



Determinants of instructors' educational ICT use in Ethiopian higher education

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Abstract

ICT can address concerns about access and quality of higher education in developing countries like Ethiopia. The crucial role of ICT in education has become more evident than ever during the COVID 19 crisis. Despite its role in addressing educational quality and access issues, evidence about the educational use of ICT in developing countries is scarce. Many previous studies on determinants of educational ICT focus on higher education in developed countries, while it remains unclear whether existing models explain ICT use by instructors in developing countries. This study reports the findings of a qualitative study conducted in three public universities of Ethiopia in order to elaborate determinants of instructors' educational use of ICT. First, it presents a conceptual framework of factors that explain instructors' ICT use based on literature. Second, based on empirical evidence collected from instructors, it assesses their experiences and opinions in relation to the proposed framework components. In-depth data were collected through focus group discussions from twenty-one instructors. The data were analyzed thematically with ATLAS.ti software. The results confirmed that the institutional, individual and infrastructure-related determinants of the framework are perceived to be relevant in determining instructors' ICT use. Moreover, the study revealed the necessity of extending the proposed framework through aspects of management support, course-related factors, students' ICT competence and access to ICT infrastructure as new determinants of instructors' educational ICT use. Implications for theory-building are discussed and follow-up research is proposed.

Keywords ICT use determinants · Higher education · Developing countries

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1 Introduction

Higher Education (HE) in developing countries (DCs) experiences a problem of quality. This is attributed to poor physical infrastructure, shortage of qualified staff, alongside a mismatch between curricula and needs of the labor market and limited hands-on experience of students (Mohamedbhai, 2014). Ethiopia, a country in Africa, is not an exception to this problem. Its Ministry of Education indicates that the quality of HE is suffering from large class sizes, high proportions of inexperienced teachers, teacher-dominated pedagogy and curricula that hardly respond to local needs (Ministry of Education [MoE], 2017). Although ICT is not a panacea for all difficulties in HE and for students' learning (OECD, 2015), it may address some of the challenges of HE in DCs. ICT use may facilitate the implementation of teaching approaches that promote students' engagement, collaboration and interaction (Shelomovska et al., 2016; Talebian et al., 2014), as well as create unrestricted access to relevant teaching and learning resources in HE (Shelomovska et al., 2016).

Despite widespread understanding about the benefits of ICT in teaching and learning, and increased investment in ICT (Kozma & Vota, 2014), scholars argue that it is not used satisfactorily for teaching and learning purposes in HE in developing countries in general (Choeda et al., 2016; Barakabitze et al., 2019), and in Ethiopia in particular (Alemu, 2015; MoE, 2017). This was also noticed in the first week of the COVID-19 outbreak in Ethiopia when the Ministry of Science and Higher Education directed all higher education institutions (HEIs) to implement online classes but many of the HEIs, including those with a decent ICT infrastructure, failed to do so. Studies conducted in the context of HE in developing countries focused on identifying determinants of students' ICT use (Macharia & Pelsler, 2014) and its impact on learning (Rowe et al., 2012; Bernard et al., 2014). However, limited attention is being paid to instructors; their role and voice are under-represented in these studies (Bervell & Umar, 2017). Ergado et al. (2021), for example, in their recent study of barriers for ICT implementation in Ethiopian HE institutions collected data from HE leaders, students, experts in the ministry of science and HE, and international organization (e.g., World bank group in Ethiopia) excluding HE instructors. The perspectives of instructors regarding ICT use need to be examined as the decision to use technology in teaching and learning mainly rests on instructors (Howard & Mozejko, 2015). Besides, when ICT initiatives are introduced in HEIs, it is the instructors who first experience the pressure to use ICT (Teo, 2011) and also play a role in its adoption (Chang, 2010). Furthermore, previous studies of ICT use determinants in HE focused on listing and categorizing barriers (Ali et al., 2018; Andersson & Grönlund, 2009). While the identification of generic determinants is important, policy makers in HE in DCs also need to know if there are ICT use determinants which are unique to their specific contexts if they are to make informed decision. Given these considerations, and the contextual nature of determinants of ICT use (Lim et al., 2020), we assume the need for a profound study of factors that determine ICT uptake and sustained use in Ethiopian HE. In so doing, we first propose a

conceptual framework that consists of individual, institutional and infrastructure-related determinants of instructors' ICT use based on available literature. Afterwards, we assess the proposed determinants based on qualitative evidence generated from instructors.

