Leaving No-One Behind: Improving Climate Change and Entrepreneurship Education in Sub-Saharan Africa Through E-Learning and Innovative Governance Systems

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Abstract Poverty and climate change vulnerability is increasing in Sub-Saharan Africa (SSA) because the region lacks education and skills development facilities, and sustainable governance systems. Arguably, mainstreaming climate literacy in secondary schools through Information and Communications Technology (ICT) modalities can promote sustainable development and climate change resilience by providing early opportunities for the youth to gain knowledge and awareness of the behavioral and cultural changes that may foster improved climate change resilience. Through an inductive analysis based on research articles, case studies, policy briefs, and academic literature reviews, this chapter sought to highlight emerging ICT learning contexts in SSA as a means to determine the extent to which ICT may be used to promote climate change and sustainable development education in secondary schools. The chapter showed that climate literacy at secondary schools was being constrained by a lack of climate change education material and content on existing ICT learning platforms; and a lack of innovative governance systems to support governments in delivering climate literacy content to secondary schools and the youth. Consequently, to "leave no-one behind" requires non-state actors to develop and utilise innovative governance systems and digital climate literacy material that can complement government efforts to mainstream climate literacy at secondary schools.

Keywords Climate change education · Leave no-one behind · Massive open online courses (MOOC) · Microfinance · Sustainable development goals (SDGs)

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Introduction

Despite the existence of many programmes and frameworks to improve climate change education, capacity building, adaptation and mitigation such as the United Nations Framework Convention on Climate Change (UNFCCC), climate change vulnerability in Africa is arguably increasing. For example, the Intergovernmental Panel on Climate Change (IPCC) highlighted that even though African countries have initiated comprehensive planning processes for climate change, the implementation of these plans is lagging; and the integration of climate change programmes with national economic and development planning is limited (Niang et al. 2014). To add to this, many climate change resilience-building interventions in the region do not include measures to improve access to secondary/tertiary education even though improved access to secondary/tertiary education is an aspect that many communities and beneficiaries consider imperative for local climate change resilience-building (GOM 2013a; UNDP 2014). To make matters worse, Africa is in dire need of (i) education and skills development facilities, (ii) sustainable governance systems, and (iii) hard infrastructure (WEF 2014) in order to overcome its development challenges and have a good chance to address its problems related to climate change, poverty and inequality. Consequently, Africa's education and skills development inadequacies are projected to make Africa to eventually become home to 50% of the world's illiterate population (WEF 2014).

Many universities in Sub-Saharan Africa (SSA) have various environmental programmes related to climate change capacity building. However, some commentators have pointed out that focusing on the provision of climate change education at university and targeting climate change education towards university scholars with an interest in climate change might not be the best solution for improving climate change knowledge and resilience (Mutasa 2016). Arguably, SSA needs to drastically reform the current education curriculums so that climate change studies and entrepreneurship should be taught to learners at all levels including secondary schools (Mutasa, 2016; Ajufo 2013; Baah-Boateng 2013; Musarurwa 2012; UNESCO 2010; Amanchukwu et al. 2015). However, whilst reforming education curriculums to incorporate climate change studies at secondary schools may have the potential to reduce climate change vulnerability in SSA, challenges still exist in developing and implementing pertinent curriculums and education policies since many SSA governments have problems in sufficiently funding and investing in education and skills improvement systems (WEF 2014; Mambo et al. 2016). Additionally, donor support to African education systems and climate change programmes has been inadequate and unreliable (e.g. Official Development Assistance (ODA) to Africa declined 0.5% in real terms between 2013 and 2014 although in nominal terms it was virtually unchanged—$135.2 billion in 2013 as against $135.1 billion in 2014; and ODA to least developed countries, landlocked developing countries, and small island developing States declined 16% in real terms compared to 2013) (UNECA 2015).

