ICT to provide a much more meaningful experience for local Tongans who value the benefit of both. Lastly, there needs to be better financial support and recognition for bottom-up initiatives utilising ICT.

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Southern-Driven Human-Computer Interaction



Socio-Technical HCI for Ethical Value Exchange: Lessons from India

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Abstract. Ethical value exchange is moving to the forefront of the global challenges that HCI will have to address in the coming years. We argue that applying a context-sensitive, socio-technical approach to HCI can help meet this challenge. The background is that the life of marginalized people in contemporary society is challenging and uncertain. The marginalized can face health and cognitive issues as well as a lack of stability in social structures such as family, work and social inclusion. Three questions are of concern when innovating together with people ‘at the margins’: how can we describe users without stereotyping badly, what socio-technical HCI methods fit the local context, and how to make the design sustainable in the face of current planetary challenges (e.g., climate change)? We discuss a socio-technical HCI approach called human work interaction design (HWID) to meet the challenges of designing for ethical value exchange where value extraction is not dominated by one party but equally shared across all stakeholders. We introduce an ongoing case of a digital service to support fishers in Alibaug, India. As a multidisciplinary team of researchers we evaluate the socio-technical infrastructure surrounding a mobile app to support sustainable fishing. This is done through the lens of HWID by highlighting inwardly and outwardly socio-technical relations between human work and interaction design. We conclude by highlighting the value of a context sensitive, ethical socio-technical framework for HCI.

Keywords: Socio-technical · Human work interaction design · Ethical value exchange

1 Introduction

Ethics is moving to the forefront of Human-Computer Interaction (HCI) in these years, adding a new dimension to the current user experience and web 2.0 platform designs [1]. For example, an emerging network for product and service innovation in resource constrained environments explores new design methods, experiences and knowledge of doing innovation with people ‘at the margins’, for example in South Africa, India and Brazil [2]. In these projects that look at Global South Service Innovation there is a lot of focus on a frontstage mindset (e.g., touchpoints, user friendliness, user interfaces), but the methods, tools and infrastructure used to analyse and/or do backstage ‘work’ are envisioned and driven to a large extent by Global North assumptions (e.g., analytical cognitive styles, horizontal decision-making structures, economically-driven thinking). The life of people living in resource-constrained environments is challenging and uncertain. Approaching these people is challenging – their relative exclusion from society and societal resources has created estrangement. Moreover, a lack of resources may make it hard for them to take part in the dominant patterns of innovation and consumption. In addition, it is a significant problem that stereotypes of these people at the margins fail to grasp their experiences and life perspectives [3].

There is therefore a need to revisit HCI analysis and design methods with the aim to co-create alternative patterns of innovation that include the marginalized. Furthermore, in the emerging transformation economy, the focus on assessing the ethical value of design with trust and collaboration in the foreground requires empathic, in-context experimentation and data collection, which requires a socio-technical (ST), context-sensitive approach to HCI [1]. This paper illustrates with a concrete case study pre-mises proposed in a previous publication [4].

In the context of the study of a project supporting sustainable fishing through a mobile app in Alibaug, India, we argue that through a socio-technical¹ HCI (ST HCI) design approach, exemplified with the Human Work Interaction Design (HWID) model [5], researchers and designers can visualize and do something about these critical gaps, and more generally, contribute to an HCI of ‘ethical value exchange’ [1] where value extraction is not dominated by one party but equally shared across all stakeholders. The larger questions that we want to contribute to answer by analysing this case on sustainable fishing in India [6] are how we can innovate together with people ‘at the margins’, how ST HCI methods can address the local societal context, and how to make the design sustainable in the face of current planetary challenges (e.g., climate change).

While fishing is an important source of income in Alibaug it is also an uncertain business in the sense that going fishing is no guarantee of catching any fish. Without fish there is no income but the costs of the fishing trip, in terms of for example ice and diesel, still have to be paid. On top of the certain costs and uncertain incomes fishing also incurs risks to the fishers’ health. High wind speeds, large waves, and dynamically changing weather conditions may damage equipment, injure fishers, and cause fisher

¹ In this paper we use the term socio-technical in a broad sense to cover various traditions thinking social and technical changes together, including the more recent term sociomaterial.

boats to go down. These conditions have motivated the development of an app with a map that shows where the concentration of fish is currently likely to be high. The app also provides local weather forecasts. In this paper, we investigate the ST infrastructure of which this app is part. We develop these arguments through theoretical reflections on ST HCI, present HWID as an instance of ST HCI and then apply HWID to analyse different relations of the ST infrastructure found in Alibaug. We conclude the paper by demonstrating the value of ST HCI for sustainable and ethical design.

2 Socio-Technical Human Computer Interaction

The usability concept, method and professional practice was frequently criticised in the 1980s, because of its lack of focus on the context of use and on non-tangible aspects of the user engagement with interactive systems, i.e. their experience. The response to these criticisms was what Bannon and Bødker [7] would refer to as the second wave in HCI, the shift from ‘human factors to human actors’ [8]. This shift triggered an increasing focus away from individual cognitive theories of human action into social theories such as ethnomethodology [e.g., 9] and hermeneutics [e.g., 10], where context, meaning and collective action were central. However, none of these theories provided a distinct focus on users’ work in the way of ST systems theory as articulated by Mumford in her ETHICS approach [e.g., 11, 12]. ETHICS was Mumford’s attempt to re-articulate the tradition of the earlier work of the Tavistock Institute on human relations in the context of information systems design. ST approaches’ emphasise user involvement and decision making in organisational work contexts, but no clear handles have been provided by authors like Mumford and Weir [12] or Cherns [13] to interactive system designers trying to make their systems more useful and satisfying from a user experience perspective. Dillon [14] defines this gap very well by pointing out that ‘Criteria for effectiveness, efficiency and satisfaction must be derived from the social not the individual context of use’ and calls for ST approaches to be operationalised at the level where user interactions are designed.

ST focuses on the design of IT but insists that the social should be taken into account in various ways. First, the social should be taken into account at the interface level (HCI, UX, interface). Second, ST sees the social in terms of considering the individual worker (job satisfaction, job design, automation), organizational issues (decentralization, decision making, business models, strategy), and societal and ethical matters (access to IT, unemployment, privacy, wealth distribution) [15]. An updated ST HCI approach for the study of workers’ interactions should reflect that any interaction is embedded in a larger context [1]. We use the HWID framework [5] as an emerging ST HCI approach that studies how we can analyse and design for the complex and emergent contexts in which human life and work are entangled. HWID builds on cognitive work analysis and design [16]. It aims to be an updated ST framework for HCI, with a narrow focus on the relations between human work analysis and interaction design.

3 Human Work Interaction Design

HWID emerged around 2005 [17]. It is a framework sitting in a social-relativistic paradigm [18] and can thus contribute to the design of systems supporting work satisfaction and organisational ST HCI design goals. HWID leans heavily on the HCI and human factors traditions' specific interpretation of the *social* and the *technical* elements of the ST system. In HWID the social is analysed as end-users' work tasks performed through IT systems within a given work domain. The focus is on the user's experience of tasks (procedures) and modelling the IT artefact based on its purposes and the constraints imposed by the environment, including task distribution across humans and IT artefacts, and how these agents could communicate and cooperate. Hierarchical Task Analysis [19] and Work Domain Analysis [20] are among the methods that can be used to analyse the goal-directed tasks, and map the work environmental constraints and opportunities for behaviour. In addition, there is a strong tradition in HCI for studying work with ethnographic methods [21] and from ST perspectives, [e.g. 22]. These approaches focus on work as end-user actions performed together with other people in a field setting, that is, the user's experience of using systems is social and organizational. Various approaches and techniques for analysing and interpreting the human work can influence user experience, usability and interaction design, which eventually manifests in the design of technological products, systems and applications.

In HWID the technical focus is either on interaction designs as such, i.e., user interfaces, or at interaction design methods and techniques, i.e., usability evaluation, sketches, prototypes, and more. Interaction design is presented in textbooks as an approach consisting of conceptual models, scenarios, task analysis, persona, usability evaluation, and other user-centred techniques [23, 24]. Importantly, prototypes, storyboards and sketches are presented as sources of inspiration in the design process rather than as the interaction design itself. For example, sketches, such as freehand drawings or low-fidelity prototypes, have been studied for their role in design and have been found to stimulate reflection, particularly in the early stages of design [25]. When moving from analysis to design, that is, from conceptual models to physical design, interaction design relies on the iterative testing of prototypes with users of the future product. In many of these techniques, communication between stakeholders about user requirements is supported by the use of prototypes, mock-ups, and sketches. These relations between work and interaction design are illustrated later in Table 2 in the context of the Alibaug case study. For the original framework see [17].

The value propositions of HWID for ethical value exchange are inspired by Gardien [1]. These imply that HWID theories should conceptualize interaction at the individual level as well as at the organizational, societal, and global levels to help determine what is ethical when speaking of HCI. Users should not be stereotyped in ST HCI methods, which must unfold within the local societal context where they are used. The need for a stronger socio-technical perspective in HCI methods, mainly focused on individual user experience, has already been indicated in the literature [14]. HWID brings this wider perspective to interaction design activities and artefacts.

4 The Alibaug Fishery Case Study

Fishing provides jobs for nearly a million fishers in coastal Indian towns. In addition to the fishers, fishing also provides the livelihood for several million people in the processing and marketing of the landed fish. This makes fishing an important source of income for a sizable group of people in regions with low average incomes and high illiteracy rates. The fishing sector in India faces multiple challenges, which include catch reduction, increased cost of the catch, harsh sea conditions, quality management and also international security concerns.

Technology, especially Information and Communication Technology (ICT) like mobile phone apps, can play an important role in addressing many of these challenges. It can be used to relay information about, for example, the Potential Fishing Zone (PFZ), wind speed, and wave height to the fishers. The development of the app, called mKRISHI® Fisheries, has been a decade-long collaboration between Tata Consultancy Services (TCS), Indian Council of Agricultural Research (ICAR), Central Marine Fisheries Research Institute (ICAR-CMFRI), Indian National Center for Ocean Information Services (INCOIS), and the local fishery societies in a consortium led by the

Table 1. Project timeline

Year	Project event
2011	Idea conceptualization and first stakeholder meeting with fishers, fishing societies, data scientists, and ICT developers. Launch of the first prototype with PFZ and the Wind Speed and Direction Forecast. PFZ forecast available twice a week
2012	Services extended to 13 fishing societies. User Interaction Review workshop with the fishers. Service modified to access the information offline (in a no or low mobile signal network range). Fishers demanded PFZ information on daily basis. Designing the pilot for the signal extension in deep sea
2013	Mobile signal extension in deep sea. Signal extended up to 30 km in sea, across a 120 km coastal area, creating a 3600 sq. km digital highway. User Interaction Review workshop held. Services extended to 56 fishing societies. Image processing algorithm applied to reduce the size of the PFZ images to below 100 KB to make it easy to download on a 2G network. Newer services like Tsunami added. Services rolled out in Ganjam in Oriya language. Service appreciated during Extremely Severe Cyclonic Storm Phailin
2014	User Interaction Review workshop held. Wave Height information service and IMD Weather forecast added to provide a land based weather forecast along with Oceanic state forecast
2015	User Interaction Review workshop held. Use of local language and colloquial terms generally used by the fishers. This reduced the “Learning curve” and dependency on external sources to “interpret the messages”. Added Best Management Practices
2016	User Interaction Review workshop held in other Indian states. A single mobile app (One App) supporting multiple languages and multiple regions (coastal states) has been developed
2017	User Interaction Review workshop during Interact 2017
2018	Single line local language PFZ advisory SMS for the fishers with basic mobile phone handset has been started

Indian Agricultural Research Institute (ICAR-IARI). Table 1 shows key events in the project. Eight years of design and development elapsed from the project was initiated to the fishers started using the app. Since then the app has gone through multiple revisions and it has, in turn, influenced fishing practices in Alibaug.

The resulting app has two main features, see Fig. 1. The first is the PFZ map that shows the locations at which the concentration of fish is likely to be high. The map is updated four times a day on the basis of satellite data. For example, the satellite data give the water colour, which can be used to infer the amount of plankton in the water. Plankton is a crucial food source for the fish; thus, a large amount of plankton in the water attracts a large number of fish. In combination with other information, such as the water temperature, the water colour can be used for predicting the location of fish. The second main feature of the app is weather forecasts. Like the PFZ map the weather forecasts are derived from satellite data. The weather forecasts are tailored to the fishers' needs and, thus, give the wave height, wind speed, and wind direction. This information is particularly important because the area is frequented by tropical storms during which the fishers and their boats are at considerable risk, if they are at sea. While some of the big fishing boats have equipment such as sonars for locating fish, most of the fishers rely on their traditional knowledge. For them fishing was to a large extent a trial-and-error process before the app became available. In addition, the small fishing boats have little or no safety equipment, which increases their vulnerability to bad weather conditions. The information in the app is presented graphically, thereby reducing the need for reading skills. In addition, training sessions have been organized to explain the content and use of the app to the fishers.

On the basis of their first-hand experience with the PFZ map that marked the predicted location of fish, the fishers had a high degree of confidence in its predictions. One of the fishers explained it like this: "You can go and catch fish everywhere but the marking shows: more fish here!" Previously, this pertinent information had been unavailable, or it had merely existed as individual fishers' intuitions. Often, fishers would keep such intuitions to themselves in order not to lose a good catch to someone else. With the app, which was free of charge, this information became openly available. The only thing the fishers needed to access the information was a mobile phone with basic features; almost 90% of the fisher families had such a feature phone. The widespread adoption of feature phones among the fishers had been key to the decision to develop the app for such phones, as opposed to for example smartphones. While the predictions were not infallible, their open availability accentuated a longstanding tension between traditional and industrial fishers. The traditional fishers have small boats and are, therefore, restricted to one-day fishing trips close to the coast. The industrial fishers have big boats for multi-day trips further away from the coast. Because the most attractive fishing locations on the map are often not reachable within one-day trips, the fish at these locations are caught by the industrial fishers. The traditional fishers feel that, as a result, fewer fish come sufficiently close to the coast to become reachable within one-day fishing trips. Without sufficient quantities of fish close to the coast the traditional fishers may not be able to sustain their livelihood. To facilitate a regulation of this tension the project includes activities other than those directly related to the development and deployment of the app. For several days a month TCS and ICAR-CMFRI have officials at the landing centers to monitor the

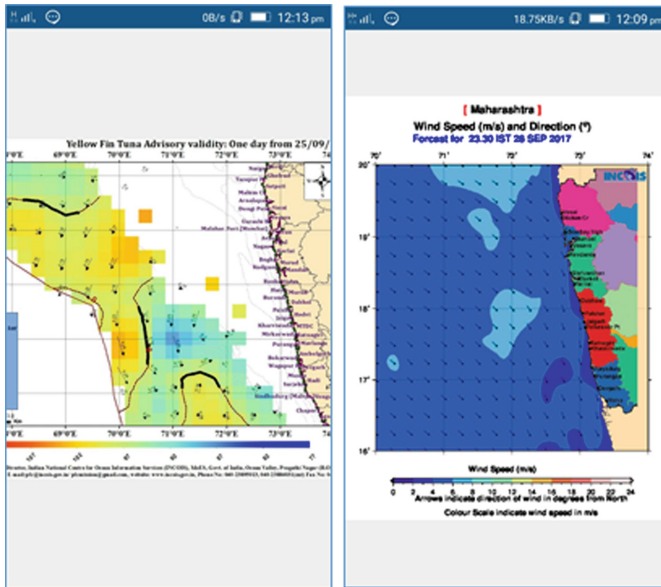


Fig. 1. The two main features of the mKRISHI® Fisheries app: the PFZ map with the predicted location of fish (left) and the weather forecast (right).

amount of fish landed by traditional versus industrial fishers. This monitoring feeds into long-term efforts to support sustainable fishing practices and illustrates that the app is but one component in a complex ST network.

While the app supports the fishers in locating fish and foreseeing the weather, it also serves to bring out tensions in this ST infrastructure. On the one hand, such tensions must be addressed by the project in order for the app to support the traditional fishers, who are its main target group. On the other hand, the ability of the app to bring out such tensions creates opportunities for the project to identify and, hence, work with critical features of the ST infrastructure. It is by seizing such opportunities that the project has continued relevantly for more than a decade.

5 HWID Analysis and Discussion

The Alibaug study was the focus of a workshop at a major HCI conference in India. This was a unique opportunity for local and overseas researchers and mKRISHI® Fisheries project members (including the authors of this paper) to observe and engage with technology-mediated innovative work practices in informal settings. In this context, away from the mainstream industrial sites of the global north, the workshop used the HWID approach to analyse findings related to opportunities for design research in this type of work domain. On day one, workshop participants did a field trip to visit Alibaug. On day two, the workshop participants gathered and reflected critically on the ethical and other aspects of the ICT solution and proposed add-ons and design

revisions. The workshop participants and the TCS and CMFRI representatives shared interpretations from the field trip and discussed HWID activities for ethical value exchange. Since the workshop more discussions have taken place about the status and evolution of the mKRISHI® Fisheries project in Alibaug.

An observation script based on the above presented HWID model and research objective was used to collect data and engage during the field trip and workshop. Based on these data and activities, we used the HWID framework to analyze how the app has become an entry point for the project and fishing community to evolve fishing practices in Alibaug in a sustainable manner. Table 2 shows the different phenomena and relevant relation-theories that went together to form the HWID gestalt emerging in the Alibaug case. Table 2 cites previous studies and theories to help make sense of the ST-HCI relations, with a specific focus on ethical value exchange.

Because an HWID analysis is grounded in the dual epistemology of a social-relativistic paradigm [18], we identified both ‘outwardly looking’ HWID relations that made sense of existing ST tensions (including political and practice ones) and ‘inwardly looking’ HWID relations that informed ST HCI interventions (articulating social and organizational insights for design). Inwardly looking relations of experience design to work artefacts (#1, #5, #7) and work analysis to design requirements (#2), were intertwined with outwardly looking relations of implemented design interfaces to choices of how to do the fishery work (#3, #4) and chosen changes in work practices to appropriation of interaction designs (#6).

Each of these relations in the table invite further discussion. For instance, the first (#1) inwardly relation we identified was how interaction design directly supports human work in the Alibaug case. How specific kinds of design (co-designed visuals and language for easy understanding) support the work of the ‘bottom of the pyramid users’ (illiterate and semiliterate fishers) has been discussed both in practical HCI and in more general consumer research literature [26, 27]. Outwardly relation #3 denotes a relation of conflict between the service provided by the mobile app, granting open access information about fishing zones, and previous knowledge sharing practices among fishers. This phenomenon is identified as echoing recent research on unintended consequences of technology adoption in cultural heritage and economic structures in traditional fishing villages [30]. Moreover, this type of tension can be framed, from an Actor Network Theory perspective [31], as a shift in power relations in a community of practice when its actors ‘translate’ new technology. While there is no space in this paper to discuss each of the relations in the analysis in detail, we hope these two examples illustrate the rationale of an ST HCI approach. While HWID resembles other design-in-use theories e.g. [38], it provides not only design but broader ST HCI interventions-in-use.

Table 2. HWID analysis of Alibaug ST infrastructure

#	Human work	ST-HCI phenomena and relevant Relation Theories	Interaction design
1.	Affordable and accessible app for low end android phones	Direct Supportive relation. Designing for bottom of the pyramid users drive Alibaug fishers' work life [26, 27]	Co-designed visuals and language for easy understanding by illiterate and semiliterate fishers
2.	Go or No Go Advisory shared among fishers. They can verify relation between physical conditions and prediction and save diesel	Direct Supportive relation. Work analysis of small scale fishery construct requirements to design of interactions [28, 29]	Colour coded Wind Speed Visibility Interface for easy decision making
3.	Previously, this information had not been available at all or merely as intuitions held by individual fishers, who would often keep such intuitions to themselves in order not to lose a good catch to someone else	Conflict with existing practice. Design interventions conflict with fishery work practices and vice versa [30, 31]	Potential Fishing Zone (PFZ) Location service map Interface
4.	Fishers Society as a coordinating and regulatory body, including distribution of diesel	Indirect positive consequence (save diesel). Unintended relational consequences of design [32, 33]	Wind and weather advisory information
5.	Different fishing technologies, boat sizes and fishing gears	Takes risks into account. Interaction design decreases risk involved in losing boat, fishing gears and nets [34, 35]	Risk information needed according to type of boat
6.	Community of elderly males lose power, as local key knowledge can be de- and reclassified using the app and thus change gender, e.g., female users of the app might tag areas with fish in new ways	Community of elders delegate decision power to app users, app can be used by non-males. Relational construction of interaction design and fisher(men) gender [36, 37]	mKrishi® fisheries app is designed to be used by any skilled individual, e.g., tagging of fishing areas can be done by any IT knowledgeable person
7.	Small size of the app and the visual content in the app	Direct Supportive relation. Designing for bottom of the pyramid users in the low infrastructure region (poor mobile signal network) [26, 27]	Co-creation based on the input on the network speed and availability

6 Conclusions

As a conceptual framework, HWID in this study helped us create a holistic gestalt of emerging computer-human relations in the Alibaug fishermen's' life. This study provided us with the opportunity to explore how technology design as process and as product could be adapted, through the ST lens of HWID, to articulate ethical issues of value exchange. Through the context-sensitivity of the HWID framework, social issues, technological issues and their interrelations have been considered to address our three questions about ethical value exchange:

How can we innovate together with people 'at the margins'? Our suggested ST HCI approach visualizes power relations in the process of design in order to give people a 'say' and not only a 'voice' [39]; the Alibaug experience shows that while you can ask for feedback and input into the design of interfaces and features, this does not guarantee a full participation by the community where they would be able to articulate the main agendas driving their livelihoods and knowledge sharing practices. How can ST HCI methods address the local societal context? We have demonstrated through outwardly and inwardly looking HWID relations how a predominant focus on the front-end use and experience of the app could overlook delicate and tacit social and cultural back-end arrangements, and what has been and can be done to address these. How to make the design sustainable? ST HCI forces the necessary questions for this beyond interface design principles and provides designers with handles to address sustainability, as an important ST dimension [14]. Thereby, this case study illustrates that sustainability is not only a matter of resource extraction but also of avoiding to destabilize existing traditions and tacit agreements.

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Usability Problems and Obstacles to Addressing Them in Health Information Software Implementations

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Abstract. Usability is widely recognized as a desired attribute of technology, referring to how usable it is to the intended users. As health information systems in developing countries are increasingly digitalized, interaction with familiar analog technologies is replaced by digital user interfaces for many health workers. An array of literature documents usability problems in such initiatives, arguing for their adverse effects on the users, and the system as a whole. What makes it challenging to achieve usability in this context has, however, not been explored extensively. This empirical paper attempts to bring focus to this gap, by defining the concept of *usability design obstacles*, which refer to aspects that complicate the usability design process. The relevance of the concept is illustrated through three empirical vignettes based on two action research projects in Uganda and India. Three concrete obstacles are outlined. These are (1) constraints introduced by software, (2) constraints introduced by legacy design, and (3) scale and heterogeneity of user groups. It is argued that to address the usability problems commonly outlined and discussed by existing literature, more focus on how to overcome such usability design obstacles is crucial. The obstacles identified in the empirical case of this paper also represent avenues for further research, which are discussed.

Keywords: Usability · Design · Generic software · User interfaces · Developing countries

1 Introduction

Health information systems (HIS) play a key role in the strengthening of healthcare by supporting operational and strategic decisions with evidence-based information. Yet, many developing countries are struggling with poor use of such information, bad data quality, and low reporting rates [1]. With increased access to computers, smartphones, and the internet, these countries are taking advantage of digital software packages to support the collection, flow, analysis, and presentation of such health-related information [2]. To the end-users at the lower levels, this means that established paper-based reporting routines are replaced by interactions with computers and smartphones. The digital literacy of these users may at times be limited, while the tasks to be completed may require advanced operations. Further, digital tools often come in addition to, not instead of, paper-based systems and are thus creating additional workload [3]. Hence,

how well the software is designed to support the end-users in their work is potentially an important determinant of the success of these implementation initiatives, possibly affecting user acceptance, data quality, and timeliness [4].

Usability problems in health information software and their impact have been discussed in a variety of research literature, both based on experiences from developed countries [e.g., 5, 6], and in developing country contexts [e.g., 4, 7]. What this paper terms *usability design obstacles* have received less attention. That is, contextual characteristics and aspects that make the process of solving such problems difficult. Based on experiences from implementations of a health information software in India and Uganda this paper argues that the achievement of usability in such projects is associated with some interesting obstacles that will require more focus from researchers and practitioners in order to reach the aim of more usable health information software. Considering the documented negative impacts of insufficient usability, it is timely to go beyond identifying specific usability problems and their effects to explore the underlying reasons for why they exist and how they can be solved. Part of this will be to understand the obstacles to solving them. This research paper explores the question: *What are major obstacles to strengthening usability in health information software implementations?*

The aim here is not to provide an exhaustive list, but rather to illustrate the relevance of the concept of usability design obstacles, by highlighting and discussing some seen as particularly challenging and in need of further research. Before addressing this question, a background and brief overview of related literature are provided. This includes defining usability design obstacles, as a phenomenon distinct from usability problems. An empirical case is then presented through three vignettes that highlight the challenges experienced during different software implementation projects in Uganda and India. Finally, these are categorized into three high-level obstacles, which are argued to be appropriate for future research that seeks to contribute to theory and practice on usability in health information software in developing countries.

2 Usability in Health Information Software

Digitalization of health information systems routines is driven by the variety of benefits that digital systems can yield, such as storing, aggregating, combining, analyzing, and presenting large amounts of data efficiently [2]. The process of digitalization might also impose a variety of unintended, undesirable consequences, for instance, in the replacement of well-established paper forms with digital interfaces. Ash et al. [8] illustrate how the implementation of a computerized physicians order entry system introduced adverse effects such as more time used for data entry, decreased end-user satisfaction, and unwanted changes in workflows and interpersonal relations. Ghosh et al. [9] document beneficial properties of paper that the end-users value, and which are lost in the process of digitalization of a mobile banking system in Ghana. The authors note that *“recovering or preserving these affordances in a digital solution requires additional consideration to design and implementation.”* p7. Pal et al. [4] reports from a project in India where data reporting forms used by a group of community health workers (CHWs) were digitized. After implementation, data entry on

mobile screens were slower, and the CHWs reported that they preferred the old paper-based system to the new digital system. The challenges were attributed to the complexities of the existing data entry process, and to the limitations of the digital media. For example, paper margins were commonly used to explain errors, an affordance that the computer system did not accommodate. Moreover, none of the participants fully understood fundamental concepts in the system, such as how to go back to start, rename, save or send the report. The authors noted that the implementation of digital systems “*involves altering existing practices and, in many ways, fundamentally changing the CHW workflow and relationships with communities*” [4]. Based on such challenges, a variety of literature calls for an extended focus on usability in health information systems software development and implementation [5–7, 10]. Usability is a term that describes the quality of the interaction that takes place between a user and a product. A system with high usability should enable the intended users to achieve specific goals with effectiveness, efficiency, and satisfaction [11]. This means that usability is not a result of the layout and structure of a system alone but how well the system works with a set of users in a specific context of use. Typical measures of usability include learnability, efficiency, memorability, errors, and satisfaction [12], all of which may be of relevance to health information software implementations in developing countries with resource constraints and users with varying digital literacy, suffering from high workloads and understaffing. For instance, high learnability and memorability may reduce the need for extensive training and ensuring that users can easily identify the right actions for the intended task [13]. Efficiency is an obvious advantage in a situation where the use of information software is only but one of several tasks during the workday [1]. Errors during data entry is a frequent problem experienced in digital health information reporting regimes, documented to range between 2 and 14 percent for novice users pending on the amount of training received [13]. A common argument is thus that systems should be designed to minimize the risk of entry errors [6]. Furthermore, user satisfaction is both of intrinsic value by improving the lives of the health worker and may further affect user acceptance which may have a positive impact on the adoption and correct use of the system [7].

2.1 Usability Problems and Obstacles to Solving Them

To move beyond outlining and describing specific usability problems, this paper makes a distinction between problems experienced by users of a system, and the difficulties software implementers face when trying to avoid or solve them. Usability problems are the standard term used to refer to specific aspects of a system that makes use difficult to end-users, and thus reduce usability [e.g., 12]. A standard term for aspects that might challenge the ability to solve such problems does however not exist. ‘*Obstacle*’¹ is a good candidate and can be found used for this purpose in Seffah et al. [14] and Bak et al. [15]. Other literature uses the term obstacle either to describe something end-users has to overcome due to usability problems [16], or present usability itself as an obstacle

¹ Defined by the Oxford English Dictionary as “*something that stands in the way or that obstructs progress*”.

to reach a greater goal of a system [7]. This paper suggests using the term *usability design obstacle* to refer to contextual aspects that might constrain or obstruct the ability to ensure usability in a system. Table 1 provides a summary with definitions of usability problems, usability as an obstacle, and usability design obstacles.

Table 1. Usability problems, usability as an obstacle, and usability design obstacles.

Term	Meaning	Example of use
Usability problems	Specific aspects of a system that makes use difficult to end-users, and thus reduce usability	<i>The software has several usability problems affecting user satisfaction and efficiency</i>
Usability as an obstacle	The limited usability of a system represents a constraining factor in reaching a greater goal	<i>Insufficient usability in data collection software is an obstacle to ensuring data quality in the health information system</i>
Usability design obstacles	Contextual aspects that might constrain or obstruct the ability to ensure usability in a system	<i>Ensuring usability in the software is difficult due to several obstacles</i>

2.2 Usability Problems

Usability problems with software in health-care settings have been widely documented in both developed and developing contexts. For instance, Koppel et al. [6] report how problems that can be subscribed to the usability of the UI of an order entry system facilitated frequent fatal medication errors. Atashi et al. [7] present results from a usability evaluation of a nation-wide health information system in Iran, outlining a variety of severe usability problems that may affect data quality, efficiency, and user satisfaction. Based on this, the authors argue that the design should take the end-users mental models and prior knowledge more extensively into account. Khajouei et al. [5] present a review of the literature reporting usability problems in computerized physician medicine ordering systems, where several frequently occurring issues are outlined. The authors argue that usability can be improved by ensuring that systems follow pre-established work-routines. Medhi et al. [13] report usability problems experienced by novice users of mobile interfaces in India, Kenya, South-Africa, and the Philippines. These relate to typical digital design concepts such as hierarchical navigations, vertical scroll-bars, and soft-key mappings. Nabovati et al. [10] identify several severe usability problems in a widely used laboratory and radiology information system, many in which they classify as major or even *catastrophic*.

2.3 Usability Design Obstacles

As the set of literature presented in the previous section, most research on the usability of health information software in developed and developing countries contributes by identifying and categorizing usability problems. Often, they further argue for designs that are more sensitive to the intended users. Aspects which is here termed usability design obstacles have been outlined and discussed by general usability literature.

For instance, Bak et al. [15] outline six obstacles to usability testing in organizations based on surveys and a literature review. Major obstacles identified include the mindset of the developers, resource demands, finding and motivating customers to participate, conducting the tests, and institutionalizing routines within the organization. Edwards et al. [17] briefly discuss how usability problems are handled to affect the design in such projects. They comment that a common aspect of health information systems design projects is the use of commercial software products. Even if the software is customizable, a substantial part of the design is beyond the power of the implementers and will require changes in the core application. This aspect may constrain the ability to respond to usability problems, thus acting as a usability design obstacle. Martin et al. [18] reports similar experiences, where usability problems that cannot be solved through technical redesign tend to end up solved through end-user training.

Usability design obstacles typical to health software implementations in developing country contexts are however under-researched. An exception is Ghosh et al. [9] which reflects on how routines and understandings around existing paper forms play an important role and might hinder the ability to achieve usability in digital interfaces.

In sum, there is a broad consensus that usability problems within health software are frequent and may result in fatal consequences. To cope with these challenges, systems should be designed according to the context of use, and the end user's practices and mental models. Investigations and explicit discussions on usability design obstacles are however limited. After outlining the research methods of this research and three empirical vignettes, three such prominent obstacles will be described and discussed.

3 Methods

The research providing the foundation for the empirical case of this paper is a part of the Health Information Systems Program (HISP), an Action Research (AR) project following health information systems strengthening and software implementations in a variety of developing countries during the last two decades [19]. The vignettes presented here are resulting from a two-year AR project in Uganda, and an ongoing AR project in Uttar Pradesh in India.

AR is a methodology that aims at identifying challenges within systems and introducing, evaluating, and learning from interventions. It is often presented as a five-stage cyclic process with (1) a diagnosis of the system of focus, (2) action planning directed by theory and existing research, (3) *action* by introducing an intervention, (4) evaluating the outcomes, and (5) specify the learnings [20]. In Uganda, several cycles of AR was completed, and the author of this paper had a central role throughout the process by being involved directly in all stages of the project. A variety of discussions, interviews, observation, and participatory design activities were conducted and documented as data. This was analyzed using thematic analysis [21]. Parts of the data has been re-analyzed for the sake of this paper. In India, the AR project is in an initial phase, and the data presented here are from the diagnostic stage, where the author has played a central role in identifying usability problems in a software already being used across the state. As part of this, interviews and discussions were conducted

with four software implementers, two key actors at the organization of implementation, and six end-users of the implemented software. Data were analyzed through thematic analysis and compared with data from the Uganda-project.

4 Case: Implementing DHIS2

This section will present empirical experiences from Uganda and India that illustrate how some usability problems are difficult to solve due to usability design obstacles. A commonality between the projects is the replacement of existing paper-based regimes, and the use of the DHIS2 software as a central component in the new digital solution. First, a brief description of this software will be provided, before moving on to three vignettes as examples of implementation.

4.1 DHIS2 and Three Implementations

DHIS2 is an open source software package that was originally developed in close collaboration with end-users to support routine reporting in the South-African health system in the nineties [22]. Proven to be a success, the software has over time been implemented in an array of countries, to support collection, transfer, analysis, and presentation of health-related data in several domains [e.g., see 2]. This implies that the system is increasingly being taken to settings that deviate from the logic originally inscribed in the software. To respond to this, the global software development team are aiming at making the system generic rather than specific to implementations, to allow for variety. When the DHIS2 is installed to be used in a new setting, local implementers will start by configuring the system to correspond to the specific needs of the use-case. Organizational hierarchies, health programs, and data elements are defined, and dashboards, reports, graphs, maps, and data entry forms are designed to allow for the collection and presentation of data. To facilitate this, the software comes with a variety of customizable tools. For instance, data entry forms can be created using a standard setup, or by using HTML, CSS, and JavaScript to achieve custom layouts. To support more extensive customization, the DHIS2 software allows for the development of third-party applications or ‘apps’. An application programming interface (API) enables developers to interact with the software’s core resources (e.g., organizational structures, user rights, health programs, data elements, forms, etc.). The final app can be installed into the software so that it appears as an integrated component to the users. By being mediators between the implementing organization and the software, the implementers of DHIS2 could act as customizers, developers, and designers. We now turn to three vignettes providing insight into the process of implementing the DHIS2 software.

Vignette 1: Health Commodity Ordering in Uganda

In 2012, DHIS2 was implemented as a national health commodity ordering system in Uganda, used by health workers at public clinics and hospitals to report on bi-monthly consumption (see [23]). The user interface was customized to suit the domain-specific concepts of logistics management and various contextual particularities. However, due to lack of flexibility for customization of aspects such as how to display forms and

deadlines, the interface required the end-users to change their work practices and adopt terminology and logical concepts that were alien to them. Moreover, when presented on a digital surface, the form was hard to navigate which caused frequent entry errors. To respond to these usability problems, a participatory design process was initiated with end-users of the system. However, the level of customization needed was beyond minor configurations of the form and would require the development of a third-party app. Although this provided the implementers with extended design-flexibility, development required more time and competence.

Moreover, the users of the system were widely heterogeneous regarding frequency of use and technical competence. For the less digitally fluent, the paper-based forms were central to their understanding of the reporting process, and when design prototypes deviated too much from the paper forms, these users were often confused about the relation between the interface and the familiar entry process. Thus, the possibility to design radically new layouts that could make it easier to present the extensive form on desktop screens was limited by the layout of the paper form, and tradeoffs had to be found. In sum, the process was characterized by obstacles related to finding a balance between design-flexibility and use of resources, paper, and digital layouts, and the diversity of needs and preferences within the user-group.

Vignette 2: Routine Reporting in Uttar Pradesh, India

In the state of Uttar Pradesh in India, DHIS2 has been implemented as a standardized system for routine health reporting from thousands of health facilities to the state level. Around 45 different reporting forms have been implemented in the system to be used on desktop screens by health workers at facility and district level. The forms are designed based on the existing paper-based layouts by using the built-in configuration tools in the software. The layout is argued to be beneficial as it provides a familiar design to the users. However, the presentation of these large forms on a digital surface has introduced usability problems, making the data entry process cumbersome and more time-consuming. Also, more technically fluent users indicate the desire for more advanced functionality, and less paper-inspired layouts to make their work more efficient. A process of redesign is now being initiated to strengthen usability. As in Uganda, how to balance the varying needs and how to reflect these in DHIS2 represents obstacles that imply a challenging process forward.

Vignette 3: Doctors Diary Reporting System in Uttar Pradesh, India

Another part of the project in Uttar Pradesh is the implementation of DHIS2 to support around 20.000 doctors to report their daily workload and challenges experienced regarding infrastructure and equipment. Here, another generic part of the software is used to set up data storage functionality, and the user interface. In the DHIS2 software, this generic component is designed for other types of data collection processes in mind, and the customization capabilities are limited. This has caused a layout non-intuitive to the users, making fundamental tasks both time-consuming and prone to failure. The implementers' ability to ensure usability has thus been constrained by the flexibility of the software. Plans for improvements involves user involvement and development of a third-party app. Although promising regarding design-flexibility, the process is complicated by obstacles such as the geographic distribution and heterogeneity of the users, and the required resources and competence to develop third-party apps.

5 Analysis and Discussion

The three vignettes give a brief insight into obstacles implementers face when attempting to achieve usability during the implementation of DHIS2. While much literature has pointed out a variety of specific usability problems in health software, these examples illustrate that responding to such matters is not straightforward. These difficulties can be categorized into three high-level usability design obstacles: (1) constraints introduced by the software, (2) constraints introduced by legacy design, and (3) scale and heterogeneity of user groups.

Obstacle 1: Constraints Introduced by the Software

Much of the software used in health information systems today are commercial, off-the-shelf, and *generic* [17], and not built specifically to the use-case of implementation. DHIS2 is one example of these types of software, designed to support variety, and implemented and made locally relevant through a process of customization. Design affecting usability is as such happening at two levels and with contrasting aims and rationales. The global designers are culturally and geographically distant from the final end-users, and aim at providing usability in basic, widely used aspects of the software, while empowering local implementers with customization capabilities [24]. In line with Edwards et al. [17], the ability for the local designers to mold the software according to the user's mental models and established practices, and to address usability issues that are discovered during and after implementation may be greatly constrained by these options of customization [25]. When constrained by the lack of such options, Edwards et al. [17] promote the importance of close relations and frequent communication between implementation projects and the global software development team. Optimizations beyond the ability of the local implementers could be communicated to core developers to be improved in the generic software. However, as generic software aims at supporting variety, and usability is achieved by being sensitive to specifics within a domain, organization, and group of users, universal usability across all use-cases would be impossible. The ability to create third-party apps is one means of dealing with this issue in DHIS2. Albeit flexible, this introduces new tensions on resources and competence. The same tension appears in the planned process in Uttar Pradesh, where the flexibility of DHIS2 to support variety is pushed to the limit. This represents an obstacle that leaves implementers with decisions related to the balance between flexibility and costs, which will ultimately affect the ability to ensure usability for the end-users.

Obstacle 2: Constraints Introduced by Legacy Design

In the two first vignettes, well-established paper-based systems have been replaced by the DHIS2 software. By designing the digital form based on the paper layout, the designers aim to provide a familiar design to the users, making the transition from analog to digital easier. However, as illustrated by Pal et al. [4] and Ghosh et al. [9], a variety of useful characteristics of the original paper forms are lost in this process, and the layout may not be appropriate for presentation and navigation on digital surfaces [23]. This situation poses a major obstacle to implementers as the use of familiar concepts and elements must be balanced with new ways of structuring the data entry

when moving from paper to computer surfaces. In the process, designers must attempt to understand which elements and properties of the existing design that provide useful affordances to the users, and how to bring these into or offer substitutes in the digital surface [9]. For global generic software designers, finding a one-size fits all solution may be an impossible task as the right concepts and elements to bring into the digital design may vary significantly between different domains, use-cases, and cultural settings. Thus, the local implementers are faced with tough decisions, opportunities, and constraints introduced by both the technical and analog artifacts.

Obstacle 3: Scale and Heterogeneity of User Groups

Customization aims at making the generic more specific, and usability is reliant on designing systems according to the intended users and their context [11]. A common way to ensure this fit is by involving the relevant users in the development process [26]. The ‘specific’ in our three vignettes is however strikingly diverse with an enormous scale in the number of use-sites and heterogeneity of end-users. In Uttar Pradesh, the routine reporting forms are used thousands of health facilities, and the doctors reporting system is aimed at supporting 20 000 doctors. Similarly, in Uganda, the commodity ordering system was used by health workers in a high number of health facilities. Within each project, all sites may have different practices and routines, and users with different mental models and experiences with technology. Designs that could make use easier for a novice rural health worker may be perceived as inefficient by a statistician at the district health office. The statistician might wish for advanced functionality based on prior experience with statistical software, but this might confuse other users and reduce usability. Reaching for ideal solutions and usability for all might be impossible, and questions such as who to design for and how and who to involve in the design process represents an obstacle. One option would be to allow end-users to customize the software themselves according to their needs [25, 27]. This might, however, complicate training activities, support, and further updates to the software. Also, imagining that health workers in rural areas, overloaded with clinical work will spend the time to customize advanced software packages may be overly optimistic. It may be especially problematic when working with software that is to be implemented in a developing country context where differences in computer-literacy between users can be significant. How to align such diversity within the “specific” represents a significant obstacle with no easy solutions and is yet to be handled in implementation projects such as those in Uttar Pradesh.

6 Conclusion and Future Research

This empirical paper has attempted to move beyond outlining usability problems in health information software by putting emphasis on usability design obstacles to ensuring or improving usability in such implementation projects. The relevance of the concept of usability design obstacles has been illustrated through three vignettes reporting from two case-studies. Three high-level obstacles have been identified and outlined; (1) constraints introduced by software, (2) constraints introduced by legacy design, and (3) scale and heterogeneity of user groups. All representing aspects that

might constrain or obstruct the ability to ensure usability during implementation of health information software. Based on these, three avenues appropriate for further investigation in future research are suggested in the following section.

6.1 Moving Forward

The experiences presented in the vignettes and the three main usability design obstacles outlined give rise to three questions that call for a further investigation by researchers, and that are relevant to practitioners attempting to ensure usability when implementing or trying to improve health information software.

How can generic software cater for local usability?

For global software designers, reducing this obstacle could, for instance, involve reflecting on technical features that can empower local implementers with the means to achieve local usability through customization. For implementers, this is not just a question of flexibility, but also how to utilize the design-space provided with limited resources at hand. Theories, concepts, and models from research on meta-design [27], and software platform architectures [28] discuss such technical and institutional arrangements and could be of relevance to further investigations on this topic.

How to balance between the skeuomorph and designs adapted for contemporary digital interfaces?

Rather than merely copying paper layouts to a digital surface or designing brand-new layouts which provide no familiarity to the user, compromises should be found. Going into detail on the design elements of existing systems and “*shed light on specific affordances of paper that low-income, low-literate users in the developing world may especially find beneficial*” [9], could be a critical step towards digital interfaces that are more usable to end-users such as health workers. Here, the concept of skeuomorph design, that is, bringing and adapting design-elements from the physical world into digital interfaces might be suitable and find its renaissance.

How to facilitate participation and balance between needs and requirements in large, distributed, and heterogeneous user groups?

The “specific” in which achieving usability during development or customization implies, is often rather diverse in health software implementation initiatives in developing countries. Making health software more usable to health workers will require research beyond the ‘generic global’ versus the ‘local specific’ and discuss how distribution and heterogeneity can be handled and balanced at the level of implementation.

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Human-Computer Interaction for Development (HCI4D): The Southern African Landscape

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Abstract. Human-Computer Interaction for Development (HCI4D) research aims to maximise the usability of interfaces for interacting with technologies designed specifically for *under-served*, *under-resourced*, and *under-represented* populations. In this paper, we provide a snapshot of Southern African HCI4D research against the background of the global HCI4D research landscape. We commenced with a systematic literature review of HCI4D (2010–2017) then surveyed Southern African researchers working in the area. The contribution is to highlight the context-specific themes and challenges that emerged from our investigation.

Keywords: HCI4D · Systematic literature review · Southern African snapshot

1 Introduction

Research into the social implications of computers in developing countries is the primary goal of IFIP 9.4¹. There is a specific focus on the experiences relating to information and communications technology (ICT) implementations in developing countries. This resonates with the *raison d'être* of the Human-Computer Interaction for Development (HCI4D) research domain, *viz.* understanding and designing technologies for *under-served*, *under-resourced*, and *under-represented* populations [1]. The global evolution of HCI4D has been described in seminal papers by Ho, Smythe, Kam and Dearden [2], Toyama [3], and Dell and Kumar [1] while Abdelnour-nocera and Densmore [4] presented perspectives and challenges for international development in information and communication technologies (ICTs). These papers highlight the fundamental concerns, trends and challenges, on a global scale. However, the current literature does not address Southern African and situated HCI4D. The research reported here bridges this gap. The purpose of this paper, thus, is to provide an overview of the current status of HCI4D and then focus on Southern Africa, specifically the Southern African Development Community (SADC) states², Uganda and Kenya. Kenya and

¹ http://www.ifip.org/bulletin/bulltcs/tc9_aim.htm.

² <https://www.sadc.int/member-states>.

Uganda have active HCI4D communities involved in AfriCHI therefore; we added those countries to the SADC countries. Henceforth this sample will be referred to as the *African Southern and Eastern (A_SE) set*.

2 Research Design

The mixed-methods research design consisted of three phases. The *First Phase* systematically reviewed HCI4D literature to pinpoint the salient concepts and to prioritize topics to guide the subsequent *Systematic Literature Review* (SLR). The *Second Phase* conducted a SLR of HCI4D literature over the last decade. The *Third Phase* surveyed Southern African HCI researchers to add a Southern African perspective.

2.1 Phase One: Identify Concepts and Topics

Information and Communication Technology for Development (ICT4D) has been defined as *the application of any entity that processes or communicates digital data in order to deliver some part of the international development agenda in a developing country* [5]. Human-Computer Interaction for Development (HCI4D) was originally focused on *adapting traditional HCI methods and techniques for designing and deploying solutions for developing nations* [6]. Abdelnour-Nocera and Densmore [4] argue that HCI4D was an outgrowth of HCI that specifically sought to address tensions between local cultures and the assumptions, priorities and values embedded in the extant tools and concepts deployed by this discipline. Therefore, HCI4D lies at the intersection of HCI and ICT4D.

Toyama [3] reviews the historical relationship between HCI and international development and compares their disciplinary approaches. This is useful, in terms of positioning HCI4D as an interdisciplinary field, distinctly shaped by its inheritance from HCI and ICT4D, especially in terms of highlighting its methodological differences. According to Abdelnour-Nocera and Densmore [4], HCI research and literature provides conceptual and methodological tools that are useful in understanding the human dimension of ICT4D. The human element is also pervasive in ICT design, implementation and evaluation, where the focus is on the difference in the performance of technology in different geographies. HCI4D, on the other hand, reports on local experiences, adapting and implementing conceptual and methodological HCI frameworks to make them locally accountable.

The following two studies informed the methodology we adopted, because they, too, reviewed the HCI4D literature. Ho *et al.* [2] presented a conceptual map with the aim of making sense of the emerging HCI4D literature. Dell and Kumar [1] presented an empirical analysis of HCI4D literature (2009–2016). Their findings were based on a survey of 259 HCI4D publications selected from peer-reviewed journals and conference papers that mentioned the keywords ‘*HCI4D*’, ‘*ICTD*’, ‘*low-resource*’, ‘*developing world*’, ‘*developing regions*’, and ‘*development*’. They depicted the evolution of the research domain, with an overview of the (1) geographies covered, (2) technologies targeted, and (3) the epistemological and methodological underpinnings. We adopted the methodology from Dell and Kumar [1] for our review, the methodology categories in our survey is based on Toyama [3] and the analysis of grand challenges on [1–3].

2.2 Phase 2: Systematic Literature Review (SLR)

A systematic literature review comprises a systematic search for, and appraisal and synthesis of, research evidence of comprehensive scope with clear inclusion and exclusion criteria [7]. A critical literature review goes beyond a description of the identified articles, to include a measure of analysis and conceptual innovation, typically manifesting as a hypothesis or model [8]. The latter applies to the goal of this study: i.e. to represent the overall state of HCI4D in terms of *where* the research was conducted, *who* was involved and *what* challenges were addressed. The review was conducted on ACM, Springer, Scopus, and Web of Science databases for peer-reviewed conference and journal articles published between 2007 and 2017 using the search string “HCI4D”.

- Step 1.** A total of 239 papers were returned. Removing duplicates left 159 papers.
- Step 2.** Google Scholar returned a further 314 items.
- Step 3.** Combining the results from Steps 1 & 2 gave us a total of 473 papers. Duplicates were removed, leaving 349 papers.
- Step 4.** Panels, workshops, editorials, extended abstracts, forums, books, and book chapters were removed, leaving 213 papers to support in-depth analysis.

A key limitation of this study is that the authors’ country affiliation is operationalized as the location of the institution where the authors worked, instead of where they are originally from. In some cases, it is possible that although some authors were not affiliated with a developing country, they are in fact from a developing country. Another limitation is that the selected search engines covered mostly journal papers; this was mitigated by including 314 Google Scholar papers.

2.3 Phase 3: Survey

The survey was emailed to the AfriCHI mailing list, AfriCHI being the premier Southern African HCI conference that draws researchers from the global HCI community but especially from SADC countries, as well as Uganda and Kenya. The study received ethical clearance from the School of Computing at the University of South Africa. The survey can be found at [<https://goo.gl/53XBsd>] and we received 20 responses.

3 Results

3.1 Literature Analysis

WHERE: Figure 1 shows where the research was carried out, as well as the location of 1st and 2nd author institutions. The largest number of first authors came from the USA (88) followed by South Africa (28), the UK (17), India (14) then Australia and Namibia with 9 authors each. The 52 papers from the *A_SE set* (constituting 24% of the papers) authors’ distribution was as follows: South Africa (25), Kenya (8), Namibia (7), Lesotho (3), Uganda (2) with Congo, Mozambique, Tanzania and Zimbabwe each

with one paper. The remaining 3 papers reported on inter-country comparisons. This reveals discrepancies between the countries where the research was carried out, and the location of the first authors. For example, many studies carried out in India and Kenya were published with first authors from the northern hemisphere. Publication practices, such as publishing in teams (design laboratories) and alphabetising authors, the types of papers (overview or theoretical papers not country based) and the distribution of highly prolific authors, could be distorting this overview to some extent.