2 Research context

Ethiopia, as has been the case in other countries, has its own context that might have implications for ICT use in HE. As a result of the massification of HE in Ethiopia, its quality seems to be compromised. In the Ethiopian HE sector issues of access, relevance, equity and quality are the major challenges that need to be addressed during the implementation period (2018–2030) of the current education sector development roadmap (MOE, 2017). ICT is a relatively new phenomenon in Ethiopia (Alemu, 2017) and its penetration in the education sector has been slow (Tibebu et al., 2009). The Ethiopian government has embarked on ICT-enabled transformation in all sectors including education to enhance performance and deliver a better public service with the ultimate goal of improving the lives of its citizens (Lixi & Dahan, 2014). In its fifth Education Sector Development program (ESDP V) 2015/2016–2019/2020 the government plans the expansion of ICT integration in order to transform the quality of teaching at all levels of education. The plan stipulates that, during the implementation period of ESDP V, an ICT in education policy will be ratified; ICT and internet connections will be provided to all universities; pedagogy, technology and content will be integrated; ICT will be mainstreamed across core subjects, digital contents will be developed, and Learning Management Systems (LMS) will be in place at all levels of education to support teaching and learning activities (MoE, 2016). On the basis that the use of ICT is a key tool for addressing the multifaceted problems of Ethiopian HE, the government not only highlighted the need to transform HE campus environments via ICT but also engaged in increased investment in ICT. However, ICT is underutilized in Ethiopian HE (Alemu, 2015; Ergado, 2019; Tibebu et al., 2009), and yet to benefit from its use.

3 Towards a conceptual framework

3.1 ICT use

In the context of this study, ICT use refers to professional use of ICT (for teaching and learning activities) which comprises supportive use of ICT (e.g. searching supplementary materials online) (Mama & Hennessy, 2013), the administrative and managerial use of ICT (e.g., using e-mail to communicate with colleagues and students) (Mama & Hennessy, 2013) and classroom use of ICT (e.g., using ICT as a tool for demonstrations in the classroom) (Van Braak et al., 2004).

3.2 Determinants of instructors' ICT use

We capitalized on available reviews and other empirical studies to elaborate on a conceptual framework for determinants of instructors' ICT use in the HE of Ethiopia. It includes three major categories, namely: institutional characteristics, infrastructure and individual characteristics.

3.2.1 Institutional characteristics

Institutional characteristics refer to determinants that are not directly attributed to individual ICT users but systematically influence ICT use (Ali et al., 2018). *ICT vision* relates to universities' aspiration regarding the role of ICT in teaching and learning (Zhu, 2015). Institutional ICT vision is a key for ICT use (Goeman, 2008; Zhu, 2015) as it gives a general framework for strategic and operational planning and decisions regarding the allocation of required resources (Salik & Zhiyong, 2014). Research evidence shows that the lack of ICT vision is one of the critical determinants of instructors' ICT use in HE (Barakabitze et al., 2019; Raphael & Mtebe, 2016; Rana & Rana, 2020).

The *ICT plan* refers to a document prepared by universities and contains the overall philosophy and goals of ICT use in education, technical and infrastructural specification, strategies of implementation and monitoring and evaluation techniques (Vanderlinde et al., 2012). One of the potential explanations for differences between educational institutions in terms of the level of ICT integration is the presence of an ICT plan (Baylor & Ritchie, 2002). For HE in DCs, where the place of ICT in education is not clearly figured out and the institutions operate with the meager financial resources they receive from government, the role of an ICT plan is critical.