Distance education and distance education institutions were hyped as a solution to reach out to the isolated, marginalised, challenged and minority groups (Prinsloo 2016). Unfortunately, distance education never fully realised this promise due to regulatory constraints, institutional inefficiencies and structural inequalities affecting access to education (Prinsloo 2016). However, with the advent of the internet and mobile phones there is now potential to finally reach out and educate societies' marginalised and isolated communities through various Information and Communications Technology (ICT) education platforms. In Africa, 14.7 out of 100 inhabitants use the internet, which is much lower than the World average of 43.7 (UNECA 2015). However, Africa's average annual growth rate of internet users per 100 inhabitants is growing faster than the World average growth rate (i.e. 21.7% for Africa against a World average of 10.2%), hence if the current growth rates are maintained over the coming years, Africa may match or exceed the World average internet usage rate (UNECA 2015). Arguably, such remarkable growth in Africa's internet usage rates may therefore be embraced by development practitioners and education policy specialists as an opportunity to promote the use of ICT based education platforms either as compliments or replacements of distance education and distance education institutions.

ICT is considered as a catalyst that can facilitate life-long learning, climate change education (Alexandru et al. 2013), inclusive human development (Asongu and Le Roux 2017) and entrepreneurship (Fatoki 2016). The Sustainable Development Goals (SDGs) are calling for the youth to have access to learning opportunities that can help them to acquire the knowledge and skills needed to exploit opportunities and to participate fully in society (UN, 2015). Therefore, arguably, ICT may be harnessed to mainstream climate change education programmes in secondary schools and support the implementation of the SDGs. This may be important in the context of SSA as SSA is experiencing high rates of population growth to the extent that it is the only region where the rural population is continuing to grow in absolute terms (Moore 2015), hence enhancing the knowledge, awareness and participation of the youth and women on climate change issues can promote sustainable development by significantly helping in the effective implementation of climate change programmes at community level (GOM 2013b).

Previous studies on climate change education, entrepreneurship and sustainable development include Gupta et al. (2015) who analysed innovation for social enterprises in Africa and concluded that in the absence of a favourable environment for innovation, the impact of social entrepreneurship and social enterprises in Africa was constrained by existing institutional voids and market inefficiencies. Timothy et al. (2016) looked at e-learning (electronic learning) experiences from Nigeria, South Africa and the United States of America, and concluded that a combination of technology and learner's attitudes towards e-learning material and activities were aspects that determined the success of online courses. Tenzer and Pudelko (2015) discussed how the private sector through African–European partnerships between entrepreneurs could facilitate the attainment of the SGDs in SSA. Asongu and Nwachukwu (2017) assessed some factors that could facilitate inclusive human development in SSA and concluded that educational quality, innovation and

internet penetration influenced knowledge diffusion hence mobile phones were an integral component in facilitating knowledge diffusion for inclusive development and sustainable development. However, there are knowledge gaps regarding the innovations that could be implemented is SSA to promote ICT based learning for climate change education and facilitating sustainable development at secondary schools. This chapter therefore sought to address these knowledge gaps by highlighting emerging ICT learning contexts in SSA so as to determine the extent to which ICT may be used to promote climate change education and diffuse knowledge about sustainable development in SSA's secondary schools. To achieve the goals of the chapter, an inductive analysis using secondary data consisting of various research articles, case studies, policy briefs, and academic literature reviews focusing on the challenges and opportunities for climate change capacity building and ICT based education was undertaken.

The chapter is structured as follows: Section "E-Learning and M-Learning Strategies for SSA" provides a brief background on some e-learning and m-learning (mobile learning) platforms that have been developed to support primary and secondary education in SSA. In Section "A Case for Integrating Climate Change Education with Entrepreneurship Education", the chapter provides an argument on how a combination of climate change education and entrepreneurship can increase the agency of the youth towards climate change action. In Section "Discussion", the chapter provides a discussion focusing on how climate change education can facilitate the attainment of the "Leave No-One Behind" principle of the Sustainable Development Goals (SDGs). The discussion also shows how non-state actors such as microfinance institutions can implement polycentric governance approaches in order to support national governments in promoting climate change education at secondary schools. The chapter ends with a conclusion in Section "Conclusion" which emphasises the need to mainstream climate literacy at secondary schools through ICT in order to foster behavioral and cultural changes in the youth that can promote sustainable development.