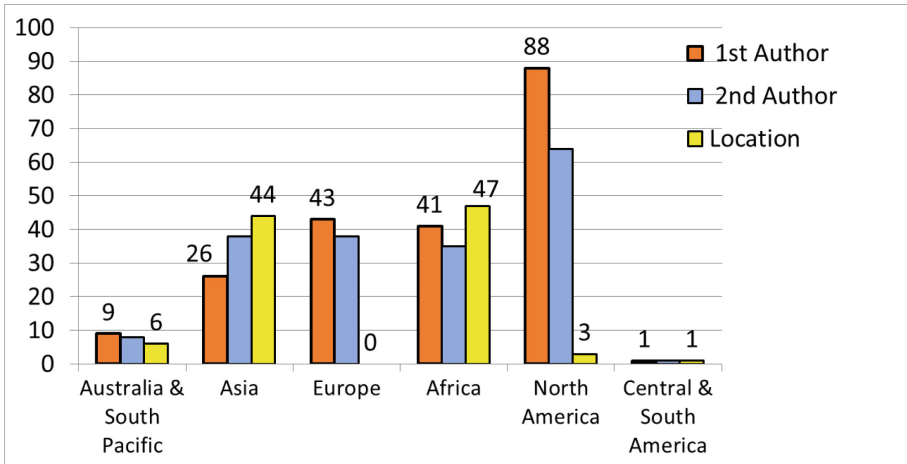


Fig. 1. Research location, 1st and 2nd authors, shown in broader geographical areas.

Authorship is a multi-faceted issue and global collaborations can be mutually beneficial. However, this should not occur at the expense of local voices [9] or allow the Global South to become a playground for Western ICT4D scholars [10].

WHY: In terms of the focus areas, *Community* was the most prominent, followed by *Health, Theory, Access* and *Education* all at similar frequency levels. Theory development has received more interest since the previous survey, where the frequency rating prioritised Education, Access and Health in declining order with Theory in the 10th position [1]. Table 1 categorises the papers we reviewed using categories proposed by Dell and Kumar [1]. The findings confirm that all these user groups are still being investigated in HCI4D research and that the research is geographically distributed. The ‘General’ group comprises papers where the user group is all-inclusive or undefined; this also includes overview and theory development papers.

HOW: The research methodologies deployed in the analysed papers were (in order of frequency): Ethnography, Design Science, Participatory Design, Action Research, Case Studies, Mixed Methods, Literature Review, Grounded Theory, Actor-Network and Activity Theory. The methodologies used confirm the HCI4D focus on addressing real world problems, *in-situ* research and practice-led contributions [3]. In terms of technologies used in the research, 58% used mobile phones, 24% used laptops, 7% used other technologies, 2% used DVD or video and 9% did not specify a technology.

Table 1. Papers categorized (based on categories by Dell and Kumar [1])

Ground-level users		Examples	Research conducted (Location)
<i>Under-Served</i>	The Elderly	[11–13]	Canada; X*; South Africa (SA)
	Low-income	[14–16]	China, India, SA
	Illiterate, semi-literate	[17–19]	0; India; Pakistan
<i>Under-Resourced</i>	Migrants or Refugees	[20–22]	Palestine; Kenya; Palestine
<i>Under-Represented</i>	Patients	[23–25]	SA; Sweden; SA
	Women	[26–28]	Bangladesh; India; India
	Agricultural Community	[29, 30]	India; Pakistan
<i>Specific Use Scenarios</i>	Mobile phone users	[31–33]	Bangladesh; Morocco; Australia
	Wi-Fi users	[34, 35]	Cuba; India
	Households	[36–38]	SA; India; Kenya
	Pupils or children	[39, 40]	Mexico; India
	University students	[20, 41–43]	USA; China and Australia; Palestine; Malaysia
	Teachers	[44–46]	Indonesia; Indonesia; SA
Human-Access Points			
Healthcare workers		[47–49]	X; Mexico; X
Microfinance		[50, 51]	Azerbaijan; India
Researchers		[52–54]	X; Kenya; X
Collective Entities			
Communities		[55–58]	Australia; SA; SA; India
Organisations		[59, 60]	India; India
Citizens		[61–63]	Bangladesh; SA; Namibia
Rural		[64–66]	Namibia; India; India
Other			
General - No specific group		[1–4]	X; X; Kenya; X

*Note: X means that the research country was not indicated

3.2 Survey Results

We received 20 anonymous responses to the survey; too few to support statistical analyses. However, a number of valuable insights *did* emerge in the categories of *whom*, *why* and *how*.

WHOM: Based on the voluntarily divulged email addresses, we observed that most respondents were South Africans or Namibians.

WHY: The participants were asked to select all applicable options so the total number of domains selected exceeds 20. The most prevalent focus area was *Education* (18 of 20 participants), followed by *Community* (8), with 7 each in *Government*, *Social Media* and *Health*, 6 in *Theory*, 5 in *Sustainability* and the *Internet of Things*, 4 in *Access*, 3 in *Gender*, *Assistive Technology* and *Politics* each and at least one person working in each of the fields of *Agriculture*, *Business*, *Cybersecurity*, *Transportation* and the *Environment*. The focus on *Education* highlights the challenges with human-capacity development and 21st century skills development. Furthermore, there is sustained interest in most of the categories previously identified, with *Government*, *Internet of Things*, *Business* and *Cybersecurity* now added.

HOW: The participants were asked to select all applicable options so the total exceeds 20. The deployed *philosophies* were *Interpretive*: 16 (76%); *Post/positivist*: 9 (42.9%); *Critical realist*: 6 (28.5%). In the category, *Other*, there were 4 researchers (19%) and the listed philosophies include ‘decolonist’, post-colonial feminist, African Philosophy, pragmatism and constructivism’. The remaining researchers did not actively use or promote a philosophy.

The *methodologies* (based on Toyama’s categorisation [3]) included *User studies* (needs and context): 15 (75%); *Design & iterative prototyping*: 12 (60%); *Participatory design* 11 (55%); *Evaluation using observation* 10 (50%); *Evaluation using self-reporting* 9 (45); *Evaluation using digital logging including eye tracking* 8 (40%); *Ethnography* 6 (30%); *Other* 5 (25%); *Critical Computing*: 2 (10%). Participants added *Design Science Research*, *Anthropology* and *document analysis* to the list of options provided. Smartphones were the most frequently used technology: 17 (81%) followed by PC or Laptop: 15 (71%) and Basic or feature phone: 11 (53%).

Table 2. Mapping challenges identified to survey responses

Ho et al. [2]	Dell and Kumar [1]	Toyama [3]	Corresponding challenges mentioned by Survey Respondents (quotes Ri refers to individual respondents)
Improving <i>HCI Capacity</i> in Developing Regions	How can we further build capacity?		“Acquisition of funding for basic research on development”. (R10); “Lack of researchers in HCI, and availability of viable projects due to limited technology by the community”. (R16);

(continued)

Table 2. (continued)

Ho <i>et al.</i> [2]	Dell and Kumar [1]	Toyama [3]	Corresponding challenges mentioned by Survey Respondents (quotes) R _i refers to individual respondents
Reflection around <i>HCI4D</i> practices	How can we broaden the scope of HCI4D?	Technology Alone is Not Enough	“We need to understand the real needs/incentives/ expectations of the recipients first. More often than not, we are “throwing” technology at humans, then analysing the outcomes in the hope that it would have an effect/outcome. We should first ask ourselves - what is required/needed/ practical? It is a fine line, but to me it seems that for many proponents, HCI4D is all about doing the “right thing” in the context of our history as opposed to doing what is really required”. (R4)
	How can we engage with a wider audience?	Technology Sharing and Intermediation	“ <i>Diversity</i> of end users, rapid evolution of technology (with many left behind)”. (R13)
Develop replicable, low-cost approaches and hardware that can be appropriated and adopted by community-based organizations with minimal requirements for external support	How can we design for non-traditional settings?	Hardware and Infrastructure Constraints	“There are pockets of very good use of ICT, but the issues around resources and infrastructure prevent the general use by the majority of the population. Africa is already fallen behind in participating in the knowledge economy due to low computer literacy levels, however we have a real chance to address the situation using mobile”. (R9)
User Interfaces for Illiterate and Semi- Literate Users	How can we improve interactions for diverse users?	Cultural, Linguistic, and Non-Linguistic Adaptation	“Diversity of end users, rapid evolution of technology (with many left behind)”. (R13) “The depth of the multiculturalism”. (R14)
Mechanisms to evaluate designs whereby we can accumulate knowledge that can inform effective and sustainable development interventions			“The ongoing framing of all interactions, HCI methods and designers’ identity by Silicon Valley through materialities, pedagogies and capital”. (R5) “To adopt an African philosophy of doing in a world westernized and politically tough, where politics means human relationships”. (R20)

4 Discussion and Reflection

The findings from the SLR, and the survey, will now be triangulated towards providing a snapshot of the Southern African HCI4D landscape, in terms of the researchers, focus areas, methodologies and challenges. While acknowledging other influences, the ratio between the number of first authors and the number of studies per country provides some indication of the type of collaboration (when authors are ranked by contribution). Our findings indicate variations between authorship patterns: for South Africa and Namibia, the number of first authors correspond with the number of research projects but that was not the case for Kenya. Upon ranking the 56 papers in the *A_SE set*, according to citation count, we found that the highest ranked paper *not written in collaboration with a Northern-based author*, namely de la Harpe [25], was in position 39 of 56. Furthermore, more than 70% of the publications had foreign authors (previously or currently from the North). There is general agreement that local researchers ought to be spearheading HCI4D research in their own countries, but our findings indicate that the involvement of foreign researchers remain important when publishing research. Therefore, partnerships which involve a measure of mentoring and knowledge transfer may be more beneficial to developing local voices than deliberately limiting international collaboration.

We compared the keyword frequency for the global set (114 papers) with the *A_SE set* (56 papers) and depicted the results in Figs. 2 and 3, respectively. That excludes the review papers, which are not country based, and inter-country studies. The terms *design*, *mobile*, *ict4d*, *ictd* and *community* dominate both sets. This highlights the importance of community and design-focused research, with mobile phones as the central technology, in HCI4D research (as supported by our survey). The terms *participatory*, *rural* and *health* feature more prominently in Fig. 3. The findings reveal a diverse range of philosophies and methodologies; both the *A_SE set* and global papers have an action-orientated, design and development focus with due recognition of the user communities. This places HCI4D researchers in a strong position to respond to the calls for practice-led research [67].



Fig. 2. Global papers



Fig. 3. SADC Kenya and Uganda

In terms of the challenges, Table 2 demonstrates a large overlap between the previously-proposed categories [1–3] and our survey responses. This confirms the relevance of the following challenges for Southern driven HCI:

Capacity building in research leadership. Collaborations should involve local researchers not merely as facilitators in data capturing but by making a deliberate effort to develop all their capabilities as independent researchers, reviewers and project managers.

Multiculturalism and an appreciation for diversity, which requires continued research on interactions and interfaces for diverse user groups considering cultural, linguistic, and non-linguistic adaptations.

Appropriate methodologies: HCI4D cannot thoughtlessly appropriate Western-focused HCI tools and approaches without consideration of their appropriateness in the African context. Participatory design is useful in addressing this issue but the process and actual participation of the users, as well as ethical data capturing and governance practices, have to be monitored.

The commitment to socially situated, community-centred research is clear, but Pal [68] warns that the gravity of social good needs to be adequately reflected in the ways HCI researchers approach their investigations. The challenge of broadening the HCI4D scope appears to have been replaced with the challenge of redefining the HCI4D niche. For Southern researchers, this means moving beyond user-centred design, usability and user experience to also consider stakeholders as well as the social, ethical and financial implications of IT systems.

5 Conclusion

The paper presents a Southern African perspective on HCI4D research against the backdrop of the global view. The snapshot reveals a diverse and sophisticated research community, with mature, independent research groups in countries like South Africa, Kenya and Namibia and growing and maturing research groups in Uganda. There are also strong international links, which are beneficial to researchers who need some initial mentoring, especially towards high-impact publications. Our findings highlight various application domains of ‘HCI4D’ (with Education being most important in the Southern African landscape) and the evolution and diversification of the methodologies. The challenges in Southern Africa resonate with those previously identified regarding the need to consider the positioning of, and the critical role that HCI4D researchers have to play, in the ICTD field. The validated set of presented challenges provides a point of departure to characterise the challenges inherent in this field of research. All the findings and conclusions should be considered in the context of the study’s limitations as stated earlier. Future studies will benefit from the inclusion of a wider variety of sources to support more detailed analysis and to gather responses from a larger survey sample.

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A Local Perspective: Working an Agricultural Information Service into a Rural Community

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Abstract. Accounting for the ways in which ICT initiatives are worked into local communities is part of rendering “the local perspectives” within ICT4D. This paper is part of that. Based on in-depth fieldwork, we investigate the integration of an agricultural information service into a rural community in Bangladesh. We find that it takes work beyond the initial design and cursory introduction of the service to make the service work in a low-income rural community: it takes the strength of the farmers self-help groups to circulate the messages by word-of-mouth, it takes posters placed at key junctions according to a socio-geographic understanding of the village manifest in a map, and it (ideally) involves the support of the elite of the community via the broadcast of messages at places of high symbolic value. It takes all this in addition to a well-made information service delivering relevant and timely messages on for example agricultural matters. Hence, reducing the issue to one of technical delivery mechanism does not tell the full story.

Keywords: ICT4D · Agricultural information services ·
Mobile agricultural advice · Appropriation · Technology · Field study

1 Introduction

Information and communication technology enabled services has the potential to increase the reach of for example agricultural extension by providing agricultural advice to smallholder farmers in the Global South [12]. Previous studies have presented and examined the different forms that such agricultural services may take, ranging from mobile services [7, 16], to radio [4, 14] as wells as Internet portals [2, 3]. These studies, then, suggests that farmers in the Global South can benefit from agricultural information services receiving, e.g. agricultural advice, market information, and actionable information on local climate. However, these studies rarely focus on describing, in detail, the cooperative work of making these services work locally. Making the agricultural information service usable for the farmers may take considerable work and may only be achieved as it becomes embedded into a wider, trusted, socio-technical ecosystem.

In the words of Donovan “technology cannot be airdropped into a situation and guarantee positive results” [9, p. 57]. This is because technology is not really *technology* until it is part of a living practice [6]. Generally speaking, research in HCI and HCI4D may (ideally) report on local experiences of adapting and implementing technology, including on how it may be made to work locally [21]. In this paper, we aim to contribute to this agenda. Knowledge emerging from explicitly local or indigenous perspectives, approaches and experiences with ICT in the Global South has not yet become substantial within ICT4D and HCI4D [1]. Indeed, there is a lack of research detailing, for example, the cooperative work of making technological initiatives work in disadvantaged communities in the Global South. Arguably, this is a piece of the puzzle that is crucial to understanding why some initiatives thrive where others fail.

In this paper, we report from a field study of the integration of an agricultural information service into a rural community in Bangladesh. We report from the CAIS project designed and implemented by Welthungerhilfe, mPower-Social, MMS, and FIVDB. Welthungerhilfe is an international, German based, aid organization, mPower-Social specializes in ICT interventions for development, whereas MMS and FIVDB are local non-governmental organizations specialized in aid work. In the paper we examine the cooperative efforts that enable smallholder farmers to benefit from an agricultural information service; we investigate how the agricultural information service is worked into a wider socio-technical ecosystem. Our findings show that it took concerted effort past the initial design and introduction of the service to make the service work for the community: it took the drive of the farmers self-help groups to circulate the messages by word-of-mouth, it took posters placed at key locations according to a socio-geographic mapping of the village, and it (partly) involved the support of the elite of the community via the broadcast of messages at places of high symbolic value – although this was soon discontinued. It took all this in addition to a well-made information service delivering relevant and timely messages on agricultural matters to make the service work locally.

The paper will proceed as follows. First, we will consider related research. Secondly, we will turn to the field setting and the methods of the study. Third, we present an analysis of the integration of the agricultural information service into the rural community in question. Fourth, we will provide a discussion and concluding remarks.

2 Related Research

Agricultural information services in the global south typically aim to overcome the shortfalls of information within smallholder rural communities by supplementing local knowledge with (expert) agricultural advice, local weather forecasts, or local market prices for agricultural products, or some combination of the three [9, 12]. For example, the Knowledge Help Extension Technology Initiative (KHETI) in Madhya Pradesh, India, was used to raise awareness of agricultural extension services among farmers by providing them with mobile phones with short dialogues and videos [10]. Another example is Gandhi et al. [17], who developed Digital Green in India to provide targeted agricultural advice to farmers via video. Using a comparative experimental design, the authors found that Digital Green users had higher adoption rates for certain agricultural

practices as compared to conventional extension approaches used by another group of farmers. Christensen et al. [7] examine the use of an agricultural advice service using voice messages pushed to the farmers feature phones synchronised with the growth stages of their crops. In addition, Patel et al. [16] developed a voice message forum to foster the creation of online communities of farmers sharing advice and local knowledge. Some messages were on weather-related issues, others on pest control, irrigation, fertiliser use, and the crops cycles in general. The authors found that the farmers were mainly interested in (expert) technical agricultural advice, thereby suggesting the need for such advice. Other initiatives have focused on improving the bargaining power of smallholder farmers vis-à-vis traders by servicing them with market information for example by sending text messages with price information on several nearby markets [12] – thereby ideally providing farmers with an informed choice on where to sell their produce. A key assumption of these services is that addressing a key market failure – that of imperfect information – will help poor rural populations sell their produce at higher prices [3, p. 43]. While some studies have noted that access to markets information services actually have improved the livelihood of farmers, other studies have found that the lack of trust in unfamiliar traders, road distances, and long-standing ties with dominant traders, often weight heavy on the farmers decision making when it comes to deciding where to sell their produce [9].

ICT initiatives may vary not only in terms of the types of agricultural services and the information they provide but also in terms of the human and institutional support that they are associated with. The least supported services offer access to voice-based or text-based databases of information regarding agricultural practice, weather predictions, or market prices – but no additional support. More integrated services may offer in-person technical and agricultural training, support by phone, or support through e-learning programs [3]. Some services are part of a larger socio-technical environment comprised of, e.g. physical facilities, human expert advisers, and access to agricultural inputs. For example, the eChoupals initiative, operating in Madhya Pradesh in India, provides market prices and weather information integrated with crop transportation facilities, weighing and storage, and payment system (Kumar 2004). Another service is Grameen Foundations *Community Knowledge Worker* initiative in Uganda, which equips extension agents with smartphones to act as community agents of agricultural information [13].

The above studies, then, suggests that farmers in the Global South can benefit from agricultural information services receiving agricultural advice, market information, and actionable information on local climate. However, these studies rarely focus on describing *in detail* the cooperative work of making these services work locally. Making the agricultural information service usable for the farmers may take considerable work and may be achieved only as it becomes embedded into a wider, trusted, socio-technical ecosystem. To reiterate, there is a lack of research detailing the cooperative work of making technological initiatives work in disadvantaged communities in the Global South. However, one notable effort to fill this gap, albeit outside ICT for agriculture, includes O'Neill et al.'s [15] ethnographic investigation of the work of making a new digital loan payment service for auto-rickshaw drivers work in Bangalore, India. O'Neil et al. [15] describe how making the service useful took considerable cooperative work on the part of not only the drivers but also on the part of

the employees of the local NGOs. It was largely achieved because the initiative was embedded into a wider established setting, and because of the commitment and work of the human actors within that setting. We take inspiration from this study.

3 Methods and Setting

We conducted the field study of the practices associated with the introduction and use of the agricultural information service over a period of six months in late 2017 and early 2018. We conducted participatory observation and carried out six in-situ semi-structured interviews as well as three focus groups. The participatory observation was conducted mainly by the second author, while the focus groups and interviews, and a lesser part of the observations, was conducted jointly by the two authors. The focus groups with the farmers included questions on education; family; community; village life; financial circumstances; income; climate; farming; and their experiences with the agricultural information service. The interviews were conducted in Bangla, the language of Bangladesh. We conducted six semi-structured interviews with NGO staff and local government officials. The interviews with the NGO staff included questions on background; work experience; the NGO; relationships with farmers; village life; climate; and their experiences with the agricultural information service. We conducted observations of the use of the service in the villages. This included accompanying the NGO staff working in the villages during their employment of the information service, and it included being with the farmers as they used the service, shared and talked about the information, and farmed their land.

The data was recorded through extensive field notes, audio recordings and photographs. The interviews were translated and transcribed. Our analysis took a broadly practice-oriented perspective [5, 6, 8, 20, 22] with inspiration from ethnomethodology [11, 18]. Practice studies, in our perspective, explicate how participants organise their practice and emphasise the ways in which technologies and artefacts are an integral and indispensable part of the accomplishment of that practice. The authors read through and discussed the data in various analytical sessions in person and on Skype. The data was organised into themes as topics emerged from the analytical sessions. A concerted effort was made to have the themes, and in turn, the findings emerge from the data itself.

The geographical setting of our study is part of the Chalan Beel wetland in the Sirajgonj District of Bangladesh. Surveys typically classify Bangladeshi smallholder farmers in this area as poor or extremely poor [19]. Smallholders typically earn minor amounts on a seasonal basis depending on crop yields and prices. In addition to relying on their farms for financial income, the farmers in our study depend on their agricultural output for sustenance. Low crop yields, or outright crop failures, therefore represent a serious challenge to the farmers. During flooding or other agricultural crisis, the male household member often seeks alternative employment such as running a local tea stall or operating a rickshaw on the mainland. However, this alternative self-employment is typically inadequate in terms of supporting a household of often ten members or more. Some of the households that were part of our study were struggling.

4 Working an ICT Initiative into a Rural Community

It is little more than a truism that working an ICT initiative into the fabric of a rural community in the Global South requires collaborative work and effort. Relatedly, the interesting point is what kind of work it takes, whose work, what the modalities of this work are, and what social and technical infrastructure it is based on. We may dub such efforts *integration work*. These are the themes that we address below. However, before doing so, it is timely to introduce the design of the agricultural service alluded to above.

5 The Design of the Agricultural Information Service

As indicated above, the service in question is a mobile service that delivers agricultural information to the handsets of smallholder farmers in Bangladesh. It was developed in a collaboration between mPower, the technical partner, the farmers and the local NGO called MMS. All funded by the German NGO Welthungerhilfe. During the development, mPower, the technical partner, visited the field site twice and facilitated a co-design process with representatives of the farming community together with the local NGO team. In this process it was agreed that the service should support smallholder farmers by (1) assembling weather forecasts from the public domain for the specific village locations, (2) associate agricultural advice with the weather forecasts, and (3) send text messages to the farmers with the weather forecasts and the associated agricultural advice. The rationale for this new service was that smallholder farmers in remote rural areas do not have access to such information. The governmental agricultural extension service does not have the resources to visit the farmers on the Char islands. Not only is the public agricultural extension service understaffed and underfinanced, it is also considered somewhat dangerous for the extension officer to visit the Char islands. In addition, there is no electricity on the Char islands other than one or two solar panels per villages. These are mainly used for charging mobile phones. Nobody owns a TV set. Hence, the farmers in the area do not have access to local weather forecasts, nor do they have access to expert agricultural advice.

The service was designed to send SMS messages to 250 farmers once a week during normal conditions and up to three times a week during disasters such as flooding. To make the service operational, basic data on the names of the farmers, their mobile phone numbers, crop types, crop stages, and more had to be collected by MMS and entered into the system. In addition, an initial series of alert types had to be created by agricultural experts working for the project. That is, for each crop types, crop stage, and weather condition an appropriate message for the farmers had to be created. Here is an example of a message sent by the service:

A cold wave with heavy fog may occur in your area in the next 2–3 days. During that time, to protect your tomato plants from fungal attack spray fungicide (Dithene M-45) onto the plants. Use 20 mg in 10 L of water for every 5 decimals of land. (SMS sent 2nd Jan 2018)

Another example of the content of the service is a message which is also concerned with the prevailing cold weather and fog in the area. The concern here again springs from the fact that fog may leave dew on the leaves that in cold weather may lead to fungus. A method of removing the dew drops is advised:

The mild cold wave with heavy fog will continue this week too. Due to cold weather do not irrigate in the sweet gourd field at the flowering stage but do mulching. Remove dew (fog) from the upper leaf of the Boro rice plants by using a string moving across the field. (SMS sent 14th Jan 2018)

The designers of the service mapped the connections between crops type, crop stage, DAS stage, weather condition, threshold values, and SMS message texts. First, a list of priority crops was selected by the farmers in collaboration with the NGO field staff. Subsequently, a list of adverse weather conditions was drawn up defined by threshold values. The idea being that if real-life conditions at a given time meet the values of a defined “adverse weather condition” then the associated set of SMS messages would be sent to the farmers. The messages sent to 500 farmers designate as “lead farmers”, i.e. those individuals leading a particular village self-help group. The lead farmers would receive only those SMS messages that pertained to his or her group, that is, their crop types and the stages of these crops. This logic required MMS staff to record data on the lead farmers (i.e. name, location, phone number, group) and record and update data on the groups continuously (i.e. crops types, sowing dates, and crop development). It was important to have accurate data on these items for the service to be able to function as planned. This data work was assigned to MMS staff.

Having presented the service, and the basic features of it, we are now in a position to consider how it was worked into the fabric of village life.

6 Word-of-Mouth

At first, the main village studied resembled any other village in the Charlands of rural Bangladesh that the authors had visited during their stay in the Sirajgonj district. Yet, from talking to the villager’s something about its organisation stood out. Assisted by the local NGO, the villagers had organised themselves into self-help groups each comprised of about ten farmers with one of the farmers acting as ‘lead farmer’ for the group. The lead farmer was someone with a certain standing in the local community and was, without exception, the owner of a mobile phone. Far from all the farmers in a self-help group owned such a device.

A shared consensus among the farmers, that village life benefitted from these groups, emerged from conversation. The self-help groups had mapped the village, created a savings scheme, and acted as conduits for the information delivered by the agricultural information system. The lead farmer of the group would receive the messages from the service and in turn relay the advice to the rest of the group (most of which had no phone). This oral retelling of the advice created a word-of-mouth network, where the lead farmer would tell one or two other farmers from her group,

and these farmers would, in turn, tell other group members, and perhaps also the neighbours, and so on. In this manner, the advice would spread by word-of-mouth. Word-of-mouth would extend the digital infrastructure of the agricultural information service. This was necessary to reach more farmers.

During this process of retelling, of relaying the advice from the phones of the few to the ears of the many, the information would be contextualised through conversation, it would be interpreted, and instructive conversation sparked by the information would emerge.

“I could not at first understand the message about the fertiliser, but she explained it to me, and showed me how to mix the fertiliser and the water right.”

By word-of-mouth the information from the service would be retold, lead to instruction and learning, and in this manner be far more valuable than mere ‘objective’ relaying of the messages could ever be. The point is that the engaged retelling of the information by the members of the self-help groups improved the service, it added value to the service. This is because the retelling created opportunities for conversation, instruction, and collaborative learning. This would happen, for example, in relation to understanding the use of fertiliser as the quote above indicates, and it would happen in relation to learning new farming techniques such as the removal of dew from plants to avoid fungus. One message from the service reads like this on a mobile phone:

The mild cold wave with heavy fog will continue this week too. Due to cold weather do not irrigate in the sweet gourd field at the flowering stage but do mulching. Remove dew (fog) from the upper leaf of the Boro rice plants by using a string moving across the field. (SMS sent 14th Jan 2018)

Figuring out how exactly to move a cotton string across a rice field to drop dew from rice plants is not obvious if you have not tried it before a farmer told us. The retelling of a message, such as the one above, by one farmer to another may create a collaborative learning situation where the two farmers in collaboration figure out how this is done, or if need be, ask for further assistance from for example the lead farmers, who have often been educated in farming techniques by the local NGO.

Another matter for deliberation among the farmers is the accuracy of the weather forecasts which were often part of the messages as seen above. On one occasion the weather forecast was off (as such forecasts occasionally are), that is, the message had predicted heavy morning fog, and the farmers had taken precautions by covering up some of their plants to lessen the risk of fungus, but in the morning no fog. This situation prompted some good-humoured mockery of the NGO staff by the farmers. The NGO staff who had introduced the service was seen as vouching for it, as responsible for it. When weather predictions were right, it would lead to praise of the NGO staff by for example farmers asking – half in jest and half in earnest – “are you some sort of magicians?”. And when the predictions were off it would as mentioned lead to good-humoured taunts. This goes to show the degree to which the local NGO staff were strongly identified with the service that they introduced to the farmers (but only in part designed).

The weather predictions were more often right than wrong, and the farmers ended up mostly adhering to them, as ignoring them could have serious or even devastating consequences for their crops. Taking precautions against adverse weather such as fog (covering plants), or heavy rain (digging rain gutters), was at worst a waste of time if the weather forecast was wrong. It was not a disaster as ignoring the weather forecast might be as fungus-induced by fog or rain might take the plants. In this manner, there was a certain economy of practice in adhering to the weather forecasts, rather than ignoring them. The prediction of rain may also save on irrigation, but if the rain does not come, the plants are at risk of drying out. So, there is something at stake, and therefore the messages were often the object of reflection, conversation, and deliberation, rather than something which was followed ‘mechanically’.

7 Posters

Another way of reaching those without phones was through posters placed at central spots in the village. Posters were most often handcrafted by the lead farmer, or NGO staff, and displayed the (phone) messages that were deemed to be of special importance to the farmers.

Messages were at times, though not always, placed at spots where they were especially relevant. For example, messages about the risk of flooding were placed at flood-prone areas, posters on the risk of fog were placed where fog might gather, and messages about certain crops were placed at their fields. It emerged from conversations that the farmers had very good knowledge of the layout of the village. The farmers pointed to the collaborative creation of maps as contributing towards this understanding. Let us elaborate.



Fig. 1. Map of the village made by local farmers in collaboration with MMS the locally active NGO. The map roughly represents an area of 2,25 km².

The farmers had in collaboration with the local NGO created a map of the village which depicted the village, its households, and its (ecological) vulnerabilities (see Fig. 1). Lowland and saline-prone areas were singled out on the map as potential

trouble spots. That is, areas that called for vigilance and a concerted collective effort. In addition, all the households were shown and given a number for easy reference on the map. Furthermore, important structures such as the village Mosque and the local boat mooring site is also shown. The map shows all 366 households of the village, it shows what kind of crops are planted where, and it shows what areas are flood-prone, what areas are drought-prone, and where fog may gather. Furthermore, it contains information on the quality and nature of the soil that are important parameters for agriculture. Furthermore, colour codes are used to designate households with for example pregnant women or children under the age of five. Both being indicators of a vulnerable household – someone to “look extra out for”. Every six months or so the maps were to be updated – to reflect the development in each household and each crop field if any.

This mapping of the village, this sense of place, was used by both those (lead) farmers that placed the posters and by those farmers that subsequently read them. The digital information service was extended by the posters, then, and in this work of integrating the advice into the fabric of the villages the maps played an important role as enabler. For example, from looking at the map, it was readily apparent to the farmers that messages concerning maize cultivation, maize pests, and maize diseases belong next to the maize fields. While, messages concerning fog were relevant to those farming the fields where the morning fog gather, and so on. In this manner (some of) the advice and forecasts stemming from the service were ‘plotted onto the village map’ and in the process gathered more meaning and significance. For whom, what, or where a message might be relevant was partly settled with the help of the village map. Not necessarily by overtly pointing to the map but more often by reference to the knowledge that the making of the map had created.

That the map of the village, and the knowledge made in the process of producing it, became a frame for appreciating the messages testifies to the importance of framing. That is, we may argue that the (fruitful) reception of the messages was in part due to the villagers own high level of self-understanding and appreciation of their situation which was (partly) generated in spatial terms via the map and mapping process. We should not overemphasise the importance of the map as an artefact but rather recognise the process of making the map as a contribution to the villages self-understanding and by extension also to their sense of community and solidarity.

The map, then, in its many incarnations and versions, is not a traditional map for travel, locomotion or navigation. Rather, the map is a depiction of the socio-spatial configuration of the village, including the vulnerabilities of the farmers, including their flood-prone fields, their drought-prone fields, their saline soil, and places where fog may gather and in turn fungus may appear. Moreover, one can see the placement of the posters as a direct extension of this mapping, this spatial view of the village. The poster was placed, assigned places, in accord with the villagers’ socio-spatial knowledge of themselves and their lifeworld. Placing a poster well, where the message might be needed, is a way to continue to manifest socio-spatial knowledge.

The map reaches out beyond the agricultural and includes as mentioned all households, with an emphasis on vulnerable families with children, has landmarks such as the mosque and more. The local mosque, in the midst of the village, was also central to the circulating of the messages as we shall see next.

8 Public Announcements

The village mosque lies at the centre of village life, metaphorically as well as physically. It is the spiritual, moral and religious epicentre of the village. Therefore, it was a blow to the project that the local Imam, after consideration, disallowed NGO staff's use of the mosque's PA system as a means to broadcast messages. The local Imam did not approve of the announcement of messages such as weather forecasts and associated agricultural advice, stemming from the service, in his mosque. The field officer assigned from the local NGO to the village comes every five days or so and was hoping to announce some messages and forecasts to the villagers using the mosque. Select messages on for example extreme weather predictions such as drought or flooding that may be considered important and even vital for the welfare of the village. And the NGO officer was hoping in the process to promote the service and the work of the NGO. A few messages were mic'ed in the Mosque – to use the expression of the NGO officer – before this practice was discontinued.

Using the Mosque as a platform would have not only potential practical benefits - i.e. a large audience for the messages - but also symbolic significance. That is, by broadcasting from the Mosque, by using the mosque as a broadcasting platform, the legitimacy and status of the service would be heightened considerably according to the NGO staff. As mentioned, this was not to be as the practice was soon discontinued by the intervention of the Imam. By this act the reverse of what the NGO hoped for happened, that is, the legitimacy of the agricultural information service decreased in the eyes of the villagers. In conversation with the local field officers it became apparent that the support of the local elite, including the Imam, was important to the implementation of any development initiative, including the agricultural information service in questions here.

Although the Imam, then, denied the NGO the legitimacy associated with speaking the messages in the Mosque, the promotion of the service outside of the Mosque was tolerated by the Imam. He just preferred to reserve the Mosque for the exclusive of religious practice.

The farmers, for their part, valued the weather forecasts. The records of the NGO show that approximately four out of five messages were accurate in terms of predicting the local weather. One has to keep in mind that prior to the introduction of the service the farmers had not experienced a digital service of this kind before. Previously their access to general regional weather forecasts was very limited as the village had no televisions nor radios. Mobile (feature) phones were the only communication technology available - and the village was without access to the Internet. Thus, information from beyond the island came with people coming and going to and from the village by boats and small ferries and by phone calls. Before the introduction of the service, accounts of the upcoming weather were anecdotal at best and based on regional forecasts that the travellers or commuting workers had seen or heard in the city perhaps the day before. In contrast, the weather forecasts of the service were local, rather than regional, and associated with agricultural advice such as “cover your tomato plants with plastic sheets due to upcoming heavy rain”, or “dust your eggplants with ashes as fog is expected tomorrow morning”. One farmer told us that he lost almost an entire

field of eggplants the year before the introduction of the service due to fungus infection, this year he spread ashes on the leaves to prevent morning fog from settling on the leaves, this, in turn, prevented the spreading of fungus and improved his yields. The farmers tell us that he hardly lost an eggplant to fungus this year. We heard many accounts like this. Obviously, the value of the service, especially in relation to crop yields, cannot be evaluated based on anecdotal evidence alone, and therefore we will make no sweeping claims regarding yields. Rather, we will suffice to say that it emerged through conversation that the farmers experienced the service as valuable and worthwhile.

Moreover, using the service can be characterised as a learning experience, rather than a mere ‘consumption’ of messages. For example, the technique of spreading ashes to prevent fungus was new to the farmers. It was something that they learned through the service, and through conversations with peers using the service. The farmers also learned to moderate their use of fertiliser and pesticides and thus save money, safe keep the environment, and improve crop yields. Just as they learned a number of other agricultural techniques associated with the crop cycle, weather, disease and pest prevention. In this manner, the experience of using the service, the outcome, was to a large extent educational. For example, once the farmers had learned that fog threatens fungus and that spreading ashes is the appropriate countermeasure against this threat, then this lesson had been learned, once and for all. That is, after having used the service for a while some of the advice associated with the weather forecasts became somewhat superfluous to some farmers. The weather forecasts in time became enough for those of the farmers that had learned the weather-related advice by hearth. They had, from engaging with the service, already learned the techniques and did not need to have them repeated. This testifies to the educational value of the service.

9 Discussion and Concluding Remarks

As mentioned in the introduction, research within HCI and HCI4D may (ideally) report on local experiences of adapting and implementing technology, including on how it may be made to work locally [21]. In this paper we have aimed to contribute to this agenda as knowledge emerging from explicitly local or indigenous perspectives, approaches and experiences with ICT in the Global South has not become substantial as of yet in our field [1]. Accounting for the work to make ICT work locally may arguably be a piece of the puzzle that is crucial to understanding why some initiatives thrive where others fail. Although all good technology may appear as magic to its users, none was involved in our case. Rather, it took hard work and a concerted collaborative effort to make the service work. To reiterate, our findings show that it took concerted effort beyond the initial design and cursory introduction of the service to make the service work in the community: it took the vigour of the farmers self-help groups to circulate the messages by word-of-mouth, it took posters placed at key places according to a socio-geographic mapping of the village, and it involved the acceptance of the initiative by the community elite. It took all this in addition to a well-made information service delivering relevant and timely messages on agricultural matters to make the service work locally.

Our finding resonates with the work of O'Neill et al. [15] that emphasises the collaborative effort of working an ICT initiative into a community in the Global South. There are many differences between the two studies, e.g. urban vs rural, finance vs agriculture, and more. However, common is the acknowledgement that ICT initiatives do not sort themselves out by default, it takes work to make them work. This point echoes the slogan purported by Donovan, namely, that “new technology cannot be airdropped into a setting” [9]. The work to make ICT initiatives work, embed themselves, and become an integrated part of local practice may easily be overlooked. An agricultural information service in action may metaphorically speaking be described as a living and breathing entity, that needs nurturing, care, and legitimacy to work in a community. In the eyes of the users’ legitimacy may be achieved through the demonstration of practical value as well as through more symbolic means - two distinct kinds of legitimacy.

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Digital Wallets ‘Turning a Corner’ for Financial Inclusion: A Study of Everyday PayTM Practices in India

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Abstract. Financial transactions are intimately bound with social interactions and woven into everyday economic lives. In this paper we focus on PayTM, a digital wallet, and a specific set of users of PayTM, street vendors in urban India. Through an ethnographic investigation we offer to unpack two questions: 1. Can digital forms of money create financial inclusion by opening up access to the marginalized 2. Can digital platforms amplify socio-economic capacities of low literate users enhancing financial literacy? We argue that digital and financial literacy are an immersive component of digital wallet use acquiring ‘everyday life’ in specific socio-economic ecosystems. Our study captures daily practices of digital money staking a claim in advancing the understanding of financial inclusion as a lived process accumulating habits, practices and stakes to expand socio-economic capabilities.

Keywords: Financial inclusion · Digital wallet · PayTM · Ethnography · India

1 Introduction

Bill Maurer refers to the use of financial instruments as ‘appearing in accordance with a desire to alter financial status’ - a powerful reference to the ‘meanings’ users infuse their economic transactions in everyday life [1]. The paper proposes to study and explain everyday practices and implications of the digital wallet, PayTM, in urban India as an instrument of financial inclusion. We attempt to probe two broad questions that set the context for the rest of the paper 1. Can digital forms of money represent the ‘next stage’ in the evolution of money to create financial inclusion; 2. Can digital platforms be viewed as optimising and amplifying user capacity to transact with money? We engage with the above questions to interrogate the following: First, is digital money in India expanding technology literacy? Second, does digital money support micro-entrepreneurship in the context of street business prevalent in India? By virtue of the above two questions we ask a third; is digital money an instrument of financial inclusion? We wish to add another layer of inquiry to deconstruct bottom up processes enabling financial inclusion through PayTM among marginalised users in

urban India - does digital money promote easy and efficient access to financial transactions in the 'everyday'. We employ an immersive context study of PayTM in India among micro and small street vendors in two Indian metropolitan regions. PayTM embarked on its journey in the Indian mobile commerce platform by offering recharge and bill payment services in 2010 on boarding 25 million wallet users in the first two years of its introduction. With 150 million users on the platform, PayTM has become synonymous to e-wallet and added five million new users, 62.9 million transactions and registered over seven million transactions worth INR 1.2 billion every day in June 2018 [2]. These numbers exclude approximately a billion and 150 million Indians from the e-wallet platform. The challenges faced by PayTM and its acceptance from the banked and unbanked segments are both a broader issue of shifting gears from a traditional transactional system and a more immersive one of gaining technical and financial literacy. While PayTM is predominantly a part of the digital wallet universe, a recent study [3] situates digital payments 'within a larger undertaking of technology-driven modernity that drives these initiatives, rather than just efficiency or productivity gains...'. What does it take to cast PayTM as a modern technologically driven instrument of financial inclusion in India? We argue that digital and financial literacy are an immersive component of PayTM or digital wallet use and interrogate this premise in the context of micro-entrepreneurship and street vending in urban India.

Financial inclusion intermediates different actors in an economy: providing opportunities for the poor to improve the regularity of incomes and quality of life; for vendors and suppliers to provide steady low-cost savings; and for the state to channelize funds and reduce poverty [4]. New practices in the domain of financial inclusion invite new powerful players and practices to intermediate the lives and fortunes of the poor. While MFIs, community-based programmes and cooperative institutions are the gold standards for financial inclusion, actors like payday lenders, large banks, technology firms, mobile network operators and credit card companies are now 'included' as agents of financial inclusion. The latter blurs the lines between different types of service providers and practices in the domain of financial inclusion to create an 'enabling' environment for new technologies' [5]. The Indian government, since 2014, has emerged as the organ of financial inclusion for the country, with its 'largest financial inclusion scheme in the world' [Pradhan Mantri Jan Dhan Yojana] for universal bank accounts, promotion of cashless payment cards and the strategic strike of 'demonetization' of high-denomination rupee notes in late 2016, aimed at driving the uptake of digital financial services [6]. This sets up a compelling context to situate PayTM as a private player arbitrating digital money uptake, technology literacy and an entrepreneurial emissary for the low resourced street merchants in India. A more pressing question is if digital payment systems acquire everyday life within the constraints of a specific socio-economic system? We attempt to identify processes promoting 'financial inclusion' and modes of acquiring 'literacies' in order to participate in the processes of 'financial inclusion'. In this paper, the context of street vending offers a backdrop to map the journey of PayTM as an instrument of financial inclusion and the challenges in acquiring digital literacies as part of business practice.

2 Literature Review

In this section, we offer an understanding of financial inclusion around digital wallets and payment platforms while situating digital money in the ongoing discussion on financial inclusion. A simple definition of financial exclusion is the inability to access necessary financial services in an appropriate form [7]. Financial institutions are seen as a ‘coalition of depositors’ [8] providing a diversity of services to low income and subsisting populations in developing countries who manage money primarily through informal networks lying out of the formal financial system. Financial inclusion is both pro-poor as well as pro-growth creating access to financial services and opportunities to use savings and credit to make productive investments [9–11]. Only 35% of the adults in India have access to an account at a formal financial institution [12]. Major financial inclusion policies follow a supply side-centered approach providing access to basic banking services such as a ‘no-frills’ savings account [13]. However, when bank accounts remain largely under-used and informal money management persists, it is necessary to consider people’s constraints and rationales that go beyond behavioural constraints [13]. A major critique of financial inclusion strategies is the inability to address financial arrangements in interconnected socio-cultural contexts including the household, the larger village or town, the banking systems and infrastructures of financial access [14]. A range of research studies suggests mobile money services as a subset of ‘what will eventually be an extremely diverse ecosystem of mobile technology-based offerings, many of them outside the financial sector’ [15–17]. New practices of financial inclusion bring powerful players into organized financial dealings with the poor and the underserved blurring different types of service providers and practices [18]. A report commissioned for Visa estimates that micro and small merchants in developing countries alone will pay around 35 billion USD annually in fees, if their transactions, amounting to more than 6.5 trillion USD, are digitized and brought into the formal financial system [19]. The broad emphasis on competition as a supposed driver of financial inclusion suggest private profit-seeking entities (which respond to competition) should take the lead [20].

The rapid penetration of mobile phones and the growing popularity of smartphones in the developing nations have created tremendous opportunities and severe challenges for conventional payment systems dominated by traditional banking and financial institutions [21–24]. India is home to more than 145 million unbanked families, a potential segment for financial inclusion via mobile phones [25]. Mobile banking and digital wallet technologies are the new locus expanding financial capacities by reducing costs of transaction making payments electronically transferrable and a variety of small transactions cheaper, easier and faster for service providers and customers [26–29]. But how expansive and deep are these instruments and does sustaining and deepening mobile money services for financially excluded population require a far more socially multi-faceted approach? [30]. One explanation commonly put forward by financial inclusion advocates such as the G20 experts [31], is ‘low levels of financial capability’ form a significant barrier for many poor and low-income people to fully recognize formal financial sector offerings, and how they must behave to benefit from them. For example, Deb and Kubzansky [32] argue about the ‘financial capability gap’ - the lack

of skills and knowledge to make informed financial choices impacting low-income earners adversely in understanding the implications of their choices and actions'. Bawden [33] and Eshet-Alkalai [34] caution about the inconsistency between those who conceive digital literacy as 'primarily concerned with technical skills and those who see it as focused on cognitive and socio-emotional aspects of working in a digital environment' [35]. From a sociocultural perspective literacy is then a matter of social practices [36] and is 'best understood as a shorthand for the social practices and conceptions of reading and writing' [37] and 'a set of socially organized practices which make use of a symbol system and a technology for producing and disseminating it', which in other words means "applying knowledge for specific purposes in specific contexts of use" [38].

PayTM as a digital wallet and agent of financial inclusion is claiming a phenomenal increase in adoption of digital payments in tier two and three cities of India constituting 50% of the total user base: a major factor being the multilingual app used by over 25% of users. The platform, over the past year, on-boarded 100% more female users and 300 thousand villages, 3 million merchants [39] accepting digital payments in small towns through cashless transactions through its smartphone app and QR code solution. The platform is powering the largest offline payments network with over 8 million offline merchant partners who accept payments via the PayTM QR [40]. While millennials continue to be the most active users, the platform surged with an annual run rate of 5 billion transactions and 50 billion USD GTV (Gross Transaction Value) [40]. PayTM claims to be the largest contributor towards all forms of digital payments including UPI, Wallet and Cards and, since January 2018, processed over 400 million digital transactions, a preferred alternative to net banking. It also saw a 500% growth [40] in money transfer transactions with offline stores accepting PayTM payments directly into their bank accounts. This new feature will accept payments from any bank account into their bank accounts at zero transaction charges [41]. Much of our paper engages with aspects of situation driven challenges to viewing PayTM, despite its apparent uptake, as socio-cultural phenomenon inhibiting small-scale businesses to optimize income generation. We introduce the notion of 'digital literacy' as 'contextually framed' and 'learnt' in the processes of street vending and mobile money transactions.

2.1 Social Use of Money

In this section we specifically draw attention to studies that highlight the intersections of digital money and their social contexts. Digital currencies and payment technologies not only offer new ways of interacting with money but also transform user's understanding of financial operations, how they occur, making sense of financial information and ways in which new forms of money or payment methods change social interactions [42]. Studies have drawn attention to the importance of ecosystems surrounding mobile payments and suggest targeted yet different solutions for the tech-savvy and the under resourced markets - where the former allowed more state-of-the-art solutions and the latter basic solutions aiding financial inclusion [43]. Conceptions of locality, community, identity, information exchange 'impact the use of digital and physical forms of money while forms of currency can make the invisible visible, exposing identities and values as much as business models and transaction details' [44]. The adoption of digital

money is shot through with cultural and social factors that constitute its specific character; one such example are ‘the Japanese conceptions of the aesthetic and moral virtue of smooth flow and avoidance of commotion’ impinging on not only the design but also user adoption of digital money. Implications for design of mobile payment systems stress the need to ‘produce open-ended platforms that can serve as the vehicle for multiple meanings and experiences without foreclosing such possibilities in the name of efficiency’ [45]. Another study reports on a specific digitally mediated transaction system (transactions are mediated by a third phone transferring money from one account to another through a SMS notification request) affording ‘opportunities for rich social interactions through which individuals are able to express themselves as members of their community and make lasting connections based on trust’. The authors elaborate on social meanings of money building rapport and, in particular, trust-based transactions inextricably linked with the community of transactions or users of digital money enabling ‘reciprocation of common concerns’ [46]. In this paper we offer a variety of ways in which the marginalised merchant population in urban India socially adapt and adopt PayTM adjusting and expanding their understanding of ‘money’ as dematerialised digital currency.

3 Methodology

The study builds on our findings from ethnographic observations and interviews conducted amongst street vendors in urban Indian markets to investigate PayTM as a mode of payment in their day-to-day dealings. Our aim was to urge respondents to elucidate their everyday business transactions to uncover the socio-economic factors behind the usage of PayTM. We carried out fieldwork in five markets in two regions of the country: the national capital region of Delhi (NCR), situated in North India and Greater Hyderabad, a metropolis and major technology hub in South India. The markets were Lajpat Nagar, a popular market with plenty of street-side vendors in South Delhi witnessing a footfall of about 100,000 people a day and 150,000 on weekends. Many of the shops sell women’s clothes, shoes, apparels tending towards a female-dominated customer base. PayTM usage here is not widespread but definitely on the rise with cash being the predominant mode of payment. The second market in South Delhi, Nehru Place market, is a more male-centric shopping area in an office district. It is surrounded by offices, electronics goods shops, a few eateries, and frequented by office goers who work in the vicinity. This market witnessed a dramatic decline in the usage of PayTM with time post the demonetization initiative. Cash is the most convenient mode of payment, with vendors mandating digital transactions only for purchases worth more than INR 100 [1–2 USD]. The place in the NCR region, Murthal, a village in the Sonapat district of Haryana, situated around 31 miles from New Delhi is primarily an eatery district, locally called ‘dhabas’ serving staple North Indian cuisine. Travelers, traders, and tourists constitute the primary clientele. While the ‘dhabas’ accept payment in cash, debit or credit cards, as well as digital wallets like PayTM and Google Tez, the usage of PayTM wallet here, has been restricted to transactions valued not more than INR 1,000 [12 USD] - a sort of reverse mandate that was found in the Nehru Place market. We will dwell on the reasons for these mandates in our findings section.