Critical for ICT uptake by instructors are *professional development* initiatives which focus on both technology and pedagogy (Goeman, 2008; Kopcha, 2012; Teo et al., 2018). These can be organized as face-to-face trainings, online tutorials, workshops or seminars that aim at improving instructors' ICT competence (Al-Busaidi & Al-Shihi, 2012). As new technological tools and pedagogies are introduced, instructors need professional development interventions that not only equip them with the required competencies to use ICT but also help them develop a positive attitude (Inamorato dos Santos et al., 2019).

Technical support, which refers to expertise support provided to instructors by specialized personnel skilled in using technology for instruction (Moses et al., 2012) is another ICT use determinant. Technical support may cover providing helpdesks and online support service (Teo, 2010) including access, operation and troubleshooting of hardware, software and network resources (Dexter et al., 2002). While working with technology instructors may face some technical issues which are beyond their capability. Also, it is not uncommon for instructors to experience confusion, intimidation and frustration when they are required by their institution to adopt new technology in the teaching-learning activities (Mouakket & Bettayeb, 2015). In such circumstances, availability of on-time technical support is important to fix technical issues (Aldheleai et al., 2019) and enhance instructors' willingness to adopt ICT (Rizana et al., 2020). In the absence of adequate technical support instructors may

not be motivated to use technology because they do not want to take risks of failing with using technologies (Buabeng-Andoh, 2012). This may imply that an efficient and effective ICT users' support system needs to be in place in universities so that instructors would be adequately supported. An ICT technical support service is, therefore, crucial as it may boost instructors' confidence for integrating ICT into their teaching (Martins & Baptista Nunes, 2016). Yet, it is frequently reported to be among the impediments to ICT use (Ali et al., 2018; Bervell & Umar, 2017; Kaliisa & Picard, 2017; Wingo et al., 2017).

3.2.2 Infrastructure

The second category of determinants refers to ICT infrastructure which encompasses ICT hardware and software, internet and electricity. Several reviews reported infrastructure to be among the major determinants of ICT use (Ali et al., 2018) in developing countries (Barakabitze et al., 2019). The availability and accessibility of ICT infrastructure are fundamental requirements of ICT use in education. Lack of ICT infrastructure may cause frustration and discouragement among instructors and, eventually, result in poor ICT use. Many recent studies stress that infrastructure matter when it comes to ICT use (e.g., Asuman & Clement, 2018; Barakabitze et al., 2019; Bridget, 2016).

3.2.3 Individual characteristics

The third category refers to attributes of instructors. We consider instructors' ICT attitude and ICT use competence in our framework. Attitude, which refers to instructors' liking or disliking for using ICT in education, determines instructors' ICT use. Teachers tend to integrate technology into their teaching when they have a positive attitude towards it. Supporting this claim, several studies showed that teachers' attitude towards ICT is among the major determinants of ICT use (Ali et al., 2018; Goeman, 2008; Kaliisa & Picard, 2017; Rohayani et al., 2015). Likewise, ICT competence is a prominent influencer of ICT use (Bervell & Umar, 2017; Rohayani et al., 2015). It denotes the instructors' knowledge and skills in using ICT in the teaching-learning process (Vanderlinde et al., 2014). ICTs have only recently been introduced into the universities of many DCs. Hence, many instructors may have no or little exposure to work with various technological tools in education which might imply limited ICT competence. Instructors' ICT competence remains one of the challenges to ICT integration in HE in Africa (Barakabitze et al., 2019).

4 Method

In this study, the researchers intended to assess determinants in the aforementioned framework based on a field study among HE instructors in Ethiopia. We employed a qualitative research approach because we wanted to gain a more profound understanding based on the instructors' knowledge and viewpoints (Creswell, 2012a, b; Flick, 2018). In this regard, qualitative research is appropriate for collecting and

analyzing in-depth information from participants in different university settings (Ary et al., 2018).