E-Learning and M-Learning Strategies for SSA

ICT education platforms, more especially, e-learning and m-learning modalities can be utilised to promote access to education in various contexts. E-learning is defined as knowledge delivered by online services as education and training. E-learning is therefore a technique to enhance learning and teaching experiences and is used to educate students with or without their instructors through any type of digital media (Alexandru et al. 2013). M-learning is an extension or subset of e-learning which encompasses the use of wireless and mobile technologies (e.g. smartphones and tablets) to wirelessly transmit learning modules and administrative data, and to enable learners to communicate with lecturers and peers (Brown 2003). Developing and developed countries have various challenges in relation to improving the deployment of ICT for life-long learning, climate change education, poverty

reduction and entrepreneurship hence innovations that are effective in developed countries might not necessarily be effective in developing countries. For example, the main e-learning challenge in developed countries is how education enterprises can attract learners to their e-learning services and platforms due to an influx of Massive Open Online Courses (MOOC) (free internet based courses and programmes run by universities and development organisations) (Timothy et al. 2016; Liao and Lu 2008). In contrast, the main e-learning challenges in the developing world include a lack of relevant infrastructure (e.g. accessible and affordable broadband coverage to rural regions), and a lack of relevant learning environments (Brown 2003; Timothy et al. 2016; Asongu and Le Roux 2017). Since the constraints for enhancing the use of ICT for education vary between developing and developed countries it can be argued that developing and developed countries require different policies, strategies and actors in order to improve climate change education through ICT.

Table 1 shows some of the challenges, threats and opportunities in the climate literacy ICT domain particularly in relation to the development and use of e-learning and m-learning platforms. Notwithstanding the issues contained in Table 1, various local e-learning and m-learning platforms have been developed in SSA. Such platforms have arguably been developed as business opportunities or as social enterprises noting that the education systems in many SSA countries are characterised by poorly funded government schools, low quality education standards, overcrowding in classrooms and expensive private education (UNECA 2015; Mambo et al. 2016).

Below are examples of four e-learning and m-learning platforms that are trying to make primary and secondary school education more inclusive and affordable in the context of SSA. The examples provided below were identified through purposive sampling hence are not intended to provide a representative sample of the e-learning and m-learning platforms available in SSA but rather to provide an indication of the different implementation modalities and the nature of various non-state actors that are providing ICT solutions for secondary school education.

Eneza Education

Eneza Education is a virtual tutor that allows students to learn through their mobile phones. Eneza Education is available through text messaging and an Application/App for smartphones. This enables the service to be accessible to people in both rural and urban areas as it can work in areas with limited or no internet access and is compatible with normal phones and smartphones. The Eneza platform provides tutorials, tips, and assessments that are aligned to local primary and secondary school curriculums through virtual tutors and teacher's assistants. The platform also has a Teacher Development Course to help teachers in developing good skills in class, staff and finance management; and a Business Course to help small business owners to develop appropriate skills in banking, financial management and

Table 1 ICT challenges, threats and opportunities for creating learning and innovative education in climate change

Challenges	Threats	Opportunities
Bridging the digital divide and bringing Informatics systems for climate change education to groups that have the greatest need	Inadequate information on the best use of ICT and on how to incorporate climate change issues in education	The emergence of identifying and delivering different types of information needed for effective adaptation to climate change
Directing users to high quality information and to teach them how to assess the quality of information	Climate change information on the internet is of variable quality, overwhelming and often difficult to interpret	Institutional and individual capacity to deploy training programmes using e-learning methods
Guiding teachers and students to use specific information in educationally appropriate ways	Low ICT literacy—a potential difficulty for users to understand specific information, better manage their own way of living, and make informed decisions about personal choices	Guaranteed validity and consistency of the available information provided by the information systems for climate change education
Developing strategies to ensure high quality standards in the publication of web based information	The lack of adequate infrastructure in certain regions	Raising awareness on the fact that ICT can decrease vulnerability both to natural climate instability and human-induced climate change
Generating new web applications able to anticipate the long-term unexpected impacts of the climate change	The use of the Information systems for climate change education will work differently in different contexts, both geographically and over time	A strengthening of the teacher-student relationship in which information flows in both directions