We studied two markets in Hyderabad city: DLF Street, located in the IT districts of Hyderabad hosting offices of giant tech companies opens at 4 PM and shuts shop at 2 AM. Many snack stalls cover a mile-long stretch of the roadside. The customers for these stalls are predominantly IT employees in ‘the graveyard shift’ and students from 2 universities nearby. PayTM is being used here not only as a wallet service for business but its partnership with Uber and the ability to extend use for the shopkeeper’s personal expenses comes in handy. A key agent for adopting PayTM has been incentives like cashbacks and coupons. The second market, Indira Nagar, also located near the IT district of Hyderabad, is a big commercial street with a mix of shops, eateries, fitness centers and beauty salons. A row of small snack stalls dot the street, many of them appear and set shop on their cycles and carts in the evenings and briskly disburse street food vending business. Our observations and interviews were centered around the level of acceptance of PayTM wallet among the street vendors and their adoption of the wallet in reference to their everyday businesses. Broadly, our probes touched upon discussions around value, frequency, and context of transactions to figure out the level of comfort with PayTM usage for business, sometimes for personal use. PayTM wallet adoption history, financial interactions with other vendors and raw material suppliers were investigated to understand the overall embedding of PayTM in the street business ecosystems. Usability issues were also noted during interviews to engage with PayTM as a digital platform. We were alert during our research sessions about socio-cultural factors in the ecosystems of small vendors and shopkeepers influencing PayTM usage. A total of 25 semi-structured interviews [21 male, 4 female] were conducted. The respondents fell in an age bracket of 22–55 years, including micro-business owners, street vendors, waiters, and Dhaba owners. Two researchers carried out the ethnography, took field notes, recorded and transcribed interviews and carried out a first order analysis of the findings. This was followed by a third researcher drawing relevant themes and weaving them together.

4 Findings: PayTM as Digital Transaction

PayTM use is investigated as everyday money and its sustenance as a digital channel for monetary transactions. We consolidate our findings from micro and small-scale street vendors in five commercial markets in the cities of Delhi and Hyderabad to understand the affirmative, uncertain and constraining economic, socio-cultural impetus for PayTM and digital money. Our ethnographic engagement accorded a more composite and heterogeneous adoption pattern and response to PayTM as a new digital channel of money exchange and transfer.

4.1 PayTM – a Walk Through

We begin with a walk-through of PayTM usability features. New customers are required to register with a mobile operator and complete a ‘Know Your Customer’ verification using a national social security number [called the Aadhaar in India] to perform digital wallet to digital wallet transactions. User can pay through scanning QR codes or entering their registered mobile phone number. People have the facility to add

credit/debit cards, especially bank accounts to transfer money to PayTM wallets - and transfer money from PayTM wallets to bank accounts. PayTM can be used to transact the smallest amount of money but there are rules for transactions between the digital wallet and a bank- there are minimum and maximum capping for money transfers in a day and the total transacted money for a day. Merchants who sign up PayTM for business have more liberal capping amounts to promote adoption of digital money. We will address the ecosystem of PayTM as digital transaction in the following section and the meaning making of digital wallets as a financial instrument with immediate transacting capabilities like liquid cash.

4.2 Making Meaning of PayTM as Financial Instrument: The Persistence of ‘Cash’

In this section, we look at the persistence of liquid money or cash, as a component of and driving valency to adopt PayTM as a financial instrument. Cash formed the crux of small business transactions in India and PayTM adoptions continued to use the ‘notion of cash’ as a measure of competency with the digital wallet. We unpack this ‘notion of cash’ in the following ethnographic vignettes. Nehru Place, a market in south Delhi, dominated by offices and male employees and well known for its ‘electronic goods’, payment through PayTM has dropped in the past year. Saurav works at a small stall in Nehru Place and sells tempered glasses and covers for mobile phones to 5–7 customers per day. Though his customers prefer cash an average day gets him around INR 700–800 [10 USD] through PayTM. The Lajpat Nagar market, a few miles away from Nehru Place but a wealthier market, the usage of PayTM is on the rise. But Shopkeeper Nitin, who deals with custom confiscated goods and clothes, owns a nice shop with glass doors, assessed his PayTM in terms of amount of ‘cash’ the digital wallet is bringing in “.. if I do not have PayTM on my phone I will lose 2–3 customers daily or INR 2000 [70 USD] worth of profit per day....” Amit, who runs a small business of readymade ladies’ dresses, claimed to use PayTM even before demonetization due to its ease with small transactions - what would formerly have been a cash transaction, is now made easy due to PayTM. Sumit, a mobile vendor of snacks in the same market, says, “As long as people have PayTM on their phones, they won’t feel handicapped with respect to money transactions in case they run out of cash. There is this sense of security that you have access to cash at any point in time.” Shobha [female, early 40s], has been vending ‘fashion’ jewellery in Nehru Place. Her scope of business is small [she sells products between INR 20–200 which is less than 1 to 4 USD] and isn’t very ambitious about digital money. She is happy to go with the customer’s preference. She sites cash crunch, the release of 2000 rupee notes and the withdrawal of 500 rupee notes pushing digital money transactions, “...Once the 500 rupee notes were back in circulation, ‘cash’ too became a dominant transactional mode.” Apparently, demonetization pushed people to digitize their transactions - it was not organic to everyday behaviour with money. According to Sri Teja, a mobile street vendor selling *Pani Puri*, a popular savoury in the IT suburb of Hyderabad, “Even a penny can be transferred through the wallet. Digital money is small cash.” PayTM acquires new meanings consistent with and interpreted through existing notions of ‘money’ which in turn become drivers or constraints in the adoption of digital money.

4.3 Is Digital Wallet a Bank Too? Banking with PayTM

New capacities for digital wallets allows it to function, as expressed by a young Ice-cream street vendor in Hyderabad, 'like a bank in a pocket'. How does banking come to the PayTM user? Does it bring financial inclusion or literacy? Our research does not offer neat answers to this question, evident in the following selection of our 'data for the field'. Madhav, who owns a small multi-purpose store, has an interesting story that goes beyond PayTM for his vending business. He has two bank accounts and has opted out of linking any of them to PayTM. PayTM was 'cash in and cash out' and Madhav did not explore the option of looking at PayTM money as bankable, despite the many affordances networking the wallet to banking. The manager of Gulshan Dhaba, in Murthal, a peri-urban area on the outskirts North of Delhi, had another issue. The cap by PayTM with regard to the volume of money transferable to his bank account was not optimal for the money that the wallet was making. He reverted to asking some of his customers for cash which could easily be deposited in a bank. During the early days of demonetization sales through card and wallets had increased multi-fold, making transferring of money from PayTM to the bank a thorny issue. Initially, a sum of 400 USD and later a sum of 1200 USD served as caps to move money from the wallet to the bank account. But this process depended on the account holder undergoing a detailed Know Your Customer [KYC] process which posed a set of new problems for people like Madhav; he had issues with filling out these forms in any language. PayTM stood in as 'temporary storage' of money; not an instrument that can pad a savings account in a bank. PayTM as this easy everyday wallet is rendered a complex transacting instrument when linked to banks and banking - the long documentation process such as the KYC demanded a certain kind of financial literacy.

4.4 PayTM as a Situated and Shared Wallet

PayTM appropriation by vendors in urban India followed a certain socio-cultural pattern borrowed from the everyday context of street vending. The digital wallet was not only part of a smartphone ecosystem but also part of a situated business ecosystem of micro-businesses optimized for small margins of profit. PayTM was a shared digital storage for cash; friendly neighbourhood-businessmen could operate PayTM jointly; they could use PayTM as a 'record keeper' for their business transactions; substitute PayTM money for lending and borrowing; enrol themselves as merchants on the platform. All of the above were first-time occurrences in the life of these 'businessmen'.

The DLF food street is abuzz in the wee hours of the morning, catering to IT workers on a late work shift in Hyderabad. Most of the street vendors had a longer history with PayTM use than those in the Delhi street markets. Sohail, the owner of Hi-fi Tiffin Centre selling Indian fast food, has seen the transition of PayTM in the last three years, 'from a glitch-ridden the platform to a smooth operating one'. He said, "My customers came with a request to pay through digital wallets and I realized the potential they had for business." Amit has three young men working under him, in a busy market street of Lajpat Nagar, New Delhi, who look after four different stalls selling dresses, humbly priced at 5–6 USD a piece. To Amit PayTM is a boon for street

vendors - it ‘functions as a log book’ and aided managing co-workers without undue concerns about ‘petty theft’ in day to day business. A group of 4 vendors with individual stalls selling jewellery at throwaway prices share their business profits. One of them a young man named Rajat, currently performs only micro-transactions through his PayTM account but seemed enthusiastic about the entire concept of mobile wallets. Rajat shares this account with the four vendors around him. His product and price range result in small transactions, several through the ease of PayTM, and the proximity of co-vendors who he can trust has resulted in an organizational arrangement that optimizes their small business turnover without compromising on the benefits a digital wallet brings with it. “We pay each other cash to settle our account based on the PayTM records. That is one good thing with PayTM. There is a record of transactions.”

Anand [male, 59] a small vendor in the Nehru Place market, selling files and folders along with fidget spinners was sharing his ‘friend’s’ PayTM account. Anand insisted on his customers buying over 100 INR [<2 US\$] worth of products in order to transact with PayTM. One of the authors had to buy a products worth around 100 INR to be able to pay using her PayTM wallet. In Lajpat Nagar, a lot of street vendors function in groups of three or four and share a PayTM account. Jatin owns an open stall in Nehru Place, that sells men’s clothes using a couple of helpers. Jatin has two PayTM accounts and a self-confessed PayTM ‘fan’; “I want notes to be banned and everyone should be made to switch to cashless transactions. It would also affect my sales because not everyone roams around with cash. A lot of people generally carry cards with them however, all places including my own stall, do not accept cards.” He claims that there’s been a huge increase in sales with around Rs. 2000 [25 USD] as PayTM money each day and around INR 7000–8000 [950 USD] a week. Sumit has an independent business selling Indian snacks he carries around on a bicycle in and around street markets in Delhi. On an average, he serves 250–300 customers in a day with a 10% use of PayTM per day. Sumit is very PayTM proactive and has a merchant barcode for PayTM linked to his bank account. If his customers scan the barcode and make the payment, the money directly goes to his bank account. If they use his contact number to make the payment, it goes to his PayTM account. Sumit uses PayTM for micro-transactions like TV recharge, mobile phone recharge, small transactions for the household; “The system of mobile wallets is really great and useful. As long as people have PayTM on their phones, they won’t feel handicapped, be it in the marketplace, bus tickets, local train tickets, PayTM can be used anywhere. There is a sense of security that you have access to money all the time.” Move 50 miles outside of a big city you find a different approach to digital platforms. Murthal, a location on the outskirts of South Delhi, is strategic for small eateries to serve people passing by to stop for meals. Sukhbir, 28, a waiter in the Tavva Rasoi Dhaba, Murthal, Haryana, said, “Everyone has a PayTM account here but how it’s being used is known only by vendors like us.” To people like Sukhbir, PayTM like services seem to be an additional option to pay but does not affect sales per se. Interestingly the nature of context affects digital money exchanges; Sukhbir continued, “Our customer base either pay in large amounts (being in groups) or are payments from the lower-economic class (who do not even own a smartphone). I have had a PayTM account as well but there is little use for it here. Since I don’t get money into it I don’t take out money from it.” Dev, in his early twenties, works in *Mannat Dhaba*, a local eatery in Murthal on the outskirts of Delhi. He claims PayTM to

be an alternate yet weaker platform with around 5% of their daily number of transactions going through PayTM. Truck drivers who pass through or people from nearby are not typical PayTM users and usually go for cash (many do not have a Smartphone) whereas traders and people on an excursion opted for other payment techniques like PayTM and cards. Jagad, who sells ‘paan’, a digestive and mouth freshener, sits in a small kiosk outside the very popular *Amrik Dhaba* had a whopping 30–40% of the payments through PayTM. His product, the Paan, is worth INR 20 to 25 [30 cents] per piece and suited the microtransaction quality of the PayTM wallet.

5 A Discussion About PayTM and Acquired Financial Literacy

In this section, we attempt to discuss and locate PayTM, specifically, and digital wallets, broadly, as bearers of financial inclusion in developing countries like India. Some of the themes we will touch upon are challenges to digitally executing tasks on PayTM, which rests on two major challenges - one, arising from everyday business dealings and second, from the broader socio-cultural response to capacity building on digital devices and platforms. While many of our participants in the study find scratch cards, cashbacks and coupons easy to utilize, they admitted to finding basic features of money transfers and banking via PayTM tough to execute. People like Sunil, a footpath vendor, who are otherwise savvy with the phone and aware of PayTM as part of the phone app ecosystem, mention literacy issues with operating code or coupons in the use of PayTM. Aman who owns an open stall in Nehru place selling mobile phone covers and managing three people working under him, could not adjust to the technical aspects of PayTM and decided to discontinue its services despite looking at a loss of around INR 3000–4000 per day. By ‘technical’ he mentioned ‘whenever he would log out and try to sign in again’, the app ‘always flashed wrong password’. He had tried to contact customer care but had never been able to connect to them. He had also faced hassles while getting his KYC done. Aman mentions ‘PayTM is only for micro-transactions’ because he has never been able to trust PayTM as a system for banking. The virtual and digital aspects of PayTM were disconcerting – He said, “Companies like Airtel have service centres where you can go in order to raise any concern. But that isn’t the case with PayTM.” Despite mobile wallets being ‘huge time savers’, issues in ‘operating PayTM’ were insurmountable for Aman. Sometimes, people like Sunil, the footpath vendor, make ‘entry errors’ of bank accounts ‘when accidentally 4 k was transferred to a client account during a bank transfer’. He was also worried that “Losing my phone was like losing my actual wallet and exposing my bank accounts!” Interestingly, the more business-rich shop for ‘confiscated goods’ in the South Delhi market, separate their PayTM for business and personal use. PayTM and digital money was more to maintain and log their everyday business accounts and using cash in their personal transactions. With more of ethnographic persistence we understood that a lot of ‘grey’, unaccounted money, was used up as cash transactions in everyday use. An evolved literacy around digital wallets actually helped separating different forms of money and business dealings.

Sumit, the bicycle vendor of pastries, is ‘in awe’ with PayTM. For Sumit, micro-transactions and PayTM seem to share a symbiotic relation,” “Small transactions can push towards and pull away from PayTM – it’s so small that it’s easy to cash out and at the same time PayTM is so easy when a small change is not available”. Sumit goes on to say, “In my personal life, I use PayTM for TV recharge, mobile phone recharge, small transactions in the market like when buying milk etc. I have a merchant barcode for PayTM and its linked to my bank account.” If his customers scan the barcode and pay, the money directly goes to his bank account and if they use his contact number it goes to his PayTM account. “I trust PayTM more than my clients. As long as people have PayTM on their phones, they won’t feel handicapped with respect to money transactions in case they run out of cash in the marketplace, for bus tickets, local train tickets. PayTM can be used anywhere, it provides you with this sense of security that you have access to money at any point in time.” Sumit’s acquired ‘literacy’ and persistence with PayTM in his everyday helped evaluate his experience with the wallet’s social-technical eco system.

Several street entrepreneurs in our study did not concur with Sumit’s enthusiasm. Many of them share PayTM accounts and the cap for money transactions did not bother them [they were doing small transactions] but re-distributing the money among themselves needed some ‘off-digital’ tactics. The vendors manually attempted to calculate ‘who owed what to whom’ and wished there were ‘easier ways to unlock the money from PayTM’. Like Manish, owner of an ice-cream parlour near the Hyderabad’s IT park, small vendors ‘gave up’ persisting with PayTM or the ‘notion’ of allowing digital wallet or money to enter their everyday business: “I did not go beyond the first month with PayTM after facing a technical glitch that impacted my payments! I still don’t understand what went wrong! Even after PayTM removed transactional and transfer charges which ate into our profits, I believe PayTM is here to ‘pull wool over our eyes’ as an easy, profitable and smooth option to run a small business.” Manish actually believed that digital money cut into his honest business earnings. Saurav, the owner of a footpath stall, uses PayTM for many reasons but has no bank account; he was both eager and suspicious to use digital wallets and vest trust in their capacity to store and secure his money. For instance, it took a while for Saurav to understand ‘mandated caps for the value of transactions per day on PayTM’. But the street vendor continue to persist with PayTM. Is Saurav’s persistence with PayTM a result of acquired literacy through trial and error? Or is it demand for the wallet to easily execute micro-transactions pushing its adoption and thereby the literacies to use the wallet optimally? Is Saurav the emerging user of wallets like PayTM which is integrating the financially marginalised and underserved sections in the context of developing countries like India?

6 Conclusion

By way of conclusion, we suggest that the process of ‘inclusion’ is as much a bottom-up process even if engineered top down via national and state-driven economic policy. We explained PayTM use in the context of gaining digital literacy and their relationship to the street vending businesses in street markets in two Indian metropolises and their

surrounding suburbs and peri-urban locations. A significant learning has been the reciprocal influence of business contexts [the type of business, range, and movement of products, nature of clientele, location] on the adoption practices of digital wallets. Social and business contexts operate as frameworks in the use of PayTM thereby affecting financial and digital literacy abilities. Digital-financial inclusion is as much a product of local actors and social systems as it is an achievement of the more formal economic and political enablers. Our paper outlined financial literacy, the bedrock of financial inclusion, an acquired habit borne from everyday practice and assemblage of experiences impacting consequences for the underserved and marginalized populations. We also made a compelling contextual inquiry of PayTM as stakeholder arbitrating access to digital money uptake, technology literacy and entrepreneurial ability for the low resourced street merchants in India.

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Research in Progress: Holistic Climate Service Prototypes for Farmers in Tambuu, Tanzania

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Abstract. Urgent efforts are needed to address climate change and changing climate variability. Solutions are needed at economic, political, scientific, educational, as well as technological domains. Our previous research in Tambuu, Tanzania, shows that the acute information needs of the community are credible and trustworthy weather information, knowledge in best uses of weather information, and education about best farming practices. Delivering the information for end users in Tambuu is a challenge in itself. Based on these results and following the principles of System Action Design Research, we developed prototypes for future climate services together with local farmers in Tambuu community. These prototypes and our future plans are presented in this research-in-progress paper.

Keywords: System Action Design Research · Climate services · Climate change · Mobile technology

1 Introduction

Climate change is one of the most serious problems of the world today. Climate change may cause uncontrolled sequences of fatal harms, and it directly threatens the future existence of humankind. The negative effects of climate change are already being experienced globally, but particularly in the Global South, mainly by the most vulnerable groups of people. Therefore actions need to be urgently taken in order to adapt to changing climate conditions.

This paper reports second phase of our project, which initiated climate service prototype development. This work is based on results of our previous research about needs and priorities of Tambuu community, Tanzania [14]. These developed climate services would assist smallholder farmers in adapting to climate change, and will help steer their development in a sustainable direction.

2 Previous and Related Research

Our previous research [14] shows that the farmers in Tambuu village have experienced the impacts of climate change. The farmers' experiences of changing climate patterns were found to be well aligned with measurements done by the Tanzanian Meteorological Agency (TMA) [14]. Research shows that scenarios for future rainfall vary a lot [17]. The only certain thing is that uncertainty about amount, duration, and timing of rain will increase [14]. In addition to climate related acute information needs, several other information needs were also found, including information about agricultural practices and training to use them properly. The current sources for information were found to be often unreliable [14]. The information needs in Tambuu are sum up in Table 1.

Table 1. Information needs of Tambuu villagers [14]

Acute information and other needs
Credible and trustworthy weather information
Knowledge in best uses of weather information
Education about best farming practices
Farming inputs (seeds, fertilizers, equipment)
Soil management tips and soil testing service
Financial services and marketing skills

In regards of the current mobile phone usage patterns, voice calls, short messages, calendar, and clock were the most popular applications [14]. Some “modern” uses were also found, when, for example, farmers took photos of insects and sent them for analysis to a relative [14]. Smartphone ownership was found to be low. Without electricity coverage in Tambuu, charging of mobile devices was done with the help of generators or solar panels [14]. A number of related challenges were revealed. These included weak network coverage, low technical competence, high prices of mobile usage and phones, usability issues of smartphones, especially relating to the touch-screen, and English language [14].

A number of projects have attempted to use mobile technology to provide farmers in developing countries with services such as weather information, market data, agronomy tips, crop information, and various others [9–11]. Common examples of those approaches include market information and market place service M-Farm¹, and Airtel Kilimo², which provides farmers with agricultural information, weather forecasts, and market information. Many other services are still in testing and development phase, with little proven positive impacts to farmers' activities [11].

Many current climate services projects have been launched for instance in Tanzania, Kenya and Uganda, from which learnings about the suitable content for climate

¹ <https://www.mfarm.co.ke>

² <https://www.gsma.com/mobilefordevelopment/programme/magri/airtel-kilimoproject-update-insights-from-the-midline/>.

services can be adopted. In Tanzania, project operating under Global Framework of Climate Services was using participatory methods to train intermediates, which would spread climate information to rural farmers³. In Uganda, a project called Climate Change Adaptation and ICT (CHAI) reached 120 000 farmers, which receive weather forecasts and locally tailored agricultural advisories by SMS. It collected weather data from 22 sub-country weather station, as well as crop and livestock market information from 46 market places⁴. Project in Kenya provides evidence about the impact of these climate services by revealing that farmers, which received climate information were better in crop management and got also higher yields, as compared to farmers in the control group [16].

Generally well suited rules relating to the content of these mobile services for small scale farmers include following points; (1) Information must be relevant, timely and actionable by the farmers [1], (2) Information should be disseminated based on the crop cycle (3) Information should be breaking down into comprehensive pieces for farmers to understand (4) Use of information intermediates could be a one solution in spreading complex information to farmers [2].

In terms of technical qualifications of the app, the past literature has identified following well tried and tested design principles for mobile services in developing countries; (1) Understand users and their needs [1], (2) Use participatory design, (3) Identify suitable partners, (4) Develop viable business model and (5) Monitor and evaluate the progress [2, 4].

In Tambuu, we found that the mobile infrastructure is decent, however, mobile internet connectivity was relatively weak. Many small scale farmers in Tambuu, and in Tanzania, do not, at the present moment, have smartphones. Designing applications, especially ones delivering weather and climate related information, for USSD is difficult, due to its technical limitations in terms of presenting visual elements and cumbersome navigation between different menus [1]. Second, estimates show that smartphone ownership is increasing in emerging economies (e.g. [15]), which makes them a potent platform for future applications.

3 System Action Design Research

The situation calls for a resilient and iterative design research methodology. First, functioning of crucial systems change constantly. These systems include cultivation practices, agricultural education, technology in local communities, climate, and climate variability. To address the needed resilience and agility in this project, we use the System Action Design Research framework (SADR) and Epistemic Implementation Delphi model (EID) [6] in project implementation. SADR is an extension to Design Science Research (DSR) [8, 13]. EID is a scientific model for project implementation that is based on building a mutual agreement between stakeholders [6]. DSR is different from “routine design”, where existing knowledge is applied to solve problems by using

³ <https://www.wfp.org/stories/climate-services-farmers-tanzania>.

⁴ <https://www.fhi360.org/projects/climate-change-adaptation-and-ict-chai>.

“best practice” knowledge and theory [7]. In SADR and EID, rigorous research methodology is brought to back up the design process in situations, where the end-user demands, contextual and sociocultural factors, and many other important issues in the design process are not understood well enough to use a linear design process [6]. SADR and EID are specifically designed to fit well into the developing country contexts [6].

4 Approach

The design activities were conducted in Tambuu village. The later part of the activities consisted of a technology prototype workshop, to which total of eight farmers participated. These farmers represented various ages and educational and mobile literacy levels. Four of the participating farmers were interviewed (Group 1) during previous days of primary data collection [14], and four were not (Group 2). Group 1 consisted of three males and one female (average age 41, min = 23 max = 58) and Group 2 consisted of three females and one male (average age 47, min = 43 max = 58). Aim of the workshops was to introduce our first technology prototype for the participants, and to get their first impressions about using it.

In addition, the workshop contained a session about weather icons. Several weather-related icons were presented and the farmers’ viewpoints to those icons were asked. This was followed by an icon-design experiment, where the participants and researchers designed icons for few weather related situations, such as drought and floods and few agricultural related actions such as planting, weeding, and harvesting. This workshop was led by local researchers in ki-Swahili, assisted by other researchers by drawing icons into flipcharts based on the farmers’ ideas and comments.

We used the examples of Sapelli project [18], where icons and interfaces were designed for application aimed for collecting traditional ecological knowledge by non-literate forest people in Congolese rainforest, and Street vendor’s project [12], where icons were designed for bookkeeping application aimed to street vendors in Dar es Salaam, Tanzania, as a source of ideas and inspiration when planning the activities of this workshop.

5 Technology Prototypes

To address the information needs of Tambuu community, we came up with a number of possible ideas for future technology solutions, as a result of the interviews and workshops as well as the prior literature research phase. In Table 2, ideas for future applications are listed. Due to its major importance, the main focus of this project is with weather and decision making tools that help farmers in adapting to the changing climate. However, farmers needs in terms of information about best farming practices, access to seed and market data, financial services, and soil management, need to be crucially addressed too.

Table 2. Technology solutions for Tambuu

Future mobile solutions for Tambuu
Credible weather information services
Farming decision making tools
Educational applications for best farming practices
Trusted market for farming inputs
Financial services and marketing technology
Soil management and soil testing application
Information exchange applications

5.1 First Prototype

During the workshops, it was found out that the villagers were very knowledgeable about the local effects of climate change and they were interested in credible weather predictions and forecasts in relation to the whole growing season. In addition, specific farming knowledge in regards of different plants was found to be of high interest. The three primary information needs in regards of climate are as follows: (1) long-term seasonal weather predictions, (2) short-term weather predictions, and (3) common knowledge about effective farming practices. This observation is also mentioned in one prior article covering farmer's information needs in Tanzania [3], which also pointed out the special importance of information about the starting point of the rains, expected rainfall of the season and end of the rains for the farmers. Since reading and writing skills were found to be at a reasonable level, we decided to include both a picture and text for each navigation element and icon. This was intended to reduce the required cognitive workload and make the correct functionality easier to find.

In developing a climate service application, three problems need to be addressed. First, credible weather data needs to be acquired, together with supportive agricultural and other information. Second, that weather and agricultural data needs to be algorithmically processed. Third, the processed data needs to be presented to end-users. The following sections will give our ideas about how to address these problems.

5.2 Sources and Access to Data

In order to develop a mobile climate service, climate and weather, as well as other supportive data needs to be acquired. The source of climate and weather data can range from local or international meteorological agencies, NGOs, universities and research institutions, to data from sensors such as local weather stations or soil moisture measurements, or data collected by mobile devices from farmers themselves. A number of agriculture related content platforms have been launched, including Toto Agriculture⁵ which is dedicated to sharing agricultural information in actionable formats.

In regards of Tambuu, the local Sokoine University of Agriculture (SUA) has an impressive repository of research-based farming information, which is one important source for supportive agricultural data. Then, one crucial question is, how to

⁵ <http://www.totoagriculture.org>

automatically process that data, which is currently in the form of reports, theses, journal articles, raw statistical data, and pamphlets, into data that can be used to give concrete suggestions for farmers in their decision making.

5.3 Algorithmic Processing of Data

After the data is obtained from the data sources, such as international or local information services, or from repositories such as SUA's research repository, the data needs to be algorithmically processed before it can be presented to an end user. This design process, which needs to be done in collaboration with different stakeholders, using statistical methods, big data processing methods, machine learning, and natural language processing (NLP) methods need to be creatively applied to write sophisticated and contextually relevant data processing algorithms. All available components and suitable algorithms for processing weather and climate data must be used in order to avoid reinventing something that has already been invented.

5.4 Presenting the Data (User Interface)

In the first prototype experiments, which were conducted together with the farmers of Tambuu, we started with the assumption that all possible climate and weather, as well as other required data is available. The first mobile user interface prototype was created beforehand for Android-platform which is the most common mobile platform in many developing countries. In the user interface design, material design [5] was used. The first prototype application was designed by using Google's Flutter-library⁶. In Fig. 1 we show the very first prototype of the user interface for the application as an English language version. During the session used ki-Swahili language version.

5.5 Icon Design Experiments

In the beginning of the second activity, we presented the farmers with commonly used weather icons and they were instructed on what each of them meant. They were also asked, whether they considered the symbols self-explanatory, meaning did the symbols make sense to them initially, or did they require explanation. This part revealed that some elements of the symbols, such as lack of ground level and shape of the clouds where confusing for the locals. To overcome this challenge, we plan to implement explanation-menu into the final app prototype, where weather icons are explained in simple terms. Finally the study participants were given a task of co-designing an icon for flood and drought conditions.

Originally we were also thinking of re-designing the common weather symbols, but decided to drop that idea since those are so commonly used by other weather service outlets, such as newspapers, TV and other apps, that remaking them would probably just confuse users. Icon design sessions started with the researcher explaining the idea of the session and the category for the icon in question. Sessions were led by our local

⁶ <https://flutter.io>.

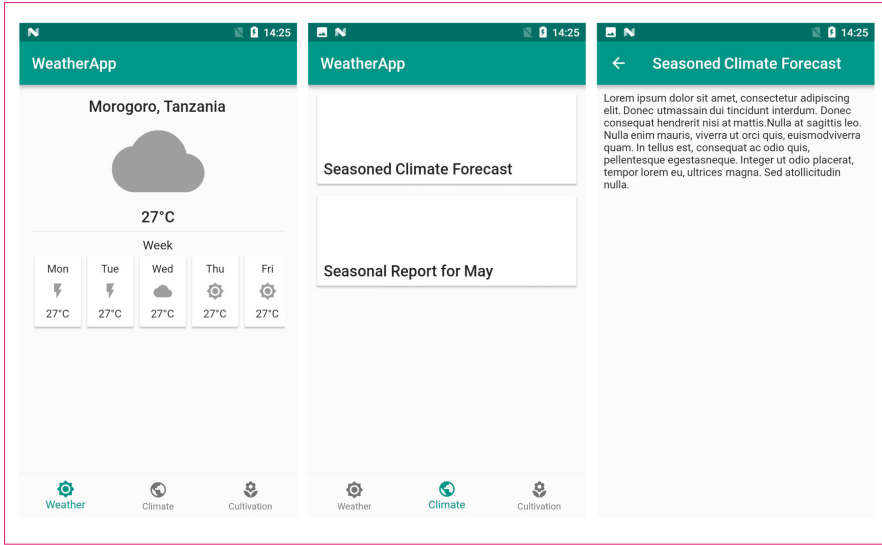


Fig. 1. Screenshots of the first prototype. From left to right: short term weather forecast, menu selection and seasonal climate forecast.

researcher in Swahili, assisted by other researchers, who were drawing the icons into flipcharts, based on the farmer's comments. As a final part, participants were instructed to design icons for planting, weeding and harvesting actions, following the same procedure as with weather icons.

The reason why we focused on icons, both the weather related and farming related, was that they were something tangible, something to which farmers can connect their farm activities and therefore are able to give ideas, for example, on how the planting icon could look like. This method was estimated to be the most functional way to get farmers to participate into the design process and build ownership to the app at this point. All the session where successful, and participants willingly and openly expressed their opinions and ideas, as well as ask questions from the researchers.

6 Conclusions

The design of the future climate technologies is a challenging task, but an interesting and inspiring one, too. This task requires experts from multiple fields, for example, meteorological, statistical, computational, human computer interaction (HCI), and interaction design (IXD) skills are crucially required. Technology initiatives cannot solve big problems alone, but they must work in collaboration with other development efforts and initiatives. Thus, participatory design, which means involving all stakeholders and especially the end-users in the design process as equal members, is of utmost importance.

There are three specific information needs in Tambuu community: short-term weather predictions, long-term weather predictions, and common knowledge about effective farming practices. Therefore, we will take a holistic view to the climate services, and we will include also the short term weather forecast and general agricultural information to the app. Short term weather information will allow farmers to make detailed decision on when to start planting. General agricultural information, for instance about Climate-Smart Agriculture (CSA), helps farmers to adapt and prepare for the changing climate conditions in their farms.

We are addressing this design problem from three fronts: by exploring the reliable sources of data, by algorithmically processing the data, and by designing contextually relevant user interfaces. In regards of user interface (UI) design, the future steps include designing various options to present additional information in the app. Then, when our researchers visit Tambuu next time, they would present those different UI design options to local farmers and would integrate them into the process of selecting and fine-tuning the most suitable UI elements. During this phase, other feedback, about such topic as suitable content and features, is also collected, in order to build the final version of the app.

Besides the importance of UI design, we will have few other guiding principles for the technical development of this climate service. Firstly, the final app design will be optimized in terms of its data usage, meaning in practices that after the initial installation, the future updates and other data transfers are kept in minimum, so to guarantee that apps usage doesn't create a too big data bill for its users and cause them to stop using the service. Secondly, we will focus on the user privacy, by keeping all the data in secured servers and when analysing the user data, it will be done anonymously, so that the individual users cannot be recognized from the data.

Final version of the app will be used in the actual field testing phase, which has the aim of verifying apps benefits by comparing app users to farmers without access to information. We acknowledge that the icon design is only a small part of the whole app design, but aim of this exercise was mostly to find out how the co-design sessions can be held in the village, e.g., what type of interaction and explanation works there, in order to prepare the team for the next phases of the development process.

This app is not, naturally, going to be any "silver-bullet" that will solve all the issues among the farmers and that is a reason why we also emphasize the need for improving the access to physical farm inputs (such as improved seeds and fertilizers) and improvements in road network and electrical grid coverage, among other aspects.




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Factors that Influence Workers' Participation in Unhygienic Cyber Practices: A Pilot Study from Nigeria

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Abstract. Participation or engagement in unhygienic cyber practices could ultimately harm an organization's information and communication technologies, if unchecked. This present study used concepts from the theory of planned behavior and organizational control theory to examine the effects of factors such as attitude, subjective norms, organizational facilitators, monitoring, and self-efficacy on workers' participation in unhygienic cyber practices. A cross-sectional survey of Nigerian professionals was used to test the formulated hypotheses. Partial least squares technique of structural equation modeling (SEM) was used for data analysis. The results indicate that attitude toward cyber hygiene has a negative effect on worker's participation in unhygienic cyber practices; similarly, subjective norms have a negative effect on engagement in such acts. The data did not show that organizational facilitators, self-efficacy, and monitoring had a meaningful impact on Nigerian workers' participation in unhygienic cyber practices. Implications of the study were discussed and contribution to the extant literature noted.

Keywords: Cyber hygiene · Information security · Employee · Survey · Nigeria

1 Introduction

Information and communication technologies (ICT) enhance societal development and advancement across the globe [1]. Private and public organizations from Accra to Zanzibar have deployed and used ICT and other digital platforms for their activities and operations [2]. When processes and activities hinged on ICT platforms are compromised, either by non-malicious mistakes or malicious attacks, the consequences of such acts can have disastrous effects [3, 4]. To ensure the safety of data resources, savvy organizations and business operators often provide workers with guidelines and instructions on how to properly use organizational ICT and other digital assets [3–6]. Prior research has examined employee ICT misuse [5], ICT abuse [4], compliance, and noncompliance with information systems (IS) security procedures [3–8]. These foregoing themes do not specifically focus on employee engagement or involvement in cyber hygiene malpractices [9, 10]. Additionally, information on which factors influence or discourage participation in such behavior is not readily available in the noted studies.

The proposed research study contributes to prior research by investigating the effects of attitude, monitoring, subjective norms, organizational facilitators, and self-efficacy on employee participation in unacceptable or ill-sanctioned cyber practices. Specifically, this study is designed to address the following research questions:

(a) *What is the effect of attitude toward cyber practices on employees' participation in unacceptable cyber hygiene practices?* (b) *What is the effect of subjective norms on employees' participation in unacceptable cyber hygiene practices?* (c) *What is the effect of organizational facilitators on employees' participation in unacceptable cyber hygiene practices?* (d) *What is the effect of employees' self-efficacy regarding cyber practices on their participation in unacceptable cyber hygiene practices?* (e) *What is the effect of monitoring on employees' participation in unacceptable cyber hygiene practices?*

The study is relevant because the majority of previous work in the area of end-user security behaviors has been conducted in the developed West [3–8]. Not much research has been done in Africa [11–13]. Information systems (IS) issues in advanced societies should not to be conflated with those in developing parts of the world, including Africa [11–13]. Factors that influence employee involvement in unacceptable cyber practices in Africa, with the Nigerian worker as an exemplar, may not necessarily be the same for a German or American worker. In this study, we provide a perspective of IS security management issue from a region of the world that has not been well-represented in the extant literature. Moreover, findings from a study such as this one could provide useful insights for the national cyber security frameworks recently launched in Africa, including Nigeria [14]. As well, the management of such behaviors among workers, in the region, also benefits from empirical studies of this nature. To the best of our knowledge, no previous research has explored the relationships between the effects of attitude, self-efficacy, subjective norms, organizational facilitators, and monitoring on employee participation in unacceptable cyber practices, as this present study aims to do.

2 Literature Review

2.1 Information on End User Security Behavior and Cyber Hygiene

Various taxonomies on individual IS/ICT security behaviors are available in the extant IS security management literature [15–17]. For example, Magklaras and Furnell [15] discussed a model for predicting insider threats by focusing on IS misuse and abuse with examples, including data theft and stress. We build on the study by Loch et al. [16], who identified sources of information security threats to an organization, and Stanton et al. [17], who proposed a taxonomy of end-user computer security behaviors. The study focuses solely on human sources, e.g., employees and non-malicious acts. Actions of malicious entities, i.e., hackers, are outside the scope of this study, so are natural disasters, i.e., flood, fire, and so on. Stanton et al. [17] categorized the nature or acts of threats as either malicious or non-malicious. Thus, malicious end-user security behaviors include, for example, an employee who breaks into an employer's protected IS to steal trade secrets; non-malicious end-user security behaviors include items such as responding to spam email. A few researchers have investigated similar issues in

developing countries, e.g., Nigeria [11–13]. For example, Longe et al. [13] presented an overview of criminal uses of ICTs in Sub-Saharan Africa with special emphasis on the Nigerian 419 scam. Ifinedo et al. [12] reported on top non-malicious, counter-productive computer security behavior engagements among employees in Nigeria. Empirical information on workers' cyber practices and potential determinants of such in Africa are not readily available.

In essence, cyber hygiene refers to the practices, precautions, and steps users of computers and other digital devices take to maintain, safeguard, and secure data resources from intrusions and outside attacks. Here, “cyber hygiene practices” refers to the positive or favorable notion of the phenomenon while *unhygienic cyber practices* connote unfavorable and ill-advised acts. In developing an illustrative list of unhygienic cyber practices for the study (see Table 1), we consulted prior academic literature and practitioners' reports on the subject matter [6, 9, 10, 18].

3 Theoretical Foundations

A plethora of theories have been used to explore factors affecting end-user security behaviors [19]. It is not possible to include all relevant theoretical frameworks in this preliminary study. For illustrative purposes, we will fuse common theories such as the theory of planned behavior (TPB) [20] and monitoring from the organizational control theory (OCT) [21], to understand factors that impact employee involvement in unacceptable cyber hygiene practices.

3.1 Theory of Planned Behavior

Ajzen [20] proposed the theory of planned behavior (TPB). Its three proximal predictors of behavioral intention and behavior are attitude, subjective norms, and perceived behavioral control. Attitude refers to an individual's positive or negative feelings toward engaging in a specified behavior. Subjective norms refer to an individual's perception of what people important to him/her think about a given behavior. Perceived behavioral control (PCB) refers to an individual's beliefs regarding the efficacy and resources needed to facilitate a behavior. Two sub-constructs, i.e., organizational facilitators and self-efficacy, are used to represent PCB as research shows these constructs are similar to it [8]. The former relates to resources that an organization provides to encourage or discourage engagement in a target behavior. The latter relates to an individual's ability to organize and execute courses of action required to produce/perform a specific behavior [22]. Behavior refers to an individual's observable response in a given situation with respect to a given target. For the purpose of this study, behavior is represented by unhygienic cyber practices. Several researchers have used TPB to study employee compliance with acceptable IS security behaviors and intention to use protective technologies [19].

3.2 Organizational Control Theory

Organizational control theory (OCT) is a multifaceted framework that describes the process by which one party attempts to influence the behavior of another within a given system [21]. Here, it includes management mechanisms through which an organization manages and directs the attention of its members, as well as motivates and encourages them, to act in accordance with its goals and objectives. The specific aspect of OCT considered for this present study is monitoring. Here, monitoring is the observing and checking of workers' computing practices over a regular basis. Other components of OCT, e.g., reward and specification, will be considered in future research inquiries. Monitoring was chosen for this initial study because it provides an opportunity to investigate the impact of organizational efforts aimed at checking workers' adherence to prescribed IS security guidelines. Moreover, past researchers [e.g., 5] found monitoring to be relevant in understanding workers' compliance with desired IS security behaviors.

4 Research Model and Hypotheses

The study's research model is presented in Fig. 1. Discussions on the formulated hypotheses are provided as follows:

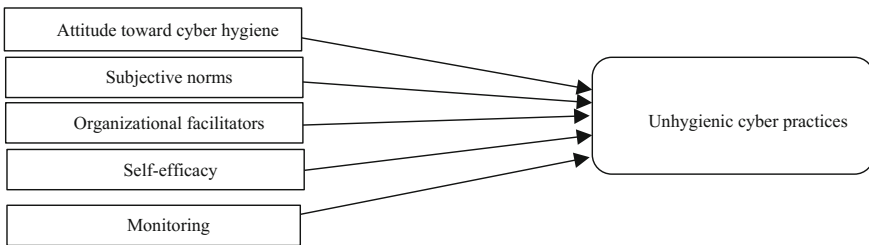


Fig. 1. The research model.

In tune with the tenets of TPB, positive attitudes influence favorable behavior and conversely, negative attitudes will diminish a target behavior [20]. Past studies show that employees who have positive attitudinal beliefs about their organization's IS security rules are the ones that readily comply with such guidelines [8, 19]. Thus, it is expected that employees with positive attitudes toward cyber hygiene will have fewer compulsions to engage in unacceptable cyber hygiene practices.

H1: Attitude toward cyber hygiene negatively affect participation in unhygienic cyber practices.

Evidence exists to support the view indicating that an individual's behavior is influenced or motivated by what he or she observes to be the norm in his or her environment [6, 20]. With regard to following acceptable organizational IS security rules, employees are more likely to adhere to their organization's ISSP if they notice that those around them, i.e., superiors, peers, and subordinates, are complying with

such guidelines [6–8, 19]. Past studies [7, 8] found that subjective norms significantly affect ISSP compliance in organizations.

H2: *Subjective norms related to cyber hygiene negatively affect participation in unhygienic cyber practices.*

The availability of organizational resources facilitates a target behavior such as compliance [20]. Organizational facilitators, e.g., provision of acceptable IS use policy and the availability of IS security awareness programs, play a significant role in shaping individual perceptions of acceptable ICT use in organizations [3, 5, 18]. It is reasonable to expect that workers, in contexts where adequate organizational resources exist, will have less tendency to engage in ill-sanctioned computing practices and related acts.

H3: *Organizational facilitators negatively affect participation in unhygienic cyber practices.*

An individual's confidence in their knowledge and skills plays an import role in engaging in a target behavior [20]. With respect to compliance with acceptable IS security guidelines and rules, past studies demonstrated that employees with higher levels of skills and knowledge of IS security issues and consequences related to poor choices are less inclined to indulge in unfavorable ICT use practices [3, 8]. Those with lower levels of knowledge do not readily follow IS security rules [23] and may knowingly or unknowingly engage in unhygienic cyber practices.

H4: *Self-efficacy negatively affects participation in unhygienic cyber practices.*

In accordance with OCT, management often evaluates and monitors the actions of employees to ensure compliance with desired goals and objectives [21]. If a worker believes that management does not monitor his/her computing practices (and their use of technologies at work), s/he is more likely to flout acceptable directives. D'Arcy et al. [5] found that when employees know that computer monitoring is in place, incidents of IS misuse drop significantly. Thus, it is expected that employees' participation in unhygienic cyber practices will likely be low if they know their organization monitors their ICT use practices.

H5: *Monitoring negatively affects participation in unhygienic cyber practices.*

5 Research Methodology

5.1 Study Design, Data Collection, and Subjects

To test the formulated hypotheses, a survey research methodology was adopted. A pilot survey was initially conducted among 25 MBA students in a local university to enhance the content and face validities of the items used for the study. Questionnaires used in the final survey were administered to working MBA students in a university in Lagos, which is the commercial capital of Nigeria; participation was voluntary. Of the 125 questionnaires distributed, 76 were returned; thus, the effective response rate for the study was 60.8%. The response rate is considered adequate for a study such as this one. Incomplete responses and poorly completed responses were excluded from subsequent data analysis. In all, 71 responses were used for the study.

Demographic information about the respondents is presented as follows: 37 are males (52.1%) and 20 are females (28.2%); the data has missing entries. Many of them (49%) have bachelor's degrees and 25% have other master's degrees. In the sample, 42.3%, 18.3%, and 15.5% of respondents were in the 21 to 30, 31 to 40, and 41 to 50 age ranges, respectively. The participants' average years of computer use is 11.5 years (standard deviations [S.D.] = 6.8) and they have 4.6 years (S.D. = 3.4) tenure at their current organizations. Some participants noted their job titles as accountant, software engineer, system analyst, project manager, internet scammer, lecturer, and customer service manager. Forty-two (42) are IT professionals and the rest are non-IT personnel. Diverse industries such as IT, manufacturing, banking, education, and so forth were represented in the sample. The data sample included an even distribution of organization size and annual revenue.

The survey collected both independent and dependent data from the same source; this could lead to common method bias (CMB) [24]. The procedures recommended to account for the effects of CMB were followed [24]. For example, respondent anonymity was assured and questions in the survey were ordered in a randomized manner. Additionally, two post-hoc statistical analyses to further reduce concerns related to the presence of CMB were used. First, Harman's one-factor test was conducted for the reflective, independent constructs. The results showed that five factors were extracted; the first factor explained 39.8% of the variance. Second, Pavlou et al. [25] suggest that an inter-construct correlation higher than 0.9 is a possible indicator of CMB. There were no correlations in Table 2 above 0.90 to further show CMB was not a problem for our data. Both tests indicated that CMB was not problematic for the collected data.

5.2 Operationalization of the Constructs

Measuring items used to represent the unhygienic cyber practices construct were taken from the following sources [6, 9, 10, 18]. The dependent construct was modeled as a formative construct because its constituting variables measure differing phenomena.

Table 1 shows the questionnaire items used for the formative construct and their descriptive statistics. The study's participants were asked the question: "Please indicate how often you participate in the listed unhygienic cyber practices listed in Table 1." Their responses were assessed on a seven-point scale ranging from "Almost never" (1) to "Almost always" (7). The four (4) measures for attitude toward cyber hygiene, which include "Following the organization's IS security policy is a good idea", were taken constructs that have been validated [8, 22]. Four (4) items for the subjective norms construct were adapted from [7, 8] as well with an example: "My boss thinks that I should follow the organization's IS security policy". For the four (4) measuring items used for organizational facilitators, we used items such as "My organization has established rules of behavior for use of computer resources and other digital assets"; this was modified from [5, 18]. The self-efficacy construct has items adapted from Bandura [22]; items in the construct include "I have basic knowledge on how to avoid unhygienic cyber practices." Five (5) measuring items adapted from D'Arcy et al. [5]

were used to operationalize the monitoring construct. An example includes “I believe that my organization monitors its employees’ cyber practices and engagements.” As indicated, the measuring items used for the reflective, independent constructs have been validated in prior studies. All the items were assessed on a seven-point scale ranging from “Strongly disagree” (1) to “Strongly agree” (7).

Table 1. Questionnaire items used for the formative construct and their descriptive statistics.

Item	Unhygienic cyber practices	Mean	SD	Weight	P-value	VIF
1	Responding to spam (i.e., unsolicited emails)	3.28	2.29	+++	+++	3.879
2	Using weak passwords at work	3.63	1.92	+++	+++	4.014
3	Not updating work-related passwords regularly	3.82	2.08	0.155	0.087	2.078
4	Visiting non-related websites at work	4.05	1.69	0.115	0.015	1.285
5	Not updating anti-virus and/or anti-spyware software at work	4.15	1.96	+++	+++	4.569
6	Not logging out of secure systems after use	3.33	2.16	0.147	0.010	1.911
7	Not always treating sensitive data carefully	3.07	2.01	0.109	0.068	1.843
8	Allowing others (e.g., family) to play with work laptop	3.34	2.26	0.094	0.021	1.794
9	Downloading unauthorized software (i.e., freeware) onto work computer	3.80	2.18	0.159	0.081	1.634
10	Pasting or sticking computer passwords on office desks	2.85	2.57	+++	+++	4.963
11	Disclosing work-related passwords to others	2.95	2.38	+++	0.086	1.918
12	Leaving one’s work laptop unattended	3.66	2.27	+++	0.081	2.016
13	Not backing up work files	4.38	1.81	+++	+++	3.987
14	Logging onto unsecure networks outside work, e.g., WIFI	4.19	1.90	0.153	0.09	1.666
15	Using unauthorized or personal USB at work	4.16	2.12	0.172	0.065	2.619
16	Storing work files in the cloud without authorization	3.51	2.25	0.163	0.075	1.648

Note: +++ represents entries excluded from final data analysis.

6 Data Analysis

Data analysis was done using the Partial Least Squares (PLS) technique of structural equation modeling (SEM), which is suitable for theory testing [26]. PLS supports the use of small sample sizes and does not impose data normality requirements [26, 27]. WarpPLS 5.0 software was used for this study [27]. PLS supports both formative and reflective models and recognizes two components of a causal model: the measurement and structural models.

6.1 Measurement Model

For the reflective constructs, item reliability, composite reliability, and convergent and discriminant validities were examined. Item loadings above 0.7 are recommended [26] in assessing item reliability. Item loadings from 0.700 to 0.933 were obtained for the study (they were not presented due to space limitations). Composite reliability higher than 0.707 for each construct is preferred [26]; results obtained in this regard are presented in Table 2 to satisfy this criterion. In addition, convergent and discriminant validities were assessed using the following criteria: (a) the average variance extracted (AVE) should be no less than 0.707 (i.e., the AVE should be above the threshold value of 0.50); (b) the square root of AVE should be larger than the correlations between that construct and all other constructs; and (c) the items should load more strongly on their respective constructs than on other constructs. This requirement for “c” was met but not included due to space consideration; however, information relating to the AVEs is provided in Table 2. All AVEs are above the recommended threshold of 0.50.

Table 2. Composite reliability, AVEs, and inter-construct correlations.

	COM	AVE	1	2	3	4	5	6
ATT	0.85	0.59	0.77	0.63	0.52	-0.05	0.48	0.28
SUB	0.87	0.62	0.63	0.79	0.52	-0.05	0.45	0.60
FAC	0.93	0.76	0.52	0.52	0.87	0.06	0.55	0.34
CYB	na	na	-0.05	-0.05	0.06	na	0.16	-0.03
MON	0.91	0.66	0.48	0.45	0.55	0.16	0.81	0.12
SEF	0.90	0.76	0.28	0.60	0.34	-0.03	0.12	0.87

Note: (a) COM = composite reliability; AVE = average variance extracted; (b) Off-diagonal elements are correlations among constructs; (c) the bold fonts in the leading diagonals are the square root of AVEs; (d) ATT = Attitude, SUB = Subjective norms, FAC = Organizational facilitators, MON = Monitoring, SEF = Self-efficacy, CYB = Unhygienic cyber practice

For the formative construct, i.e., unhygienic cyber practices, the presence of multicollinearity is checked and the item weights evaluated. Excessive collinearity within formative scales is problematic for a construct. To assess multicollinearity among the variables, the variance inflation factors (VIF) are checked. VIFs below the conservative cutoff of 3.33 are considered adequate [28]. Items weights show how significantly linked item indicators are to their specified constructs; weights with statistical significance are preferred [28]. Table 1 shows that VIFs and item weights used to capture the dependent variable are adequate. Namely, all VIFs are below 3.33 and the weights are significant at $p < 0.10$ level.