4.1 Context and sampling

Based on their year of establishment and size in terms of student population, Ethiopian universities are categorized into three generations (groups): established, emerging and new. Established universities are those founded between 1950 and 2000, have a relatively larger student and teacher population and better ICT infrastructure when compared to emerging and new universities. Emerging universities are relatively younger universities (established in 2010 and 2011) with a relatively smaller number of students and teachers and with undeveloped ICT infrastructure. New universities are those established between 2006 and 2009 and are in the middle between established and emerging universities in terms of student population and ICT infrastructure (Geda, 2014). Accordingly, the researchers considered three universities as a sample (one from each category). We used a snowball sampling technique (Creswell, 2012a, b; Patton, 1990) to select participants who were considered as information rich, willing and interested in sharing their views of ICT use determinants from different faculties at three different universities of Ethiopia. The participants were identified in such a way that first teachers whom the researchers know were contacted and the title and purpose of the study were explained to them. Thereafter, they were asked to mention instructors who might be interested and volunteer to discuss determinants of instructors' educational ICT use and have a teaching experience of at least two years. At each university the instructors whom we first contacted recommended us two or three instructors whom we should contact in each of the faculties/colleges. Accordingly, we met these instructors on the phone and explained the purpose for which we needed them. If the first person we contacted in the faculty was volunteering, we would stop there and go further with another faculty/college. If the person whom we first contacted was not volunteering, we would go for the second person on the list. We repeated this procedure till we secured one participant from each faculty/college in the three universities. Twenty-one instructors, with varying disciplinary backgrounds (health science, social sciences, natural sciences, engineering, agriculture science, and business and economics) and teaching experience between 2 and 20 years participated in one out of three focus group discussions (FGDs) (one for each university). About 85% or 18 instructors obtained a Master's diploma, 9.5% ($n=2$) a Doctoral degree and the remaining university staff held a bachelor's degree. The majority of the participants taught at undergraduate level.

4.2 Data collection

We collected information-rich data from university instructors through FGDs. We opted for this data collection procedure as we intended to generate data which is shaped by group interaction (Flick, 2018) and provides information that might be forgotten or repressed if collected by other methods such as an individual interview (Berg, 2001). Three face-to-face FGDs, each consisting of 6 to 8 participants, were

conducted at the three universities at locations preferred by the participants and permitted by the universities. The moderator of the discussions did not reveal the theoretical framework to the participants. He rather encouraged them to freely discuss their experiences and opinions regarding what determinane their educational ICT use.

The FGDs had three sections. The first part was the introduction section in which the FGD facilitator and the participants introduced themselves to each other and discussed the study objectives. The second section dealt with the discussion part whereby the participants reflected their views and perceptions based on questions posed by the facilitator. The last part of the FGD was devoted to the section whereby the facilitator summarized the main points, asked if the participants had any additional thoughts to share and acknowledged the group for participating. The FGDs began by acknowledging participants for their willingness to participate in the FGD. Then the moderator introduced himself and explained the purpose of the study. The researcher further read and explained the FGD consent content to the participants (all the participants did sign the consent form). The three FGDs started after having confirmed that the participants had no further queries and concerns. To his level best the facilitator attempted to probe the discussion and let all the participants actively engage by giving them an equal chance and controlling the dominance of few individuals. The discussions were led by guiding questions such as “What institutional factors do you think determine your ICT use? What instructors-related factors affect your ICT use? What infrastructure-related determinants affect your educational ICT use? What other factors do you think as determinants of your ICT use?” The duration of the FGDs ranged from 90 to 110 min and was audio recorded using a digital sound recorder to facilitate its transcription. The audio recorded data were stored on a computer. Each FGD was transcribed verbatim and sent back to the participants to ensure the reliability of the FGD data. More than half of the respondents provided feedback. After the participants checked the transcripts and confirmed their correctness, two researchers started analyzing the data.