Source Alexandru et al. (2013)

investments. More important are the assertions that up to 30% of the platform's users are not the school going segment that the platform was intended for but either drop-outs or older learners that do not go to school (Eneza Education 2017). This arguably demonstrates the zeal that people have for learning in non-traditional/non-classroom learning environments and that when there is relevant material available that is affordable and easy to access, even the non-traditional learners will try to access it to improve their understanding of things.

Ruzivo Digital Learning

Ruzivo Digital Learning is an online interactive digital learning platform targeted at primary and secondary school students in Zimbabwe. The platform is a product and

business entity of Econet Wireless (Zimbabwe), Zimbabwe's largest provider of telecommunications services (i.e. mobile and fixed wireless telephony, etc.). The Ruzivo Digital Learning platform allows students and teachers to subscribe and access digitalised academic content, including interactive lessons, exercises and tests. The platform also records the exercises and tests that a learner/subscriber undertakes and generates detailed performance reports hence his/her progress or lack thereof can easily be ascertained by the student, guardian, parent and teachers (RDL 2017). The platform therefore enables students and school authorities to easily gauge their performance and standards against national benchmarks and other schools.

Shasha

Shasha is an online repository of notes, exam questions and preparation materials for secondary school students. The platform also promotes peer-to-peer learning through online discussion forums. The platform does not charge access/user/subscription fees as it collects revenues for its sustainability through online advertising revenues (Shasha Network 2017). The platform therefore partly reduces the financial constraints to accessing education material that poor households have.

Padziwe Digital Library (PDL)

Padziwe Digital Library (PDL) is a secondary school focused learning software that can be used online and offline. The software package also has study guides and past exam papers which guide students on the topics for them to cover in preparation for certain exams; notes capability so that users can write and store their own notes in a database; and study tips providing helpful tips on how students can study and handle exams effectively (PDL 2017). The content on this platform is delivered through a variety of media types (animations, videos, audios, slideshows, graphics, and plain texts) hence the interactivity and visual presentations engage the students in a variety of ways and makes the learning process to be less monotonous.

Various businesses, entrepreneurs and philanthropists have risen up to the challenge and tried to address the capacity gaps in SSA's educational systems by enhancing student and teacher education and training through e-learning and m-learning modalities. The case studies demonstrate various transformative ways to provide accessible and affordable educational material and support services to primary and secondary school children from diverse backgrounds and in various contexts. The case studies also highlight an urgent need for climate change education to be included in primary school and secondary school curriculums. This follows that the focus of many platforms is to prepare students for national exams as per their national curriculums hence their content was based on the subjects in the

national curriculums (e.g. Agriculture, Mathematics, Geography, etc.). Since climate change education is not in most curriculums, most platforms therefore do not consider climate change material as being worthy of teaching or hosting. Climate change is not an environmental issue, but a phenomenon that fundamentally affects how societies develop; hence effective mitigation and adaptation does not only encompass measures to increase awareness but requires measures to facilitate various behavioral and cultural changes (GoM 2013a; IPCC 2014; Wibeck 2014). The omission of climate change education in curriculums and the lack of climate change education material on most ICT platforms therefore thwart efforts to promote sustainable development and youth empowerment since the opportunity to foster behavioral and cultural changes in society early on is missed.