6.2 Structural ModelF

The structural model provides information about the path significance (β) of hypothesized relationships and the coefficient of determination, squared R (R^2) [26]. WarpPLS 5.0 results for the β s and the R^2 are shown in Fig. 2 (* indicates significance at $p < 0.5$ level). The independent variables explained 19% of the variance in the dependent variable to show the model has significant value [26]. WarpPLS 5.0 also provides information on Goodness of Fit (GoF), which is a global fit measure that accounts for both measurement and structural model performance [29]. The GoF obtained for this study is 0.33, which is close to the cut-off value of 0.36 for large effect sizes [30].

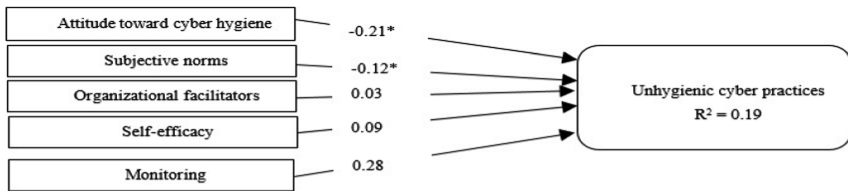


Fig. 2. The PLS result.

Consistent with H1, attitude toward cyber hygiene has a negative effect on participation in unhygienic cyber practices ($\beta = -0.21$, $p < 0.05$). H2, which predicted that subjective norms would have a negative effect on participation in unhygienic cyber practices ($\beta = -0.12$, $p < 0.05$), was confirmed as well. The data did not support H3; namely, organizational facilitators were not found to have a negative effect on participation in unhygienic cyber practices ($\beta = 0.03$, $p = 0.41$). Support was not found for H4, which predicted that self-efficacy negatively affected participation in unhygienic cyber practices ($\beta = 0.09$, $p = 0.17$). H5 was unconfirmed; monitoring was not found to have a negative effect on participation in unhygienic cyber practices ($\beta = 0.28$, $p < 0.01$). The path is statistically significant; however, the result is inconsistent with the stated prediction.

7 Discussions and Conclusion

The study's main objective was to examine the effects of relevant factors taken from TPB and OCT on workers' participation in unhygienic cyber practices. Our result confirmed that Nigerian workers with favorable attitudes toward cyber hygiene were more likely to shun participation in unhygienic cyber practices. This result supports prior studies [6–8] that showed individual attitudes towards end-user security practices are an important factor that modifies engagement in desired IS security behaviors. We found that the sampled Nigerian workers were more likely to avoid participation in unhygienic cyber practices if they believed significant others, i.e., colleagues in their workplaces, did not approve of such practices or acts. This finding is consistent with the espoused viewpoint indicating that group approval of safe and acceptable computing behaviors augurs well for compliance with the sanctioned organization's IS procedures and rules [6–8].

The result indicating that organizational facilitators mattered less for Nigerian workers with respect to their engagements in unhygienic cyber practices could be explained by contextual factors. The result is at odds with observations in a developed country that indicated that organizational facilitators help to prevent employee engagement in nonmalicious IS security acts [18]. It is possible that the sampled participants are employed in organizations where organizational resources are inadequate or lacking. For example, during an informal discussion with the researchers, one participant commented that “the attention of my company is on how to increase its market capitalization; issues like IS security is not [company X] priority.” We found no meaningful association between Nigerian workers' self-efficacy and participation in unhygienic cyber practices. The result in this aspect might indicate that the sampled workers may not believe they possess sufficient skills and knowledge to help them deal with cyber issues or related practices. This might be discouraging given that past studies [6–8, 19] from developed countries have shown that adequate levels of skills, capabilities, and knowledge of end-user IS security issues are pertinent for suppressing involvement in ill-sanctioned computing behaviors. It is somewhat surprising that the relationship between monitoring and the dependent construct was unsupported in our research setting. Prior IS security studies that used monitoring found it to be an important mechanism for shaping behavioral intentions to comply with acceptable rules [5]. Our result shows that more monitoring seems to lead to more participation in unhygienic cyber practices. A plausible explanation for the lack of support for H5 might be due to extraneous factors. For example, it is possible that the sampled participants are unperturbed by IS security directives and monitoring in their organizations or are able to circumvent such efforts through neutralization techniques [31]. To some degree, their profession or occupation might also have an influential role. Recall most of the study's participants are IT professionals and four (4) of them candidly indicated they are internet scammers. Evidence exists to show that employees likely to flout organizational IS security directives are those with more advanced IT know-how [3].

7.1 Contributions to Research and Implications for Practice

This study is one of the first of its kind to investigate worker's participation in unhygienic cyber practices by using perspectives from TPB and OCT. No previous study has considered the effects of the selected variables on the dependent construct with data collected from Africa. This study offers support for the applicability of TPB and OCT in understanding employee participation in unhygienic cyber practices in work settings. Findings of the study lend credence to prior studies emphasizing the roles of attitudinal beliefs and subjective norms in shaping desired behaviors. There are implications of the study's findings for practice, in particular, the management of workers in Nigeria in relation to their discouraging participation in unhygienic cyber practices in work environments. Management can better control workers' behaviors with respect to the phenomenon by proactively providing incentives (e.g., campaigns, training) that can enhance positive attitudes towards favorable cyber hygiene practices. Well-tailored communication could also influence attitudes toward desired behavior.

Given the importance of subjective norms in reducing employees' engagement in unhygienic cyber practices, management should ensure concerns related to acceptable cyber practices are regularly discussed at department meetings and widely situated in the social functioning of the enterprise. Influential persons in the organization could be given the responsibility to act as "champions" of the cause of promoting good cyber hygiene practices [7]. It is likely that the amount of variance explained in the research model could increase further if more favorable organizational facilitators are made available to workers. Similarly, identifying specific measures that can enhance worker's self-efficacy in relation to cyber practices could help produce more fruitful results. Reliance on monitoring mechanisms may not be totally effective in a context where workers possess above average ICT/IS knowledge; deterrence and sanction mechanisms may be needed to ensure compliance [4, 7].

7.2 Study's Limitations and Future Research Directions

There are several limitations to this study. First, the data came from a cross-sectional field survey; longitudinal data may facilitate more insight. Second, the data was obtained from Nigerian workers. Findings in this preliminary study may not be applicable to workers in other parts of Africa; perceptions may vary across the continent. Third, the sample is small. Fourth, although CMB was not problematic for this study, it is still possible that participants might have provided "socially desirable responses" [24] to some of the issues being investigated. Future studies could overcome the noted shortcomings in this study. Comparative studies on the continent and elsewhere could be conducted. Attention should be paid to other end-user security behaviors such as those related to malicious acts. Other aspects of OCT, e.g., reward, could be explored. Likewise, other relevant theories in the area of IS security management [19] could be used to study the phenomenon and case studies could be used to enhance insights.




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Investigating the Adoption of an Integrated Hospital Information System in Rural Uganda: A Case of Kisiizi Hospital

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Abstract. Electronic Medical Records (EMRs) have been proposed to improve the quality of services in healthcare organisations. However, sometimes, the design contexts of these systems tend to be different from the use contexts. This and other factors have been reported to cause failures of EMR adoptions. By focusing on factors from the Unified Theory of Acceptance and Use of Technology (UTAUT) model, we use interviews and questionnaire as data collection instruments to study the adoption of an EMR which was locally developed in rural Uganda; to generate lessons that would sustain the use of the EMR.

We found out that all of the following factors, from the UTAUT model, significantly affected the usage of the system and, consequently, facilitated the adoption of the EMR at Kisiizi Hospital: expected improvement in job performance, the easiness with which the system can be learned and used, support and influence from management and peers, and the availability of organisational and technical infrastructures to support the use of the system. All of these were largely due to the fact that physicians from Kisiizi Hospital initiated and drove the system development and implementation processes, making sure that correct requirements were captured, and championing the use of the system by staff at the hospital. The in-context explanations for the findings are also provided.

Keywords: Hospital information system adoption ·
Electronic Medical Records · Electronic health records · UTAUT

1 Introduction

To improve the quality of healthcare services amidst huge routine workloads for clinicians and other staff in healthcare delivery organisations, EMRs have been proposed [1–3]. However, some of the EMR solutions are designed in contexts that differ from the use contexts [4, 5]. As a result of this and several other factors, users find it

hard to appreciate the value of these systems in their (users) routine workflows. Further, in some cases, there is lack of appropriate mechanisms to sustain the use of EMR systems after their initial implementations, and so some of them go unused and phase out after short periods of time [6].

The value of EMRs in improving healthcare provision has been studied [7, 8], and the reasons for failure of EMR implementations have been studied [4]. Such failures have largely been attributed to poor implementation strategies which tend to focus more on technical and functional aspects of the systems at the expense of cultural, sociological and user dependent factors [9, 10].

To sustain the use of the newly adopted EMR (known as Stre@mline) at Kisiizi Hospital, it was deemed important to study the adoption process and generate lessons about what is being done better and what could be strengthened. In this paper, focusing on factors from the UTAUT model, we use interviews and a questionnaire to study the adoption of an EMR developed by local experts for the local hospital in rural Uganda; to understand how acceptable and useful it is in enhancing the quality of healthcare services. We also report about the significance levels of various factors that affect the adoption and describe the recommendations to sustain the use of the system. More specifically, this study provides answers to the following research questions:

RQ1: How acceptable and useful is Stre@mline as an Electronic Medical Records system at Kisiizi Hospital, and what affects its acceptability?

RQ2: What is the level of significance of the factors that have affected the adoption of Stre@mline as an Electronic Medical Records system by health workers at Kisiizi Hospital?

We found out that all of the following factors, from the UTAUT model [11], significantly affected the usage of the system and, consequently, facilitated the adoption of Stre@mline at Kisiizi Hospital: expected improvement in job performance, the easiness with which the system can be used, support and influence from management and peers, and the availability of organisational and technical infrastructures to support the use of the system. All of these were largely due to the fact that physicians from Kisiizi Hospital initiated and drove the system development and implementation processes, making sure that correct requirements were captured, and championing the use of the system by staff at the hospital.

2 Literature Review

Verbeke et al. [9] and Cresswell and Sheikh [10] investigated reasons for success and failure of Health Information Systems (HISs). They found out that paying too much attention on technical factors, at the expense of social, economic, and political factors, could lead to adoption failure. Nilashi et al. [12] propose the use of human, technology, organizational and environmental factors in evaluating the adoptions of HISs. Ismail et al. [13] identified lack of computer skills by system users and system complexity as other factors that affect adoptions of HISs. Terry et al. [14] identified management involvement, change management strategies, and phased implementations of new systems to be key barriers and facilitators of system adoption processes.

Further, different theories and models have been proposed to guide the adoption of HISs. The Technology Adoption Model (TAM) [15] presents four factors that influence the choice of how and when users use a new technology. Specifically, the four factors are ease of use, usefulness, attitudes towards use, and intention to use. Also, the Theory of Planned Behavior (TPB) [16] introduces perceived behavioral control (people's appraisals of their ability to perform a behavior) as an additional determinant of the intention to use a system.

The UTAUT model [11] combines the just-introduced theories and use Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions and moderating variables of Gender, Age, Experience and Voluntariness of Use as determinants of user acceptance and use behavior. In particular, Performance expectancy is defined as the degree to which an individual believes that using the system will help them attain gains in job performance. Effort expectancy is the degree of ease associated with the use of the system. Social Influence is the degree to which an individual perceives as important others (boss, colleagues, etc.) believe that he or she should use the system. And Facilitating Conditions are defined as the degree to which an individual believes that the organizational and technical infrastructures exist to support the use of the system, [11].

Hoque et al. [17] argue for the need to use existing technology adoption models to study the implementations and adoptions of information systems, particularly in the midst of slow diffusion of eHealth systems in developing countries. Other technology adoption theories have been used to study the adoptions of EMRs in a variety of settings [5, 18–20]. In a work similar to ours, Wills et al. [21] investigated the influence of several factors from the UTAUT model on the adoption of an EMR in the United States of America. In another similar work, the UTAUT model was used by Kijisanayotin et al. [22] to study the factors affecting the adoption of Information Technology (IT) systems in the community health centers in Thailand. We focus on the context of a locally developed solution, the implementation of which was initiated and driven by users. The preliminary impact of Stre@mline at Kisiizi hospital in rural Uganda was studied by Liang et al. [23]. We use four factors from the UTAUT model (Performance Expectancy, Effort Expectancy, Social influence, and Facilitating Conditions) to study the adoption of a locally developed EMR in the context of a developing country in rural Uganda. This work uses these factors to study the acceptability and usefulness of Stre@mline and studies the significance of influence of each of the four factors on the usage behaviour of the system.

3 A Brief Introduction to Stre@mline

Stre@mline is an EMR system implemented at Kisiizi Hospital in rural Uganda. It is the result of the collaboration between a local technology company (Innovation Streams Limited) and the team of physicians from Kisiizi hospital who wanted an EMR that would meet the data and information requirements of their context. It follows the patient journey, incorporating demographics, triage, consultation, patient safety, investigation ordering and results, prescriptions, stock control of medicines, insurance, finances and the generation of statistical data needed for reporting into government HIS

systems such as the District Health Information Software (DHIS2) [24]. More information about Stre@mline, its functionalities, the process by which it is integrated to the hospital system, key context specific challenges addressed by the system, etc. can be found in the work of Liang et al. [23].

The system has been under implementation since 2015 and is now in use in 5 different hospitals in Uganda. The implementation has seen the development, customization and installation of the software, hosting the system on a server complete with a power backup system, delivery of over 20 computers for use by clinicians as well as training and support to hospital staff on the system. Over this time, the system has been taken on to serve a wider range of the hospitals’ clinical and administrative functions.

4 Methodology

4.1 Interviews

We conducted qualitative interviews on 10 purposively sampled staff, to assess how acceptable and feasible Stre@mline is at Kisiizi Hospital. The profession distribution of the interviewees were: Medical Doctor (2), Clinical Officer (1), Nurse (2), Lab Assistant (1), Medical Laboratory Technologist (1), Data Officer-IT (1), Records Clerk (1), and Accountant (1). From the population of 93 staff, the 10 interviewees were chosen based on the substantive role they had played in the implementation of Stre@mline at Kisiizi Hospital. The interview questions focused on four key constructs from the UTAUT model: Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions (see Fig. 1).

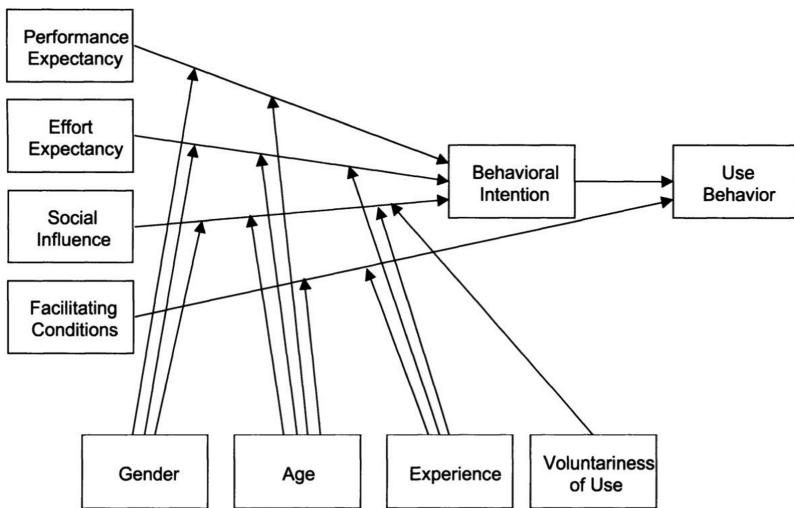


Fig. 1. Conceptual diagram for the UTAUT model (Source: Venkatesh et al. [11])

4.2 Quantitative Questionnaire

A quantitative questionnaire developed in reference to the UTAUT model was administered to identify the level of significance of factors affecting the adoption of the system. In addition to introductory and demographic questions, the questions also included the 4 Likert-scale (1 = Strongly disagree, 2 = Disagree, 3 = Agree, 4 = Strongly agree) questions that captured the respondents’ opinions regarding the four major constructs of the UTAUT model. Respondents filled in the paper-based questionnaire.

Inter alia, the questions on the questionnaire aimed at providing information that would be used to accept or reject the following hypotheses:

- H1: Performance expectancy has significant influence on usage behaviour*
- H2: Effort expectancy has significant influence on usage behaviour*
- H3: Social influence has significant influence on usage behaviour*
- H4: Facilitating conditions have significant influence on usage behaviour*

We got responses from 28 out of 30 (93.33% response rate) people who were given the questionnaire. Of the 28 respondents, 11 were male and 17 were female. Furthermore, the age distribution of the respondents were: 18–25 (14%), 26–30 (39%), 31–35 (29%), and 36–40 (18%). Besides, while the education qualifications of respondents were as shown in Fig. 2, the roles played by the respondents at the hospital were as shown in Fig. 3.

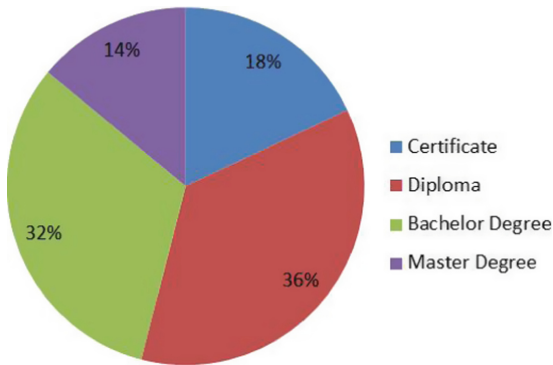


Fig. 2. Respondents’ education qualifications

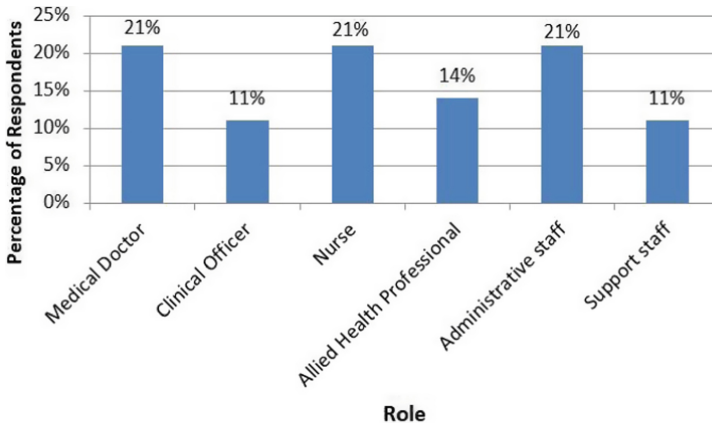


Fig. 3. Respondents' roles at Kisiizi Hospital

4.3 Data Analysis

We used Grounded Theory [25] to analyze interview data. Three stages were followed: (1) axial coding – relating codes (categories and properties) to each other via inductive and deductive thinking; (2) open coding – identifying, naming, categorizing and describing phenomena found in the text; and (3) selective coding – choosing one category to be the core category and relating all other categories to that category.

As for the quantitative data from the questionnaire, we tested each of the four null hypotheses using the one-way analysis of variance (ANOVA). We used SPSS 22.0 to conduct this analysis.

5 Results and Discussion

This section presents the results of our study and the discussion of their significance.

5.1 RQ1: System Acceptability and Usefulness

Regarding **Performance Expectancy**, the following were the main reasons for why the interviewed doctors, nurses and other clinicians accepted and used the system: the system's ability to act as diagnosis assistant, ensuring that important information is not missed during the diagnosis; facilitation of quick retrieval of patients' historical data; ensuring that drug prescriptions match guidelines; and facilitation of staff-staff and staff-patient communications. All of these can be linked to the fact that physicians from this hospital initiated and drove the system development and implementation process, capturing the local context; as opposed to other solutions whose development contexts might be different from the use contexts, introducing the design-reality gap [4]. However, medical doctors also insisted that the system should as well be used by other staff in the hospital, to allow doctors enough time to cope well with loads of patients. As the implementation of the system at the hospital continues, this concern deserves

due attention, to avoid lengthy workdays, reduction in numbers of patients seen, or both, as argued by Miller and Sim [26]. For example, the system can be adjusted in such a way that doctors and clinicians can appreciate the efficiency and effectiveness brought by the system in their routine workflows.

With respect to **Effort Expectancy**, interviewees thought that Stre@mline is easy to use as it mimics their usual workflows. However, since the system is used in only some departments in the hospital, some users were concerned with the need to write manual notes, in addition to entering the same data into the system. This is especially true when communication has to be done between two hospital sections, one of which does not use the system. In general, these are the challenges one can expect when the system is implemented in only some sections of a large integrated organisation. They can be addressed by implementing the system in all sections of the hospital.

As regards **Social Influence**, peer support and management support were reported by interviewees to have been the catalyst for system learning and use. Nonetheless, in some sections, the presence of a few staff trained on system use meant that the system could not be used to its full potential in service delivery. Training of all staff across all hospital sections could address this challenge. Finally, with respect to **Facilitating Conditions**, interviewees said that the management championed system use by ensuring that the infrastructure required to use the system is in place. Interestingly, given the level of support the hospital management has provided in developing and operationalizing the system, some interviewees believe that even the existing challenges, such as the scarcity of computers and the associated devices, and instability of the computer network at the hospital, will be addressed in due time.

Apart from the four factors of the UTAUT model, User Resistance came out of the interviews as another important factor that affected the adoption of the system. Particularly, a clique of hospital staff tried to resist the system in the early days of implementation:

“Some nurses claim they are quite busy and do not have the time to use Stre@mline. Because of the culture, there has been little resistance to change under the guise of the deception that it is adding more to their workload, I think most people are not keen to take on more work even if it provides more accurate data for the patient safety, but my hope is that continuous demonstration and education of the use of the system can help” (Interview 7, Medical Doctor).

Apt leadership, with the ability to manage changes, would be required to see the hospital through the complete adoption of the system.

5.2 RQ2: Significance of Factors Influencing System Usage

As highlighted in Sect. 4.3, we used the one-way Analysis of Variance (ANOVA) to test the hypotheses stated in Sect. 4.2. This method compares the means of more than two independent groups to determine whether the means are significantly different. A significance level of 0.05 indicates a 5% risk of concluding that a difference exists when there is no actual difference. If the p-value obtained is less than or equal to the significance level, the null hypothesis is rejected; and if the p-value is greater than the significance level, there is not enough evidence to reject the null hypothesis.

Table 1 summarises the significance levels of various factors that affect usage behaviour of the system, as reported by respondents. For H1, 3 variables (PE1, PE3, and PE6) had p-values (refer to the Sig. column in Table 1) greater than 0.05, with high significance levels; and 3 variables (PE2, PE4 and PE5) had lower levels of significance with p-values less than 0.05. Thus, because of the significance showed by the 3 independent variables, H1 was not rejected. For H2, while EE1 and EE2 registered p-values greater than 0.05, the p-value for EE3 was less than 0.05. Thus, H2 was not rejected because majority of the variables had higher levels of significance. Also, both two variables for H3 had p-values greater than 0.05, leading to accepting the hypothesis. Finally, H4 had 2 variables (FC2 and FC3) whose p-values scored greater than 0.05, and two variables with p-values less than 0.05. Thus, H4 was not rejected.

Table 1. Significance levels of factors influencing the adoption of the system

Hypothesis	Variable	Sig.
H1: Performance Expectancy	Stre@mline helps me do my tasks more quickly (PE1)	0.363
	Stre@mline has improved the quality of work I do (PE2)	0.001
	It has made it easier for me to do my job (PE3)	0.893
	It provides me with accurate information (PE4)	0.015
	It makes data analysis easier (PE5)	0.007
	It has given me greater control over my job (PE6)	0.498
H2: Effort Expectancy	Find it easy to use (EE1)	1.000
	Learning to use it was easy for me (EE2)	0.712
	I am comfortable with using it (EE3)	0.034
H3: Social Influence	Management thinks I should use it (SI1)	0.279
	Colleagues think I should use it (SI2)	0.307
H4: Facilitating Conditions	Training was available to me (FC1)	0.013
	Management provides necessary resources (FC2)	0.197
	It fits well with my work (FC3)	0.085
	A specific person is available for support (FC4)	0.009

In general, from the ANOVA results in Table 1, all of the four factors from the UTAUT Model, Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions significantly influenced the usage of the system. More specifically, with respect to **Performance Expectancy**, while perceived job simplification significantly influenced the system usage behaviour (see PE1, PE3 and PE6), there was no significant evidence that the use of data and information from the system to inform various aspects of the respondents' work significantly influenced the usage behaviour (see PE2, PE4, and PE5). This suggests that, so far, data from the system has not been widely used as the main decision supporter.

Further, with reference to **Effort Expectancy**, the easiness with which the system could be learned and used significantly influenced the usage behaviour (refer to EE1 and EE2). However, some respondents were yet be comfortable with using the system (refer to EE3). This suggests the need for more training and support as the system continues to

be used at the hospital. As well, with respect to **Social influence**, the support from both management and peers had significant influence on the usage behaviour (see S11 and S12). Finally, as regards **Facilitating Conditions**, while management support and the perceived alignment of the system with the respondents' works significantly influenced the usage behaviour (see FC2 and FC3), neither training (FC1) nor availability of continuous support (FC4) seems to have significantly influenced the usage behaviour. However, it is our intuition that more training and institutional arrangements for continuous user support could improve system use in the long run.

6 Conclusions

Several factors affect the adoption and use of EMRs in low-income settings. In this paper, we have used interviews and questionnaires, focusing on four factors from the UTAUT model [11], to study the adoption of a locally developed EMR in rural Uganda. The following factors, mainly attributed to users' initiatives and continuous involvement, were found to have largely affected the adoption of the EMR: expected improvement in job performance, the easiness with which the system can be learned and used, support and influence from management and peers, and the availability of organisational and technical infrastructures to support the use of the system. We have also provided the implications of the findings.

Part of our future work is to evaluate the adoption of the system with large numbers of users, and from all of the five hospitals that are using the system; to generate more insights on the effectiveness of locally developed EMRs in low-income settings.

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Using PESTELMO to Frame HCI Contextual Development in Developing Countries

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Abstract. HCI4D is context-oriented. Literature highlights that successful implementation of HCI solutions in developing countries needs deeper understanding of the context. Despite numerous literatures pointing the importance of context-oriented HCI4D, there is no holistic method that guides researchers and implementers of HCI solutions in analysing different contexts of countries. To bridge this gap, this paper introduces the PESTELMO (Political, Economic, Socio-cultural, Technological, Environmental, Managerial and Organisational) analysis method for holistic analysis of contexts in which HCI4D is researched or implemented. PESTELMO analysis method is proposed in this research as an integrated approach to analyse the external and internal environment surround HCI4D research or deployment, as a suitable method for analysis of dynamic political, economic, socio-cultural, technological, environmental and legal parameters in long-term planning and finally as a holistic approach to assess relations, interactions and interdependences among the PESTELMO factors and sub-factors.

Keywords: HCI4D · ICT4D · PESTELMO · Developing countries · Developed countries

1 Introduction

Sustainable development is among the key issues in the current global conversations on socio-economic development agendas. The role of Computer Science and related disciplines/fields, including HCI, is clearly reflected in global development agendas. For instance, the UN has highlighted the importance of technology to achieve each of the Sustainable Development Goals [16]. In developing countries, information and communication technologies are heavily embedded in all aspects of socio-economic development in the formal and informal employment sectors. In the latter, ICT enabled financial services using mobile phones and other PDAs, especially mobile money, have become the core of business opportunities.

The diffusion of information and communication technologies and tools in developing countries, and to rural and marginalised communities continues to be very high.

Consequently, diverse needs, preferences and abilities in using information and communication technologies, tools and gadgets emerge. These users' needs, preferences and abilities must be catered for in order to achieve the potentials of technologies and tools in socio-economic developments. In an attempt to cater for the Tanzanian majority diverse needs, for the first time in 2017, Tigo (Tanzanian Telecommunication Company) “[launched] a smartphone with a Swahili menu [...] which opened up digital access and adoption in Tanzania to majority of the population who use Swahili as the primary language of instruction” [15]. Such efforts clearly highlight the need to contextualise HCI developments taking into consideration the surroundings in which HCI is operationalised.

Research in HCI is abundant on one hand and falls in different application domains including education, health, finance, communication and politics. On the other hand, research in HCI4D has proven to be among the fast growing field in which key interests have been the contextualisation of HCI to fit the application area and needs [6]. There are numerous factors in HCI4D that are yet to be understood such as social, technological and cultural factors, especially in developing regions. This paper serves to contribute in HCI4D research by proposing PESTELMO analysis method for contextualising HCI4D towards effective and meaningful implementations in developing regions. The paper proposes the PESTELMO analysis method to address the knowledge gap in contextualising HCI4D based on literature review and previous work of the authors in ICT4D-based research.

The remainder of the paper is as follows: Sect. 2 sets the grounds of the research and provides insights into the need for a holistic analysis method for contextualising HCI4D. Section 3 presents the PESTELMO analysis method. The value-add of the method in HCI4D is then reflected in Sect. 4. Finally, Sect. 5 concludes the paper and provides directions for future research.

2 Setting the Grounds and Related Work

Ho and colleagues define HCI4D as “a subfield of ICT4D that focuses on understanding how people and computers interact in developing regions and on designing systems and products specifically for these contexts.” [7]. The understanding of different technological and systems needs of developing countries that is different from those in developed countries has long been pointed out in literature. The notion that information and communication technologies, tools and systems made in developed countries cannot simply be directly applied to developing countries has also been discussed by different scholars (see [4, 5, 8, 11, 13]). These authors have called for better understanding of the users, context, infrastructure, resource settings and other factors when deploying a new technologies and information systems. We collectively term these factors as contextual factors that define the context of a certain region/country. A context of a region/country is generally defined as the environment in which a region/country functions and is defined by aspects that differ from one region/country to the other such as policies, people and culture, political and democratic practices, economic status, information systems, availability of ICT infrastructure, ICT literacy of public sector staff and citizens etc. [11].

Contextual understanding continues to be at the centre of HCI4D because of the heavy reliance of developing countries on developed countries on new and sophisticated technologies and information systems. Developing countries rely on developed countries for their expertise, experiences, design approaches and solutions; hence, facilitating a transfer of the same among the countries. Chetty and Grinter point out that the developed world, where HCI technologies, methods and systems are borne, has much to offer to the developing world [5]. However, the authors caution that it is essential for the differences between the two contexts to be recognised for building useful and useable systems in the developing world (*ibid.*).

A “context-oriented” approach involves assessment of whether e-government systems design and implementation approaches from one country are applicable and valuable in another’s context [9, 14]. Similarly, Dell and Kumar’s extensive work highlights a context-focused approach in designing, developing and implementing HCI technologies and tools [6]. The authors argue that even though research communities in HCI4D understand that each context is unique, there is a need of clarity in parts that are context-dependent and others that are not (*ibid.*). In similar lines, Burrell and Toyama call for empiricism in research related in ICT for socio-economic development, i.e. non-dogmatic approach to flexibly design and implement ICT tools, technologies and information systems that best suite certain context [3]. The authors depict practical example that is still relevant today in HCI4D – “the preferences of mobile phone users in downtown New York will likely not have much in common with the mobile phone preferences of fishermen in Uganda” (*ibid.*). In the same perspective, as mentioned earlier, starting 2017 a Tanzanian telecommunication company Tigo is offering Tecno smartphones with a Swahili menu to enhance the uptake of smartphones by wider communities.

In another empirical study, Gitau and colleagues emphasise that HCI developers must take into account the social settings and different constraints of users of HCI technologies and tools in particular context [7]. An account of context-oriented mindset in developing HCI technologies and tools effectively contributes to socio-economic development issues intended for.

The previous paragraphs have established the need to contextualise HCI4D. The basic question that remains is the general understanding of what constitutes “context”. Table 1 presents a literature scan of factors that need to be analysed in different contexts before deploying HCI technologies, tools and systems.

Table 1 depicts similarities and differences of factors of consideration when describing a context before deployment of HCI. Some authors mention two factors while others mention as many as eight factors. The differences in these factors affect how researchers formulate HCI4D and implementers deploy HCI4D solutions. Therefore, it is imperative that a holistic analysis method is in place to guide researchers and implementers to better understand the contexts in which they are involved in. The following section introduces the PESTELMO analysis method and describes its characteristics.

Table 1. Contextual factors of analysis before deployment of HCI technologies, tools and systems.

Literature source	What constitute context
Brewer et al. [2]	Language, literacy
Burrell and Toyama [3]	Political practices, economy, culture, ecology, policy, people, technology, infrastructure
Chetty and Grinter [5]	Technology, people, infrastructure, literacy
Dell and Kumar [6]	Social factors, culture, infrastructure, language, people, literacy, finances
Gitau et al. [7]	People, literacy
Ho et al. [9]	Infrastructure, people, culture, literacy, environment, technology, financial aspects, social aspects
Mkude [11]	Policies, people and culture, political and democratic practices, economic status, information systems, availability of ICT infrastructure, ICT literacy of public sector staff and citizens

3 PESTELMO Analysis Method

PESTELMO (Political, Economic, Socio-cultural, Technological, Environmental, Legal, Managerial and Organisational) embarks from PESTEL, which analyses macro-environmental factors in strategic planning [18]. Dinçer (2004), cited by Yüksel, argues that the PESTEL analysis is a “pre-condition analysis which should be utilised in strategic management” (ibid.). Since first introduced by Aguilar in 1967 as ETPS (economic, technical, political and social), several modifications have been applied [1]. Richardson used PEST/STEPE with an additional ‘E’ in his study to scan the environmental changes and identify the barriers and constraints in developing libraries [12]. Katko introduced the legal factor ‘L’ and the environmental factor ‘E’ to the ETPS of Aguilar (1967) but changed the other ‘E’ to ecological to assess the development of traffic safety [10]. Similar to Katko, Yüksel added the legal and environmental factors to ETPS, and modified the ‘S’ to include socio-cultural factors to form PESTEL [18].

In this paper, we use PESTELMO analysis method first introduced in [10] to ensure that the multidisciplinary nature surrounding the fields HCI4D, ICT4D and e-government are taken into account [17]. Furthermore, the method is recommended for three purposes outlined below:

1. An integrated approach to analyse the external and internal environment surround HCI4D research or deployment
2. A suitable method for analysis of dynamic political, economic, socio-cultural, technological, environmental and legal parameters in long-term planning
3. A holistic approach to assess relations, interactions and interdependences among the PESTELMO factors and sub-factors

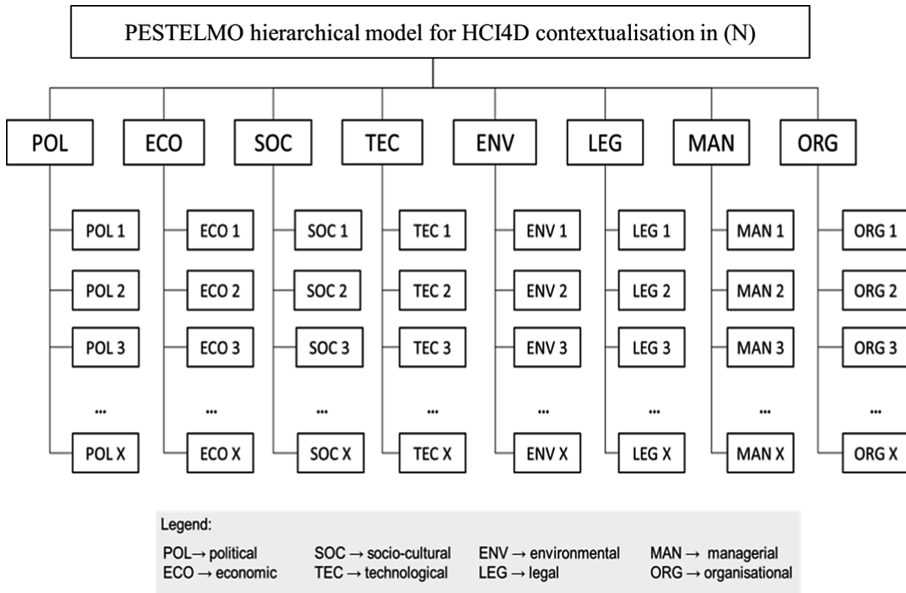


Fig. 1. PESTELMO hierarchical model for HCI4D contextualization in country/organization

Figure 1 presents the PESTELMO analysis method for contextualising HCI4D. The first level of the model contains a title of the model (the HCI4D researchers and implementers specify in (N) the name of a country or an organisation). The second level of the model contains the main categories of PESTELMO. The third level contains the factors identified by researchers/implementers (such as those mentioned in Table 1).

In the following section, the value add of PESTELMO analysis method is discussed and an exemplification is provided.

4 PESTELMO for HCI4D

In Sect. 2, it was established that an account of context-oriented mind-set in developing HCI technologies, tools and solutions effectively contributes to socio-economic development issues intended for. PESTELMO is introduced to provide a holistic analysis of the contexts in which HCI4D research is conducted or solutions implemented.

First, a context is analysed along the main factors of PESTELMO: political, economic, socio-cultural, technological, environmental, legal, managerial and organisational. Second, within each main factor, an analysis of sub-factors is made. For instance, in reference to the factors outlined in Table 1, the following is the analysis under the PESTELMO method:

Political: the analysis in this factor looks into the policies at the national level that support research, development and implementation of HCI at all levels of the

government and in both the public and private sectors. Also, the democratic and political practices are looked into to analyse whether a government advocates HCI research and implementation in development sectors.

Economic: the analysis in this factor looks into the economy of a country to fund HCI research and implementation, and support maintenance. This factor also analyses the financial capabilities of users to buy HCI solutions. For instance, a solution in country A might not be effective in country B because users cannot afford it.

Socio-cultural: in this factor, numerous aspects are analysed such as: the cultural influence to research and use certain HCI solution, gender influencers, literacy level of users, literacy level of ICT staff in public and private sectors, language used in HCI solutions and localization of content.

Technological: the main sub-factor is analysis of availability of infrastructure to support deployment of HCI solutions. For example, a successful implementation of a rural mobile health information system depends on, among other things, availability of reliable network connectivity.

Environmental: this factor looks into the environment-related factors that can facilitate or hinder the successful implementation of HCI solutions. For instance, a lack of proper e-waste mechanism in an area might hinder further HCI solutions that produce more e-waste.

Legal: in this factor, legal aspects existing in a country in relation to HCI research and implementation are analysed. For instance, it includes an analysis of laws or regulations that regulate the implementation of HCI solutions for disabled. In another instance, it includes presence of laws that regulates age appropriate HCI solutions, etc.

Managerial: this factor analyses managerial aspects that support implementation of HCI solutions in the public and private sectors. Furthermore, it looks into the managerial commitment to promote HCI solutions.

Organisational: this factor analyses the organisational settings that support HCI implementation. For example, it analyses the acceptance of HCI in organisations. This factor also analyses aspects such as organisational inertia towards acceptance of new HCI solutions in the public and private sectors.

Following analysis of PESTELMO main and sub-factors, the context is analysed further by looking into the interdependencies among the sub-factors. A deeper understanding of a context is required to ensure that HCI solutions are robust and sustained. Furthermore, For example, there is a need to understand if there are interdependencies between the literacy level and culture of people. In another example, poverty might have interdependencies with literacy level of people. Further studies into the interdependencies of HCI4D contextual factors are included in future research.

5 Conclusion

An effective implementation of HCI4D depends on whether the context of a country in which the solutions are deployed has been taken into account. Literature mentions numerous factors that define a context a country and that are important to be understood in HCI4D. However, there is no holistic analysis method to guide HCI4D researchers and implementers in understanding the context of a country in which they

research or implement HCI4D solutions. In this regard, the main contribution of this paper is to propose a holistic method for analysing a context in which HCI solutions are researched or implemented. This paper proposes the PESTELMO analysis method for contextualisation of HCI4D in any country or organisation.

The PESTELMO analysis method is proposed in this paper for three main reasons: as an integrated approach to analyse the external and internal environment surround HCI4D research or deployment, a suitable method for analysis of dynamic political, economic, socio-cultural, technological, environmental and legal parameters in long-term planning and finally a holistic approach to assess relations, interactions and interdependences among the PESTELMO factors and sub-factors.

Future research includes application of PESTELMO analysis method in the research field or implementation of HCI solutions and analysis of interdependencies among the contextual factors.

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**Sustainable ICT, Informatics, Education
and Learning in a Turbulent World -
“Doing the Safari Way”**



Information Systems Education for Development: A Typology of ICT4D Pedagogies

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Abstract. This paper is an attempt to position Information Systems (IS) education within the Information and Communications Technologies for Development (ICT4D) research and practice discourse. The motivation for the study comes from an understanding that, while the research on ICT4D theories and practice has grown in popularity, there has been very little effort directed towards establishing the link between university education and ICT4D practices. IS education literature is still preoccupied with discussions on curriculum and pedagogies focused on equipping students with instrumental knowledge grounded on the ‘catching up’ and ‘conformist’ IS practices. As a result learners, especially at the undergraduate level, are left with little to no exposure to the IS discourses of reformists and transformists that have been identified as critical to the success of ICT4D. By drawing parallels to other patterns in ICT4D research and practice, this study hopes to shed light on a gap in IS education that, if not addressed, will continue to be a major obstacle to ICT4D initiatives in developing countries.

Keywords: IS education · Curriculum · Pedagogy · ICT4D

1 Introduction

In the past two decades, the role of Information Systems (IS) as a discipline has been discussed, as has, to some extent, the role of Information and Communication Technologies (ICTs) in general. These discussions have evolved beyond any pre-occupation with attaining a competitive advantage through improving productivity and efficiency within organizations [1]. One of the new discourses is that concerned with how Information Systems are implicated in the process of national (as well as regional) development, specifically in the context of developing countries. In this stream, many studies on IS and its implication to various socio-economic and political discourses such as public health, access to education, access to information, promotion of human rights, as well as democracy and freedom, just to name a few [2–4].

While the focus on the social implications of IS has however, generated many useful theoretical as well as practical insights, some areas of research have been largely ignored. One such area is the role of education, especially undergraduate education, in engaging challenges that are repeatedly being raised by ICT4D [5]. This is particularly alarming, considering what is already known of the impact of education in facilitating and sustaining systemic changes within societies [6].

This paper represents efforts to position IS education within the ICT4D discourse. It does so by first unpacking the link between development and ICTs. It then uses the work of Avgerou [7] and Roberts [8] to lay a foundation on a typology of ICT4D practices in developing countries. This typology is then juxtaposed with the work of education scholars in order to draw parallels and subsequently establish if there are any useful insights. The intended contribution of this research work is to challenge and subsequently improve – or at least diversify – the existing assumptions, beliefs and challenges embedded within IS education, specifically in contexts where the colonial structures still perpetuate and manifest themselves in the interaction of society and ICTs as well as in the relationship between developing and developed countries.

2 Development in the ICT4D Discourse

The term development as used in ICT4D discourse is largely associated with Sen's conceptualization of development as the ability to freely choose and pursue the kind of life one values [9]. In ICT4D, development is often associated with efforts to help individuals, especially those in underdeveloped countries, not only gain access to basic human needs but also freely pursue opportunities that they value. However, despite wider acceptance of Sen's conceptualization of development, a careful analysis of ICT4D scholarly work still points to great interest and emphasis on technology (technology determinism) presenting it either as a silver bullet to solving developmental challenges or as development in itself [10, 11].

There have, over the years, been increasing calls for more theorization of the 'development' aspect of ICT4D [10, 12–15]. This is partly because of the growing internationalization and multidisciplinary involvement in ICT4D efforts. It is now increasingly common to have academics and researchers from different fields, policymakers, and practitioners all attempting to collaborate in the ICT4D space. There is also the mix of grassroots-level or locally born initiatives and those which are set up and driven by funds from large donors and international agencies. All these stakeholders have different interpretations of development and ways of achieving it, often shaped by their historicity, composition, interests, values and a multitude of other agendas.

3 The Role of Technology in Development

Since some background to the concept of development and the efforts to achieve such development has been provided, it is now possible to unpack the role of technology, specifically from the perspective of developing countries. In order to do this, various assumptions, values, and interests that shape the role of IS will also be examined, as will subsequently its practices and research into it.

One of the typical issues highlighted by studies on IS practices in developing countries involves investigating the implication of introducing to a developing country technologies or practices, typically those that originate from western countries, such as ERP systems, project management, and business process management. The rationale is

that developing countries can take advantage of these technologies or practices to 'catch up' by imitating or replicating their success [16]. In some cases, these studies will acknowledge the contextual challenges and will make recommendations which involve modifying aspects of the practices or technical functionalities as a means to address the contextual differences. Heeks refers to such innovation that emerges outside the context of developing countries as 'pro-poor' innovation and highlights their susceptibility to 'design versus reality gap' [17]. This phenomenon has also been observed in the context of technology adoption in small, medium and micro-scale enterprises in South Africa and Tanzania [18]. In their analysis of what they referred to as 'thin' and 'thick' forms of technology integration, they warned of the potential to marginalize the local industries which were supposed to benefit from such technology adoption [18]. For the sake of this study, this first role will be referred to as a transfer and diffusion perspective in line with Avgerou's classification [7].

The second classification on how technology is conceptualized in relation to development is that which strongly believes that technology can only make a meaningful impact in developing countries if it's deeply integrated with the needs and practices emerging from the local context. Avgerou refers to this approach as 'socially embedded' [7]. Here, the emphasis is on solving problems as defined by local actors through following a socially and locally construed IS-innovation process, taking into consideration the values, priorities, and meanings emerging from the context. The many challenges that have emerged from the transfer and diffusion approach have convinced local and international policymakers as well as various development agencies to question this approach. However, some researcher are skeptical of this approach especially with regard to the type of local actors involved in these initiatives and the reasons for their participation [17].

Both the transfer and diffusion as well as the socially embedded approaches often take for granted the relationship between technology and development [12]. This has the risk of falling into the trap of seeing the use of technology as the development of itself and ignore not only the potential implication of such usage but also the issue of whom the real beneficiary is [10]. There are many cases where technology has been introduced as a way of providing local communities with access to information but ended up converting community members into perpetual consumers of western products and cultures [18]. From an organisational perspective, there are numerous cases when the introduction of technology has resulted not only to efficiency but also to a dependency on technology, practices, and expertise that are only from overseas, resulting in a significant outflow of cash and other economic benefits from the developing country [16].

The last approach, referred to as 'transformative', is critical of the relationship between technology and development. It questions the many assumptions behind the development in question as well as how technology is implicated [7]. The transformative approach is also critical of the kind of social, economic and political changes that are facilitated through technology. It is concerned with the resultant power imbalances as well as the wellbeing of the vulnerable and marginalized. For the perspective of transformation, the role of IS is to enhance individuals' agency, especially those subjected to marginalisation and oppression, to challenge the status quo and achieve the kind of development they value [13]. The transformative approach posits

that the involvement of local actors does not always guarantee an outcome that contributes to the wellbeing of the local community. There are many examples when local actors used technology to promote local practices, norms and values that violate the rights, dignity and wellbeing of other people [13, 17]. Sen even warns about the possibility of ‘adaptive preferences’, a condition where people in desperate conditions normalize their suffering, deprivation, oppression or any other challenge, typically as a psychological defensive mechanism to mitigate their pain [19].

Avgerou’s classification of IS innovation in developing countries is aligned with at least two other similar analyses, one focusing on IS research and other on ICT4D practices [7]. The first one is an analysis of assumptions about social reality within the three dominant IS research streams namely positivist, interpretive, and critical research [20, 21]. While their analysis is more detailed, only the part relevant to the comparison with the three categories of IS innovation proposed in [7] will be focused on. According to their analysis, positivist research is seen to be most concerned with measurement and the accurate representation of objective reality on IS practices in organizations. This focus on measurement is grounded on the overall objective to measure, manage and replicate the impact of IS practices in an organization – or any other given context for that matter. This approach seems to form the foundation of what Avgerou has described as the transfer and diffusion approach [7].

The second category is that of interpretive research. Interpretive IS research conceptualizes IS as social systems intentionally enacted and embedded in the way people accomplish their tasks [20]. Interpretive research in IS practices is, therefore, grounded on an understanding that the design, usage, and benefits of IS are based on the experiences of local actors in a particular cultural and social context. This category is aligned with Avgerou’s socially embedded approach [7].

The third and last category is that of critical IS research [21]. This perspective sees IS interventions in organization as not only been shaped by social and cultural factors but as a process with historicity that has great implications for social structures and power relations. This approach is concerned with exploring deeper structures and in revealing hidden forces that are often ideologically inscribed and are a subject of a long and continuously evolving history [20]. Perhaps one of the most distinguishing features of the third category is its emphasis on IS research that takes an explicit stance on its values and that is grounded on confronting and transforming asymmetric power relations in society [21]. With transformation as one of its core principles, this third category can be seen to be closely aligned with the transformative category in the Avgerou classification [7].

The final analysis focuses on ICT4D practices and is closely aligned with Avgerou’s categorization of IS innovation. This ICT4D typology builds on the work of Ineke Buskens, and divides the ‘intent’ of ICT4D initiatives into three categories, namely, conformist, reformist, and transformist [8]. Conformist ICT4D, as the name suggests, has no intention of disrupting the status quo but rather aims to improve efficiency within the existing hegemonic development paradigm. As a result, conformist ICT4Ds are prone to making use of IS or ICTs to further the already existing marginalization and exploitation that is embedded in some development initiatives. On the contrary, reformists ICT4D initiatives are intended to address issues related to inequality or marginalisation. However, this is usually done without challenging the

underlying structural causes of such inequality and marginalization. Most ICT4D initiatives fall under this category [8]. Lastly, transformist ICT4D initiatives, as the name suggests, are aimed specifically at transforming the underlying structural and historical causes of any form of marginalization or asymmetric power relations in developing countries. They pay special attention to issues of gender, race and class relations, as well as any colonialist or imperialist agendas within the development discourse. The conformist, reformist and transformist approaches to ICT4D are largely aligned to Avgerous's transfer and diffusion, socially embedded, as well as the transformative categories.

It is important to highlight that the categories or perspectives discussed represent more of a continuum than an exclusive relationship. Furthermore, all three analyses have carefully avoided to paint a view that one category is somehow superior to another. However, all three analyses indicate that IS and ICT4D research and practices predominantly embrace positivist and instrumentalist worldviews with a preference for initiatives that place emphasis improving efficiency and controls. There are very limited IS initiatives that are fully grounded on critical perspectives and aimed at challenging asymmetric power relations in organizations as well as in society.