4.3 Data analysis

The six steps of Creswell’s (2012a, b) approach guided the qualitative data analysis. First, the taped interviews were transcribed and digitalized by the principal investigator. Afterwards, the principal researcher and one colleague researcher coded one transcript, after which the coding schemes were discussed and one final scheme was established. The remaining transcriptions were coded accordingly (Syed & Nelson, 2015). The thematization process was conducted using ATLAS.ti software and involved the identification of basic, organizing and global themes. Formation of the basic themes was conducted inductively with strong reliance on the transcriptions. The theory-driven framework was used as a blueprint for defining categories and global themes: even so, a series of new themes emerged from the FGD data in an inductive manner (Armat et al., 2018). After repeated coding, we identified fourteen basic themes that are categorized under four organizing themes to form one global theme (Attride-Stirling, 2001) (see Fig. 1).

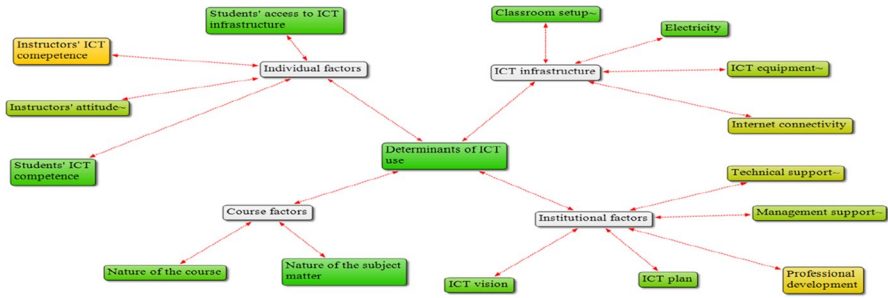


Fig. 1 Thematic networks of the emerging themes

Descriptions of the themes are supported with sample quotes from participants because of their enriching character. To ensure anonymous reporting, the universities and instructors are represented by letters (A, B and C) and numbers respectively. We used square brackets to indicate the part of the transcript that has been omitted to focus on what is key for illustrating the findings.

5 Results

The results of our study indicated that institutional characteristics (ICT use vision, ICT plan, professional development, management support and technical support), individual characteristics (instructors' ICT competence and instructors' attitude, students' ICT competence and access to infrastructure) and infrastructure (internet, ICT equipment, electricity and classroom setup) are perceived by the instructors to be their ICT use determinants.

We further extended our initial framework to include five new themes which are labeled under the three existing and one new categorizing themes, namely: *management support* (institutional characteristics), *students' ICT use competence*, *students' access to infrastructure* (individual characteristics), *classroom setup* (infrastructure) and *course factors* (new category). The initial and emerging determinants are presented in Table 1 and discussed in the following sections.

5.1 Institutional characteristics

Institutional characteristics encompass *ICT vision*, *ICT plan*, *professional development* as well as *technical* and *management support*. Management support, which was not in the original framework but emerged from the analysis, was included in the institutional characteristics category. Each of the determinants in the institutional characteristics category is discussed in the upcoming sections (Table 2).

Table 1 Overview of existing and emerging determinants of ICT use

Categories	Determinants	Exists and supported	Emerged (new)
Institutional	ICT vision	✓	–
	ICT Plan	✓	–
	Professional development	✓	–
	Management support	–	✓
	Technical support	✓	–
Infrastructure	Internet connectivity	✓	–
	ICT equipment	✓	–
	Electricity	✓	–
	Classroom setup	–	✓
Individual	Instructors' ICT competence	✓	–
	Instructors' ICT attitude	✓	–
	Students' ICT competence	–	✓
	Students' access to ICT infrastructure	–	✓
Course factors	Nature of the course	–	✓
	Nature of the subject matter	–	✓

5.1.1 Professional development

Professional development encompasses capacity building interventions organized by universities (awareness raising, counseling and skill development trainings) and instructors' self-training (from videos and continuous ICT use practice). It was learned from the discussion that since a majority of instructors do not have the required competence, professional development interventions that are geared towards teachers' technical and educational ICT use skills need to be in place if ICT has to be used. Even those instructors who were previously involved in ICT training complained that the training they received is inadequate and that, consequently, they need further training to use ICT in an innovative manner.