A Case for Integrating Climate Change Education with Entrepreneurship Education

Abandoning the traditional framing of climate change as an environmental problem and reframing climate change issues has the potential to encourage more people to take actions to enhance climate change mitigation and adaptation. For example, climate change can be reframed as a security issue, emphasising risks to personal security posed by drastic climate change; or as an economic issue, linking climate change impacts with national economic performance (Wibeck 2014). Africa's poverty and climate change vulnerabilities are characterised by a predominance of rural poverty whereby poverty is noted to be at least three times higher in rural areas than in urban areas because of poor rural infrastructure, youth unemployment and limited access to quality education (UNECA 2014). Arguably, framing climate change in the context of an opportunity to eradicate poverty (and its contributing factors), create jobs, promote entrepreneurship and promote equality may therefore encourage the youth to develop an interest in climate change issues and incentivise businesses, entrepreneurs and philanthropists to develop climate change education ICT content for various market segments.

In addition to framing climate change as a socio-economic opportunity to foster sustainable development, there is also a need to put more effort into developing climate change education content that is engaging and salient to SSA secondary school students so that SSA's youth should feel that they have the agency to mitigate and adapt to climate change. Wibeck (2014), considers that agency is a key factor in determining whether people will engage in pro-environmental behaviour or not. Therefore, unless people believe that they can do something about the problem, and that it is worth doing something, it will be difficult to encourage engagement (Wibeck 2014). Consequently, the failure of some climate change programmes and strategies could be attributed to their climate change communications which contained alarmist messages and visualisations that increased public awareness of the severe impacts of climate change but also engendered feelings of

hopelessness and apathy in the audience (Wibeck 2014). Arguably, by integrating climate change education with entrepreneurship education it might be possible to improve the interest of secondary school students (the youth) in climate literacy and empower them with the knowledge to enable them to understand the aspects that they can do in order to reduce their climate change vulnerabilities. Entrepreneurship education can enhance the creative abilities of people and their values thereby enabling them to establish more efficient and effective processes and products, shape new norms and beliefs and enable them to take action in the midst of uncertainty (Iyigün 2015; Gutiérrez and Baquero 2017). More importantly, teaching entrepreneurship can reduce youth unemployment in SSA and hence promote sustainable development by reducing inequality and the marginalisation of the youth in accessing jobs (Ajufo 2013; Efe 2014). Due to the flexibility of e-learning and m-learning modalities, there is therefore a significant scope that ICT education platforms can therefore enhance secondary school learning environments in SSA by providing mechanisms to promote the integration of entrepreneurship and climate change education so that African youth can develop a sense of climate change agency and to enable secondary school learners to develop new practices and strategies for managing their climate change risks.

Discussion

The SDGs stipulate that by 2030, all learners should acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles (i.e. SDG 4.7); and that various stakeholders should improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning (i.e. SDG 13.3) (UN 2015). In order for this to happen, the utilisation of ICT for climate change education particularly to secondary school students and the youth will be imperative since ICT modalities provide the means to which secondary school students can access external materials and support related to climate change education; and secondary schools can provide climate change education and sustainable development knowledge even where the schools do not have a curriculum and teachers for such subjects.

Since some of the Millennium Development Goals (MDGs) were not achieved in many countries, global leaders, through the SDGs have made a pledge to "Leave No-One Behind." Through this pledge, non-income-based inequalities (such as access to education) will be tackled and governments will attempt to ensure that marginalised groups make progress on human development indices more quickly (UN 2015; Stuart and Woodroffe 2016). Arguably, these aspects mean that development practitioners and policymakers have to deploy new innovative strategies and engage various stakeholders into the education, climate change and poverty reduction fora to enhance knowledge and implementation of the SDGs and climate change mitigation and adaptation programmes. Consequently, there is an

urgent need to improve access to climate change education through different media and approaches especially to the youth and non-environment specialists (i.e. enhance climate change awareness raising and integration into school curriculums; enhance the sharing of climate change traditional and local knowledge; enhance participatory action research and social learning; and enhance knowledge-sharing and learning platforms) (IPCC 2014). A failure to improve access to climate change education at various levels may therefore exacerbate climate change vulnerability and cause many poor and marginalised communities to be left further behind.