4 The Role of Education in Development

The role of education in developing countries, like that of technology, is a complex phenomenon. For most developing countries, the pre-colonial education system was aimed at passing on contextually grounded knowledge from one generation to another. Education played many roles, it was essential for exposing the younger generation to skills necessary for their day-to-day survival in a given context. It was also a source of exploration and innovation through mixing the as lived experiences of the older generation and the energy and curiosity of the younger generation, and was a way of socializing younger generations to the norms and customs of their community [22].

With colonialism came formalised forms of education. As history would put it, education was one of the means used by colonialists to evangelise and indoctrinate the colonised with their imperialistic and capitalistic interests and values including, among other things, the technology-deterministic, market-driven economic theories and the superiority of western epistemologies [23, 24].

Most of the well-established postcolonial universities are, in fact, products of the colonial project. Their conceptualisation was based on the imaginations and needs of the imperial and colonial project which was primarily concerned with the interest of the western industrialized nations, the colonizers. This meant that after the end of colonialism it was imperative for universities to undergo serious transformation to free themselves from their colonial legacy and embrace a new, locally emergent, agenda for the benefits of previously colonized. However, decades after political independence very little progress has been made in terms of transforming and decolonizing universities in many developing countries, including in sub-Saharan Africa. One can even argue that, in some cases, universities have even taken a step backward by abandoning the scholarly activism that was on the forefront of the fight against imperialism and colonialism and that had gained significant momentum in the 1960s especially in

universities such as the Makerere University in Uganda and Tanzania's University of Dar-es-Salaam. It would seem, nowadays, that universities are increasingly competing for recognition and assimilation into western academic standards and as well are embracing asymmetric relationships with capitalistic multinational corporations in the search for funding and opportunities for students' employment [22, 25].

5 Curriculum and Pedagogy in Postcolonial Education

Pedagogy of the Oppressed by Paulo Freire is arguably the most influential scholarly work to date on the critical analysis of colonial and postcolonial education in the context of developing countries [6]. It focuses specifically on the relationship between students, teachers and their society. Through his experience of working with poor and marginalized Brazilian adults as they learn to read and write, Freire's work presents a detailed analysis of the relationship between the oppressed and the oppressor as well as the colonizer and the colonized within the educational context. Freire's analysis categorizes two modes of education, one that is based on hegemonic colonial epistemology and ontology and another which he proposes as an alternative. The two modes are the 'banking model' (or concept) of education as well as the 'problem-posing' model of education. Freire describes the banking model as one directional relationship where the student is a perpetual receiver of often decontextualised knowledge and the teacher is a narrator [6]. It is oppressive and meant to create students who are incapable of critical thinking and unable to come up with inventions or transformation that can meaningfully advance their well-being. The banking education model was conceptualized by – and is linked to – the interests of colonisers who were only educating the colonised for the purpose of using them to advance their colonial and imperialistic interests [6]. By continuously participating in the banking education model, educators, knowingly or unknowingly, are socializing with an education system designed to oppress learners instead of empowering them.

The ontological and epistemological assumptions embedded in the banking education share similarities with the positivist and transfer and diffusion approaches [7, 21, 26]. There is an assumption of objective decontextualised reality, which can be discovered and passed on objectively as knowledge [6].

As an alternative to banking education, Freire proposed another form of bi-directional, critical and, hence, transformational education and name it as 'problem-posing' education [6]. Problem-posing education sees both educators and students as cognitive actors engaging in a process of mutual learning through dialogue. Students assume the role of critical co-investigators and are expected to know, engage and recreate knowledge instead of just memorising. The objective is to develop a reflective and critical consciousness and subsequently critical agency which is instrumental for innovation and transformation of the social world. These objectives bear similarities with those critical of IS research and transformative IS innovation [7, 21].

Another useful analysis of education comes from Miller and Seller, whose work on the role of education focuses on the curriculum and its ontological and epistemological implications [27]. They define curriculum as a set of interactions carefully designed to facilitate learning, development and interpretation of experience [27]. This includes the

explicitly documented curricula as well as the implicit norms and rules or expectations commonly referred to as ‘hidden curriculum’. Echoing Freires work, categorizations of education in Miller and Seller highlight two extreme curriculum perspectives: one extreme which involves students merely absorbing or memorizing information and another that involves a deeper and mutual interaction between student and educator as they cooperatively solve problems [6, 27]. However, Miller and Seller take their analysis a step further by presenting three curriculum positions that are shaped by assumptions on the role of education. The three positions are transmission, transaction, and transformation [27]. These positions are informed by assumptions or beliefs on issues such as the overall aim of education, the conception of the learner, the learning process and the learning environment, conceptions on the role of the educator as well as how learning should be evaluated. Furthermore, the transmission position sees the role of education as the transmission of knowledge in the form of facts, skills and values to students. Knowledge is seen as objective, essential for prediction and control, and its transmission is one directional. The transmission position can be traced back to colonial times and is grounded on the philosophy of logical positivism and is closely linked to capitalism and conservative economic theories. The transaction position is based on assumptions that students are rational beings with agency. Education involves dialogue between students and the curriculum and is aimed at problem-solving in a given context guided by a democratic processes. Lastly, the transformation position sees education as a vehicle for driving personal and social changes. It assumes a more critical view of the role of education in a society which involves political and social activism that challenges the dominant economic interests [27].

This analysis of perspectives of education, summarized in Table 1, sets the scene for the analysis that links IS education to the assumptions and perspectives on the role of IS, IS research and ICT4D practices.

Table 1. A typology of IS/ICT4D research, practice & education

	Perspectives			Source
IS research	Positivist	Interpretive	Critical	[21]
IS innovation	Transfer & diffusion	Socially embedded	Transformative	[7]
ICT4D practices	Conformist	Reformist	Transformist	[8]
Curriculum	Transmission	Transaction	Transformative	[27]
Pedagogy	Banking	Problem-posing		[6]

6 Information Systems Curriculum

Information Systems is a young discipline as far as higher education is concerned. Its formal recognition as a discipline or field of study dates back to the late 1960s and early 1970s, when for the first time billions of US dollars were being invested in equipment and people involved with computers and data communication in the United States alone [28]. Then referred to as Management Information System (MIS), it combined concepts from numerous other existing disciplines such as Computer Science, Management and Organisation Theory, Operations Research, and Accounting [1].

There are reports that point to universities offering IS/MIS undergraduate programs as far back as 1966 [1]. However, the first formal IS curriculum for higher education studies can only be traced back to 1972, when the Association of Computing Machinery (ACM) published a report with a set of guidelines for new and existing graduate level IS programs. The report, which consisted of course outlines and recommendations for new specialisations, was an outcome of a work done by a ten-member, US-based, committee in consultation with industry and academia [29]. The committee then went on to create another set of guidelines targeting undergraduate IS degree program. The undergraduate curriculum was released by ACM in 1973 with the intention of providing guidance for the design of an IS program, with the expectation that IS departments in universities would modify and adapt it to fit their own context [30].

While ACM was driving IS curriculum discussion in the United States, another organisation known as the International Federation of Information Processing (IFIP) was doing similar work in Europe. In 1974, IFIP's Technical Committee for Education (TC3) and the Administrative Data Processing Group (IAG) proposed an IS curriculum specifically focusing on system designers. Several well-established institutions such as the London School of Economics and the Royal Military College of Science adopted the curriculum [1]. Other curriculum initiatives in the 1980s and 1990s include a curriculum called the Data Processing Management Association (DPMA), published in 1981, and the IEEE software engineering curriculum which was published in 1999.

In 1994, the Association for Information Systems (AIS), an international association for IS academics, was formed [1]. Three years later, the IS curriculum was revised by representatives from AIS, ACM, and Association of Information Technology (AITP, formerly DPMA). This led to the release of what was then considered as the first international IS curriculum known as the IS 1997 Model Curriculum [31]. The IS 1997 Model Curriculum was later reviewed and updated to create the IS 2002 curriculum and also the most recent version, IS 2010 Curriculum [32].

This history of the development of the IS curriculum is important as it puts the discipline into context and reveals several issues that are of interest. For instance, what is now considered as the international IS curriculum is predominantly a product of two regional IS bodies, Europe and North America, with each region bringing to the table its unique institutional characteristic. The review body for the initial IS 97 model as well as the IS 2010 curriculum were exclusively constituted by academics and specialists from European and American institutions. This is important because while the review process, especially for the IS2010 curriculum, has made efforts to be as consultative as possible, the process is still subjective and the final decision on what should be included or excluded lies with the review team. This is supported by observations from other researchers who have pointed out the fact that the curriculum, to a great extent, aligns IS with business faculties which is typical in North American institutions where most of the review body members are based [33, 34].

Furthermore, while the IS discipline is young, it is also in many ways implicated in the issues of unequal power relations between the dominant western and often capitalistic discourse and the 'Other'. This dichotomy becomes even more prevalent when one observes the research and teaching of IS in developing countries. There the discipline is still dominated by positivism and grounded in western ways of being and

knowing [35, 36]. This can be partially attributed to the infancy of the IS discipline which has resulted to a scenario whereby most senior IS academics, especially those in developing countries, have a background in mathematics, statistics or computer science. Furthermore, In many cases, the ICT departments/faculties/schools in developing countries were established in partnership with ‘parent’ universities from the West and accompanied with a flow of Western academics to Africa to help ‘set-up’ and develop local capacity to run the computing units. Overtime IS (or Informatics) departments started to emerge, often as sub-units in accounting, management and, in some cases, computer science (or ICT). The newly established IS departments would then be run by academics with MIS qualification from overseas. These departments emulated the courses and research focus of their Western counterparts (or ‘parents’). This was accompanied by efforts to implement an ‘international’ curriculum as a way to gain legitimacy [5, 37].

7 Information Systems Education for Development

In the past two decades, discussions on the role of Information Systems as a discipline have taken place, as had to some extent, those on the role of ICT in general. Such discussions have evolved beyond the pre-occupation with attaining competitive advantage through improving productivity and efficiency within organizations [1]. One of the new discourses is the one concerned with how Information Systems are implicated in the process of national (as well as regional) development, specifically in the context of developing countries. In this stream many studies can be seen on IS and its implication to various socio-economic and political discourses such as public health, access to education, access to information, promotion of human rights as well as democracy and freedom just to name a few [2–4].

However, while the move towards the social implications has generated many useful insights on a form of theories and even practical knowledge, some areas of research have been largely ignored. One such area is the role of education, especially undergraduate education, in confronting the many challenges that have been repeatedly being raised by other ICT4D research [5]. This is particularly alarming considering what is already known as the impact of education in facilitating sustaining systemic changes into the society [6].

There have occasionally been generic mentions of the issue of shortage of skills or resources but this has often meant, at least to this author’s interpretation, vocational or technical skills to implement the plans and ideas that are raised. There has also been substantial discussion on how many of the ICT4D challenges require a multidisciplinary approach, as opposed to being driven by just Computer Science, IT or IS. In some ways, this has often meant a collaboration at the research level (problem diagnosis level) and, in some cases, at the implementation level to mean creating diverse ICT4D project teams [17]. What has been lacking is theorizing on how this can be sustainably addressed at university level – specifically what it means for undergraduate studies. Heeks points out the need for ICT4D champions/leaders/professionals with understanding from three disciplines: Computer Science, Information Systems, and Developmental Studies [17]. However, he envisions this as something that can be done

through master's programs. One review of ICT4D research in top IS journals and conferences, mentions education as the third most researched ICT4D theme after 'business' and 'empowerment' [38]. They do not, however, go into detail as to what aspects of education are the subjects of the research.

8 Conclusion

The above exploration of the link between IS, development, and education has clearly confirmed that IS as an academic discipline and a practical field in developing countries is still heavily influenced by positivist and instrumentalist perspectives. This is mostly attributed to the history of development as it has now come to be known, its long-term relationship with technology, as well as the history of the IS as a discipline. While there is an increasing focus on interpretive studies, as well as socially embedded initiatives that aim at developing local understandings and local IS solutions such initiatives are struggling to meaningfully transform the role of IS in the context of postcolonial developing countries. With few exceptions, IS is still seen as a means for organizations to improve productivity and efficiency for the purpose of increasing revenue. Practices such as software development, business process management, and project management are still initiated with the main intention of serving the often exploitative interest of corporations by maximizing profit with little concern for human impacts. In ICT4D, which is still confronted by high failure rates, there is very little evidence of IS paying a transformative role. On the contrary, most initiatives have been criticized for further entrenching the western superiority complex as well as developing solutions that feed-off the already asymmetric power relations between developed and the underdeveloped countries.

One way of dressing this challenge is through IS education, especially given the role education itself has played in establishing those practices in the first place. However, before IS education can be used as a means towards transformative and sustainable ICT4Ds, it needs to first undergo self-reflection and self-transformation. Fortunately, research points to a number of tools that can be used to diagnose and transform IS education. One such tool is critical research. A successful application of critical research in IS education can result in the transformation of IS education practices which over time can lead to the transformation of IS practices to ones that will challenge the existing social order and replace it with a new one that safeguards the interest of individuals and societies in developing countries.

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Data Science Postgraduate Education at University of Dar es Salaam in Tanzania: Current Demands and Opportunities

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Abstract. Several studies indicate that there are not enough people in the market with data science skills and even those graduates in ICT from universities do not possess skills required by employers. Thus, researchers have suggested the urgency for universities to review their curricula as the world is heading towards the data era. The aim of this research was to analyze the current skill-gaps needs from stakeholders and opportunities to establish a data science postgraduate programme that reflects the current technological trends and market demands at the University of Dar es Salaam (UDSM). A questionnaire was administered to 85 identified organizations to solicit information on the needs for data scientists and existing skill gaps. A total of 61 filled questionnaires were received out of the 85 that were administered to selected organizations indicating a turn out rate of over 70%. Overall the analyzed data articulated a compelling evidence for the local industry growing need for data scientists. The survey that was conducted was followed up by the conduct of various workshops and meetings to solicit inputs from different experts and stakeholders on different versions of the developed curriculum. Finally, a new programme in MSc in data Science was approved and established from April 2018 at UDSM. Despite its late approval and without formal advertisement on the public media, the programme attracted a large number of applicants for the 2018/19 academic year, compared to other several postgraduate programmes in ICT offered at UDSM.

Keywords: Data science · Data scientists · UDSM · Data science education · ICT · Skills-gap

1 Introduction

Significant advances in ICT and underlying communication infrastructure within the last decade has prompted the new era of data [1]. Data and information have taken an unprecedented turn in recent years due to the new ways that it is being created and collected including the speed and diverse nature of its format, fostered by the ever expanding new digital telecommunication technologies that bring a close inter-twining of societies, including the internet and mobile devices. This has demanded change in

methods of storing and analyzing such data in order to benefit from gaining insight for evidence based decision making. Further, it has prompted need for change in computing device architecture and algorithms thereof for data analytics and processing [2]. The volume of new body of knowledge resulting from such activities put demands for more focused specialization, not just for researchers but also data professionals.

The potential for this relatively new and exciting data era has led to data science sub-discipline in fueling growth of the industrial and knowledge economy is immense and anchored within data-driven decision making. Data Science, an emerging field that combines techniques of computer science, Mathematics, statistics and numerical computational for scientific and business data analytics in order to foster better decision making. The universal nature for need of data driven decision making across sectors is now vivid. For example, the urgent need for countries to mobilize data to support monitoring of the Sustainable Development Goals (SDGs) targets and indicators to meet the 2030 global development targets have seen tremendous efforts for countries to build capacity and strengthen national data landscape to guide monitoring of global, regional and national development frameworks. Besides, data is a vital asset to any organization. It holds valuable insights into areas such as customer behavior, market intelligence and operational performance which can aid organizations improve its resource planning and better direct the investments [2]. As universities have been strategic partners to meet skilled human capital demands for numerous industrial disciplines, it is imperative and timely now for universities to assume and respond to the growing local and regional skill gaps within the data science sub-discipline.

In Tanzania, the need to improve the national capacity for data-driven decision making, policy planning and industrial investment is at high stake now than ever in an effort to sustain the national industrialization agenda. Globally and particularly in Tanzania, lack of adequate data science skilled individuals is apparent, while the need for this expertise is set to rise as the role of data in development globally increases. It is imperative to bridge the current national knowledge and skill gaps in data science, and bring the country to harness the existing and future generated massive data set to foster better policy, budgetary planning, decision making and direct for efficient and effective investments, vital for propelling forward the national industrialization agenda.

The aim of this research was to analyze the current skill-gaps needs from stakeholders and opportunities to establish data science postgraduate programme that reflects the current technological trends and market demands.

2 Relevant Literature on Data Science

Aalst [3], Discussed how data science came into existence after availability of large amount of data. Competences that data scientist needs are also revealed as presented in Fig. 1; data scientist should have a mix of quantitative and technical skills, should be creative, communication skills as well as apprehending end to end solution. Motive behind data science discipline includes; realization of many organizations that their survival is solely dependent on capability to exploit available data intelligently.

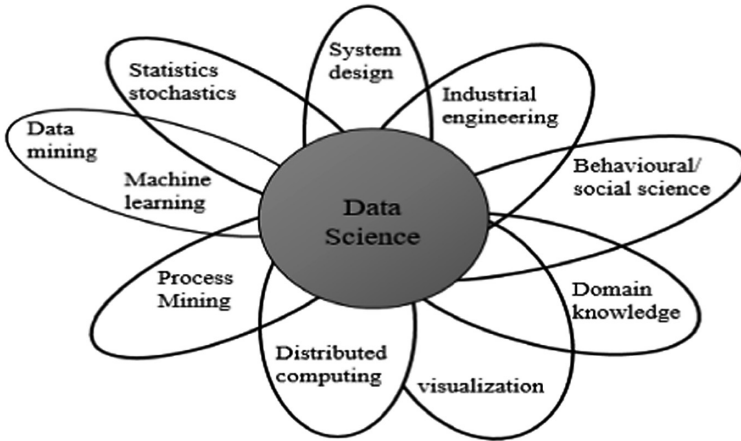


Fig. 1. Profile of a data scientist (source: Aalst [3])

Mikalef, Giannakos, Pappas and Krogstie [4], highlighted the skill gap that exists in the market. The study was done by survey and interviews to ICT companies to see if they have enough skilled labor who are able to transform data into actionable insights, also to see if what is taught in training institutes meets their needs. It was found that there are not enough people in the market with data science skills and even those graduates from universities do not possess skills required by employers. The paper further suggested the urgency for universities to review their curricula as the world is heading towards data era.

Education for Data Intensive Science to Open New science frontiers [5] extracted from Data Science Competence Framework, Data Science Body of knowledge, Model Curriculum and Data Science Professional Profile; Data Science Competence Framework has been extended based on already existing data science framework and ICT competences and skills. The report defines five groups of competences of data science; data analytics, data science Engineering, domain knowledge, data management and research methods. These are basic skills which data scientists need to have to accomplish daily activities.

Moreover Song and Zhu [6], discusses the close relation between big data and data science in this era of data. Due to advances in ICT there had been dozens of data produced characterized by 5Vs; Volume, Veracity, Velocity, Variety and Value. The emerging trend in big data led to need for new methods to analyze and making insights out of it. Thus new body of knowledge, data science came into existence. The concept of big data, data science and data scientist are well discussed from a survey, hence advice on approach on how to teach data science in colleges.

However Holman, Stuart-fox and Hauser [7] acknowledged the fact that minority of women comprise Science, Technology, Engineering, Mathematics and Medicine (STEMM) workforce. The study was done by analyzing publishing outlets; PubMed and arXiv it was established that large percentage of authors were men. The authors' recommends reforms in educational system, mentoring and academic publishing.

The results are also related to Zhang [8] which explains well the gender gap in data science jobs in USA where on 26% are employed. The article went further by explaining reasons for the gap. The reasons for the gender gap included: a lack of STEM education for women early on in life, lack of mentorship for women in data science, and human resources rules and regulations not catching up to gender balance policies, to name a few.

The National Academies of Sciences, Engineering, and Medicine established the Committee on Envisioning the Data Science Discipline, as in [9]. The Committee study report provide candid discussion on the outlook for the data science education demand in various forms and potential for academic institutions to implementation data science training at different levels, including high schools, undergraduate and graduate levels. The committee reports provided an in-depth update on key issues pertaining to data science education including the knowledge and skills required for a data scientist; the success and challenges of existing data science programs; and the challenges of creating new such programs and strategies around leveraging synergies. We note, however, that the tremendous progress and the future outlook on data science education paints a picture of the developed world than the globally. The developing world trend is by large at infancy stage of data science education with notable initiative for strengthening the ecosystem pioneered by a few players including Data Science Africa [10] fostering a networking platform for data science researchers across Africa.

South African educational institutions stands by far as African leading institutions in provision of different forms of data science education including the African Institute for Mathematical Sciences (AIMS) South Africa [11] which offers two months intensive data science training and the University of Witwatersrand [12], offering a one year degree program in Big data Analytics. Tanzania has not been left behind, in this dynamics as there has been a few initiatives that aim to strengthen data use and data driven innovation although largely funded through international donor programs. As part of open government partnership (OGP) membership the country implemented a basic statistics public data portal, and received data capacity building support through the World Bank and other international donor agencies [13]. The basic statistics portal [14] was established to provide data in a machine readable format to be used and re-used by anybody. The data provided apply only to data and information produced or commissioned by government especially the prioritized sectors of Education, Water and Health. The most recent notable program for strengthening country data capacity is the Tanzania Data Lab project (dLab) [15] that started in April 2016 to June 2018 that sought to promote greater data use in the country through fostering data availability and data literacy. The dLab project was led by the UDSM through PEPFAR/MCC funding, and one key outcome from the project has been the motivation to expand data literacy through mainstreaming the data science education in higher learning institutions.

Tanzania Development vision of 2025 [16] emphasizes the need to have a well-educated and learned society and Tanzania to have competitive economy. Furthermore, the ICT policy [17] of which was formulated in the context of Tanzania development vision 2025 recognize ICT being central to economic development of a nation.

3 Methodology

The objective of the study was to assess demand and opportunities for data science education in the Tanzanian context and in turn inform the curricular development need for a data science program at the University of Dar es Salaam. The dLab project presence was a natural catalyst to the hypothesis that demand for data science skilled professionals was, indeed, in the raise in the country, based on its internal need assessment analysis on stakeholders training need assessment in basic data management, data analysis and visualization course that were offered during the period of 2016–2018 as core project activities. The baseline data culminated with internal post training follow-up surveys consistently reflected the belief that there was a growing section of data community that were looking for cutting edge skills for working with growing data sets emerging from different communities including government, non-governmental organizations (NGOs), private organizations, researchers and innovators.

In order to sustain the ecosystem both dLab and the University partnered to carry this research for in depth assessment for demand and opportunities on data science education to lead into a concrete program at the university that pioneers the data science landscape in the country. A field study was designed to reach out to the key potential data stakeholders to solicit information through a questionnaire instrument. Through dLab's stakeholders mapping, it was established that most organizations including government agencies, private companies and NGOs were based in Dar es Salaam with operational branches in the regions, therefore for purpose of the study, the survey was conducted in Dar es Salaam.

The questionnaire was developed and administered to 85 purposively sampled organizations drawn from amongst dLab mapped data stakeholder organizations in which a consultation with individual recipient organization was conducted to identify suitable informant from within the organization. A total of 61 duly filled questionnaires response were received out of the 85 that were administered to selected organizations indicating a turn out rate of over 70%. The respondent organizations who participated in this study were specifically drawn from sectors such as the education and research sector, government agents, health sector, energy and mineral sector, agricultural sector, international agencies, financial sector and industrial sector. The informants' gender disaggregation constituted 53 male and 8 female; while participant age profile was 68% being youth with age ranging from 18 to 35 years. A graphic in Fig. 2, provides the gender and age profiling for the study participants.

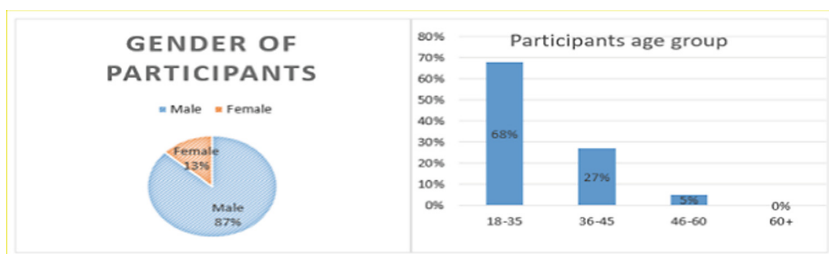


Fig. 2. Informant gender and age profile

To ensure that the informants clearly understood the information sought for by this study additional written and oral information was provided to each participant to help them understand the purpose of the study and why they were the best individuals to participate. It was made clear to each informant that filling of the questionnaires was voluntary and the information provided is categorically meant to inform the data skills needed to empower them and better perform the organizational tasks they are involved with informed decisions.

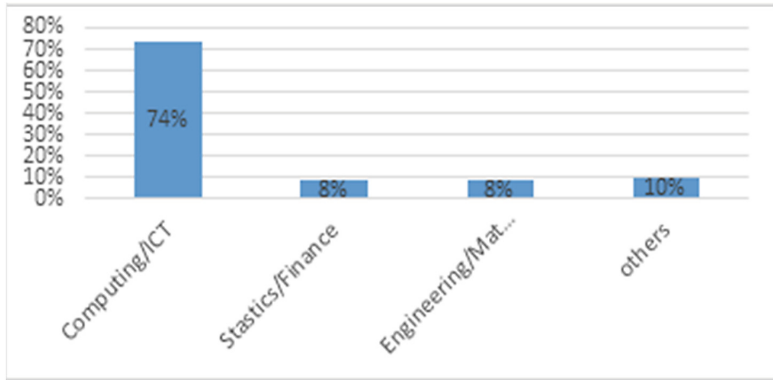
Filled questionnaires were compiled and coded in Microsoft Excel spreadsheet where analysis was done using the newly introduced Data Analysis add-ins in Microsoft Office version 2013. Different coding and analysis techniques were employed to analyze data depending on the type of information collected for each topic. Analysis was done independently for each topic covered in the questionnaire and necessary relationships between topics were established as is discussed in subsequent sections. Overall the analyzed data articulated a compelling evidence for the local industry growing need for the shortlisted skill sets relevant for data scientist.

4 Results

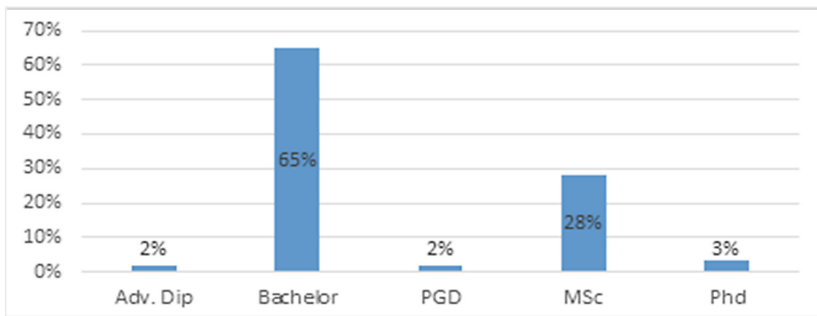
In this section the key results and findings of the study are presented which are summarized in four major subtopics; the informants' profession and level of education, the level of applicability or relevance of different skill areas related to data science education within the probed organizations, a review of informants opinion on demand for data science education and the relative preference of different available modes of learning. In terms of professional background most informants were from the fields of computing and ICT, Statistics, Finance, Engineering and Mathematics, while only a few were from other disciplines that had little or no relation to the data science field. Moreover, the informants' level of education ranged from advanced diploma to PhD, in which about 69% of respondents were yet to receive a master degree. Figures 3(a) and (b) provide a graphical view of the disaggregation of informants along the professional background and levels of education category.

In recent years many higher learning institutions have invested in providing choices for learners in terms of delivery modes, including on campus full-time or the part-time evening counterpart, on the other hand the technology mediated online learning or corresponding dual/blended mode of learning. It was imperative to find out learning mode preferences from respondents to help understand how optimal the investment should be directed along the various learning modes. When asked whether they preferred full-time, evening, online or dual mode of learning, most respondents indicated the part-time evening mode of learning as the most preferred as graphically depicted in Fig. 4.

The informants were subjected to a list of course topics relevant to the data science body of knowledge in order to rank the level of importance and applicability to their organization as shown in Table 1. In particular, from the given list of 29 data science



(a) Professional backgrounds



(b) Education Levels

Fig. 3. (a) Professional backgrounds (b) Education levels

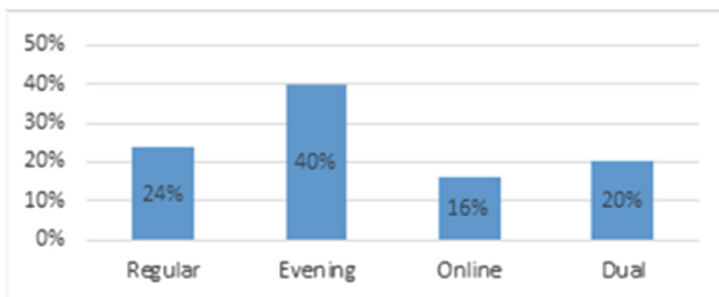


Fig. 4. Learning mode preference

related topics the respondents were to identify the relevance to their work related functions and their organizations’ needs. They were asked to rank by using 6 levels of Likert scale ranging from highest relevance level 5 for “very important” to the lowest

relevance level 0 for “not applicable”. Besides, the encoded list the informants were given an option to add in the list missed out topics of relevance. Table 1 shows the aggregated response on level of importance for respective selected course topics in addition two additional missed out relevant topics were listed by respondents, namely, High Performance Computing and Digital signal processing topics.

Table 1. Topics and respective level of importance on Likert scale

S/n	Topics	Level of importance	S/n	Topic	Level of importance
1	Statistical models and regression	3.96	16	Data management	4.67
2	Distributed systems	4.09	17	Decision Support System	4.09
3	Data Analytics and Processing	4.60	18	Data led Information Systems	3.96
4	Data Mining and pattern recognition	4.32	19	Action led Information Systems	3.67
5	Social media Analytics	3.59	20	Optimization methods	3.58
6	Spatial databases and Applications	4.12	21	Forecasting and Predictive Analytics	3.98
7	Data Visualization	4.42	22	Strategic Business Analytics	4.07
8	Statistics for data analysis	4.34	23	Big data processing	4.42
9	Information Science	4.07	24	Artificial Intelligence	3.41
10	Data Driven Application-Emerging Applications	4.26	25	Data interpretation	4.48
11	Problem Driven learning	3.87	26	Knowledge management	4.10
12	Scalable Data Systems and Algorithms	3.84	27	Expert systems	3.83
13	Data integration and sharing	4.37	28	Data standards	4.15
14	Monitoring and evaluation	4.29	29	Data security and privacy	4.77
15	Data use	4.31			

In order to determine whether a data science program would be in demand, and a market for such program existed, respondent opinion level for demand and market was sought with respect to data science knowledge to solve day to day problems. Figure 5, show a graphic representation on market demand opinion for skilled labor force on the data landscape.

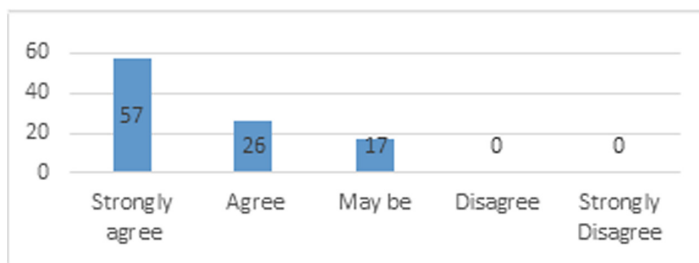


Fig. 5. Market demand

In addition to individual level of opinion, respondents were asked to further comment on how data science could be vital in respective organizations. A number of interesting approval comments emerged, as highlighted below by a few selected representative comments:

“The demand for the programme is vital and as well the programme will be used to solve lots of data demanding operations. We give it go ahead and look forward for its initiation”.

“The programme is highly needed in the country. Apparently the richest companies are data companies, thus managing data should be priority.”

“Strongly agree with the proposed programme as with data, professional and experts might produce a future analytic oriented results”.

“Importance of big data analytical tools, need for exposure to big data analysis. The market is so fragile hence forecasting of customer behavior is essential. By integrating social media data usage in telecom services/ product the organization will be in position to come up with products needed by markets hence increase revenue”.

“The outlined topics in this proposal are in line with current market demand and will help organizations to leverage on information for operational improvements and increase their competitiveness. To be able to benefit large number of Tanzanians (currently employed) especially those in remote regions, I suggest the programme to offered in online mode as well as full time”.

As a proof of concept the findings triggered a curriculum development process at the department of Computer Science and Engineering of the College of Information and communication Technologies for Masters in Data Science Program at the UDSM in partnership with dLab organization, the successor of the dLab project. The partnership aimed at creating a linkage between the industry and academia, making this one of the innovative program that harness such a linkage to foster both theory and practice. The curriculum has been approved by the University Senate under regular/full-time mode and the first cohort is ready for admission for the forthcoming academic year 2018/2019. Out of the admission process, it emerged out that this program had attracted a high number of applicants more than the second runner postgraduate programme at the host department which currently offers five postgraduate programmes as shown in Table 2.

Table 2. Summary of admission into masters programmes for 2018/2019

Programme	MSc Computer Science	MSc Data Science	MSc Health Informatics	MSc Information System Management	MSc Computer and IT Systems Engineering
Applicants	15	39	10	30	8

5 Discussion

The objective of the study was to assess demand and opportunities for data science education in the Tanzanian context and in turn inform the curricular development need for a data science program at the University of Dar es Salaam. There is compelling evidence of growing data science skill shortage in Tanzania as more data sets are becoming readily available and demand for harnessing such data is on the increase not just from the public sector but also researchers, innovators, NGOs and the private sector, it is also a concern for [3]. For, instance Government agencies such as ministries regulatory authorities need skilled labor on data science to draw insights from routine, administrative and survey data for development of the nation. Furthermore data science postgraduate education responds to [16, 17] since it prepares skilled human resource to manage the emerging data management and analytics demands in organizations. Data Science is vital to emerging data driven economy which will play a vital role in any industrialized and service driven business economy. Data Science postgraduate education will contribute towards the country's drive for industrial economy by increasing the number and quality of data scientists in organizations who will drive evidence-based decisions and policy planning in order to meet market demands.

The professional background and level of education of most data practitioners who are currently involved in organizational data related tasks confirmed that the existing graduate programs lack the necessary course topics that fosters knowledge and skill required for a competitive data scientists as in [4]. However, such professions and level of education can be leveraged as a prerequisite for entry into a data science educational program, in particular, through a postgraduate program in data science. Therefore, this bring new opportunity for educators to established postgraduate program focused in data science.

The gender disaggregation data confirmed that the field of data and ICT is skewed towards male as 87% of respondents who are also data practitioners in the shortlisted organizations were men. Indeed, this shows that the ICT related jobs in Tanzania are male dominated as discussed in hence, the same gender disparity would be expected for candidates of the anticipated data science program as discussed in [7, 8]. Higher learning institutions would need to put in place a deliberate strategy that seeks to overcome the gender disparity in the long term, possibly might attempt to reach out and engage female practitioners in the industry and schools to consider opting for ICT related programs. In this there is a lot that higher learning institutions can learn from a number of initiatives that the dLab had pioneered to promote women and young girls' involvement in data and data driven innovations. It is also noted that most data

practitioners are young people below 35 years while 95% are under the age of 45. In such age group it is likely that a practitioner has acquired a relatively good experience and a career focus, hence also suitable to enroll for a postgraduate education.

There are delivery constraint for learning institutions to consider in terms of appropriate mode of learning for a cross-section of potential learners which indicate varying needs. It is clear that although most practitioners had showed willingness to take a stride for data science education, they are constrained with keeping their jobs, therefore, it is not surprising for the overwhelming majority being in preference of undertaking an evening mode of learning. That is, the evening mode of learning is the most preferred learning mode for postgraduate education as most candidates are on employment thus can find time for studies after work.

In spite of uncovering the opportunity for data science education, the issues of policy and decision making to leverage the uncovered opportunities should come into spotlight. On one hand it has been shown that the most preferred learning mode is part-time/evening mode, but as part of curriculum implementation process, it emerged that current curriculum approval policies in some higher learning institutions including the UDSM, did not support evening mode, which impact on the majority learners' constraint. On the other hand, the country being part of the OGP membership acted as a catalyst for increased data related activities leading to demand for data science skills across national sectors. It is likely that the recent national policy shift leading to withdrawal from OGP and the further tightening to access and use of public statistics through the new enacted statistical act may humper the dynamics for uptake of and anticipated outcome of strengthening the data science education.

6 Conclusion

As for the global trend, in Tanzania data scientists will rapidly be in demand following technological adoption in new and existing business organizations faced with global competitions, leading to appetite for growth through evidence based planning and decision making. Our analysis indicates that data science field attracts growing importance nationally as demand for skilled data scientists to cater for envisaged growing demands, fueled by country policy drive for industrial economy. It is essential for local performance monitoring and the global requirement for SDGs monitoring and reporting. Higher learning institutions need to actively play the role of mainstreaming the data science education in order to sustain the near term and future supply of data scientists.






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The Role of Human Centered Design (HCD) and Challenge Driven Education in Enhancing the Innovation Capacity of Africa's Young People: Case of Youth for Children (Y4C) Innovation Hub in Tanzania

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Abstract. As the world advances rapidly and economic conditions continue to change, issues such as globalization and changing labour markets are putting a huge pressure on youth worldwide. There is an urgent need for young people to be trained with flexible set of skills that will allow them to take the front seat and actively contribute to initiatives directly affect their development. The first step towards addressing the pressing concerns of today's youth, especially in Africa, involves improving the existing education systems. This paper elaborates curriculum improvement in education systems by adapt a human centered design (HCD) and Challenge-Driven Education (CDE) approaches that encourages students to work on projects that address real challenges solicited from industry partners. Youth for Children (Y4C) innovation hub, a partnership between UDSM college of ICT (CoICT) and UNICEF Tanzania, was established in 2016 to promote child rights and provide the design skills and social context to support students in developing products and solutions with real social value. Y4C Hub provides unique value in its emphasis on HCD and CDE approaches where projects are undertaken for a period of one year and are directly linked to solving real challenges facing the society in collaboration with the challenge owners and mentors. In the year since launching the hub, 173 CoICT students, 36 supervisors, and 50 secondary school girls have been trained on HCD. A Final Year Project course curriculum has been reviewed to reflect a more challenge driven approach, offering a chance for promising projects to be incubated.

Keywords: Human centered design · Innovation ecosystems · Challenge driven education

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1 Introduction

For a long period of time, young people have been famously coined as the “future generation”, hence unwittingly overlooking their contributions in critical areas such as education, policy making, peace negotiations and leadership. Consequently, as the world progresses, current solutions and innovations are failing to capture the dynamic demands, experiences and perspectives of the young generation.

Meanwhile, as the world advances rapidly and economic conditions continue to change, issues such as globalization, automation, changing labour markets and climate change are putting enormous pressure on youth worldwide. Job markets now demand a set of digital-savvy youth who possess high perseverance and determination to cope with the dynamic market shifts. The World Bank president Jim Yong Kim, at the UN Youth2030 strategy launch [9] pointed out that the current population of young people between 15 and 30 is 1.8 billion, and half a billion of the young people that live in developing countries are either underemployed or hold insecure jobs. Moreover, 300 million continue to live with no employment or education.

Therefore, there is an urgent need for young people, especially in developing countries, to be trained with a flexible set of skills that will allow them to take the front seat and actively contribute to initiatives that directly affect their development and wellbeing. With 79% of the Tanzania’s population under 35 years [8], mainstreaming innovations for youth and supporting youth-led innovation is critical. As the institutions that are training the next generation of leaders, researchers, designers, and policy-makers, public universities are an essential part of this landscape. Especially in ICT fields, rapidly evolving technologies and corresponding market demands are not always reflected into the curriculum, meaning that even among university graduates, a relatively privileged group, there is an employability gap between the skill-level of graduating students and the skills required by many employers in Tanzania.

Most final year university students in Tanzania spend their final year working on a project. Many students do not select projects that address real life challenges, but instead go for off-the-shelf projects just for the sake of fulfilling examination requirements. Unfortunately, these projects are often developed in a vacuum, resulting in products and services that do not address a clear market need or social problem and provide little practical experience for students.

The first step towards addressing the pressing concerns of today’s youth, especially in Africa, involves improving the existing education systems. Education systems should adapt a challenge-driven approach that encourages students to work on projects that address real challenges solicited from industry partners. Students, especially in higher learning institutions, may build on promising projects from graduating students in order to turn projects in to solutions while fostering sustainability. Human-centered design and design thinking are critical process frameworks to guide these challenge-driven projects. Designing and innovating with the human in mind enforces students to apply design methods to conduct rigorous research and transform insights into products and services that meet user needs and market demand particularly in ICT, low-resource/low-infrastructure settings.

Youth for Children (Y4C) innovation hub was established in 2016 to promote child rights and provide the design skills and social context to support students in developing

products and solutions with real social value. Y4C Hub is housed in a dedicated space at University of Dar es Salaam (UDSM), College of Information and Communication Technology (CoICT). Recognizing that over half of Tanzania’s population is under the age of 18, University of Dar es Salaam (UDSM), College of Information and Communication Technology (CoICT) and UNICEF Tanzania have jointly established the Youth for Children (Y4C) Innovation Hub on CoICT campus to promote child rights and invest in human-centered, open innovation that contributes real social value. This initiative is committed to mainstreaming innovations for children and young people and supporting youth-led innovations in Tanzania, offering a hub space for design and prototyping alongside courses, trainings, and seminars as illustrated in Fig. 1. Students are guided based on a HCD process to develop early-stage, open source, products, services, and research that address community challenges.

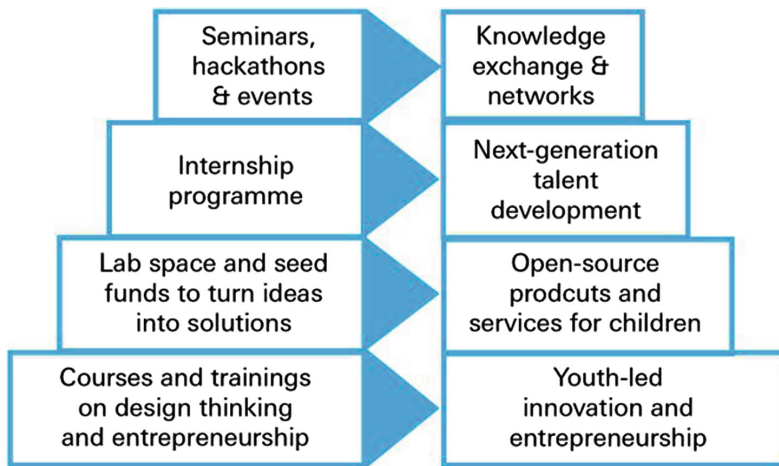


Fig. 1. Y4C hub activities and expected outputs

Y4C Hub is an innovative model of partnership between development actors (in this case, UNICEF) and local universities (in this case, UDSM) for enhancing the critical thinking and innovation capacity of young people and inspiring them to create public goods and generate positive social value.

Y4C Hub provides unique value in its emphasis on human centered design and challenge-driven approaches where projects are undertaken for a period of one year and are directly linked to solving real challenges facing the industry/society in collaboration with the challenge owners and mentors. In the year since launching the hub, the primary focus has been on developing HCD courses and training programmes for CoICT undergraduate students, with the goal of ensuring that the 120+ technology-enabled projects coming out of College of ICT each year are developed with an understanding of user needs and market demand. The process is underway to fully-integrate Y4C Hub within UDSM curriculum where it can feed a pipeline of open-source products and services for Tanzanian children and youth. The first cohort of students completed the final year project (FYP) course and pitched their projects in July 2018.

It is imperative to mention that the innovation ecosystem in Tanzania has many actors and is rapidly growing. In 2017, UK Aid funded research on the innovation ecosystem in Tanzania and the report reveals that there are currently 33 innovation hubs (22 incubators and 11 labs) in Tanzania mainly focusing on health, agriculture, energy, data collaboration, education, technology, gender issues, research and political science [1]. Y4C Hub stands out from the rest of existing innovation hubs because it is housed within a public university, allowing Hub programs to be fully integrated into departments’ core curricula and ensuring long-term sustainability. Y4C Hub is also differentiated by its emphasis on capacity building. Landscape analysis and observation indicate that many innovation actors focus primarily on supporting innovation outputs, such as ideas, products, and business concepts, while Y4C Hub focuses more on innovation process, beginning with design research, problem framing, and understanding user needs. Equipping young people with these innovation skills will serve them beyond the scope of any particular product or business they develop.

2 Related Work

2.1 Human Centered Design and Design Principles

Human centered design begins with the user and moves towards the solution, and throughout the development process, the user remains as the focal point. The human centered design approach, as depicted by IDEO’s design process [14] in Fig. 2 requires designers to be aware of assumptions about the problem and suspend any prior thoughts of what the solution to the problem might be, and instead rely on conducting research to fully explore and understand the needs, desires, behaviors, attitudes and beliefs of the users in order to formulate a problem statement based on the research rather than designer’s prior knowledge and assumptions.

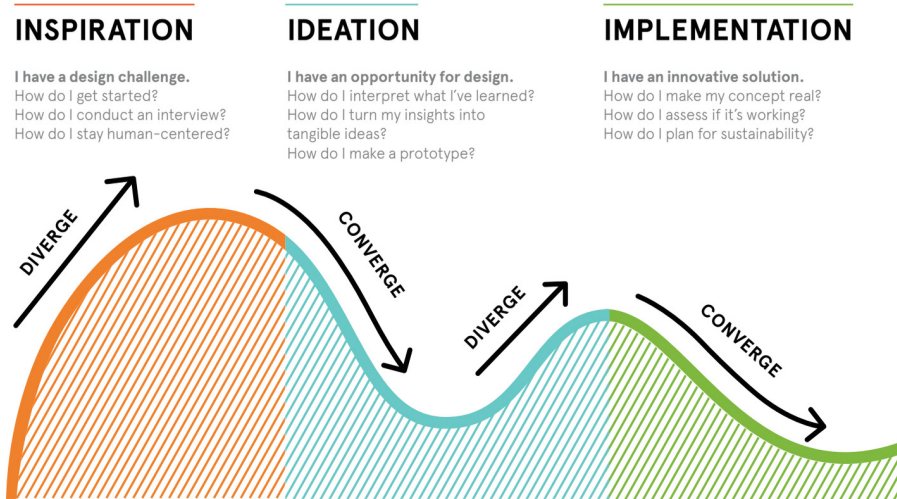


Fig. 2. Human centered design process

Y4C Hub aims to introduce modern design practices as an indispensable part of 21st century digital development. In this, it joins a large and growing number of schools and organizations globally that teach human-centered design as the preferred process for creative problem solving and strategic management.

At CoICT, human-centered design is integrated as a complement to a technical discipline, with a strong emphasis on design research and problem framing. ICT disciplines were identified as being particularly well-suited for this type of integration, both because of the partner's (UNICEF Tanzania) expanding portfolio of ICT-enabled products and services, as well as because of the affinity between contemporary practices of human-centered design and modern development practices such as lean and agile.

Equally important in institutionalizing these practices are the Principles for Digital Development [15], which are high-level guidelines developed by a community of international organizations for leveraging digital tools in development contexts. These principles intersect with principles of HCD, while laying out best-practices such as working in the open to foster collaboration and facilitate scale and building for sustainability rather than simply maximizing growth.

Norman [11], Shneiderman [13] and Nielsen [10] highlight design principles and foundational concepts that are essential for facilitating the designer's task. Designers should focus on making things visible to the users, maintain simplicity and consistency in their designs, and use visuals and graphics to map between intentions and the required actions; between actions and the resulting effect; and between the information that is visible and the interpretation of the system state.

2.2 Challenge Driven Education

Challenge Driven Education (CDE) is an innovation framework that accelerated traditional innovation outcomes by leveraging open innovation [and co-creation] along with defined methodology, process and tools to help organizations develop and implement actionable solutions to their challenges [5]. Innovation is defined as an event characterized by an act of creation or invention followed by successful implementation and deployment so that the benefits of that creation may be widely enjoyed [4]. The innovation process does not start from the point of view of a digital platform or technology but rather from an actual need or challenge. A challenge can be considered as a clearly and accurately defined problem whose resulting solution has value to the society or company [5]. Once a problem is accurately defined as a challenge is distributed to an appropriate channel for innovating an appropriate solution. Human resources can be considered as the most valuable asset for innovation activities. However, teamwork is considered more important for innovation than individuals alone since teams have more knowledge, skills, and experience than individuals do [6]. Especially as challenges become more complex, solutions benefit from cross-functional teams representing different domains of expertise.

Open innovation and co-creation concepts are used for managing innovation process. Open innovation engages a multi-disciplinary teamwork to digest and analyze complex challenges, and openly contribute knowledge, experience, and skills to create mutually beneficial relevant solutions. Co-creation is an active, creative, and social process based on collaboration team work [12] to exchange knowledge and resources. CDE focuses the entire innovation process on carefully defined challenges that target the society or stakeholders.

Universities have a large pool of young and creative students undertaking different degree programs. These young learners are required to apply knowledge gained from various classroom teaching and learning activities in solving societal challenges and in so doing they can obtain technical oriented skills and experience needed to increase their capabilities and employability.

2.3 Innovation Ecosystems

An innovation ecosystem is defined as the complex relationships formed between actors and entities whose objective is to enable technology development and innovation thereby contributing to economic growth by creating new business, and employment opportunities [3, 7]. CoICT was established in 2011 to address the increasing demand of ICT experts and employers? By strengthening the University's teaching, research, and innovation in various disciplines (Computer Science, Information Systems, Applied Informatics, Data Science, Business IT, Computer Engineering, Electronics, and Telecommunications). The College integrates scientific, ICT and engineering principles, practical work, and engineering design experiences, culminating into group work projects that use a CDE Learning approach to solve societal/community/industrial challenges.

A growing network of partners and stakeholders from both private and public sectors are engaging directly with Y4C Hub actors (UDSM students and faculty) to collaboratively analyze and address community challenges and test innovative applications of new and emerging technologies.

3 Methodology: Y4C Innovation Ecosystem

To enhance the innovation capacity of young people, innovation ecosystems must ensure appropriate strategies, systems and resources to support the youth as they create ideas, test ideas and scale ideas. As depicted in Fig. 3, Y4C youth-led innovation consists of collaboration of several agents such as funding agents, capacity builders and trainers, and agents that feed challenges and problems to the youth, all working together to push young people to operate beyond academic boundaries, hence transforming knowledge into innovation. Y4C innovation ecosystem and framework seeks to strike a balance between academic theories and industry investment in direct product development.