The case studies provided demonstrate that SSA already has some established private sector led online, offline and text message based secondary school curriculum based ICT platforms that are aimed at improving the accessibility and affordability of secondary school education material and content. However, many SSA governments/countries have under-resourced educational systems (Hendrix 2017; Mambo et al. 2016), hence they are unlikely to be able to comprehensively institute the political and institutional transformations and implement policies that are required in order to mainstream climate change education into secondary schools. This means that secondary school climate change education is not only constrained by the lack of climate change education material and content but also by a lack of new innovative modalities that can support national governments to develop and deliver pertinent climate change education material and content to secondary schools and the youth.

Arguably, the issue of developing and delivering climate change education to secondary schools can be addressed by stakeholders utilising innovative governance systems such as polycentric climate change governance systems, as a means to improve access to ICT education platforms for climate change education. This can therefore enable non-state actors to take an active role in supporting national governments in developing and delivering ICT based climate change education to secondary schools. This follows that measures for coping with climate change may be enhanced by taking a polycentric approach at multiple local, regional and national levels involving different stakeholders rather than focusing on single top-down policies (Scrieciu et al. 2015). Ostrom (2008, 2009, 2010), stated that polycentric governance is characterised by an organisational structure where multiple independent actors mutually order their relationships with one another under a general system of rules. Polycentric systems can function independently or form an interdependent system of relations in order to address collective action problems, free-rider problems and social dilemmas such as climate change education, capacity building, mitigation and adaptation (Ostrom 2008, 2009, 2010). Arguably, with various improvements in the ICT sector such as cheaper mobile phones and increased internet penetration there are now great opportunities to utilise polycentric governance approaches to promote climate change education and entrepreneurship education in different learning environments at optimal cost. To expound on this further, some non-state actors are innovating new ways to which polycentric governance systems can be utilised to promote climate change education and sustainable development. For example, the Beneficiary-Led Climate Change

Resilience Building Programme (BLCCRBP) in Malawi demonstrates how polycentric governance approaches may be used to facilitate climate change and entrepreneurship education in secondary schools (SOO 2017).

Microfinance is regarded as a development tool that provides financial services (i.e. credit, savings and insurance) and other complementary services such as skills education and training, youth empowerment, disaster risk management, renewable energy deployment and advice on agricultural practices to marginalised and rural populations (Ksoll et al. 2016; Moore 2015; Hogarth 2012; Agrawala and Carraro 2010). In the BLCCRBP, a microfinance institution has adapted its business model to include providing climate change education and entrepreneurship specifically to secondary schools to respond to the shortfall in strategies and programmes for empowering secondary school students on climate change issues.

Using a polycentric governance approach, the BLCCRBP aims to mainstream entrepreneurship and climate change studies into secondary schools and tertiary education institutions by creating and mentoring 300 "Climate Change and Entrepreneurship Clubs" at secondary schools and tertiary education institutions, and providing them with a Climate Change and Entrepreneurship Education Course for them to pursue through e-learning and m-learning modalities (Chirambo 2017). The BLCCRBP's polycentric approach focuses on empowering each climate change and entrepreneurship club to be able to identify the factors that increase climate change vulnerability in their communities and enable them to develop appropriate responses. It can therefore be anticipated that all the participants of the climate change and entrepreneurship clubs will be in a better position to develop business plans, use various financial services, and create social enterprises that can improve climate change agency and reduce their communities' climate change vulnerabilities.

Figure 1 provides a schematic diagram of a polycentric climate change and entrepreneurship education framework on which the BLCCRBP is based on. The diagram illustrates how a Project Implementer/non-state actor can get technical support, grants and social/impact investments from external sources in order to develop, teach and distribute climate change education content and material. On the other hand, participating secondary schools form climate change clubs in order to enable constructive dialogue and tutoring between the students, teachers and Project Implementers. The Project Implementers can use their own climate change education content and material, and also direct the students to appropriate content and material that is available from other online, offline and text message based e-learning and m-learning platforms.