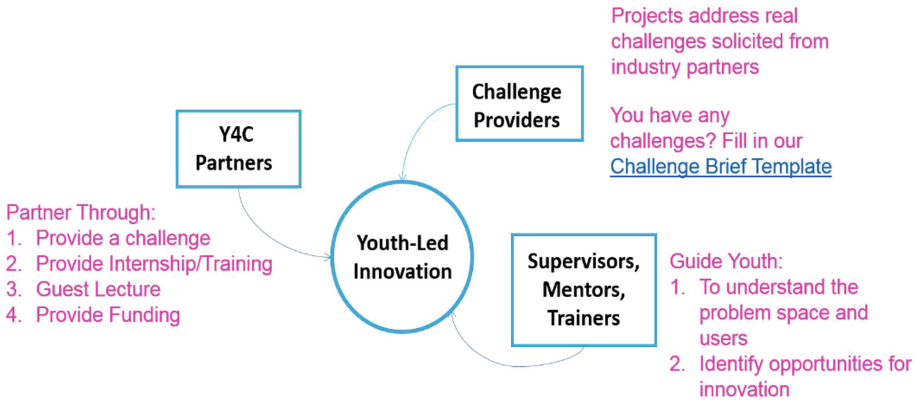


Fig. 3. Y4C innovation ecosystem

3.1 Capacity Builders

The fundamental objectives of Y4C hub are to enhance youth led innovation and entrepreneurship, foster knowledge exchange, develop next generation talent, and support open source products and services for children. Y4C hub places strong emphasis on building the capacity of innovation ecosystem actors. Mentors, supervisors and trainers guide the students to and train them throughout the innovation process beginning with design research, problem framing, and understanding user needs.

Y4C is housed within a public university with college of ICT having 116 faculty and UDSM at large having 2,068 faculty, presenting a large pool of faculty who can serve as project supervisors and mentors. Y4C hub invests in frequently training university supervisors and currently more than 75 supervisors at College of ICT have received training in HCD principles and challenge driven education. Y4C hub objective is to ensure all faculty at UDSM and other universities in Tanzania that supervise students in projects have received training in HCD and challenge driven education.

Y4C welcomes and encourages industry experts to mentor and train students in specific topical areas of their projects. On a dedicated day of the week, industry persons are invited to offer guest lectures and trainings. Students at the hub have so far received mentorship in areas such as project budgeting, big data programming frameworks, blockchain, drone technology, privacy and network security assessment.

Training and building capacity of our students at higher learning institutions, prepares them to become trainers and mentors to their peers and basic secondary schools' students. Currently more than 10 Y4C students are volunteering as mentors and trainers in a gender equality and inclusiveness project [2] where they train secondary school girls from more than 10 public schools in HCD principles while the young girls use innovation to address real challenges such as early pregnancies, school dropouts and gender violence.

3.2 Challenge Providers

All projects and tasks that students work on in Y4C hub must address real challenges solicited from industry partners. Since the launch of Y4C hub, we have solicited challenge briefs from more than 35 agencies ranging from academia, industry, development, private and public sector. The Y4C approach as depicted in Fig. 4 aims to grow a pool of continuously-updated challenges from which interns, final year students, practical trainees, academic researchers and any other designer can browse and work on real societal challenges while engaging challenge providers throughout the process.

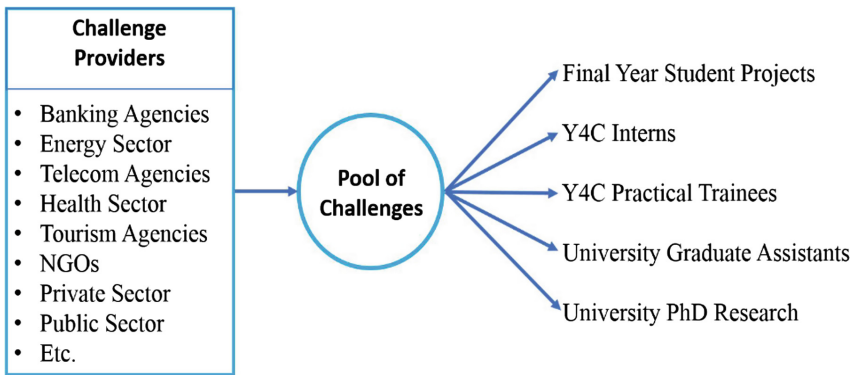


Fig. 4. Y4C challenge driven innovation

3.3 Funding Agents

We believe that numerous student innovations die due to lack of financial support needed to transition prototypes to products and solutions where industries and investors can foresee commercial potential. Y4C is not for profit, in-line with the organizational mandates of the project partners. However, it will support young people in scoping market potential and commercializing their products through existing commercialization resources at UDSM as well as through private-sector partnerships.

Y4C innovation ecosystem seeks to collaborate with and maintain a pool of Y4C partners as funding agents through striking nondisclosure agreements and memoranda of understanding. Y4C promotes interaction with Y4C funding partners by offering opportunities where students can circulate among respective partners as interns, mentors, volunteers and consultants. Y4C organizes seminars, guest lectures, hackathons, workshops and exhibitions where we invite Y4C partners to either pass skills to the students or witness a range of ideas and prototypes that can later be transitioned to products.

In order to support transparency and sustainability in parallel to project implementations, Y4C established a governance structure in 2018. A steering Committee representing private and public sector was identified to oversee the Y4C Seed Fund and

contribute to long-term resource mobilization for the pooled fund. The steering committee members explore innovative ways to monetize hub resources in order to balance out overhead costs for operations, for example through faculty-led design workshops or Y4C consulting for private sector.

4 Implementation and Results: Y4C Hub Progress

4.1 HCD Activities to Field Students

The Y4C Hub has enrolled CoICT students during annual practical training (PT) periods to engage in developing innovative products and solutions with real social value, and as a means to prototype the design curriculum and challenge-driven model prior in a well-defined environment. Since its launch, the Hub has enrolled 17 students for PT cohort of 2016/17 and 27 students for 2017/18 academic year with a focus of enabling the students to use human-centered design (HCD) methods for ICT innovation for challenges facing children and women in Tanzania. As stipulated in Table 1, the 17 enrolled students enrolled into PT-cohort of 2016/17 academic year were given 5 challenges from three stakeholders, whereby at the end of the program each team managed to produce a prototype solution that was pitched to respected challenge provider.

Table 1. Matrix of challenges and HCD-based solutions from 2016/17 PT-cohort.

S/no.	Challenge	Challenge provider	Ideation and output
1.	Children Nutrition problem	UNICEF - Tanzania (Nutrition)	<ul style="list-style-type: none"> • SMS-based social media platform for nutrition awareness and sensitization campaign • Tested prototype of the platform • Showcase the product on University exhibition
2.	Maternal and Newborn Health problems	UNICEF – Tanzania (Health)	<ul style="list-style-type: none"> • Digital platform for clinical procedures • Enrolled for incubation at Y4C
3.	Education stakeholders’ communication problem	Kinondoni Municipality	<ul style="list-style-type: none"> • Prototype of mobile application for education stakeholders’ communication
4.	Collection and transmission of data on water supply services	Dar-es-salaam Water Supply Company	<ul style="list-style-type: none"> • Digital system prototype comprising of USSD and web platform
5.	Abuse of street children	UNICEF Tanzania (Child Protection)	<ul style="list-style-type: none"> • Mobile application for Investigation and Assessment of Child Abuse • Internship opportunity to finish the project

Likewise, as stipulated in Table 2, the 27 students enrolled into PT-cohort of 2017/18 academic-year were given 6 challenges from five stakeholders, whereby at the end of the programme each team managed to produce a prototype solution that was pitched to the respective challenge provider.

Table 2. Matrix of challenges and HCD-based solutions from 2017/18 PT-cohort.

S/no.	Challenge	Challenge provider	Ideation and output
1.	Water, sanitation and hygiene (WASH) in schools	UNICEF - Tanzania (WASH Unit)	<ul style="list-style-type: none"> • Prototype of low-cost WASH facility • Internship opportunity to finish the project
2.	Life skills gap in formal and informal education system	UNICEF-Tanzania (Education Unit)	<ul style="list-style-type: none"> • Prototyped mobile application that extend delivery • Enrolled for incubation at Y4C
3.	Kids’ educational materials delivery challenges	Ubongo Kids	<ul style="list-style-type: none"> • Web application for kids’ educational cartoons
4.	Family planning challenges	Apps & Girls	<ul style="list-style-type: none"> • Prototyped digital platform for family planning awareness
5.	Ineffective volunteering platform to address shortage of teachers	UNICEF - Tanzania (Education Unit)	<ul style="list-style-type: none"> • Prototyped digital platform for effective volunteering • Enrolled for incubation at Y4C
6.	Cyber security challenge and Y4C virtual lab challenge	CoICT	<ul style="list-style-type: none"> • Y4C Virtual Lab Prototype for secured virtualization tool for resource access • CoICT security assessment document

4.2 Integration of Human-Centered Design in FYP Curriculum

The Y4C Hub collaborated with the (CoICT) of University of Dar es Salaam (UDSM) to revise a training curriculum of final year projects (FYP) programme. The FYP is a mandatory course for all final year students of CoICT with objective to simulate outgoing students with post graduate job environment. The purpose of revision was to integrate a human-centered design (HCD) lens and curriculum modules into the programme. As stipulated in Table 3, before integration the course delivery mode involved self-reading and individual lab-works, on which students pursued lengthy projects while confined to consult supervisors for advice only.

Accordingly, the curriculum revision process proposed changes in delivery mode of FYP programme by introducing seminars and workshops on innovation skills and HCD techniques. This measure intended to enable FYP students to apply

Table 3. Curriculum of FYP programme before/after Y4C Intervention.

Course aspect	Before Y4C intervention	After Y4C intervention
Deliver mode	Consultation = 6 h/Wk Self-reading/Labwork = 10 h/Wk	Consultation = 2 h/Wk Inspirational Seminars = 2 h/Wk Workshops = 2 h/Wk Self-reading/Lab-work = 10 h/Wk
Assessment mode	Documentation (30%), Presentation (20%), Demonstration (50%)	Design Research (20%) Documentation (30%) Demo + presentation to college (30%) Demo + presentation to challenge providers and stakeholders (20%)
Course contents	The student pursues a lengthy project in an area of informatics with top level advice only being provided by the supervisor	Unit I: Introduction to Design Research Unit II: Research Synthesis and Ideation Unit III: Prototyping & Iteration Unit IV: Business Model development
Reference readings	Not applicable	<ul style="list-style-type: none"> • HCD Library created at Y4C Hub with more than 8 books on design tools and methods, in addition to a number of open online resources
Team work	Only supported by Computer Science Department	<ul style="list-style-type: none"> • All departments at CoICT to support students project Team work [not more than 5 students]
Challenge driven	Not necessary	<ul style="list-style-type: none"> • Project must address a societal challenge and student must do field research with users and use data as input to their design and prototypes
Incubation support	Not applicable	<ul style="list-style-type: none"> • Criteria formalized for incubation support

human-centered design on identifying opportunities for innovation and utilize replicable design research methods to conduct rigorous research and transform insights into projects with economic, social, cultural, or environmental value.

The integration of HCD methods into FYP curriculum were first prototyped during an 8-week practical training (PT) program in 2017 and completed in October 2017. The completion paved a way for the FYP coordination team to conduct pilot implementation in 2017/18 academic year that commenced on November 2017. As stipulated in Table 4, a total of 24 h of workshops were delivered, covering broader knowledge of human-centered design and innovation skills. Moreover, a total of 6 h of seminars were delivered which involved inspirational talks from speakers with notable working

experience in information and communication technologies (ICT) industry. Each workshop engaged an average number of 120 students pursuing final year project programme while an average of 20 students attended each inspirational talk delivered during seminars.

Table 4. Status of HCD Deliverance during a pilot implementation of proposed integrated curriculum.

Aspect of HCD delivery	Number of sessions	Total number of hours	Number of students benefited
Workshops	12	24	120+
Seminars	3	6	60

Although it is too early to account for the impact of curriculum integration of HCD techniques into FYP programme in one year of pilot implementation, but there has been a clear improvement in students’ presentation skills and documentation, where students’ reports included a design research and user engagement component. The college has observed a slight improvement in results of FYP course among students. As stipulated in Table 5 that compared FYP results for 2016/17 and 2017/18 cohort of Computer Science students, the average performance of course assessment has slightly improved. There is clear harmonization of performance whereby the overall maximum score has lifted from 73.69 to 77.06, while the overall minimum score lifted from 29.50 to 50.91. Moreover, the overall standard deviation has lowered from 8.17 to 5.86, which implies positive effect on harmonization of FYP performance among projects.

Table 5. Performance improvement in FYP after HCD intervention.

Performance parameter	Results	
	2016/2017	2017/2018
Number of FYP projects	43	35
Maximum score	73.69	77.06
Minimum score	29.50	50.91
Average score	59.24	61.88
Standard deviation	8.17	5.86

5 Conclusion

This paper presents Y4C Hub, which is an innovative model of partnership between development actors and local universities for enhancing the critical thinking and innovation capacity of young people and inspiring them to create public goods and generate positive social value. The innovation ecosystem and implementation progress of Y4C hub affirms the role of HCD and CDE in enhancing the innovation capacity of youth. Y4C youth-led innovation consists of collaboration of several agents such as

funding agents, capacity builders, and agents that feed challenges and problems to the youth, all working together to push young people to operate beyond academic boundaries, hence transforming knowledge into innovation.

In the year since launching the hub, 173 CoICT students, 36 supervisors, and 50 secondary school girls have been trained on HCD. Y4C hub has offered more than 15 internships to undergraduate students. A Final Year Project course curriculum has been reviewed to reflect a more challenge driven approach, offering a chance for promising projects to be incubated. The process is underway to fully-integrate Y4C Hub within UDSM curriculum where it can feed a pipeline of open-source products and services for Tanzanian children and youth.

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Towards Developing Interactive Content for Enhancing Life Skills Education in Tanzania: Possibilities and Pitfalls

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Abstract. Feasibility study is the first and important stage in any planning of introducing a new solution for overcoming existing challenges. It saves a lot of resources that could be lost if such solution fails to solve the intended problem. On the other hand, it gives a proper way to go ahead with the plan of introducing the solution. The purpose of this study is to establish necessary and basic requirements as possibilities and pitfalls for deploying cost effective interactive multimedia content for enhancing an ineffective provision life skills education at primary school level in Tanzania. Ten primary schools were randomly selected and surveyed from which 65 teachers and 407 pupils participated in the study. Questionnaires, interviews, and documentary reviews were used as data collection tools. It was found that the Internet penetration is 45% of the population with 82.6% of Internet users are smartphones users. Number of computers and tablets at schools are still limited to 1:1036 computer pupils ratio, 96% of pupils had access of computers and smartphones from parents. Moreover, 77% of teachers used conventional and lecturing style in teaching, 100% of life skills content was static found in inadequate textbooks. Based on these results, deployment of self-learning enabled interactive multimedia content is possible and will bring positive impact if it will be developed to operate in ICT devices available in both primary schools and pupils' parents as well. This study informs the proper way of introducing cost-effective interactive multimedia content at primary school level in Tanzania.

Keywords: Interactive multimedia content · Life skills education · Possibilities and pitfalls

1 Introduction

Interactive multimedia content has become a leading cost effective alternative in enhancing educational learning systems in recent years especially in a situation where ICT infrastructure is well established [15]. It can address a number of challenges such as lack of professional teachers by mimicking a best teacher when is well designed and [25, 26], lack of teaching materials by providing learning materials with three modalities such as visual, oral and kinetic in which pupils learn better [25, 26], and poor teaching methods by providing enhanced and augmented learning styles, more

goals oriented learning, and more participatory by doing practically [26]. Flexible interactive content that can run in mobile platforms to support mobile life skills learning or offline standalone application is preferred more than others content in developing countries where ICT infrastructure is not yet well established [8].

Tanzania is one of the developing countries which have been adopting and introducing interactive content for a couple of years especially at higher learning institutions and secondary schools. Mtebe and Raphael [14] reviewed 74 e-learning articles carried out from 2007 to 2017 in Tanzania and it was found that 53 articles were for higher learning institutions, 16 for secondary schools, and only 2 for primary schools. The little interactive content studies at primary school level in Tanzania did not address the ineffective provision of life skills education in Tanzania.

Literature shows that life skills education for children has become a great concern due to its emphasis and effectiveness on promoting health, and meaningful social relationship [1, 16, 34]. It also empowers young people to take positive actions and protect themselves against various demands and challenges of everyday life [1, 16, 34]. Life skills education requires participatory teaching strategies such as classroom discussions, role playing, brainstorming, storytelling, debates, questions and answers, and educational games in order to impact pupils the required skills more effectively [22].

Tanzania introduced life skills education at primary school level to empower knowledge and prevent the pupils from challenges of everyday life such as smoking, alcoholism, use of drugs, sex abuse, school dropout and teenage pregnancies [18, 22, 32]. However, its implementation has not been effective since there is still alarming cases of life skills including among 3,797 pupils of primary schools, 95.8% used drugs, 91.2% used alcohol, 76.5% had sexual intercourse before age of 14 years and 27.1% missed classes for one or more days in 30 days [29]. The performance of pupils in the national standard four examinations of 2015 was poor in life skills topics especially *Ethics and Humanity* topic [17].

The lack of studies which can provide baseline data for introducing Interactive Multimedia Content at primary school level in Tanzania, has caused to conduct this study to bridge the gap. The results of this study will inform stakeholders the proper way of introducing cost effective interactive multimedia content in primary schools in Tanzania to enhance the provision of life skills education. Therefore, the aim of this study is to identify the challenges facing the implementation of life skills education in Tanzania and establish necessary basic requirements as possibilities and pitfalls for deploying appropriate interactive multimedia content.

2 Literature Review

Few studies are known about possibilities and pitfalls for deploying appropriate interactive multimedia content to enhance life skills education for primary school children in Tanzania. Some studies including Chacha [4], Machuve, Zlotnikova and Nyambo [11], Ntulo [19], Waddington [33], Enos [6], and Uwazi [31] pointed out in general the challenges facing primary education in Tanzania. Lack of professional teachers, poor teaching methods, large class sizes, inadequate teaching and learning materials were the challenges which have been affecting the quality provision of primary school education.

For instance, Chacha [4] studied about challenges of primary education in Tarime district in Tanzania involving 6 teachers from two primary schools and 16 parents from two villages. Structured interviews and questionnaires were used to collect data. After data content analysis, the study discovered that very few teaching materials were available in percentage including teacher guide books was 17.6%, chalks were 31%, library and laboratory was 0%, Pupils' textbook was 10.7%, extra books available was 0%, and poor parents were not able to buy textbooks for their children.

Limited studies about status of ICT infrastructure in primary schools were also found including Apiola and Tedre [2], Komba [10], and Hennessy and co-authors [8]. These studies revealed that ICT initiatives in primary schools is still constrained by unavailable electricity supply, inadequate ICT equipment leading to overcrowding of computer labs, insufficient and inappropriate software including software designed for Northern contexts or languages, unaffordable access to Internet connectivity with adequate bandwidth, lack of trained teachers and the low levels of teachers' ICT knowledge and skills. Although, ICT curriculum for discrete subject/TEHAMA had been introduced at primary level in Tanzania [8], pupils were taught basic computer skills and not how to use ICT as a tool to enhance learning [8]. The language of instruction in primary schools in Tanzania is Kiswahili which constitutes less than 2% of the Internet content. Therefore, ICT-based Kiswahili content is needed.

Other studies such as by Apiola and Tedre [2], Mruz [13], Machuve and co-author [11], and Kasumuni [9] designed and customized various interactive content for enhancing learning including mobile applications, online games, e-books, and delivering video by mobile in classrooms. After testing their effectiveness, most of them motivated the pupils to learn and pupils' academic performances were improved. Moreover, Preradović and co-authors [23], Shegog and co-author [26], Dolhalit and Salam [5], Hafiz and Ahmad [7], and Rath and coauthors [24] applied interactive content to impact the children with the preventive life skills education to eradicate various life skills cases including HIV/STI, early pregnancy, smoking, truancy and stress. Altitude against the life skills cases were enhanced and therefore interactive multimedia has significant effect on student's motivation and can remove bad behaviors among children.

All these studies have never studied about challenges faced provision of life skills education and possibilities and pitfalls for deploying interactive content to enhance provision of life skills education at primary school level in Tanzania. So far, it remains unclear about the challenges faced provision of life skills education, status of ICT infrastructure, and others possibilities and pitfalls for deploying interactive content in primary schools in Tanzania. Therefore, this study is aimed at bridging this gap.

3 Methodology

3.1 Research Design

Survey study was conducted in 10 primary schools involving 65 life skills teachers, and 407 standard five pupils who recently passed standard four national examinations. Various data were collected through questionnaires, interviews, and documentary reviews and they were analyzed using content and statistical analysis. The problems

faced the provision of life skills education were identified. The identified problems which can be addressed by deployment of interactive multimedia content were termed as possibilities while the identified problems which hinder the deployment of interactive multimedia content were termed as pitfalls. The factors which support operationalization of interactive multimedia content were identified as possibilities and those which do not support operationalization of interactive multimedia content were identified as pitfalls.

3.2 Participants

Sixty five teachers and 407 pupils participated from 10 primary schools in this study. There were two types questionnaires for teachers, one for school administrators who are head teachers for collecting administration based data and the second questionnaire was for teachers who teach life skills subjects for data such as teaching methods and challenging life skills topics. The number of female teachers who participated in the study was large compared to male teachers since the majority of teachers in the schools were females. The distribution of the teachers who participated is shown in Fig. 1.

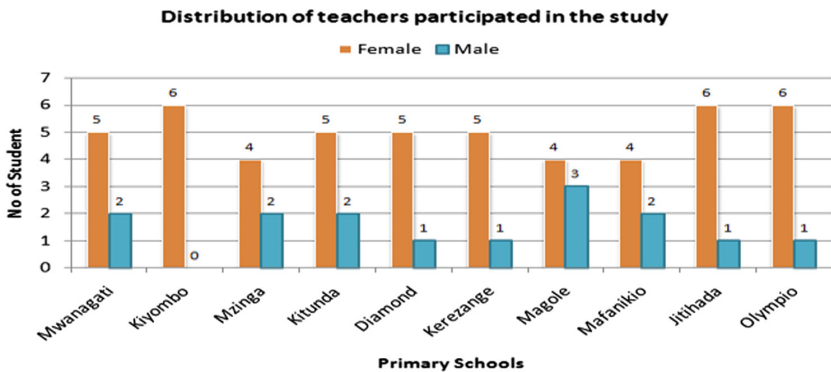


Fig. 1. Distribution of participated teachers per school

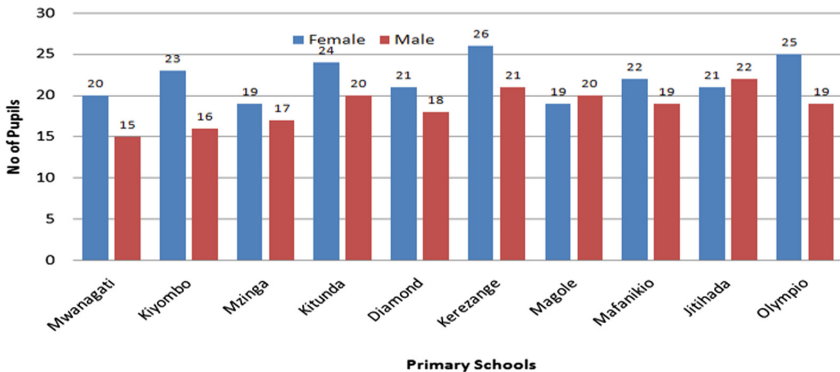


Fig. 2. Distribution of pupils participated in the study

The distribution of the pupils from 10 primary schools who participated in this study is shown in Fig. 2. The female pupils who participated in the study is large compared to male pupils since almost all 10 primary schools which were surveyed had many females enrolled compared to number of males.

3.3 Data Analysis

Quantitative data from head teachers, life skills teachers, and pupils were analyzed using Microsoft Excel Program 2010. Descriptive, computed, and comparison statistics were used in data analysis, the collected data were edited, coded, and translated from Kiswahili to English. Tables were used to summarize the results from which graphs were drawn. Qualitative data which were collected through open-ended questions and interviews were gathered, summarized and subjected to content analysis.

4 Findings

4.1 Possibilities

In this study, many factors were found supporting and demanding the possibility of enhancing life skills education using interactive content. The supporting factors were availability of ICT infrastructure, experience of pupils in learning through computer based games and video based storytelling cartoons, and availability of electricity in schools. While the demanding factors were lack of professional teacher, lack of teaching materials, and poor teaching methods.

Availability of Computer Laboratories: It was observed that three primary schools had computer laboratories out of ten primary schools. The rest of primary schools had only one computer used by head teacher for examinations preparation. According to National Basic Education Statistics in Tanzania (BEST), there were 8,334 computers, laptops and smartphones and 8,639,202 pupils from 17,174 primary schools equivalent to 1:1036 computer pupils ratio [3]. The Internet penetration has been increasing from 29% in 2014 to 40% in 2016 and 45% in 2018 while mobile phone penetration has increased from 80% in 2016 to 82.6% 2018 of the total Internet users [27, 28]. Out of 17,174 primary schools, 3,818 use national grid electric power, 262 use generators, 1295 use solar, 18 use biogas, and 14 use wind, 9,376 use others, and 2,502 have no electricity [3]. Therefore, 85% of primary schools had electricity. This is one of the factors support operationalization of the interactive multimedia content in primary schools.

Pupils' Access and Use of Computers and Mobile Devices: Pupils were interviewed to find out if they were using computers and smartphones in playing games or watching entertaining video from their parents' devices. After analyzing the data, it was found that 96% of pupils were playing games at home using their parents' smartphones and computers. Other pupils used to go to computer games business centers where they pay some money and played various games. For pupils whom their parents did not have smartphones and computers used their neighbor pupils' parents' devices as shown

Fig. 3. This factor is considered as an opportunity for deploying interactive content in pupils' parents' devices where the pupils could be able to access the interactive content for life skills education.

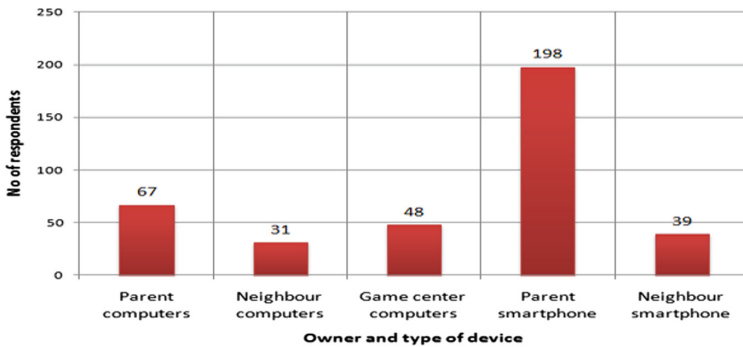


Fig. 3. Pupils playing games using smartphones and computers

Mobile Life Skills Learning: It was also found that about 58% pupils had access to smartphones, 96% had access to both smartphones and computers (see Fig. 3) and 82.6% of Internet users are smartphones users [28]. With these facts, mobile life skills learning is possible especially when the interactive content is developed to run in smartphone. The primary school education policy does not allow pupils to own and use any phone at school. Therefore, the mobile devices owned by schools and parents will be used at schools and at home respectively. This is another factor which supports deployment of interactive content.

Challenging Life Skills Topics in Teaching the Pupils: The pupils and teachers were requested to mention any challenging life skills topics which demand practical knowledge. The challenging life skills topics which were mentioned by the teachers and pupils were *Health Care, Communication, Relationship and Cooperation, Road Safety, Problems and Risk Behaviors, Critical Thoughts, Good Decisions and Plans,*

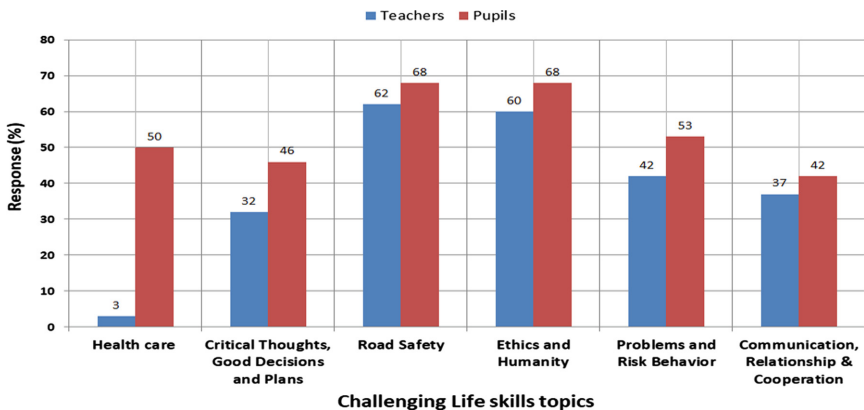


Fig. 4. Teachers and pupils responses (%) for identifying challenging life skills topics

and *Ethics and Humanity*. The Fig. 4 shows that both pupils and teachers mentioned similar challenging life skills topics and the most challenging topics were *Road Safety* and *Ethics and Humanity*. This is another factor which demands deployment of interactive content.

Lack of Professional Teachers, and Teaching and Learning Materials: Head teachers from every primary school were asked to assess availability of professional teachers and teaching materials in their schools. After analyzing the data, it was found that most of primary schools lacked professional teachers who can teach life skills especially in public schools which their deficit ranges from 4 to 15 teachers per school except Mzinga private school which had enough teachers and textbooks (see Table 1). There were deficits of teaching and learning materials for life skills including textbooks, practical and demonstration equipment, and interactive content. In public schools, some of classes did not have even a single textbook for pupils while other schools shared one textbook for 5 to 20 pupils. Interactive content is also not available at all in all schools. This is also another challenge which demands deployment of interactive content.

Table 1. Deficits of teaching materials and teachers per life skills subjects

S/N	Name of primary school	Life skills subjects (Learning materials and teachers deficits)							
		Science		TEHAMA		Personality & Sports		Civis	
		Teaching materials	Teachers	Teaching materials	Teachers	Teaching materials	Teachers	Teaching materials	Teachers
1	Mwanagati	258	3	892	3	921	3	844	3
2	Kiyombo	590	5	801	5	801	4	590	4
3	Mzinga (Private)	0	0	0	0	0	0	0	0
4	Kitunda	1251	10	1238	10	1236	10	1225	10
5	Diamond	1280	2	1284	3	1284	3	1283	5
6	Kerezange	966	6	1050	5	1093	4	926	7
7	Magole	511	2	779	3	784	3	698	2
8	Mafanikio	466	5	778	6	777	4	553	11
9	Jitihada	1154	5	1410	6	1381	5	1422	4
10	Olympio	2095	14	2098	12	2100	12	2088	15

Teaching and Learning Methods: Pupils and teachers were asked to mention and explain the methods they were using in teaching and learning life skills. After collecting and analyzing the data, it was found that both teachers and pupils agreed that conventional and traditional method of teaching and learning that is lecturing style was frequently used which depends heavily on memorization, definition, and knowledge of facts and concepts [20] (see Fig. 5). Conventional methods cannot reinforce creative and critical thinking among pupils and they are slow in transferring learning content since pupils do not participate effectively [20, 23]. This is also another challenge which demands deployment of interactive content that can include various teaching and learning methods especially practical, demonstrations, and simulations which provides active learning.

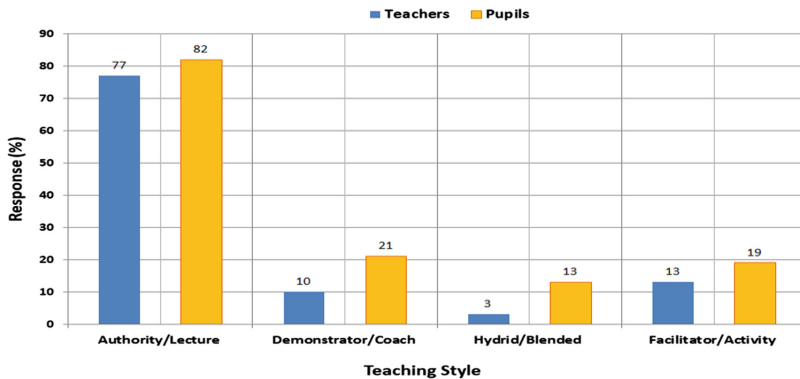


Fig. 5. Teachers and pupils responses (%) for identifying teaching styles used

4.2 Pitfalls

There are challenges that can hinder the deployment of interactive content for enhancing life skills education for children include inadequate ICT computing devices, large number of pupils in classrooms, short period time of learning, and lack of ICT knowledge among the teachers.

Inadequate ICT Computing Devices at Schools: Inadequate of ICT computing devices at school is the major obstacle for operationalization of the interactive content. In this survey it was found that there were limited number of ICT devices in the schools such as computers, tablets, smartphones and laptops. However, Mzinga private school had computer laboratory with 12 desktop computers and two public schools which each of them had 144 tablets. The rest had one computer per school. The ICT devices available at schools and owned by pupils' parents should be considered to address this challenge.

Large Number of Pupils in Classrooms: The head teachers from every primary school were also asked to provide student enrolment data especially the number of streams per class. After data analysis, it was found that most of classes had 2 to 4 streams per class and each stream has pupils from 70 to 150 pupils. This range is very large compared to the standard which is 45 pupils [12, 30]. It is difficult for a teacher to teach, assess and supervise regularly many pupils in a session of 40 min according to curriculum of 2005 and 2016 [12, 30]. This is another challenge that can be addressed by considering the ICT devices available at schools and owned by pupils' parents and the interactive content should be self-learning enabled.

Lack of ICT Trained Teachers: The primary schools teachers who teach life skills were interviewed to see whether they got any ICT in-service training to upgrade their ICT skills. It was found that most teachers had never received any ICT training even if the curriculum of 2005 introduced TEHAMA/ICT subject [12, 30]. Therefore, the primary school teachers lack ICT knowledge which is needed in order to support the operationalization of interactive content at schools. To address this challenge, the ICT devices available at schools and owned by pupils' parents should be used and the interactive content should be self-learning enabled.

5 Discussion

The aim of this study was to identify challenges faced implementation of life skills education for primary school children in Tanzania and establish basic requirements as possibilities and pitfalls for deploying interactive multimedia content. Life skills education was introduced to prevent a wide range of life skills challenges faced the primary school children such as smoking, alcoholism, use of drugs, sex abuse, school dropout and teenage pregnancies [31]. The current alarming cases of life skills in Tanzania including among 3,797 pupils of primary schools 95.8% used drugs, 91.2% used alcohol, 76.5% had sexual intercourse before age of 14 years and 27.1% missed classes for one or more days in 30 days [29] proved that the implementation of life skills education was not effective. The cost effective means of enhancing provision of life skills education is through deploying interactive content [26]. Lack of studies to provide basic information as possibilities and pitfalls for deploying interactive multimedia content created a need of conducting this study and many possibilities and pitfalls were found after surveying the 10 primary schools.

It was found that most of schools lacked professional teachers who can teach the children life skills especially in public schools where deficit ranges from 4 to 12 teachers per school. The increase of enrolment of pupils after free education declaration in 2015 caused increase of 2 to 4 streams per class, each and every stream ranges from 70 to 150 pupils. These results is exactly equal to that at national level which is 1:77 Pupil Classroom Ratio (PCR) and at Dar es salaam region is 1:102 while the standard is 1:45 [3]. It is difficult to teach large classes, assess and supervise every individual pupil. It is possible for individual pupil to learn frequently using self-learning enabled interactive content installed in both schools' computers and smartphones and parents' smartphones to complement the lack of professional teacher at low cost [26].

It was also very interesting to find out that the challenging life skills topics selected by pupils were the same with those selected by teachers after they were compared (see Fig. 4). This results of comparison proved that the selected life skills topics are real challenging and they are the same topics in which the pupils poorly performed in the national examination for standard four in 2015 [17]. These topics demand deployment of interactive content which can provide practical knowledge rather than theoretical teaching and learning [26].

Lack of teaching and learning materials including textbooks, practical and demonstration equipment, and interactive content is another finding especially in public schools. Some of classes did not have even single textbook for pupils, while in other schools there were 5 to 10 pupils shared one textbook. In Dar es salaam region the Pupil Textbook Ratio (PBR) ranges from 1:0 to 307:1 while the standard is 1:1 [21]. This is the same as what was reported by other studies [4, 6, 11, 19, 33]. This challenge demands deployment of interactive content which can serve as textbooks at low cost [26].

Another interesting finding was the teaching and learning methods mentioned by teachers were the same with those mentioned by pupils and both of them highlighted the lecturing style was applied at the rate of 77% and 82% respectively (see Fig. 5) The lecturing style does not provide active learning contrary to curriculum setting [12, 30] and life skills teaching requirement which needs participatory methods [1]. Having

similar results after comparing the two different groups proved the existence of such challenge which is also supported by the studies [4, 6, 11, 19, 33]. This is a challenge which demands deployment of interactive content that can provide active learning [26].

It was also found that the ICT resources including computer, laptops, tablets, and smartphones at primary schools were inadequate especially in public schools where only two out of ten schools had 144 smartphones. At the national level the pupil computer ratio is 1056 pupils per one computer (1056:1) which is a major pitfall that limits the deployment of interactive content [3]. On the other hand, 96% of pupils had access of computer, laptops, tablets, and smartphones from their parents and according [28] there are 19,006,223 (82.6%) mobile smartphones access Internet. Other pitfalls are large number of pupils and lack of ICT trained teachers. To address these challenges, both ICT devices available at schools and owned by pupils' parents should be used and the interactive content should be self-learning enabled.

Other important ICT resources which were found are availability of Internet connection, and electricity in which all primary schools had mobile wireless Internet while two of them had fixed wireless internet and according to [28] the increase of Internet penetration has reached 45% (22,995,109) of national population. This is very important resource for operational of interactive content. Moreover, all ten primary schools had electricity and according to [3], 85% of primary schools have electricity. Therefore, this is another important factor to power ICT computing devices for running the interactive content.

6 Conclusion

This study tried to find out the feasibility of deploying interactive multimedia content for improving quality of provision of life skills education at primary school level in Tanzania. The findings such as availability of Internet, availability of electricity, pupils's access of ICT computing devices owned by their parents, availability of learning challenges that needs interactive multimedia content including lack of professional teachers, lack of teaching and learning materials and poor teaching methods have proved that it is possible to deploy interactive multimedia content. The challenges such as limited number of ICT computing devices at primary schools is addressed by the presence of ICT mobile devices owned by their parents. While the large number of pupils in classrooms and lack of ICT trained teachers can be addressed by deploying self-learning enabled interactive content. Therefore, this study recommends that in order to enhance life skills education and bring positive impact in primary schools in Tanzania, self-learning enabled interactive multimedia content should be designed and deployed in ICT computing devices owned by both primary schools and pupils' parents. Further study is needed on how the self-learning enabled interactive multimedia content will be designed and tested to see its effectiveness.

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Community-Centered, Project-Based ICT4D Education in the Field

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Abstract. The growing demand for user-centered, sustainable, collaborative and ecosystem-aware ICT4D programs and projects brings requirements for education of a new generation ICT4D professionals. This paper presents a post-graduate field-based course in ICT4D that teaches how to co-create and deploy community-centered ICT services. The course has been jointly organized and deployed by Vrije Universiteit (VU) Amsterdam and Universiti Malaysia Sarawak (UNIMAS) for a mixed group of computer science, information science and artificial intelligence students from VU and UNIMAS. The course design, experiences, outcomes and evaluation are presented in this paper.

Keywords: ICT4D education · Community service education · Information system development life cycle · Context · User-centered approach · Ecosystem awareness · Sustainability

1 The Need for Skilled, Hands-on ICT4D Professionals

“Design with the User”, “Collaborate”, “Understand the Existing Eco-system”, and “Build for Sustainability” are the new imperatives, set by the international donor community for the ICT4D practitioners community. Formulated as the new “Principles for Digital Development” [20] these requirements mark a trend towards more agile, user-centered, and innovation-oriented approaches in ICT4D projects and practice (e.g. [5, 10, 19]). The trend results from the concerns about high failure rates in donor-funded ICT4D projects, especially where projects target the poorest populations and regions [11].

However, bringing agile, collaborative, user-centered approaches into practice in poor low-resource development environments is a challenging endeavor. Low resource, development regions may have a lack of (physical, digital, energy) infrastructures.

There may be high illiteracy rates, low purchasing power or a variety of other complex social, economic, cultural and environmental factors [1, 12]. In recent years, new, user-centered approaches to ICT4D and Digital Development have emerged that use state-of-the-art concepts, theories and methods from e.g. agile Information Systems (IS) engineering [2, 6, 8, 13]. These approaches can guide operational, socio-technical ICT4D developments in challenging and demanding development contexts. However, bringing with these frameworks into practice requires field experience and social, technical and organizational skills. Where do ICT4D professionals obtain these skills and knowledge?

Currently, ICT4D education at graduate or post-graduate levels is oriented at social, economic, development or policy studies (see e.g. a recent textbook on ICT4D [15]). However, these ICT4D curricula do not train ICT4D professionals for field-based information systems/requirements engineering under complex, real world conditions. Technical studies such as computer science, artificial intelligence and information science have traditionally focused on technology development for the “wealthy”, connected world, and have not yet included ICT4D in their curricula. Recent trends in ICT4D policy and technological innovation are demanding a new type of ICT4D education, that caters for social, technical, practical and organizational knowledge and delivers professionals with hands-on skills and a reflective attitude.

In this paper we present design and implementation of a new type of community-centered, project- and field-based ICT4D education. The paper is structured as follows: in Sect. 2 we discuss the theoretical framework to be used for course design. In Sect. 3 we outline the course objectives, structure and assessment criteria; in Sect. 4 we illustrate this with a case of a field-based post-graduate ICT4D course which was deployed in June 2018 at the Universiti Malaysia Sarawak; in Sect. 5 we discuss the evaluation and the outcomes and give recommendations and perspectives for further adjustments and deployments.

2 Theoretical Frameworks for Practical and Societal ICT4D Education

In terms of course design, an appropriate theoretical framework for designing and rolling out community-oriented, field-based ICT4D education is (Community) Service Learning (CSL) [3]. CSL is designed to connect theory and practice and meet challenging social problems while educating students for a life as responsible citizens [3, 7]. CSL uses an experimental learning methodology that integrates meaningful community service with instruction and reflection to enrich the learning experience, learn civic responsibility, encourage civic engagement and strengthen communities for the common good [16]. Moreover, CSL is useful for field-based operational ICT4D, as it combines two different (but related) goals: (i) an educational goal based on learning-by-doing and reflection (ii) a societal goal to serve the community, by co-creating meaningful solution.

For the course content, we used ICT4D 3.0 as theoretical framework. This framework matches the Community Service Learning philosophy, fits a learning-by-doing approach and offers a methodology how to “do” socio-technical development in

the field [2]. The framework is displayed in Fig. 1 as an intention-strategy map [17]. It consists of five components that cover the complete information system (IS) engineering life-cycle: (i) context analysis, (ii) needs assessment, (iii) use case and requirements analysis, (iv) sustainability assessment, (v) engineering, deploying, evaluating. ICT4D 3.0 differs from policy-oriented frameworks, as for example ICT4D 2.0 (e.g. [14]), in its practical, hands-on, grassroots approach.

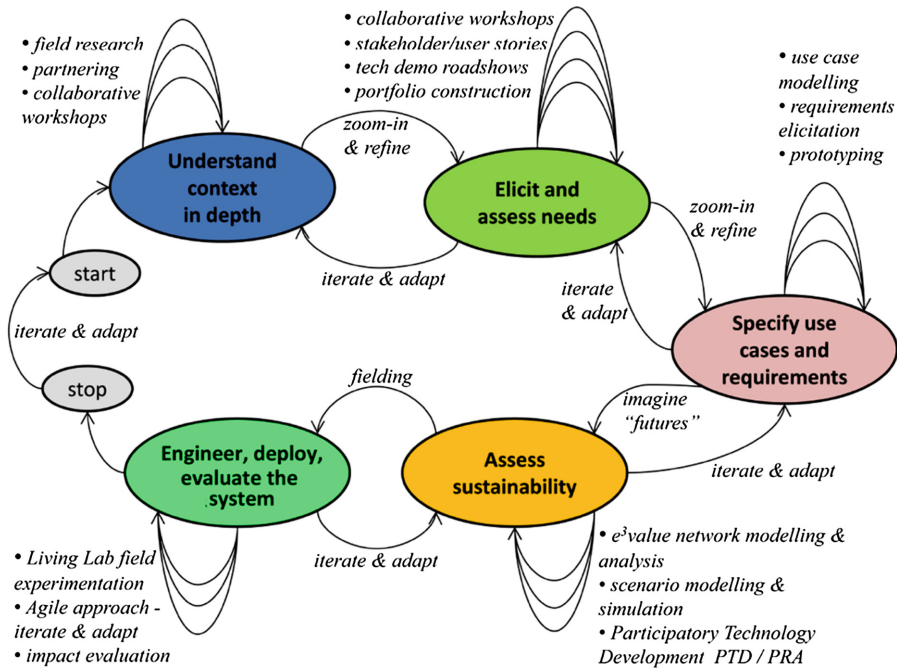


Fig. 1. ICT4D 3.0 Framework how to build ICT services in low resource environments using a collaborative, adaptive, iterative approach [2].

3 Designing a Post-Graduate Course: ICT4D in the Field

Based on the theoretical frameworks (i) CSL for education, and (ii) ICT4D 3.0 for course content, we designed a post-graduate course in ICT4D. This consisted of setting course objectives, defining content, methodology, admission criteria and assessment method. The course design is evaluated by its implementation.

3.1 Course Objectives

Based on the above considerations of Sect. 1, we formulated the course objectives as:

- to make the next generation of information and computing scientists aware of the potential role of ICTs for the developing and emerging world, with a strong

- appreciation for the highly diverse and complex contexts (in contrast to a one-size-fits-all-approach), social-cultural factors and human needs that must be addressed;
- to equip students with relevant field research and development methods and skills to develop technologies in a (poor) rural/suburban community/developing region;
 - to acquire and reflect on the experience of carrying out a full life-cycle of a real-world software development project in the field, learning to be able to deal with unfamiliar and complex contexts, and engage with communities with their specific contextual constraints, needs and goals.

3.2 Course Structure

Based on the time available (a 6 ECTS course equals one month of full time education), the course takes 4 weeks for field research and designing, modeling, engineering, testing and deploying an information system, that must serve local community's needs.

The course comprises lectures, field visits to (rural or sub-urban) communities where the envisaged users live and work. Interviews and focus group discussions, user test and feedback sessions are part of the course assignment(s). The course starts with lectures in which important topics are reviewed: (i) use case, context and requirements elicitation and analysis; (ii) conceptual modelling of information systems; (iii) selected technical aspects of ICT4D projects; (iv) value modelling and economic sustainability analysis; (v) guidelines and protocols for interviewing and focus group discussions with local communities. Based on meetings with user groups and context analysis in the field, students form teams (of 4–6 persons). Each team selects a relevant use case to elaborate, build a prototype, test with the users, evaluate, improve and deploy. Sustainability analysis and value modeling are part of the assignment. Students work in self-organizing teams, dividing tasks and working closely together. Users must be involved to make sure their needs and (business) requirements are met. The course involves reflection and open dialogue. The constraints and opportunities of the real world context are taken into consideration. The students interact and receive daily feedback from the lecturers. At the end of the course the results of the project are presented by the student teams to the users, local experts and other stakeholders, during an official symposium.

3.3 Assessment

Assessment of the student work is based on four deliverables: (i) a personal (individual) reflection about the course and the student's role in the process, and what he/she learned from it. Each team delivers a: (ii) a working information system/app, tested and validated by key users, documented and available as Open Source (group work); (iii) a group presentation/pitch during the end conference; (iv) a technical report containing the following items:

- Context description;
- High level system design and user scenario;
- A justification of the project (short);

- Interviews typed out (not necessarily literal), containing relevant info (e.g. all user and business requirements, key points, important details etc.);
- A use case and analysis report according to the structured narrative format including a stakeholder analysis, a system architecture, information concepts (activity diagram, class diagram, user interaction diagram, deployment diagram), summary of requirements in MoSCoW [4] method terms; fidelity.
- A sustainable value model/multiple scenarios using the e^3 value method [9] for quantitative and qualitative assessment of sustainability;
- Report of user tests (preferably two cycles);
- A reflection of the (iterative) process, and user interactions with the group (how were the interviews);
- A discussion section on the outcomes and what aspects of the project need further research.

To be admitted to this course students must dispose of technical (programming, modeling, requirements engineering) skills and social/communication skills. Moreover, a specific attitude is expected as well: openness to other cultures, willingness to collaborate in an interdisciplinary team, a hands-on mentality, a social orientation and a reflective nature.

4 The Case of “ICT4D in the Field” in Sarawak, Malaysia

The post-graduate course “ICT4D in the Field” was designed, implemented and evaluated as a joint educational program by Vrije Universiteit Amsterdam (VU) and Universiti Malaysia Sarawak (UNIMAS). The initiative was built on previous experiences. VU was already offering a (6 ECTS) classroom-based ICT4D course in the master tracks of computer science, information science and artificial intelligence, without field work, and running an interdisciplinary research program on ICT4D since 2009. UNIMAS was engaged since 1999 in ICT4D research projects to connect remote communities in Sarawak: eBario and Long Lamai [18]. Both universities were committed to implementation of Community Service Learning in their educational curricula.

In June 2018 eleven master students computer science, information science and artificial intelligence from VU joined a group of ten computer science students from UNIMAS in Sarawak, Malaysia for a one month ICT4D project-based field course, by a joint VU/UNIMAS lecturers team. The course was hosted at the UNIMAS campus. The students followed classes, did group assignments and participated in community visits. The course was organized according to the framework ICT4D 3.0, starting with a general context analysis. This led to the definition of three student projects in which each project proceeded with the next steps of the framework (see Fig. 1).

4.1 Context Analysis

The project started with a joint context analysis by all students and lecturers, to become familiar with local environment and eco-systems. The visited a banana plantation and a

small banana factory, talked to inhabitants of a sub-urban community or *kampung* PJ and visited a community primary school. Focus groups discussions and interviews with users led to a list of project ideas. Three mini-ICT4D student projects were selected, based on (i) relevance for the community and (ii) technical feasibility for an ICT4D student project. The projects, dubbed BannaTree, Appong and EDUCOMX are briefly described in the following paragraphs. The full reports are available at <https://w4ra.org/student-papers/>.

4.2 BannaTree Student Project

During the context analysis field visits the students learned that the government of Sarawak wants to increase income and standards of living of banana contract farmers by providing support to banana chips factory and improving work conditions of the farmers.

Elicitation of Needs: According to the interviews with farmers and other experts, banana crop yields are poorly planned. The farmers plant and harvest bananas called *pisang sekaki*. The bananas are sold to small local factories where they are processed as chips and packed for (international) export. Lack of information on timing and amount of expected crop yields leads to planning problems for the factory, waste of bananas for the farmers and supply inconsistencies for the banana chips export. To improve coordination and logistics between farmers and chips factory, the students proposed an information system with a mobile users interface: the BannaTree application.

Analysis of Use Cases and Requirements: The information system and information processes were modeled by the students according to the users and business requirements they collected. To understand the complete use case and elicit the exact requirements for the system they modeled the complete work process and information flows. Many discussions were held with key experts and users to check the validity of the requirements. Much attention was given by the students to stakeholder analysis, and to understanding their operational goals. The proposed model was discussed with the banana farmers, representatives of the banana factory, fertilizer experts, the agricultural department and a key expert from UNIMAS. The discussions led various times to changing requirements and two major redesigns of the system in one week.

Engineering, Deploying, Evaluating: The first working prototype of the BannaTree application was delivered in the third week of the course to two local experts. See <https://github.com/aoelen/banna/blob/master/README.md> for source codes and documentation.

Sustainability Analysis and Reflection: The students became aware of local ecosystems and the complexity of (sometimes opposite) interests from various stakeholders on this use case. The requirements changed several times, as users changed their ideas. This made time to finalize and fine-tune the application a stress-full activity for the days before deadline. The team learned about the complexity of the use case and discussed their own roles as reflective practitioners. The project was ready in time, but the final

delivery test to the banana farmers was unfortunately cancelled due to time constraints. Long-term impact and sustainability could not be evaluated in a real world setting due to the time constraint. An important lesson learned here is that more time than the available 4 weeks is needed for a project with a high level of complexity. The learning experience for the students was positively evaluated.

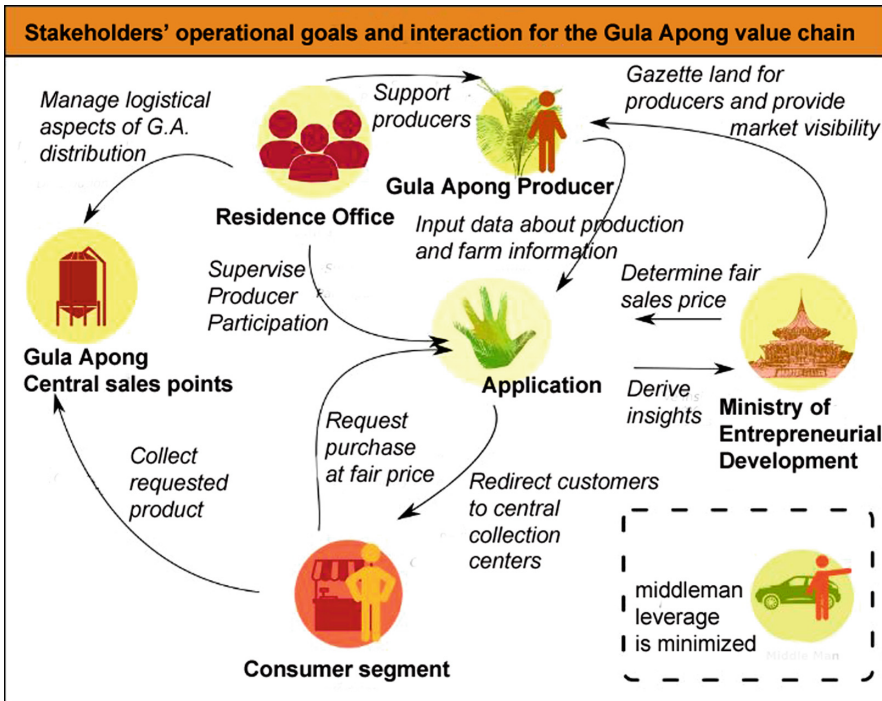


Fig. 2. Use case analysis for the Apong student project

4.3 The Apong Student Project

The second use case, dubbed Apong, consisted of a need of (independent smallholder) sugar palm farmers, to increase the sales of their product: Gula Apong.

Elicitation of Needs: From interviews with the *kampung* inhabitants, in the first course week, the students learned about Gula Apong, a traditional Malaysian sweet/sugar, produced from the Nipa palm by family farms in the mangrove forests along the estuaries of the Sarawak river. The Nipa juice is collected manually and produced (boiled) locally, in the forest. This work is challenging: there are ants and snakes in the forest. When the tide is high, the mangroves are a dangerous place for the farmers, risking crocodile attacks. The government wants to support the small producers, because Gula Apong producers protects the mangrove forests, which are

environmentally protected areas of important biodiversity. Moreover, there is a growing consumer market for Gula Apong which needs further exploitation.

Analysis of Use Cases and Requirements: The Appong use case and project was tackled by a mixed group of students from VU and UNIMAS (Fig. 2). The group held interviews at the Ministry of Entrepreneurial Development (MIED) in Sarawak, and visited Gula Apong farmers in the forest. They saw how the farmers collected Nipa juice and observed the production and packaging of Gula Apong at home. They visited the farmers' homes, to get to know the local livelihoods. A mobile app named Appong was proposed. It will serve three types of users: (i) potential customers to help increase sales; (ii) producers, to stimulate cooperation between producers; (iii) the local government. The government can support the farmers, in return for their production data, by providing them rights to harvest in the public mangrove forests.

Engineering, Deploying, Evaluating: After requirements elicitation a prototype was built. It allows Gula Apong producers to enter information about offerings and sales locations. A web interface was designed for the government, to monitor the data on overall sales activities of Gula Apong in the region. The prototype was presented by the students for evaluation at the Ministry of Industrial and Entrepreneurial Development in Sarawak.

Sustainability Analysis and Reflection: The economic feasibility of the Appong application in an ecosystem is assessed using the e^3 value methodology [9]. The e^3 value method maps the actors (or market segments) in a value network, the value they exchange with each other, and calculates for each actor the income this generates. This model can evaluate quantitatively the feasibility of a complete value network.

4.4 The EDUCOMX Student Project

During interviews with parents, school teachers and children in Kampung PJ, the ICT4D students were told that, although English is widely spoken in urban areas of Malaysia, in poor rural areas English education at primary schools lags behind the urban (private) schools. Since school subjects such as science and math are taught in English, poor knowledge of English limits education of rural children.

Elicitation of Needs: Learning English is of key importance for children in the *kampung*, according to parents and school teachers who were interviewed. Since educational resources at public schools are not sufficient, alternative learning methods are sought. The students propose a mobile Smartphone app, (as most of the families here in the *kampung* own a Smartphone, despite a lack of Internet connectivity). The app, built by a mixed group of VU and UNIMAS students is dubbed EDUCOMX. The app can be run on Smartphone or in any browser. UNIMAS has deployed a number of XO laptops (see Fig. 3) for user tests of this application in the *kampung*.



Fig. 3. Testing the EDUCOMX app with children in the kampong. EDUCOMX is platform independent. Here it is deployed on XO laptop from OLPC.

Use Case and Requirements Analysis: The students decide to build EDUCOMX as a pilot mobile app to teach children English. They try to make the app engaging, while staying in the scope of the English learning methods used at school. For the use case and requirements analysis, the students meet a group of children in the *kampung*, and ask them to draw their favorite superheroes and write down their hobbies and aspirations, as inspiration for the artwork that will be used for the reading material of the app. This process has great significance in context analysis – as taught by the ICT4D 3.0 framework – user interviews and stories are often deciding factors in the success of an application deployed in the field.

Engineering, Deploying and Evaluating: For EDUCOMX, gamification methods are used, as a game will unconsciously help improve your English. The design looks playful and includes animations, sounds, fun colors and images. A scoring system is implemented. Users (children) can continue through chapters that look and feel like game levels, which they have to complete in order continue to the next level. Status bars show user progress and scores. User testing with children was a central activity of this project. After one week of building and lab testing, the first user tests for the prototype were carried out in Kampung PJ with a group of 21 children in the age range of 10–12. The children were able to freely play with the application, in the style of a living lab see Fig. 3. The children liked the concept of the comic books and started to read the sentences aloud so it was good to hear their reading skills. The questions at the end were a bit difficult for them. We noticed that there were too many pages before the quiz started so after some pages they were having a hard time concentrating on reading. The children seemed to enjoy unlocking new chapters and were motivated to get all questions correct. They started to share answers with other children to help them unlock new chapters. They liked the sound effects of answering the questions.

We noticed that the return button and the logout button were at a wrong place on the screen and should be moved.

Sustainability and Reflection: There are two main contextual issues here, that influence design decisions: (i) connectivity and (ii) specificity. First, in rural areas there is no (consistent) internet access, making online content not a design option. Second, the now existing digital learning platforms are not tailored to the local culture or specific wishes of the end users (the children). The user tests were the central activity of this project and provided much new insights. The students learned how to make design decisions based on context and user requirements. The sustainability analysis revealed the need for further exploration of the use case. This will be followed up by UNIMAS.

4.5 Project Results

The three student groups delivered the reports and software in time and presented the projects at a community ceremony at Kampung PJ and at a final ICT4D conference at UNIMAS. Personal reflection reports were submitted. All students passed the assessment. A short video clip on the making-of the student projects can be seen at <https://w4ra.org/2018/06/28/a-living-lab-in-kampung-pinggan-jaya-sarawak-short-clip/>.

5 Evaluation and Conclusion

In line with CSL principles, evaluation of the ICT4D course is done along two axes: (i) did the course achieve its educational goals? (ii) are the student projects carried out in a community-centered way and do the results meet local needs?

To evaluate if (i) the educational goals were met, we evaluate if this course makes the next generation of information and computing scientists aware of the potential role of ICTs for the developing and emerging world, with a strong appreciation for the highly diverse and complex contexts, social-cultural factors and human needs. Based on the student assessments, the reflection reports and the group deliverables, the course “ICT4D in the Field” has achieved its educational and societal goals. The students have collaborated sufficiently with the users, learned from the context, and worked iteratively, testing and improving the technological solution according to users’ requirements.

To evaluate if (ii) the project is community-oriented and context-sensitive, we assess the student projects and the number of interactions and design decisions, based on local requirements. Concerning effectiveness and results, it is clear, in terms of serving the community, that one month is far too short to do a full context analysis, engage with the users, build a long term relationship and deploy and test a working information system. In terms of ICT4D 3.0, this was only a first cycle deployment including a number of sub-iterations. It is important to foster long-term partnerships and work with local partners. The long relationship between UNIMAS and the local communities is key in the successful collaboration. The collaboration between VU and UNIMAS is characterized by commitment and trust.

A great challenge for long-term sustainability of the course is funding. Organization and planning of a course between two continents is an interesting experience, which takes efforts and time. For the lecturers the lecturing effort is bigger than in regular

courses. In terms of community service orientation, the project is a first step towards deployment of sustainable ICT4D solutions. Continuation of the project will be needed to build up long lasting relationships with the communities and achieve long-term sustainability. The majority of student reflection reports all show that the whole experience of designing, building, deploying community-oriented ICTs in a poor rural community has been life-changing.

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Building Sustainable Collaborations and Academic Networks in Low Income Countries: Case of Master Programmes

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Abstract. During development of health information systems, local specialists were needed to take the local lead and train others. Through external funding, nine master programmes in health information systems were set up in developing countries in collaborations between a local university and the University of Oslo. While development efforts tend to fade out after initial project funds have been spent, keeping the programmes running was crucial for the upkeep also of the health information systems.

Their planning, running with external funds and continuation has been analysed by means of a Collaborative Governance Model, which was made more specific through literature on higher education. The specifics concerned initial planning, where bringing in relevant stakeholders, include local knowledge, network globally and have an interdisciplinary approach to learning were confirmed. During the implementation with project funding, small wins kept the collaboration going, and face-to-face dialogues for common problem definition helped solving emerging issues. The outcome has been that all nine programmes continue running, and local, regional and international collaboration help keeping the academics flourishing. More than 500 master students have graduated.

Keywords: Higher education · Collaboration · Health informatics

1 Introduction

Collaborative postgraduate programmes have become popular over the years, enhancing both higher education internationalization and north-south collaborations. Some of the collaborative have succeeded and culminated into fully-fledged programmes, whilst others have failed [1]. This paper presents empirical findings on how sustainability was achieved with collaborative postgraduate programmes between the north (Norway) and the south universities in six developing countries (Ethiopia, Malawi, Mozambique, Tanzania, South Africa and Sri Lanka) where programmes were implemented in the fields of Health Information Systems/Informatics and Public Health.

Health Information Systems are key in developing countries context as they support local management of health care delivery and information flows in health facilities. To ensure that proper support is given, capacity building through research and Masters Programmes is required. The Health Information System Programme (HISP) at the University of Oslo has been engaged in supporting the health information systems in developing countries for two decades in order to strengthen their health systems and their capacity to govern their Health Information Systems in a sustainable way to improve the management and delivery of health services (HISP, 2014). One necessary component has been educating health informatics specialists, which is a scarce resource [2] in the developing countries. In addition to in-service training, research education was deemed necessary in order to groom specialists who could take on central positions in the development and train others.

The traditional view of universities is buildings, expensive labs, courses and lecturers. These were the foundation for attracting students who paid their tuition and generating the income. In the developing countries where the Health Informatics has been implemented, the traditional view applies and they had no Masters Programme in informatics. University of Oslo has contributed in establishing 9 master programmes in health information systems in low and middle income countries (see Fig. 1).

Master Programmes

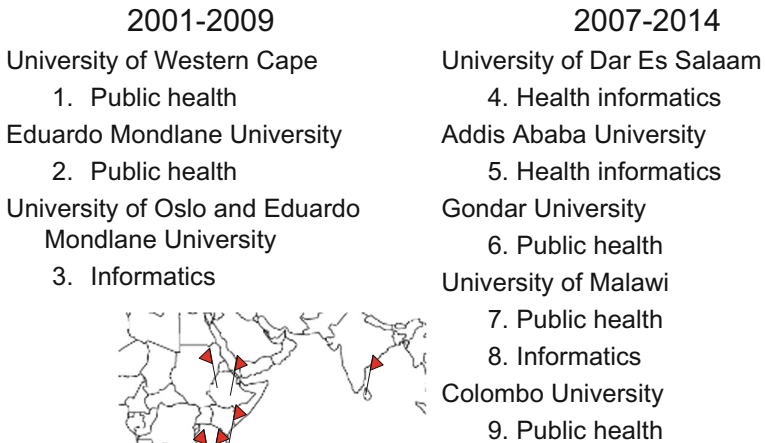


Fig. 1. Master programmes

The Health Informatics Master’s Program was prompted by the Call for Master programmes by the Norwegian Centre for International Cooperation in Education [3] in the year 2000. Demands for information across the health sector within countries

influenced the choice of area to become health information systems. The Norwegian Centre for International Cooperation in Education funded the establishment of the program the first 5–8 years. In the first phase (2001–2009) establishments started in two countries – Mozambique and South Africa, with a total of three programs. In Mozambique, two Master’s programs were established one for Public Health, fully run by Eduardo Mondlane University and the other Informatics jointly run by Eduardo Mondlane University and University of Oslo. In South Africa, one program (Public Health) was introduced with the University of Western Cape. The core aim of these establishments was building capacity by building local competence to run the programmes. As such, these establishments did not go for the expensive computer lab.

In the second phase (2007–2014), four countries (Tanzania, Ethiopia, Malawi and Sri Lanka) with a total of six programmes. In Tanzania, one program in Health Informatics was established with University of Dar Es Salaam; in Ethiopia two programmes were established - Health Informatics Programme with Addis Ababa University and Public Health Programme with Gondar University. In Malawi, two programmes – Public Health and Health Informatics were introduced, both with university of Malawi. In Sri Lanka, one programme in Public Health was introduced with Colombo University.

Research has revealed that north–south postgraduate programme collaborations do not always take a smooth ride. Challenges encountered include: lack of internationally recognized accreditation system in the south countries, inconsistent administration and management, poor communication due difference in reporting structure, difference in legal systems, lack of funds, difficult to recruitments students and differences in official language [4].

While running projects is normally feasible due to accompanying funding, activities have a tendency of dying out after initial funding has ceased, and this pilotitis has affected ICT in health in particular [5]. The question this paper will address is how the host university can continue running the master programmes after support from University of Oslo withdraws.

2 Literature Review

This section draws experiences from other collaborations, explaining why different partners venture into collaborations. Further, it reviews recommendations from existing frameworks which highlight important issues that have to be taken into account in the collaboration development phase.

The collaboration in this research is of the ‘interorganizational problem domain’ [6] type, involving Master Programme collaboration across different institutions and countries. The question - how is the Master Programme project collaborated and sustained in the participating institutions/countries is asked. The question focuses on collaboration and sustainability within institutions as entities of interest. This collaboration has taken place between public institutions, hence a theory addressing public-public collaboration would be preferred.

The closest we could find was a theory based on a review of 137 public-private collaborations [7], see Fig. 2. This theory identifies critical variables and factors that

influence successful collaboration through *collaborative governance*. The variables include prior history of conflict or cooperation, incentives for stakeholders to participate, power and resources imbalances, leadership, and institutional design. The factors include face-to-face dialogue, trust building, and the development of commitment and shared understanding (ibid.).

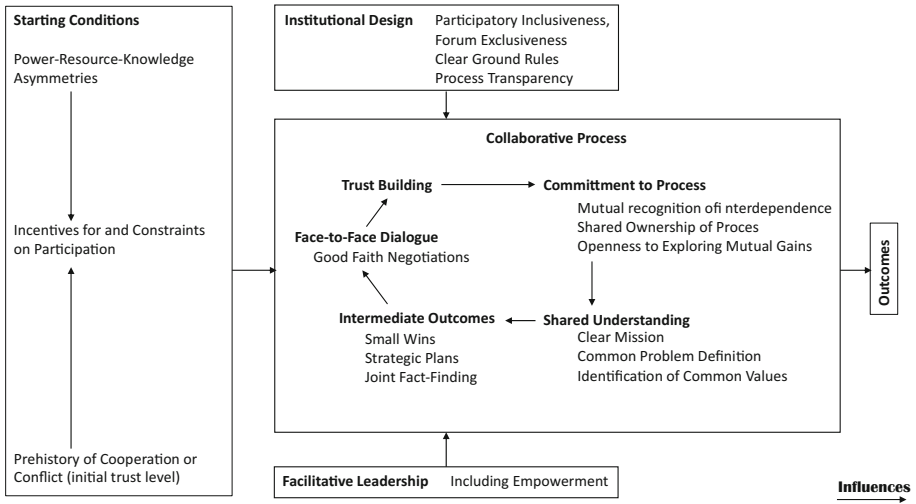


Fig. 2. Collaborative governance model [7]

Collaborative governance “brings multiple stakeholders together in common forums with public agencies to engage in consensus-oriented decision making” [7]. Ansell and Gash [7] argue that trends toward collaboration also arise from the growth of knowledge and institutional capacity; with demand for collaboration increasing as knowledge becomes increasingly specialized and distributed. The term “stakeholder” is used to refer to the participation of citizens as individuals, organized groups, and to both public agencies and non-state stakeholders (ibid.). A virtuous cycle of collaboration between stakeholders develops when the focus of the collaboration is on “small wins” that deepen trust, commitment, and shared understanding.

There is also research more closely related to our cases, including transnational knowledge sharing in the public sector. In a literature review, [8] point to various contextual distances influencing the collaboration; cultural, political, intentional, organizational, relational, knowledge, resources, physical and technical, and that much of the work in transnational collaboration consists of bridging or shrinking these distances. Ansell and Gash [7] includes knowledge and resources asymmetries in their theory, hence these distances will be investigated in our cases.

Concerning intentional distances, the European Consortium for Accreditation [9] has identified the main reasons for higher education institutions to develop joint programmes; indicated in Table 1. These fall under the Incentives category of [7].

Table 1. Reasons for joint programmes in higher education.

Institutional	Programme	Academics	Students
<ul style="list-style-type: none"> • raise the international visibility; • increase global student recruitment; • raise institutional revenue; • deepen and institutionalise cooperation; • build networks of excellence. 	<ul style="list-style-type: none"> • internationalised curriculum; • strengthening partnerships with other regions; • improve the quality of the curriculum (and of research); • increase cross-cultural competencies; • improve graduate employability; • international visibility and prestige; • strengthens funding from other sources; • access to expertise of a partner institution and its research networks. 	<ul style="list-style-type: none"> • opportunities to learn about other contexts and teaching and learning methods; • student diversity in the classroom; • networks for future collaboration; • research contacts; • professional development opportunities; • inter-cultural competences. 	<ul style="list-style-type: none"> • international jointly developed curriculum; • automatic recognition of the period spent abroad; • joint programme has expertise of more than one institution • ‘two degrees for the price of one; • no time loss or risk that credits are not accepted.

In addition to the reasons cited in Table 1 above, there are other benefits that calls for collaboration. A survey of a Swiss-funded research programme indicate that north-south collaborations has helped more than 90% of alumni to stay in global south after attaining their PhD [10]. This is a clear and very important benefit that help to curb brain-drain from the south. Further, the survey established that the north-south post-graduate programmes give opportunities to students from low socioeconomic backgrounds. People from these backgrounds are more likely to understand development challenges on the ground, and conduct research that benefits and incorporates perspective of the poor (ibid.). These specific reasons will be included in our analysis.

According to the European Consortium for Accreditation, institutional commitment is necessary for developing educational collaborations [9, 11] and ensures institutional support. In addition to the incentives mentioned above, the collaboration must be in line with participating institution’s strategy and internationalisation policy. High-level institutional strategies are not identified as important by [7], who rather point to the need for collaborative strategies for governing the collaboration.

There is also need to jointly define the need for the programme, the learning outcomes and length of the programme and jointly develop the curricula [9]. This resonates with the imperative from [7] that participation must be sought in the design of the rules for collaboration.

Braa, Monteiro [12] addressed sustainability of action research within the Health Information Systems Programme, in which the master programmes constitute one type

of actions. The idea is that the nodes in the network learn from each other. This would require including global partners in the Institutional Design. Further, the educational component is supporting the national health information systems through educating specialists and having master theses contribute to its development, thus the education is made relevant through working with actual systems in the public sector. The relevance requires participation of the national Ministry of Health, thus they need to participate as a stakeholder in the Institutional Design.

In his study of higher education in Zambia, Kantini [13] found that if universities were to support development in the country, they should network globally, have local community engagement, include local knowledge, have an interdisciplinary approach to learning, and use inventive technological applications. Networking reflects the global partners also from [12], and local community engagement may require including local partners in health and IT, including the Ministry of Health. Interdisciplinary approach to learning should be in the Ground Rules of Institutional Design, and inventive technological applications are part of the Resources in the Starting Conditions of [7].

Figure 3 illustrates the Collaborative Governance Model with additions from the other relevant literature.

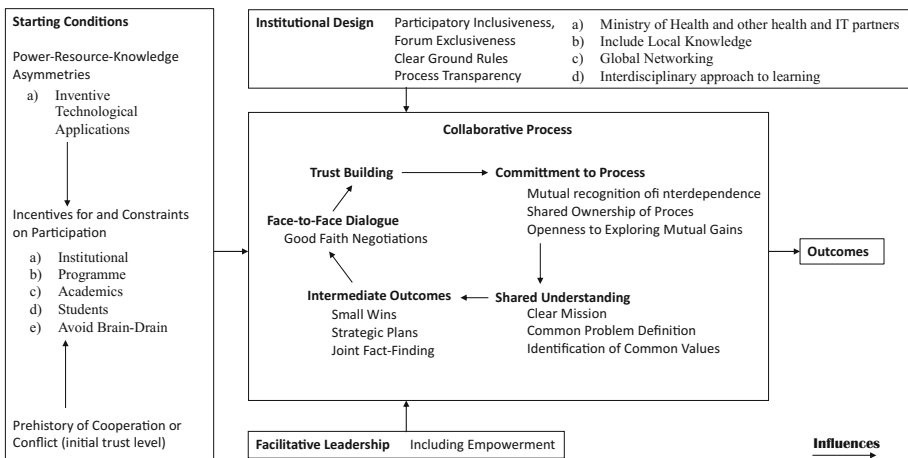


Fig. 3. Adapted collaborative governance model. Additions in Serif font.

3 Methodology

The research applied a combination of approaches that include reflection/reflectivity, participant observation, document analysis, and consultative interviews with experts in some of the universities participating in the collaboration. The focus countries for primary data collection were Malawi, Norway and Tanzania, whereas secondary data was sort from the other four countries where the Masters programmes were implemented (Ethiopia, Mozambique, South Africa and Sri Lanka). To assess sustainability of a project, there is need to have the project running for a number of years and observe

how it survives beyond project funding. This is exactly what happened in the case of the Masters Programme project, the study took place a few years after project closure. However, the study necessitated the use of data and information that existed when the project was active; hence the use of reflectivity and document analysis methods. As argued by Malterud [14], the angle of investigation chosen by a researcher and the methods judged most adequate may be affected by his/her background. In this study, the researchers have a background of being participants in the project. Since the researcher is the primary “instrument” of data collection and analysis, reflexivity is deemed essential [15]. Research has shown that through reflection, researchers become aware of what allows them to see [15].

The researchers in this study have been involved in the project from inception to implementation. Reflectivity is therefore used to review the processes of which they had been a participant, reflecting on their contributions to the process. Reflexivity in itself is an attitude of attending systematically to the context of knowledge construction, especially to the effect of the researcher, at every step of the research process.

A second method used in this study was observation, as a participant observer. This include observations made as an implementer of the project within an institution in the south, how buy-in (from the institution, potential students and faculty members) was achieved and as an initiator and sponsor from the north. These observations are analysed and discussed.

Further, document analysis was used, use of documentation from all the six countries was used to gain an understanding of the contexts in which the Masters Programmes were conceived, planned, implemented and nurtured. The documentation used was in the form of minutes, reports, presentations, photos and reflection from management meetings. To verify some of the facts from reflections and document analysis, consultative interviews with experts were held. This gave an opportunity to develop a complete understanding of the phenomena.

4 Implementation Approach

Each master programme development has gone through three phases. While the Collaborative Governance Model (theory terms Capitalized) conceives the world as conditions → Process → Outcomes, the initial phase of the master programmes contributed to establishing the conditions which the model categorises as Institutional design. Thus Phase 1, which was planning and application for funds, is a process of establishing the conditions for the Collaborative Process. During Phase 2, the implementation of the master programme with project funding constituted the Collaborative Process. The Outcome is defined as the running of the programmes after project closure, and in this case, the Outcome is a process as well, hence process phases 1, 2 and 3.

The prehistory of cooperation was good or neutral. UiO had more resources and knowledge than the partner universities, hence an asymmetry existed.

4.1 Phase 1. Planning and Application for Funds – Institutional Design

During Phase 1, plans were made for the academic contents and relevant partners were included in the planning, including the national Ministries of Health. A number of thesis supervisors were recruited from local organisations to reduce the burden of the faculty members and to broaden the scope of topics. Thus, point (a) under Institutional Design was fulfilled.

A strategy was devised to have lecturers from UiO and other partners teaching and supervising in the programmes together with local lecturers at the start of phase 2 and phasing out the international support when the local lecturers could take over. Some lecturers from the partner universities would at the same time be enrolled in PhD studies at UiO to build their capacity. These were important parts of the Ground Rules for the cooperation.

The initial funding covered salaries for partner university staff, scholarships for 4–8 students per cohort and running costs, including UiO staff travels. The partner universities needed 15–20 tuition fee paying students per cohort for sustainable funding in Phase 3. To achieve sufficient number of applicants, the partner universities had a deliberate strategy where they announced the programmes with tuition fees from the start of the project. The approach used was to enroll two sets of students: those funded by the project and self-sponsored students. There is no obvious category in the Adapted Collaborative Governance model which corresponds to this income strategy.

4.2 Phase 2. Implementation with Project Funding – the Collaborative Process

The number of applicants were around twice the number of scholarships, hence the universities received additional income from the start of Phase 2. This constituted the first Small Win during the implementation.

Getting courses up and running constituted the second Small Win. These two achievements strengthened the mutual commitment. The lecturers related the course contents to health services or other businesses like IT industry when appropriate. Also the student theses concerned local affairs.

The plan to co-teach courses such that local lecturers could take over also worked to a large extent. Some teaching was also carried out by lecturers from the region. In some instances, the locals were not up to it, and these course modules were thus abandoned in Phase 3.

While large parts of the curricula concerned health and informatics, also other subjects like organizational science, psychology, educational science and statistics were also included, hence the master programmes are interdisciplinary. Also lecturers from informatics, health and social sciences were brought into the teaching and supervision of master students.

Educating local lecturers to PhD was a necessary element in the plan. Many of the local lecturers became overburdened by both trying to teach in the master programme whilst doing their own PhD. Since teaching is a short horizon activity, this was often prioritized, and the PhD was consequently delayed. In this case, the Small Wins took prominence over the final outcome. Fortunately, UiO could extend their PhD

scholarship until they completed, hence each of the 17 lecturers who graduated as PhDs constitutes a Small Win for the Collaborative Process.

Many students had problems completing their master theses. Completion time extended in some cases up to four years and a significant portion of the students only end up with a diploma confirming their coursework. Through Face-to-Face Dialogues, the Common Problem Definition reached was that nearly all students enrolled in Malawi and Tanzania work full time, and have immediate and extended families take care of. Coursework force most of them into a structured setting such that they pass their exams. Finding time needed for concentrating on thesis writing has been difficult and impossible for some students.

One way of improving completion has been to organize one week thesis workshops where the students work intensively, discuss with each other and with supervisors. Additional retreats are organized for female students as they have more burden and less time to work at home. This has sparked some dormant students to resume their thesis work, hence some Small Wins.

4.3 Phase 3. Continuation Without External Funding – Outcome

The students and graduates spread information about the programmes through word of mouth, and this has secured the number of fee paying students after the initial funding ceased.

All programmes have three or more lecturers with PhDs, out of whom a total of 17 have graduated from University of Oslo, with two more in the pipeline. This has secured the academic basis of the programmes. UiO staff have contributed in supervising a few master students of mutual interest in Stage 3.

UiO and four of the programmes have recently received renewed funding from SIU [3], this time for student exchange. This has enabled master students who have completed their data collection to get 2–3 months of scholarship and bring them to UiO for writing up. Getting away from their obligations at home for concentrated work at UiO has worked successfully. Other outcomes are listed below.

Internal Development Team Strengthening. Master students and graduates have been offered technical positions in the universities, carrying out development work for local partners. For example, the University of Dar es Salaam (UDSM) currently has a group of 15 technicians working with development work for the Tanzania Ministry of Health and local development partners. UiO has for more than a decade developed software for health information systems called DHIS2. The project staff at UDSM have become the strongest DHIS2 development group outside of UiO.

UiO Research Students. More than 50 Master and PhD students from UiO have done field work for their theses with local supervisors from the collaborating universities. E.g. seven master and one PhD student carried out experiments in Malawi in 2017, involving three local supervisors, all with PhDs from UiO.

Local Collaborations. Staff at local industry, government and NGOs have enrolled in the programme, opening for collaboration. E.g., students at University of Malawi are

working in the Ministry, easing R&D from the university in the national health information system and enabling project funding from UNICEF into the university.

Regional Cooperation. Some lecturers from other universities with master programmes have taught in the universities in the region. While this exchange stopped after initial funding ceased, R&D collaboration is still ongoing.

International Collaboration. The strong ties between UiO and the master programme universities have enabled other funding for joint R&D, and this has taken place for all partner universities. Funders include EU, Norwegian Research Council, Research Council of South Africa, NORAD, The Global Fund to Fight AIDS, Tuberculosis and Malaria, The President's Emergency Plan For AIDS Relief, UNICEF, Bill and Melinda Gates Foundation.

5 Discussion and Conclusion

The Collaborative Governance Model for Collaboration [7] was taken as a starting point for analyzing collaborations for master programmes. Its structure Conditions → Collaborative Process → Outcomes matched the sequence of phases (1) Planning and application for funding (2) Implementation with project funding and (3) Continuation without external funding. The overall structure of the theoretical model thus corresponded well with the phenomenon studied.

Some aspects of the model were particularly useful for characterizing the master programmes development; Participatory Inclusiveness, Ground Rules, Face-to-Face Dialogue, Common Problem Definitions and Small Wins. The model helps developing an Institutional Design for academic collaboration.

Additional literature was brought in to improve the relevance of the model. The starting conditions was asymmetric resource and knowledge, and one goal of the collaboration was to contribute to levelling the unbalance. Kantini [13], who addresses the role of universities in Africa for development, recommends inventive technology application to ease the asymmetry, but the programmes reported here did not apply inventive technology for the implementation and running of the programmes. Distant, electronic communication was used when appropriate, but achieving Shared Understanding required Face-to-Face dialogues, as indicated in the Collaborative Governance Model.

Kantini [13] further emphasizes the need to bring in local stakeholders (Institutional Design (a) and relate university education to their knowledge (b). This was carried out through courses and theses. Global networking (c) was primarily through the contact between the local university and the University of Oslo, since this was the channel of funding. In addition to some lecturers from the region, research and development projects from other funders have contributed to building and keeping the global network. Interdisciplinary approach to learning (d) is a fourth component of the Institutional Design, and these master programmes were probably more interdisciplinary than most others.

These recommendations from [13] aligns with [12], hence we put these forward as necessary component in Institutional Design for university collaboration for development.

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Information and Communication Technology in Mathematics Education – Integration Readiness in Tanzania Higher Education Institutions

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Abstract. The use of ICT tools in mathematics instructions has been proved to have a positive impact on students' success. However, little is known about the ICT readiness of both teachers and students to incorporate these tools in mathematics teaching-learning process. This study investigates the readiness of teachers and students to integrate ICT in mathematics teaching and learning at a higher education institution in Tanzania. Specifically the study assesses the device, skills and psychological readiness of teachers and students to integrate ICT tools in mathematics instructions. The study employs both qualitative and quantitative methods whereby data are collected through interviews and questionnaires respectively. Seven teachers and 129 bachelor degree students pursuing business studies, form the study population. Descriptive statistics are used to analyze the quantitative data while qualitative data are analyzed through content analysis. Results show that teachers and students have device, skills and psychological readiness to integrate ICT in teaching and learning of mathematics. This is significant as it provides information that will be useful in planning the use of ICT tools to benefit teaching and learning. This study contributes to transfer and diffusion of technology discourses.

Keywords: ICT · Readiness · Mathematics · Higher education

1 Introduction

The use of Information and Communication Technology (ICT) in teaching and learning has brought a new experience for both teachers and students in different countries. According to Baya'a and Daher [1], incorporation of ICT tools in mathematics instructions provides teachers with integrative methods that stimulate students' active

and independent learning. These tools include computers, mobile devices, internet facilities, online tools and mathematical software packages. In Tanzania, the College of Business Education (CBE) has made several efforts to achieve the integration of ICT, in terms of provision of desktop computers, installation of projectors in classrooms and internet facilities. The reason for providing ICT facilities lies within the promises of ICT in improving teachers' productivity and student learning achievement.

Previous research shows that the use of ICT tools in mathematics classroom has an impact on student outcome [2]. These tools provide students with a learning platform for multiple representation of mathematical concepts and procedures that help them gain a deeper understanding of the subject [1]. According to Agyei and Voogt [3] the use of ICT tools encourage students to explore and understand mathematical concepts, hence promote higher order thinking and problem solving skills. These potentials make the use of ICT tools in mathematics teaching and learning a promising practice. However, in Tanzania teachers rarely use these tools for teaching purposes [4]. Besides, the success of ICT integration in the classroom depends on the teacher's readiness to incorporate these tools into the curriculum and use them to improve student learning [5].

Researchers Miglani and Awadhiya [6] pointed out that successful implementation of technology requires coordinated efforts by both, teachers, students and the school management. This allows the incorporation of their voices into the planning and implementation of ICT to maximize the acceptance of technology [7].

Technology is changing and new tools are evolving every day so new research is necessary to incorporate the changing needs of the user's in the ICT implementation. Besides, few researchers have examined ICT readiness in education in Tanzania [4, 8, 9]. These studies have shown that, teachers use ICT in various ways, but revealed low uptake in teaching and learning. Furthermore, these studies were limited to teachers and overall school infrastructure. In this study, we investigate teachers' and students' readiness to integrate ICT in teaching and learning of mathematics at a higher education institution in Tanzania, the CBE. Specifically, the study investigates the usage patterns (device and skill) and psychological readiness (perception on suitability and readiness) of teachers and students at CBE.

The relevance of this study is highlighted by providing an understanding of the perspective of teachers and students in a higher education institution in Tanzania regarding their readiness to integrate ICT in mathematics lessons. The college management and other stakeholders would be able to use the findings to more effectively target teachers and students needs and prioritize their technology investments to benefit the teaching-learning process. This contributes towards technology transfer and diffusion discourses in the context of higher education in a developing country. To achieve the objective of the study, the following research questions are addressed:

- i. What are the usage patterns of ICT tools for the CBE teachers and students?
- ii. What are the teachers and students perceptions on the suitability of integrating ICT in mathematics teaching and learning at CBE?
- iii. What are the views of teachers and students on the readiness to integrate ICT in mathematics teaching and learning at CBE?

2 Related Literature

2.1 ICT in Teaching and Learning of Mathematics

Many studies have been carried out worldwide in the area of integration of ICT tools in mathematics education. Some of these studies have pointed out many useful ICT tools that improve the teaching and learning of mathematics. Examples include; tools like Personal Computers (PCs), laptops, Palmtops, mobile phones, and scientific calculators. Other tools are projectors, interactive whiteboard, data handling software, graphing applications, online demonstration tools such as Java Applets [10], and simulation programs. The study by Chinwoeke [11] advocates that effective use of interactive whiteboard can transform the students-teacher classroom interactions, allowing for discussion and analysis that enhances students' inquiry and reasoning skills. Bature [2] also states that effective use of ICT improves the process of teaching and learning, problem solving skills and motivates students to learn. Conversely, the results presented in Safdar et al. [12] show that ICT was not an effective teaching strategy in public secondary schools due to scarcity of ICT tools.

Studies conducted in Tanzania revealed several challenges hindering effective teaching of mathematics. These challenges include scarcity of reference and textbooks; teaching aids such as graphical visualization tools, and models; teaching mathematics as an abstract subject; and inadequate students support due to overcrowded classrooms [13]. ICT if effectively used can help teachers and students overcome some of these challenges thus enhancing the teaching-learning process, and consequently students' performance. However, for this to occur teachers and students should have access to ICT tools and possess the necessary skills for incorporating these tools in the teaching and learning of mathematics.

2.2 ICT Readiness in Mathematics Education

Readiness can be defined as the availability of capabilities and resources to perform a particular task requiring specialized skills and infrastructure [6]. Previous studies on ICT readiness covered various aspects of readiness that include; school infrastructure, skills, device, budget, psychological [4, 14, 15], and technological readiness [16]. In this study, we focus on device, skills, and psychological readiness. In line with Miglani and Awadhya [6] we assess device readiness based on the availability of ICT devices such as a smartphone, computers, internet capability, and various software. Skill readiness is assessed based on the activities performed by the use of ICT tools. Psychological readiness focuses on the perceived readiness and suitability of using ICT tools in the teaching and learning of mathematics.

The study conducted by Ngeze [8] surveyed secondary school teachers regarding the schools ICT readiness in Tanzania and found that schools had inadequate infrastructure. Their findings also show that 77% of the surveyed teachers possessed either a laptop, a smart phone or both and they were ready to use such tools in the teaching - learning process but they lacked skills. Another study carried out in Tanzania secondary schools by Mwalongo [4] revealed that teachers used ICT tools for teaching purposes but such use did not transform their pedagogical practices. A study conducted

in Kenya by Joseph [17] found the inadequate infrastructure and poor internet connection in colleges. Teachers and students lacked skills to use technology in teaching and learning.

In summary, studies on ICT readiness show that, teachers possess ICT tools and are using them to benefit teaching, personal use and administrative tasks. However, most of these studies focus on elementary, primary and secondary school teachers. Few higher education studies conducted outside Tanzania indicate a low level of ICT readiness among students and teachers due to lack of skills and infrastructure. Nevertheless, the readiness of students and teachers towards ICT integration in mathematics instructions in higher education, in Tanzania, is not clear. The current study is proposed to investigate teachers and students' readiness to integrate ICT in mathematics instructions in higher education institutions, the case of CBE.

3 Methodology

A parallel convergent mixed research approach was adopted. We have combined qualitative and quantitative methods to achieve a comprehensive view of the problem. These methods complement each other's weaknesses and strengths [18] and yield a thorough analysis.

The study was conducted at the CBE Dar es Salaam campus, Tanzania. The participants in this study were seven mathematics teachers and 129 first year bachelor degree students enrolled in business mathematics course in 2017/2018. Two hundred and fifty questionnaires were administered to students, 179 were returned. However, 50 were excluded from analysis because they were not fully completed. Therefore, 129 questionnaires (51.6% of the total administered) from students and seven questionnaires from teachers were subjected to analysis. The students were pursuing business studies, notably, business administration, marketing, accounting, procurement and supplies in both full time (82) and evening classes (47).

Data were collected by means of the questionnaire and interviews. The questionnaire contained 32 items, consisting of closed-ended and five point Likert type items based on a scale from "1 = strongly disagree" to "5 = strongly agree". Two readiness constructs related to psychological readiness [6], were considered: perceived suitability sample statement: It is suitable that I can use ICT tools to learn anywhere, anytime, and perceived readiness sample item: I am ready to integrate ICT in teaching and learning of business mathematics. The Cronbach's Alpha reliability scores for perceived suitability and readiness was adequate as the values ranges between 0.82 and 0.83. Other questions asked for information such as types of ICT tools (Device readiness) and usage pattern of the tools (Skill readiness). Student class representatives facilitated the delivery and collection of questionnaires from other students. Qualitative data were collected through individual interviews using open ended questions such as what kind of ICT tools do you own? What kind of activities do you do? Followed by probes. Five face-to-face interviews with mathematics teachers and seven telephone interviews with student class representatives were conducted. The interviews were audio recorded and transcribed verbatim. The trustworthiness of the study was ensured through the use of member checking and multiple data collection techniques. Respondents were assured of voluntary participation, confidentiality and anonymity.

Descriptive statistics including percentages, mean and standard deviation were used to analyze quantitative data using SPSS version 23. Content analysis was used to analyze the qualitative data. At first, each data transcript was read from the beginning to the end. Then, the transcripts were re-read this time highlighting text that appeared to be related to, for example an ICT tool or how it was used, and writing a keyword or phrase that seemed to capture aspects of ICT readiness. After coding of five transcripts, preliminary codes were identified which were then used to code all the transcripts. The codes were then reviewed to ascertain the relationship with the original data while allowing new ones to emerge. Finally, the final codes were used to describe major issues pertaining to ICT readiness in relation to each research question.

4 Results

4.1 ICT Usage Patterns

Regarding the study, research question - what are the usage patterns of ICT tools for the CBE teachers and students? We gathered information about the type of devices used by both teachers and students (Device readiness) and the usage patterns (Skill readiness).

Device Readiness. Device readiness was assessed based on the possession of different ICT tools with internet capability and various software by both teachers and students. The results are shown in Table 1:

Quantitative Results. As indicated in Table 1 the majority of respondents own laptops (100% teachers and 86% students) and/or smartphones (86% teachers and 82% students). Furthermore, 71% of teachers and 33% of students own desktop computers with internet connectivity and 100% of teachers and about 1% of students own iPads. Although about 52% of the student own normal mobile phones, these are used along with either smartphone, laptop or desktop computers.

Qualitative Results. To explore the respondents' views further, the analysis focused on their comments about the types of ICT tools and software. Concerning ICT devices, their narratives fell into four categories: (1) smartphones (2) laptops (3) desktop

Table 1. Device readiness

Types of ICT tools	Teachers (N = 7)		Students (N = 129)	
	N	%	N	%
Laptop	7	100	86	66.7
Smartphone	6	85.7	106	82.2
Desktop PC (Internet)	5	71.4	49	38.0
Tablet	1	14.3	43	33.3
IPad	7	100	1	0.8
Mobile phone (Internet)	3	42.9	70	54.3
Normal mobile phone			67	51.9
Software (Presentation, word and data processing)	3	42.9	64	49.6

computers and (4) mobile phones with or without internet connectivity. The themes are evidenced by the following quotes: “I use a laptop and smartphone” (Student), “I have a desktop computer, laptop and smartphone” (Teacher).

Skill Readiness. Skill readiness was measured based on the activities performed through the ICT tools. Table 2 shows the different activities performed by respondents through ICT tools.

Quantitative Results. As per Table 2, apart from conventional use (making phone calls) teachers and students use ICT tools in ways that can benefit online teaching and learning. For example, widely reported activities included uploading and downloading teaching and learning materials (100% of teachers and about 83% of students), Internet search (about 86% of teachers and 77% of students), checking and sending emails (about 86% of teachers and 77% of students), social networking (57% of teachers and 78% of students) and sharing educational resources (71% of teachers and 70% of students). Furthermore, teachers have also reported to use their ICT tools for the preparation of notes and student results (100%).

Qualitative Results. Findings from the interviews are in agreement with themes stated in the questionnaire concerning respondent’s usage patterns of the ICT tools. Respondents’ answers, revolve around (1) internet searching, (2) downloading materials, (3) viewing and listening to music and videos, (4) sharing of learning resources, (5) social networking, (6) chatting (7) typing notes, (8) drawing graphs (9) solving mathematical problems (10) email and (11) making phone calls. In addition, issues related to the use of specialized mathematics software such as MATLAB, R, and MAPPLE also emerged. Quotes from two interviewees support the findings: “(I use my phone)...to chat, share learning materials and information with my fellow students... search for learning materials... YouTube, Google... social media...listening to music and watching movies” (Student); “I usually download notes...I type notes, prepare results... share materials...I use MAPPLE, MATLAB and R for graphing and solving equations.” (Teacher).

Table 2. Usage Patterns of ICT tools

Activities performed using ICT tools	Teachers (N = 7)		Students (N = 129)	
	N	(%)	N	(%)
Watching online educational videos	7	100	87	67.4
Sharing educational resources	5	71.1	91	70.5
Chatting	4	57.1	100	77.5
Checking and sending email	6	85.7	96	74.4
Internet search	6	85.7	100	77.5
Uploading/downloading-teaching, learning materials	7	100	107	82.9
Social networking	4	57.1	101	78.3
Prepare notes and results	7	100		
Making calls	5	71.4	101	78.3
Blogging	0	0.0	1	0.7

4.2 ICT Integration Readiness

Regarding the study, research questions what are the teacher's and student's perception on the suitability of integrating ICT tools in mathematics teaching and learning at CBE?, and what are the views of teachers and students on the readiness to integrate ICT in mathematics teaching and learning at CBE?. We gathered information about the psychological readiness of the participants through their perceived suitability and their perceived readiness for integrating ICT into their mathematics teaching and learning process.

Psychological Readiness – Perception of Suitability. *Psychological* readiness was categorized into two (a) perceived suitability and (b) perceived readiness to integrate ICT in the mathematics classroom. Respondents' perception was measured on a Likert scale ranging from strongly disagree to strongly agree. The mean score ($M > 3$) indicates positive perception, the mean score ($M = 3$) neutral perception and ($M < 3$) indicates negative perception. The results regarding perception on suitability and readiness to integrate ICT are presented in Tables 3 and 4

Perception of Suitability - Quantitative Results. As shown in Table 3, the majority of teachers and students perceived that incorporating ICT tools in the mathematics classroom provides opportunities for teaching and learning irrespective of time and place ($M = 4.08$); supports teaching and learning activities ($M = 4.20$); provides a platform where teachers can distribute and students can access teaching-learning materials and resources ($M = 3.88$); provides a communication platform ($M = 3.67$) as well as a discussion platform for both teachers and students ($M = 3.87$).

Table 3. Perception on the suitability of using ICT tools in the mathematics classroom. SD: Strongly disagree; D: Disagree; U: Undecided; A: Agree; SA: Strongly agree; M: Mean; S.D: Standard deviation. Mean = 3.94, Cronbach's Alpha = 8.2

Constructs of ICT suitability	SD	D	U	A	SA	M	S.D
1. It is suitable that I can use ICT tools to learn anywhere anytime	6.8	3.0	9.0	37.6	43.6	4.08	1.12
2. Using ICT tools would support my teaching/learning	3.8	3.0	6.1	43.2	43.9	4.20	0.93
3. I can distribute/get learning materials, assignments, grades and watch instructional videos via ICT tools	5.9	10.4	6.7	43.7	33.3	3.88	1.16
5. I can chat, call, and use social media features using ICT tools to give/obtain support to students/from my lectures	7.6	15.9	7.6	40.2	28.8	3.67	1.26
6. I can discuss course related matters via online platforms	5.2	9.7	9.7	44.2	31.3	3.87	1.12

Overall, the quantitative data show that teachers and students have positive perception (Mean average of all suitability statements = 3.94) about the suitability of integrating ICT in mathematics teaching and learning at the CBE, Dar es Salaam.

Perception of Suitability - Qualitative Results. About the suitability of using ICT tools in mathematics, qualitative data show that teachers and students find it suitable to integrate ICT in teaching-learning of mathematics. During the interview, their responses pointed to themes related to (1) easy access of notes and books (2) outright support, (3) anytime-anywhere learning, and (4) online submission of assignments. This is evidenced by the following quotes: "...you can get materials like books, notes, even help and support...at any time whenever you ask, there is an answer right then..."; "I can listen to lectures... anywhere, even when I am travelling..." (Student).

Psychological Readiness – Perception of Readiness. Perceived readiness was studied in terms of appropriateness, internet infrastructure and budget. The results are presented in Table 4:

Perception of Readiness - Quantitative Results. Data presented in Table 4 indicate that both teachers and students are ready to integrate ICT in mathematics teaching and learning (M = 3.71). Furthermore, teachers and students both agreed that: it is appropriate to use ICT tools for teaching and learning of mathematics (M = 3.60); their ICT tools have features that can support online learning (M = 3.84); Internet connectivity is adequate to support online learning (M = 3.62) and that the cost of data bundles is within their budget (M = 3.78).

Perception of Readiness – Qualitative Results. With respect to affordability and internet reliability students had mixed feelings, some indicated that they can afford to purchase data bundles, "The cost of internet is manageable...only 2000 shillings (0.87 USD) per week..." (Students). While others felt that the costs are high, especially for students living in a hostel as one student narrated "... for those living in hostels the cost is high, 2000 shilling per week you get 1 GB and 1 GB for the night...during this time

Table 4. Readiness to integrate ICT in mathematics teaching and learning. Mean = 3.71, Cronbach’s Alpha = 0.83

Constructs of ICT readiness	SD	D	U	A	SA	M	S.D
1. I am ready to integrate ICT in teaching/learning of business mathematics	7.6	10.7	11.5	43.5	26.7	3.71	1.19
2. ICT is appropriate for teaching/learning mathematics	5.3	15.3	14.5	44.3	20.6	3.60	1.14
3. My ICT tool has several features to support online learning	3.9	11.7	12.5	40.6	40.6	3.84	1.11
4. Internet connectivity in my College is adequate to support online learning	6.8	15.8	9.8	44.4	23.3	3.62	1.19
5. I can afford to buy data bundles to online learning	6.8	9.8	8.3	48.9	26.3	3.78	1.14

I am doing independent studies so I feel it is costly...". With regards to internet connectivity some students felt that the mobile internet is adequate, but they were skeptical about the college internet facility in terms of limited access and speed "internet through mobile phone is adequate...I am using Vodacom internet which is very good...for those using college internet it is about time it should be accessible in the classrooms although I feel it is somehow slow..." (Students). Generally, students and teachers have agreed that they are ready to integrate ICT in mathematics teaching-learning processes ($M = 3.71$).