Whilst the implementation of the BLCCRBP is still in its infancy hence its impacts cannot yet be evaluated, the programme is still useful in demonstrating how non-state actors such as microfinance institutions can adapt their business models in order to promote climate change education and training. An area for further research may be to evaluate the BLCCRBP to determine its ability to empower students in terms of climate literacy.

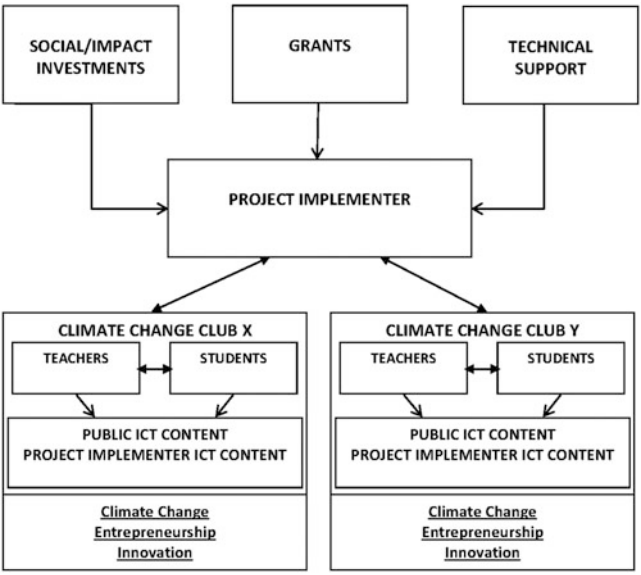

Fig. 1 Polycentric climate change and entrepreneurship education framework *Source* Author

Conclusion

The challenges for enhancing climate change education in developed countries and developing countries differ. In developed countries, there is a proliferation of various kinds of climate change information available online through learning platforms and other structures. The material is also readily accessible as the countries have good ICT infrastructure. In the developing world, there is low content on pertinent climate change information available through ICT platforms, and the situation is made even more challenging due to the poor ICT infrastructure prevalent in most developing countries. However, various stakeholders have made various initiatives to complement government investments in the education sector by implementing and developing various e-learning and m-learning platforms that improve the availability and accessibility of course material and exam material for secondary school students and secondary school curriculums. Unfortunately, most of these platforms do not contain specific climate change education content and material since climate change education is not included in many school curriculums.

Improving climate literacy systems and socio-economic institutions in SSA faces many challenges, hence there could be merits in integrating climate change education with other subjects that promote innovation and agency such as entrepreneurship. Moreover, promoting climate change education and entrepreneurship education at secondary schools to empower the youth on climate change issues through various e-learning and m-learning platforms can ensure that

"no-one is left behind" since this strategy will not only improve education on climate change but can also enable climate change challenges to be turned into opportunities for creating jobs and reducing marginalisation in pursuit of the SDGs. This can be attributed to the notion that improving knowledge on climate change can enable the youth to be more knowledgeable about society and human development processes, as well as enable them to take pro-active roles in developing strategies and social enterprises that can facilitate the development of appropriate anticipatory adaptation and mitigation options to avert the adverse impacts of climate change.

Many governments might delay in introducing climate change education in secondary schools and government investments in educational systems might be inadequate to ensure the attainment of the SDGs by 2030. Consequently, what is currently important is for various non-state actors to step up their efforts to popularise the use of ICT modalities as a means to address the gaps in the availability of climate change education material and content, and lack of implementation modalities or governance systems that can complement government efforts to develop and deliver pertinent climate change education material and content to secondary schools and the youth. Once this is achieved, SSA will be on a good trajectory to have the youth and secondary school students as agents that can facilitate sustainable development as they will, from an early stage, be equipped with the knowledge and awareness of the behavioral and cultural changes that they need to make in order to enhance climate change resilience.

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