5 Discussion

The purpose of this study was to investigate the readiness based on the usage pattern, suitability, and readiness of teachers and students to integrate ICT tools in mathematics at a higher education institution in Tanzania, CBE. To fulfill the objectives of this study, we assessed ICT readiness based on the Device readiness, Skills readiness and Psychological readiness of the participants. The discussion is organized according to the research questions.

5.1 Usage Patterns - Device and Skill Readiness

In regards to *what are the usage patterns of ICT tools for the CBE teachers and students?* (Device readiness). The study found that most of the respondents own either a smartphone or a laptop and some have more than one device. The results are consistent with Ngeze [8] who found that secondary school teachers possessed either a laptop, a smartphone or both. The results also confirm high penetration of mobile devices among students of higher education [7]. This finding implies that teachers and students at the CBE Dar es Salaam have a device readiness to use ICT tools in teaching and learning of mathematics.

With regards to usage patterns (Skill readiness), the findings indicate that teachers and students use ICT tools mostly for uploading and downloading learning materials, internet search, sending and checking emails, sharing educational resources and social networking. This result corroborates that of Miglani and Awadhiya [6] who termed these activities as basic skills needed for sending information, uploading-downloading and sharing information with a study group. Their study further revealed that fewer students (30%) performed advanced skills activities such as watching online videos, blogging and the like. In this study results show that the majority of teachers and students (more than 50%) watch online educational videos which is similar to Abidin et al. [16]. Another significant finding is that more than 50% of students use word processing, data processing and presentation software. Teachers on the other hand use specialized software to solve mathematical problems showing that teachers use ICT tools for teaching purposes. This indicates that teachers and students at the CBE Dar es Salaam have the required skills and that they can make effective use of the ICT tools in teaching and learning of mathematics. ICT tools usage could help them overcome challenges such as shortage of reference and textbooks, teaching aids, and overcrowded classrooms. Teachers can complement the face-to face interactions with online learning

space, and use of digital materials including videos, books, and online notes to enhance students' learning experiences. Teachers also need to use graphing applications and simulation programs because these tools have great value in the teaching and learning of mathematics [10]. The use of these tools can help teachers to reduce the abstractness of mathematics as it is currently perceived by students.

5.2 Psychological Readiness

In relation to *what are the teacher's and student's perception on the suitability of integrating ICT tools in mathematics teaching and learning at CBE?* The findings showed that teachers and students have positive perceptions regarding the suitability of using ICT tools in mathematics teaching and learning. Both teachers and students agreed that integration of ICT in mathematics can support teaching and learning activities. They also agreed that ICT tools foster anywhere, anytime learning; provide a platform for sharing educational resources such as learning materials, quizzes, as-assignments, student results and instructional videos; provide a platform for communication and discussion. Another interesting result is that students relate the use of ICT tools with immediacy when it comes to receiving support from their teachers, they would want a prompt reply from their teachers or colleagues when they encounter some difficulties. ICT tools like smartphones, laptops and others comes with inbuilt features that allow sharing of content such as text, videos, and audio files [6]. These features allow the production and a quick transfer of content to student populations. Therefore, teachers can use text messages, social media platforms and emails to offer support to their students [16]. The finding implies that using ICT tools in a mathematics classroom can enhance communication and didactic interactions between teachers and students, therefore minimizing the limitations that are created with geographical boundaries experienced in conventional means of teaching and learning.

In regards to *what are the views of teachers and students on the readiness to integrate ICT in mathematics teaching and learning at CBE?* Results showed that teachers and students are ready to integrate ICT in mathematics teaching and learning. They agreed that their ICT tools have the needed features to support online learning. This result is in compliance with research carried out by Ngeze [8]. Their findings indicate that respondents had positive attitude towards integrating ICT in teaching and learning. The findings also show that students are confident and feel that they would be motivated to study and enjoy more their mathematics lessons through the use of ICT tool. Another significant finding is that the majority of teachers and students agreed that the internet is adequate and they were positive about purchasing data bundles. These are the features that support online learning as both e-learning and m-learning feasibility requires reliable internet access and the cost of data bundles should be within user's budget. This implies that respondents have positive perceptions towards integrating ICT in mathematics teaching and learning except for a few students who were skeptical about the cost of mobile internet, speed and availability of the college internet as they indicated that it is slow. This result is similar to Abidin et al. [16] who found that respondents were positive about m-learning, although they were uncertain when it

comes to the costs related to m-learning. Lack of adequate internet can hinder effective implementation of ICT in teaching and learning of mathematics. The findings reported in our study shed light on the areas that higher education institutions need to pay attention in order to help teachers and students use ICT in teaching and learning. In particular, making internet facilities accessible to all student populations would create an encouraging environment for teachers and students to incorporate ICT tools in mathematics lessons.

6 Conclusions and Recommendations

Conclusively, respondents were positive about the idea of integrating ICT tools in mathematics teaching and learning as they were already familiar with possible features and communication activities required when using ICT tools for teaching and learning. However, using ICT tools for teaching and learning is still very new to teachers and students and remains at its initial stage. This may be caused by the lack of emphasis from the educational administrators regarding the implementation of ICT in mathematics instructions. Effective implementation of ICT tools requires the collective efforts of both teachers, students and administrators [6]. The findings showed also that, some students were uncertain about the cost and adequacy of the internet due to low speed and inaccessibility of the college internet within classrooms. Teachers were silent about the cost of the internet; this could be a result of the availability of internet in their offices, access to information resource center and computer laboratories. It was noted that confining ICT tools to some offices, laboratories and the course will not alleviate the problem, instead ICT tools should be accessed throughout the college environment, particularly within classrooms.

Although the findings from this study cannot be generalized to all students and teachers at all CBE campuses and other higher education institutions in Tanzania, they are indicative of the phenomenon that is observed on mathematics teacher and student populations in other higher education institutions. Further research with samples from all CBE campuses, possibly including other higher education institutions would provide a clear insight into the issues of ICT readiness in the teaching and learning of mathematics in higher education institutions in Tanzania.

Based on the findings, the study recommends that: Due to the readiness observed, plans for integration of ICT in mathematics instructions at the CBE should be prepared and implemented, the purchase of specialized software required for mathematics teaching and learning. Furthermore, Customization of a Learning Management System that runs on both web and mobile environments to support mathematics courses, Computer laboratory availability to students pursuing different courses at the CBE and the provision of wireless internet access to students. In addition, Teachers should allocate time to offer online support and guidance to their students regarding various mathematical concepts and problems.

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eLearning in an African Place: How ‘Alien’ eLearning Models Are Failing Many in Africa

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Abstract. This paper discusses eLearning in contemporary times in an African place. While the paper acknowledges the importance of eLearning in that it facilitates distance learners’ activities and bridges geographical gaps across the world, it notes that in convoluted environments such as those of Africa, eLearning raises a lot of critical questions, some of which are cultural, and others are ethical and epistemological. This ambiguity emerges largely because eLearning, as it is understood in Africa, comes in foreign packages. The paper argues for the decolonisation of eLearning – that external practices of eLearning, particularly those ‘imposed’ on Africa from Europe and North America, fail many environments in Africa. This failing is because such practices rubberstamp the long-criticised philosophy of one-size-fits-all which has been blamed for impoverishing Africa besides underestimating the potential contribution of the African continent to the global world. On this note, the paper concludes that unless we decolonise eLearning and consider the issues of sensitivity, inclusivity, and attainability, eLearning will not be palatable or at least beneficial for most in Africa.

Keywords: eLearning · Africa

1 eLearning in an African Place

The received practices and theories of eLearning, mostly from the USA and Europe, may represent internationally accepted good practice yet they also embed deep political, epistemological, and cultural assumptions that may be incongruent with the cultural knowledge of users in many communities in Africa. Generally speaking, eLearning is learning that uses electronic technologies/media such as the internet, intranets and extranets [1], also referred to as educational technology. Typically, this learning takes place outside of a traditional classroom, for example, online, or blended and somehow informal as was the case in African education systems before colonialism. While this kind of learning seems worthwhile as it facilitates distance learning, provides convenience, and tries to bridge geographical gaps, in an African context, eLearning raises many questions some of which are cultural, and others are ethical and epistemological. The first question that [African] critical minds engage with as soon as they receive eLearning guidance from outside is: who designed the eLearning model and for what reason? Given the exclusion of Africa in the designing

of most contemporary dominant eLearning applications, from a cultural and political perspective, this overture could be interpreted as cultural imperialism as just like what colonialism did to Africa. In this manner, a theory can impose cultural ethos of Europe and the Americas on Africa. The question that remains perturbing is where Africa in this whole eLearning discourse and model designing is? The second question is to what extent does e-Learning speak to the cultural and ethical concerns of Africa? This question, as is the issues raised above, is critical because any learning carries with it cultural and moral sensibilities of a people. Now, if Africa is excluded as was the case during the 1884-5 Berlin Conference when the continent was partitioned in the absence of African representatives, isn't it that imposition of eLearning on Africa tantamounts to a recolonisation of Africa? Putting it more precisely, why are most Africans remain unrepresented in the designing of theoretical and practical models that affect them directly or otherwise? The third critical question pertains to affordability – where most African rural areas are without electricity and internet connection. Is eLearning useful and practical to people living in such areas? This issue points to the fact that the imported theories of eLearning are not only culturally problematic but also morally, politically and epistemically problematic. Of course, there is a wide variety of proposed theories and practical approaches. They depend on how one approaches learning, but as noted earlier, many as they are, little comes from African perspectives.

2 Methodology

The authors of this paper are academics with decennia of experience in African institutes of higher education in Mozambique, South Africa, Zambia, and Zimbabwe. Through living research [2], they study how communities (of belonging, as will be shown in this paper) engage, review cultural heritage and contemporary cultural practices and paradigm switching and shifting in sectors which include, among others, education, health, and digital technology.

For this paper, the authors researched technology and African communities from an African positionality, embedded in institutes of higher education, supporting institutes in health, and rural communities. The authors tested these insights in e/merge 2018, an online festival of e-learning in Africa, 9–20 July 2018.

3 Discordances of ELearning with African Cultural Expressions

Nkrumah [3], an influential philosopher and political leader, provided an intellectual framework on social conscience founded in the African values of communal solidarity in his book *consciencism*. Paulo Freire (2000), the author of the widely read, *Pedagogy of the Oppressed*, documented his participatory practice from culture circles in North-eastern Brazil in the 1960s. However, it seems, contemporary, imported eLearning models are entirely ignorant of the various *epistemai* in the world.

It is necessary to pinpoint that half of the world is not connected to the Internet and that in Africa, less than a quarter of the population is using the Internet [4].

When assessing eLearning theories and practices in Africa, they need deconstruction and reconstruction as to review how they fit with features that are salient in African locales, at least, those that have existed over a substantial amount of time. There is identity grounding of African cultural properties that existed long while been recurrent in many African places in a way they have tended not to be elsewhere [5]. Although there are many and convoluted realities present in the pluriform African realities, from an assessment of the kind of African properties Thaddeus Metz [5] alludes to, we identify three main areas of discordance. These are paradigmatic, concern the channel, and deal with platforms and practices.

3.1 Paradigmatic Discordance

eLearning theories rely on the epistemic grounding of the researcher and those who are being researched. It reflects the learning-perspectives adopted, mostly categorised as associationist/empiricist, cognitive, or situated [6]. These perspectives, however, are also located. Subsequently, the models and technologies that come out of them are elements of a system of behaviour. Through models and technologies, they pass from one person to another. Therefore, eLearning models and technologies represent memes.

Contemporary theories, mostly originating from outside of Africa, are said to be undergirding ‘internationally accepted good practice’. Cognisant of the multi-epistemic world, in the complex African environment and a multi-epistemic world, one must question from which paradigm such claims of ‘good practice’ have been generated. Have Africans been widely involved, and have African communities been part of the process of research, validation, development, implementation and assessment? Therefore, on which grounds is the claim of ‘internationally accepted’ being made?

Most conventional eLearning examples put the human learner in the centre. In such an approach, invariably the learner is set as a persona in a cultural setting that aligns with a postmodern Western urban culture that wishes to be free, with the individual being self-sufficient and self-centred. African cultures, however, put the community as the centrepiece of their worldview [7] unaligned with normative epistemologies but featuring dynamic, integrative epistemology [8]. African frameworks of how societies or nature works regard the individual to *belong* to a layering of communities, being an intrinsically and always connected part of such communities [9].

So far, we are not aware of eLearning that put ‘the community’ at the centre. Of course, in contemporary learning, there is ample recognition that education is a social activity and learning approaches based upon constructivism appear to align with life in communities, but they do not do so at the paradigmatic level. The individual learner is solidly posed at the centre. eLearning and its contemporary practices that come from a paradigm reasoning from a personal self in an atomistic universe, culminated in individualism, clash with the cultural knowledge of African students across African education [10]. African paradigms view reality from social personhood, in a universe of coherence, focusing on social cohesion and collective unity, culminating in communalism, social bonding, balancing of duties and rights, and reciprocity. It is, therefore, not strange that there appears little uptake of eLearning in African institutes [11].

In many parts of Africa, learning focuses on *how the community learns*, and from such learning, how community members gain understanding [12]. The concept of

‘community of practice’ and learning approaches based upon constructivism do not adequately cover this kind of meaning-making, because they focus on the individual first and upon their relationships in a community second. In many African cultural expressions, the concept of the collective surpasses the individual. These expressions pre-date the concepts of communities of practice. In many parts of Africa, an approach putting the individual as the central focus of attention is not seen as aligned with local cultures but pushing learners towards self-cultivation, individualism and, ultimately, assimilation with foreign ways of thinking. In that sense, eLearning facilitates alien ways of meaning-making and links to gaining a different way of living, e.g. set in capitalism.

3.2 Channel Discordance

At present, eLearning is mostly proposed from ‘the West’ and aligns with the thinking/paradigm that created the information and communication channels (for instance, the internet) and tools (for instance mobile devices) that dominate in the global society. These models are complementary to, and intertwine with, broadband internet networking. eLearning platforms and services bank upon the ubiquitous use of computing devices and digital platforms, a setting that Dourish and Mainwaring [13] show to be inherently colonial. The apparent positioning of the use of internet telecommunications channels and (imported) computing devices as the preferred channels for eLearning is, therefore, quite problematic. This discordance can be explained as an analogy to the differences between narrowcasting and broadcasting. In line with the paradigmatic centrality of the individual, the current channels for eLearning link in with narrowcasting [14]. A community-centred paradigm, however, would need channels that would map with broadcasting. In the African society, one’s membership of the community is not the result of one’s ‘own choice’, but memberships are set by, for instance, one’s birthing into a family and introductions into groupings of people in a geographical area. In the Shona language, this is signified by the reference to ‘kumusha’ as this touches upon issues of *identity*. Although constructivism regards learning as behaviour, learning as the construction of knowledge and meaning, and learning as social practice, the channel of Eurocentric Information and Communication Technologies is forcing its users into individualistic framings as the technology is geared towards establishing channels with and to the individual but does not do so for the community and with the community. For instance, there is a significant difference in using the means of the Internet on mobile devices or the use of ICT in the form of radio and call-in programs.

3.3 Platforms and Practices

Western knowledge systems are structured along disciplinary boundaries, while African knowledge is embodied in a transdisciplinary community, geared towards orality [12, 15]. Therefore, eLearning can only work well when the disciplines become un-disciplined, ensuring conviviality, intellectual freedom and generative symbiosis, in line with Ubuntu principles [16]. No wonder that the paradigm mismatch and channel mismatch have stalled eLearning praxis to be ‘more of the same’ in Africa.

This situation calls for decolonisation of science and indeed the African academy [17] and moving the centre of conceptualisations near the community of users [18].

Current eLearning models and practices facilitate the belief in technology determination, as if the availability of computing devices and other tools and eLearning platforms will, by their sheer availability, lead to learning outcomes [19]. However, when underlying technologies do not necessarily align with technical, organisational and pedagogical systems that are current in African communities, such techniques are catering for foreign agendas, in their wake disrupting systems of knowing that have been working well. Thus, contemporary eLearning models and practices are discordant with African cultural expressions, because

- the paradigm mismatch negates necessities of belonging
- the channel mismatch negates the issue of identity
- the platforms and methods align with (digital) imperialism.

4 African Considerations Influencing ELearning

From our long-time experience in higher education and research, we noted three aspects of African culture that set boundaries for eLearning. These are (1) sensitivity, (2) inclusivity, and (3) attainability.

4.1 Sensitivity

Learning in an African environment is intertwined with content for specific groups and life-periods, where information transfer depending on time, place, and authority. There are great sensitivities where particular pieces of knowledge and values reside. Information can be considered sacred or subject to taboos such that they should be imparted only to specific individuals or groups of people. There are, for example, epistemic values – such as on certain rituals and rites of passages – meant explicitly for women, girls, boys, or men. In an African context, these values are not imparted in undesignated settings. eLearning is, however, not sensitive to such forms of knowledge, hence the problems when the foreign e-learning models are applied as they are in African contexts.

4.2 Inclusivity

There is a void of a decolonised understanding of the characteristics of eLearning that would make it useful for engaging African communities and their members and facilitate learnings sensitive to belonging, identity, and societal cohesion. The colonial history and presence of supremacy, hegemony, and domination, results in significant differences in the perception and realities of perceived value of what comes from ‘the outside’ and what comes from ‘the inside’, and with which system of thought, or reality, even paradigm, one links up [20]. Africans live with a history of having had to accept foreign ideas and absorbing them without critically investigating their source, history, necessity, and workability in the context of the African space. Systems of

thought were introduced which instigated rebellion against the established (and working) indigenous systems of local governance and knowledge transfer. Currently, imperialistic digital systems overlay and build out these colonial systems. Subsequently, such systems sustain the continuation of the expropriation of resources out of Africa through, what we call, super-colonialism [21]. African communities are located networks of relationships and interactions, often in line with Ubuntu – defining ‘good behaviour’. Community instigates collective identity, local participation, and diverse support networks. Community membership and participation involve aspects of belonging, identity, participation, informedness, and associations like support networks.

eLearning is designed to result in *targeted outcomes*. Such a design approach imposes models or ‘solutions’ upon communities and learners without them being able to decide if and what should be structured and, often, without their involvement. We recognise five main cultural ingredients that African eLearning practitioners could look for to be facilitating [cf. 19].

1. Putting the community, ‘being together’, at the centre. Ubuntu, for instance, is a crystallisation of African philosophy in a culture that is inclusive, focusses on the contribution of everyone in its vicinity [22].
2. Focus on oral and holistic means of communication, where the aim is for embodied knowledge, a *knowing* that develops while sharing and discussing information involving all present while working things out together, continuously and for the good of everyone, which we dubbed ‘oratio’ [12, cf. 23].
3. Focus on sharing, recognising the learner as a representative of community life and its collective (embodied) human repository of *knowing*, dubbed ‘relatio’ [24].
4. A focus on the here-and-now, the ongoing experience, having a constant re-established history and accepts an unfolding future, dubbed ‘animatio’ [cf. 25].
5. Respecting maturity and recognised and authorised leadership, dubbed ‘dominio’.

In African eLearning, the focus would not be innovation, or ‘new knowledge’ per se, but is explicitly focussed on both improvisation [example in 26] and diversity.

Richard Heeks [27] positions ICT in ‘ICT4D 2.0’ as a transformative platform. However, if such a platform does not align with local realities, its transformation might not be development but an upsetting disruption of existing established and stable community practices. Sustaining community is an iterative process in which community members, together, continuously develop and amend what binds them, in a continually changing awareness and knowledge base that informs, shapes and triggers improvisations in community life. The main opportunities for eLearning, thus, are the engagement of community members and the provisioning of space for shared development, in the community, for the community. Without such a facility, one sets up individuals with individual knowledge which might be detrimental to the development of the community and may, ultimately, lead to expulsion or migration of such individuals.

The knowledge creation and sharing in the communities are profoundly holistic and transdisciplinary [28]. This creation involves a complex context of relations and interactions with all kind of entities, both with humans and non-humans. These conversations are supported by a robust and multi-layered infrastructure of existing and

changing technologies, like transport, communication tools, and meeting facilities. Contemporary eLearning models fall short of facilitating such a complex environment in many African communities.

4.3 Attainability

We must consider the qualitative and broad political, cultural, macroeconomic, and institutional drivers of eLearning and its proposed positive and potential negative consequences. Digital colonialism, also through eLearning platforms, can be sources of impoverishment and underdevelopment [29]. The so-called 21st-century skills often necessitate imported and expensive devices and the use of foreign platforms.

5 Discussion

If we seriously consider the issue of sensitivity, inclusivity and affordability, then eLearning could be usable in Africa, otherwise, for now, the current proposals appear fruitless packages for Africa. We are not aware of research that proves or disapproves that attention to eLearning is more effective than direct support for educators, improvement of school infrastructures and labs, and such kind of interventions, the improving existing systems [30]. Reports are suggesting either way, providing a narrative of success [31] or deficiency [32]. Andreas Schleicher of OECD's directorate for education and skills concluded cautiously: "the connections among students, computers and learning are neither simple nor hard-wired; and the real contributions ICT can make to teaching and learning have yet to be fully realised and exploited." [33] It is clear; the verdict is not yet out and, thus, research is crucial to determine the impact of different methods on learning and their influences. In Africa, eLearning is a new realm, mostly apart from long existing processes, and invariably linked to Western notions of modernity.

The underlying and long-term effects of eLearning are yet unknown. There is a lack of longitudinal and qualitative research, embedded in African communities and sensitive to the epistemology, culture and embedding of people in Africa. Further, eLearning research seems often linked to a particular intervention or platform (e.g. Content Management Systems or Learning Management Systems) with a multitude of technologies that, in practice, have different meanings in different contexts. As all hegemonic theories and practices, eLearning needs decolonisation. Such an orientation puts *communities of belonging* at the centre of theory and practice. Thus, this is not the *community of learners* at the time of learning, but, first, putting the community that one *belongs* to, the complicated African citizenship at the centre [34].

What eLearning 'is' and an understanding of the undergirding theory is constructed contextually and locally. The moral grounding of currently used eLearning seems mostly (if not exclusively) framed in Western culture. As morality is a cultural variable [35], the ethical mismatch of eLearning models engendered through Western lenses and the use in non-Western societies result in severe dysfunctionalities. Most eLearning models proposed for Africa fall short in how they include the local perceptions of affection, loyalty, authority and spirituality, among others. The process of the creation

of eLearning theory and practices, and the focus of its facilitation (e.g. towards the community instead of the individual) call for putting those being affected in the driving seat of their developments which includes in the conceptualisation of the facilities for human behaviour and learning.

Current literature on eLearning cases and tools appear to prioritise ‘doing’ – its inputs and outcomes – often vocalised in weaponised language as ‘targets’ or ‘penetration’. Such descriptions and vocabulary negate its ‘being’ and are strongly influenced by military, gender, and technical perspectives. The resulting models, therefore, are value-laden. This concoction, in an Africa place, acts out super-colonial [21]. Therefore, eLearning theory and practice insensitive to the local, African contexts are *actors*, or instigator, of a social change in the direction of the researcher’s and designer’s motives, instead of being facilitators of an ongoing, locally validated and embedded social life.

Linking eLearning models to contextuality, both for the positionality of their origins and for the positionality of its use does not make it a form of relativism but constitute a call for discussion of the kinds of values that were involved in their conceptualisations. Drawing on the emerging understanding of African expressions of eLearning, there will be tools that give direction to the deconstruction of received guidance of eLearning. From careful thinking, we can be able to understand and, subsequently create and maintain eLearning facilities that support communities and decolonised education in African societies and beyond. Such a learning-(eco-)system is aligned with the resource availability and social cohesion in a context of inclusive and respectful accommodation of all people in African lived-lives.

The contemporary monistic approach to eLearning links in and strengthens the position of the dominant (often US-based) platforms. These platforms are closely linked to (usually US-based) institutes of Eurocentric (higher) education, perpetuating its views and neoliberal ideologies. This singular process aligns with the internationalisation of education, ushered forth by globalisation that fails to deliver social, political, administrative, distributive, cultural or ecological justice [36]. Likewise, the current framing of eLearning complicates and imposes the political, economic and cultural hegemony of the West by entrenching its power seeking and defining what knowledge gets validated and what not. This framing has many drawbacks, as diversity is challenged, like those of languages, culture, and indigenous knowledge and epistemologies – for instance, on how to interact with nature. As a result, the exploitation of the less powerful by a rent seeking elite accelerates. Current eLearning rely heavily upon the ideology of market, choice and unlimited growth. Its proposals are positioned as offerings in a market, based upon unfettered freedom, for individual choice, upon the adagio that the *homo economicus* knows best. The models seek the maximisation of ‘educational returns’ in a considered stable, efficient and just society. In this ideology of individual choice, the externalities, as presented in this discussion is delegated to be sorted through ‘the market of sciences’. In the current dispensation, this market is colonised by Eurocentrism and (e-)realities framed by rhetoric from corporate businesses [37]. These contexts actively omit, or nudge out, unwelcome information and ways of knowing by shifting the baselines, negating that what is considered ‘not helpful’ for their production [38]. In the meantime, (foreign) governments and (international) corporates harvest a vast amount of data through digital educational

systems and platforms, gaining knowledge of academic performance and personal backgrounds within settings where the local or national guardians or societies bear responsibilities for. The generation that grew up with computers (and dominant eLearning models and systems) think that the ecosystem in which one lives is ‘normal’ [39] although the systems pose significant dangers by their potential to distract, facilitate harm (e.g. bullying), and lower productivity. The de facto situation of a limited choice of ecosystems (with the current one neutralising ‘other ways of knowing’) represents poverty in thinking and systems conceptualisation. The result is a shrinking variety and multiplicity. Decentralisation the conceptualisation of eLearning and recognising a poly-episteme world is crucial for an eLearning transition for the field of research to be relevant (and aiding) eLearning use in many (most?) parts of Africa.

There is ample need for multiple perspectives on various purposes of eLearning in different contexts. Such is a venture to discover and formulate decolonised African expressions of eLearning. The collective action, struggle and study towards such recognition is an essential process that, by and through itself, will recreate an African identity in eLearning. This endeavour could well lead to the development of new technologies that amplify African intentions, set to support the needs and desires within African paradigms, e.g. sustaining social-cultural constructs like Ubuntu. Most probably, such a theory and practice might well be unaligned with the coloniality embedded in contemporary digital systems and platforms. They will not facilitate nor sustain the extracting of African labour for a foreign private benefit. Such an eLearning will not necessitate people to leave rural areas for the city to seek connectivity to access appropriate education. It will support education geared towards sustaining a quality of life within African communities and not set up people to have to leap beyond one’s physical borders to sustain life. The alleviation of Africa’s dependency on foreign platforms and the blocking the tromboning of African information – where a communication starts and ends in Africa, yet transits in an intermediate country outside of the continent – is critical for African improvisation of its life-conditions.

6 Conclusion

The worlds of learning and technology are both complex and diverse. In this paper, we endeavoured to show that the current rendering of these worlds in eLearning is difunctional for African settings. Significant flaws denote omitting a diversity of both worldviews and cultural practices with regards to Africa. Africa’s diverse and dynamic cultural expressions centre around communities, oral communication methods, sharing, timely relations and the recognition of authority, among others. Lived-lives in Africa, set in spirituality and social belonging, and a community life that is always available and engaging, seem to be uncatered for by current renderings of eLearning.

Contemporary eLearning theory and practices are set within powerful and framing forces of digitisation and communication technologies. The nature of eLearning, together with the use of equipment that mesmerises, appear to put constructors of models in the position where (western) thoughts and technologies limit the view on potential ‘constructs’ of their implementations, as they catalyse changes not only in

what we do but in how we think. This subjective effect influences the fields of understanding, linking eLearning models actively with euro- and technocentric, western narratives. This linking combines with a general ignorance of western-centric academia, especially in the field of natural sciences, of other epistemologies and of different ways of knowing. Therefore, it might well be that relatively few researchers have the critical background, knowledge base, and awareness to resist such a dominant framing that is part and parcel of a global narrative of technology solving problems. In this paper, we endeavoured to step back and assess eLearning according to its merit, or lack of it, in Africa. There is a great need for transmogrification of eLearning, which could, indeed, be surprising for western actors. Such an eLearning would ‘be’ in line with African ways of knowing and learning, so both knowing and learning are supported seamlessly within African cultures and established ways-of-living in communities.

eLearning practices mostly frame its use from foreign settings. They are uninvolved with African strains of philosophies of education and technology and therefore are not reflective of how eLearning could be constructed in Africa. Therefore, contemporary eLearning theories are mostly philosophically unsatisfying and its practices too rigid to cover the vastly potential of perceptions of eLearning.

African guardians of knowledge, the African academia, has a significant task to generate awareness to fulfil the vital role in safeguarding African and indigenous knowledge. In many African places, actors have multi-vocational responsibilities. Creativity and energy exist at what imperialism considers ‘the periphery’. There lies a prime source for dynamic and integrative contributions for policy development while catering for multiple worldviews, for instance, supporting students at a school, communities in the lived environment, and religious institutes in the experience of their faith.

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Developing Multimedia Enhanced Content to Raise HIV/AIDS Awareness to Children

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Abstract. It is estimated that more than two-thirds (70%) of all the 35 million people living with Human Immunodeficiency Virus (HIV) in the world are in Sub-Saharan Africa. Tanzania as one of the country in sub-Sahara region is no exceptional, more than 60% of all new HIV infections in Tanzania occur among young people. While almost all children in Tanzania aged 15 years and below have heard about HIV/AIDS, less than half have enough knowledge to protect themselves against infections. It is known that HIV/AIDS is taught in primary schools, although majority of the pupils demonstrated a very low level of knowledge about HIV/AIDS. This raised a concern on the effectiveness of HIV/AIDS and life skills education in primary schools. Information and Communication Technology (ICT) has a great potential for HIV/AIDS education to children because they like and enjoy to use ICT resources for entertainment, learning, networking and communication. Hence, it is important to apply technology for educational in teaching HIV/AIDS through the use of multimedia contents in accordance to the local context of Tanzanian curriculum for primary schools. Therefore, the main objective of this paper is to develop multimedia enhanced contents to raise HIV/AIDS awareness to children. ADDIE model, Adobe Flash Professional 5, Action Script programming language and articulate storyline2 authoring tool, were used in the development of multimedia enhanced contents. Results show that level of HIV/AIDS knowledge among pupils after using the interactive multimedia has been enhanced in the tested three knowledge areas (causes, prevention and effects). Results in this paper suggest that, multimedia enhanced contents can be used to complement text book based learning approach in enhancing HIV/AIDS awareness for children in primary schools in Tanzania.

Keywords: HIV/AIDS · Interactive multimedia content · Tanzania · Primary schools

1 Introduction

It is estimated that more than two-thirds (70%) of all the 35 million people living with HIV in the world are in Sub-Saharan Africa [1]. The region has just over 10% of the world's population, but constitutes 70% of all people living with HIV worldwide. Young people are the most affected by HIV/AIDS epidemic in Tanzania [2].

For example, it is estimated that more than 60% of all new HIV infections in Tanzania occur among young people [3]. Statistics also show that 17% of the child population in Tanzania aged between 0 and 14 years are vulnerable to HIV infection, poverty and associated threats to well-being, with 5% characterized as most vulnerable. While almost all children aged 15 years and below have heard about HIV/AIDS, less than half have enough knowledge to protect themselves against infection. There are many factors that lead to HIV/AIDS epidemic spread among children in Tanzania and other developing countries which include: early marriages, early sex debut and some socio-cultural beliefs such as female genital mutilation, spousal inheritance laws, obligatory marital sex and the encouragement to multiple sexual partners among men. However, the major cause of spread of HIV/AIDS epidemic is lack of information about the disease [4].

Bilinga and Mabula [5] indicated that 450 standard V, VI and VII pupils from 10 schools in Morogoro Municipality shows that, though majority of pupils reported to have been taught about HIV/AIDS and related subjects, majority of them demonstrated a very low level of knowledge about HIV/AIDS [6]. This raised some questions about the effectiveness of HIV/AIDS and life skills education in schools. On the basis of the study findings, it is recommended that there should be a review of the school curriculum with a view of strengthening teaching of HIV/AIDS and life skills education [7]. Moreover, there are a good number of organizations in Tanzania engaged in one way or another in fighting against the epidemic, these include Tanzania AIDS Society (TAS), Tanzania Commission for AIDS (TACAIDS) in collaboration with the National AIDS Control Programs in the Ministry of Community Development, Gender and Children, Universities and other Higher Learning Institutions in the country, International Development Partners on AIDS, Community Based Organizations, Non-Governmental Organizations, Civil Societies and government sectors [3]. All these efforts are focusing on creating HIV/AIDS preventive awareness in Tanzania. Apart from all these efforts, still HIV/AIDS knowledge or awareness among young people remain inadequate [2].

PMO [3] stated that in order to protect young people against HIV/AIDS, the children need information, skills, children friendly health services, and a safe and supportive environment. Rishante [8] stated that the study of HIV/AIDS is not easy to implement with the existing common teaching and learning methods. However, Information and Communication Technology (ICT) resources hold great potential for HIV/AIDS education for children because children like to use ICT resources for entertainment, learning, networking and communication [9]. ICT-based teaching and learning approaches are most likely to motivate children to learn about HIV/AIDS education in addition to the use of textbooks [10]. One of the advantages of the ICT is in making multimedia teaching and learning contents, in which the multimedia contents can be used as the solution to improve the student motivations in learning [11]. Moreover, development of multimedia content allows the integration of multiple multimedia elements that could ease the study and understanding of HIV/AIDS thus enriching the learning environment. Technology can change the paradigm of teacher-centered to student-centered [11].

It is important to apply technology for educational applications in teaching HIV/AIDS in classrooms through the use of multimedia content in accordance to the local context of Tanzanian curriculum for primary schools. Therefore, the main

objective of this study is to develop multimedia enhanced content to raise HIV/AIDS awareness to children.

2 Literature Review

2.1 Multimedia and Children Learning

Childhood Education is an important stage in the child's educational life. If a teacher succeeds in framing a sound base and making the entire concept clear to a child then in future the student will be able to grasp difficult thing easily [12]. ICT has the potential to raise the quality of education in childhood. Multimedia as part of ICT, empowers the teaching and learning processes by means of increased interaction between teachers and students [13]. Multimedia enriches the learning contents by providing different tools for learning the same lesson. It allows integration of multiple multimedia elements that could ease the study and understanding of a subject matter thus enriching the learning environment. The process of knowledge acquisition becomes more efficient when the learners experience an event through a multimedia contents such as simulation [14]. Multimedia overcomes the barriers of time and space for educating multi-disciplinary masses.

Skills related to creative expression and aesthetic appreciation painting, drawing can be better done in computer instead of paper and color pencil. Sensitivity towards beauty can be encouraged by PowerPoint presentation showing beautiful collections of birds, flowers, animals [15] that are attractive to children. Different types of multimedia contents such as audio, video, text, images, animations, interactive texts, exciting feedbacks (positive or negative) are highly significant on children's academic performances and all round development [16].

2.2 Related Works

The emergence of information technology has become an integral part towards the study of HIV/AIDS. In relation to that, a lot of efforts and steps have been taken to increase the students' quality of learning and understanding in HIV/AIDS courses [17].

Kaewkiriya [18] developed multimedia game for multimedia technology lesson with the purpose to assist students in learning the subject. The developed multimedia game was used to make the lesson more interesting and at the same time to provide students with real example of how multimedia works. The effectiveness of the developed game was studied by comparing results of the same test from students taking conventional class-room lectures and those using the developed multimedia game in Thailand. Results showed that those using the developed multimedia game performed better at the statistical significance level of 0.05.

Kizito & Suhonen [17] developed computer games and online lessons with discussion forum designed using open source learning management system (Moodle). The digital learning objects were for HIV/AIDS prevention education in schools. The aim was to design digital learning environment and evaluate its acceptance with students of age range from 13 to 19 years and teachers in Uganda. Hence the experimentation of

these games and online lessons in schools and the subsequent evaluation shows acceptance of games and online lessons.

Krishna et al., [19] aimed at determining whether health outcomes of children who have asthma can be improved through the use of an Internet-enabled interactive multimedia asthma education program. A total of 228 children with asthma were randomly assigned to control and intervention groups. Children and caregivers in both groups received traditional patient education. Intervention group participants received additional self-management education through the interactive multimedia program for asthma control and tracking. Results showed that interactive multimedia program for asthma control and tracking significantly increased asthma knowledge of children and caregivers, it decreased asthma symptom days (81 vs 51 per year), and decreased number of emergency department visits (1.93 vs 0.62 per year) among the intervention group participants. The conclusion was supplementing conventional asthma care with interactive multimedia education can significantly improve asthma knowledge and reduce the burden of childhood asthma.

Chuang and Chen [10] investigated whether computer-based video games facilitate children's cognitive learning in Taiwan. In comparison to traditional computer-assisted instruction, the study explored the impact of the varied types of instructional delivery strategies on children's learning achievement. One major research null hypothesis was tested: there are no statistically significant differences in students' achievement when they receive two different instructional treatments: (1) traditional computer-assisted instruction; and (2) a computer-based video game. Results indicate that computer-based video game playing not only improves participants' fact/recall processes but also promotes problem-solving skills by recognizing multiple solutions for problems.

From the existing related work, it has been noted that technology enhanced learning improves the learning process. The existing related study on HIV/AIDS focuses on examining acceptance of developed multimedia game and online lessons for students aged 13-19 years and teachers. To the best of our knowledge, there is no study that examined if multimedia contents can enhance HIV/AIDS awareness to children in Tanzania. Moreover, most of the existing multimedia content are context based on a certain culture. They are not designed on the ways Tanzanian children learn, and also not tested with children to assure that the multimedia content is fit for that age group. They also lack features for monitoring of children learning progress and do not provide feedback to their teachers or parents [13]. Walsham and Sahay [20] argue that computer based applications that are currently used in developing countries such as Tanzania originates from the United States of America (USA) and the United Kingdoms (UK). Subsequently, educational software packages are mainly based on the curricula and preferred pedagogies of these countries. This includes the existing HIV/AIDS multimedia content available on the Internet. The existing multimedia contents lack local context to match with the Tanzanian curriculum for primary schools. Therefore this paper filled this gap by developing multimedia enhanced contents that enabled children to learn HIV/AIDS awareness education in the context of Tanzanian curriculum for primary schools.

3 Methodology

3.1 Study Area and Sample Size

Participants chosen for this study were selected through simple random sampling. Two primary schools were selected, one public (Karakata primary school) and one private (Libermann primary school) with computer laboratory or computers and are easily reachable in Ilala district, Dar es Salaam region. The target population were standard three (3) to standard six (6) pupils who are taught about HIV/AIDS. The study group is composed of 40 pupils and 4 teachers from Libermann and 40 pupils and 4 teachers from Karakata, which sum up to 80 pupils and 8 teachers.

3.2 Data Collection and Analysis

Primary source of data involved children/pupils, teachers and organizations dealing with HIV/AIDS issues like TACAIDS, Ministry of Education and TIE. Secondary source of data was through learning what curriculum offers, search from Internet how interactive learning content are developed and other related publications. Tools used were interviews, observation, focus group discussion, document review and questionnaires for collecting both quantitative and qualitative data. It also involved studying pedagogies in primary school and understanding of HIV/AIDS content from TIE syllabus as the primary source of data and identification of requirements for developing the HIV/AIDS multimedia content as per the Tanzanian context.

The prototyped multimedia enhanced content was taken to pupils from selected primary schools where secondary data was collected. The pupils and teachers involved in the study were asked to fill in the questionnaire that was intended to evaluate the developed HIV/AIDS multimedia enhanced contents. Microsoft Excel was applied as an analysis tool. The developed multimedia contents were uploaded to the learning management system called, Tanzania Secondary School e-learning (TanSSeL) system, then students were given access to learn and do self-assessment on the understanding of HIV/AIDS multimedia content. The LMS provided a statistical assessment of the pupils' performance.

3.3 Method for Educational Multimedia Content Development

This paper adopted ADDIE instructional design model for contents design and development. ADDIE is an instructional design model which is valid for any kind of education material development. It provides a step-by-step process which assists in building the prototype. Its name is an acronym of the capital letters of the words: Analyze, Design, Develop, Implement, and Evaluate as shown in Fig. 1.

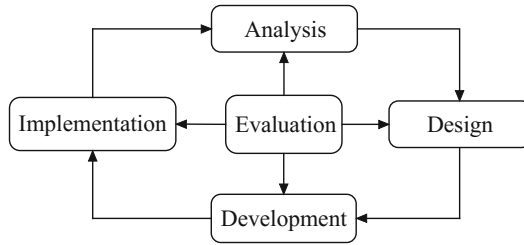


Fig. 1. ADDIE instructional design model (Source: [21])

4 HIV/AIDS Multimedia Contents Development and Evaluation

In developing the multimedia enhanced content, steps of ADDIE model were adopted. Adobe Flash Professional 5 platform, Action Script programming language and articulate storyline2 authoring tool, were used in the development of the multimedia content. The development of the multimedia enhanced contents involved teachers and pupils where the development process was characterized by stories /scenarios explaining what the multimedia enhanced content needs to do for the users. Demonstrations of the releases/versions were done repeatedly. In each iteration, units are tested before integration and evaluation tests were conducted to see whether the multimedia enhanced satisfies the expectations and needs of the users. The developed multimedia contents were uploaded and can be accessed online in TanSSeL (<http://tanssel.ecse.udsm.ac.tz/moodlecvs/course/view.php?id=76>) as seen in the Fig. 2. The same content is packed in a CD. For the user to be able to use the multimedia content, he/she has to register and thereafter login into the system. All users’ information and privileges are stored in the system database.

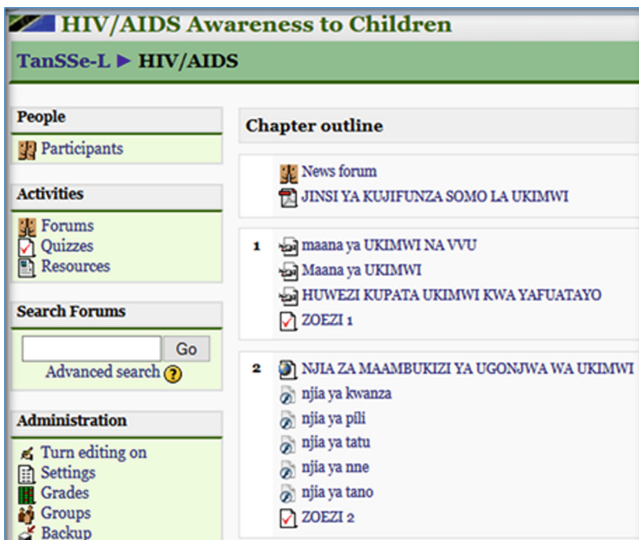


Fig. 2. A web page of the multimedia enhanced content in the TanSSeL system

Once a pupil is logged into the system, he/she can select a topic of interest, then clicks the play button so as to start learning from the multimedia enhanced contents. While learning a pupil can either pause the content, stop or rewind the multimedia content on the point where repetition is needed. The developed contents cover topics in (i) Meaning and causes of HIV/AIDS (ii) Symptoms (iii) Transmission means (v) Prevention and (vi) advises for people living with HIV/AIDS. Figure 3 shows the symptoms of a person suffering from HIV. These symptoms can be evident from a few days to several weeks after being infected by HIV/AIDS. Symptoms can be fever, coughing, headache, diarrhea, nausea and vomiting, fatigue.



Fig. 3. Fever is one of the symptoms of HIV/AIDS

One can get or transmit HIV/AIDS only through specific activities. Such as transfusion of blood which is not tested and is not safe as shown in Fig. 4. HIV/AIDS can be as well be transmitted through unsafe sexual behaviors as in Fig. 5, or by sharing of sharp objects like razor blade, needle or syringe.

After learning the pupil will be required to attempt the exercises found at the end of each topic. The exercise will be automatic marked, if the pupil has scored less than the set pass mark, then he/she will be required to repeat the exercise for the wrong answered questions. Until a pupils scored the required pass marks, then he/she will be required to move to the next level, otherwise the pupil won't be allowed to move to the next level.



Fig. 4. Unsafe blood transfusion can cause HIV/AIDS



Fig. 5. Unprotected sex can cause HIV/AIDS

4.1 Evaluation of the Developed Multimedia Contents

The developed multimedia content were used for testing/evaluation by pupils from two primary schools at Ilala district in Dar es Salaam; 40 pupils from Libermann primary school and 40 pupils from Karakata primary school, all pupils were from grade V and VI. After using the contents for three months, all 80 pupils participated in the evaluation process of the developed multimedia enhanced contents by filling in questionnaires. The questionnaire uses the 5-point Likert Scale approach. Some of the aspects considered in the questionnaire for evaluation were (i) Level of Difficulty/Easy of use (ii) Usefulness (iii) Effectiveness.

Effectiveness of the developed interactive multimedia content in HIV/AIDS awareness to children was evaluated by using pre-test and post-test approaches. The pre-test took part in January 2018 and the Post-test took part in September 2018 after pupils have been left to use the interactive multimedia in their computers. The same set of questions which were used during the pre-test was also used in the post-test as well as the same pupils who participated on the pre-test were the one who also participated on the post-test. Knowledge in HIV/AIDS awareness was measured in terms of (i) Causes of HIV/AIDS (ii) Ways of preventing against HIV/AIDS (iii) Effects of HIV/AIDS.

5 Results and Discussion

5.1 Level of Difficulty of the Multimedia Enhanced Content

Studies show that if the technology is not easy to use, users will spend more time learning how to use it rather than learning the content [22]. Therefore, it was necessary to gather feedback from pupils and teachers how they perceived the multimedia enhanced content in terms of the level of difficulty. Pupils and teachers were asked to rate the level of difficulty of the multimedia enhanced content on 5-point Likert Scale [1 = Very Difficult: 2 = Difficult: 3 = Neutral: 4 = Easy: 5 = Very Easy]. Overall, the majority of pupils and teachers (85%) indicated that the multimedia enhanced content was easy to use while 5% indicated that the multimedia enhanced content was difficult to use.

5.2 Multimedia Enhanced Content Usefulness

In order to find out if users found multimedia enhanced content to be useful in facilitating HIV/AIDS awareness creation in children, users were asked to rate on 5-point Likert Scale [1 = Strongly Disagree: 2 = Disagree: 3 = Neutral: 4 = Agree: 5 = Strong Agree]. The obtained result indicated that the majority of users 80% of pupils agreed that using multimedia enhanced content enabled to rise pupils' HIV/AIDS awareness. On the other hand, a minority of users 2.5% of pupils indicated that the multimedia enhanced content did not facilitate HIV/AIDS awareness to children.

5.3 Effectiveness of the Multimedia Enhanced Content

The effectiveness of the developed multimedia enhanced contents was evaluated by administering pre-test and post-test to pupils.

Pre-Test Results. Pupils filled out 10-item questionnaires to investigate the level of knowledge regarding HIV/AIDS awareness in terms of causes of HIV/AIDS, ways of preventing against HIV/AIDS and Effects of HIV/AIDS. Out of the 80 pupils who did the test, 60.8% from Libermann, 54.2% from Karakata) got correct answers in causes of HIV/AIDS, 60% from Libermann, 45.8% from Karakata got correct answers in ways of preventing against HIV/AIDS, and 62.5% from Libermann and 52.5% from Karakata got correct answers in effects of HIV/AIDS.

Post-Test Results. The same pupils who participated on the pre-test evaluation were given computers installed with the developed interactive multimedia enhanced content to use for three months. They responded to the same 10-item questionnaires to investigate the level of knowledge regarding HIV/AIDS awareness education. Out of the 80 pupils who did the test, 90% from Libermann and 79% from Karakata got correct answers in Causes of HIV/AIDS, 87% from Libermann and 83% from Karakata got correct answers in Prevention against HIV/AIDS, and 91.7% from Libermann and 85% from Karakata got correct answers in Effects of HIV/AIDS. The results shows that level of knowledge among pupils after using the interactive multimedia has been enhanced in the three knowledge areas (causes, prevention and effects) of HIV/AIDS education as demonstrated in Figs. 6 and 7. Therefore, the interactive multimedia content is effective in enhancing HIV/AIDS awareness education based on the results obtained.

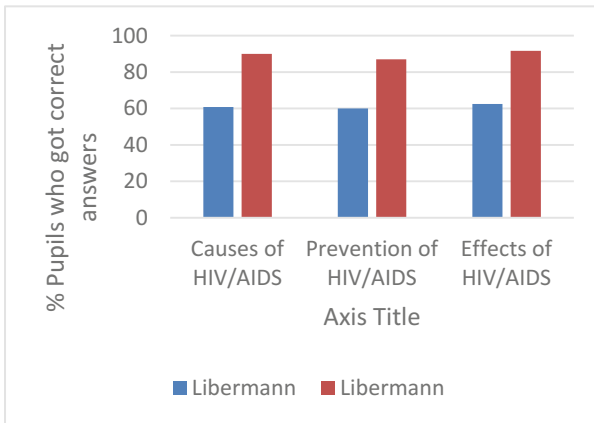


Fig. 6. Comparison of pre-test and post-test results at Libermann School

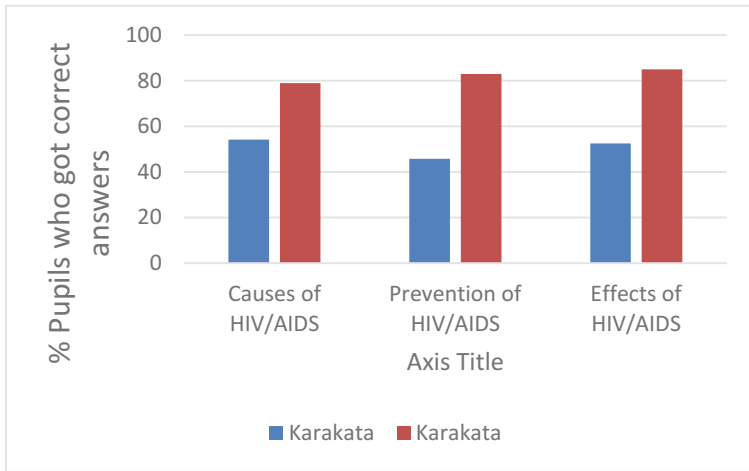


Fig. 7. Comparison of pre-test and post-test results at Karakata School

6 Conclusion and Recommendations

The findings from this paper provide a new understanding of how ICT can help to improve HIV/AIDS awareness to children. Specifically, the paper has demonstrated that multimedia enhanced contents are easy to use, useful and effective tool for enhancing HIV/AIDS awareness to children. However, one of the notable limitations of this study is that the multimedia enhanced content was tested using a small population of 8 teachers and 80 pupils in urban schools where smartphones usage and Internet coverage are high. It would be interesting to assess the effectiveness of the developed system using a large population of users including those in rural schools. Another limitation of the study was that the multimedia enhanced content was used effectively for a period of a period of three months (August - October) and then tested for effectiveness. Future research can allow many users to use the multimedia enhanced content for at least one academic year before evaluation. The developed multimedia enhanced contents were deployed to be accessible online in TanSSeL and CD only. Further studies can extend the multimedia enhanced content to be accessible in other platforms such as television and mobile devices in android, iOS, Windows, and Blackberry.

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