The participants asked for continuous training that begins with basic ICT skills and progresses towards the more advanced uses of ICT with a focus on its integration into teaching and learning. They, however, reported that ICT use training is yet to become an integral part of instructors' professional development program in their universities. There were also participants who reflected that, though training is needed, instructors should not always wait for their university to arrange trainings. They should use their own initiative to develop their skill at using ICT.

5.1.2 Technological support

The instructors stressed the need to monitor ICT use in the university in order to realize its efficient use. It was documented during the discussions that even the

Table 2 Instructors perception of institutional determinants

Theme	Examples of quotations
Professional development	<p>B3: “We need capacity building training on how to utilize ICT in a better way.”</p> <p>A5: “I have to know how to operate my computers; I have to know how to update applications I use for classroom education. Thus, digital literacy training is important.”</p> <p>A1: “But now, to train in software, you only need to go to YouTube and get ad hoc trial training.”</p>
Technical support	<p>A2: “If I have a trouble with my computer, ICT people should help me to get through.”</p> <p>C2: “We have only few skilled man powers on ICT professionals [...] the existing ones lack commitment to support and they sometimes seek incentives from teachers.”</p>
Management support	<p>C2: “Emphasis given by top management is very poor, top management is unwilling to listen to our basics and common ICT infrastructure questions.”</p> <p>B1: “I have not seen any training, any workshop on ICT use. We have to see this. The University management has to create such opportunities for instructors.”</p>
ICT plan	<p>C5: “Compared to other sectors, universities have no serious budget problem. But the budget is not properly utilized [...] the problem is that universities are not planning to improve the different ICT infrastructure and internet speed.”</p> <p>B4: “Office secretariats have better access to internet than computer teachers [...]. There are also people in the administration whose work does not demand the use of computers but given lap top by the university while teachers do not have it. Hence, the university should identify priority.”</p>
ICT vision	<p>A4: “Of course, we know university A aspires to be one of the leading higher education institutions in the world. But, if you go down, you do not find details of how this could be possible. For example, we do not know the vision of ICT after 10 years. What if it is put in detail?”</p> <p>A3: “The university needs to have a boss who has a vision and plan in the future.”</p>

existing meager ICT infrastructure including the internet are misused (mostly for entertainment) due to the absence of an adequate monitoring system.

In additions, though instructors were in need of orientation and technical support, they received little support from the ICT office as, according to the instructors, the so called “ICT experts” had neither the skill nor commitment to support instructors. Moreover, ICT technical support staff members were not available when instructors needed them. Furthermore, it seems that the technical support staff members seek undeserved incentives from instructors to perform their regular duty of providing support. Instructors usually receive support after much pleading and sometimes go to commercial computer shops in the town and pay to get their computers fixed.

5.1.3 Management support

Management support mainly involves resources (ICT infrastructure) provision and funding for capacity building trainings necessary for ICT uptake in education. It was

widely discussed by participants as one of the determinants of instructors' educational use of ICT. The participants stated that the university management needs to be in the driving seat if ICT has to be used in education. Besides, the role of university management in organizing skills development training was underscored by the participants.

Though instructors expect much from the university management, it does not seem they were satisfied with the support they received. This is manifested through the universities' management unwillingness to support educational ICT use initiatives and unresponsiveness to ICT use-related requirements. The participants perceived that such unwillingness and unresponsiveness are due to poor competence and understanding of the benefits of ICT in education by the universities' management body. Besides, the high turnover of the universities' management is another challenge as most of them are removed from their position without having sufficient time to implement their plan.

5.1.4 ICT plan

The participants indicated that, in the universities, there were multiple priorities that compete for the meager resources. The universities, therefore, need to have a specific ICT plan that rationalizes the allocation of resources for educational ICT use. For the participants, having an ICT plan helps to efficiently utilize the existing meager resources. Regarding the priority issue, the instructors complained that, currently, ICT is more accessible to administrative staff than to instructors which means that academics are given less attention when it comes to ICT infrastructure. It seems that the instructors attribute some challenges in ICT use such as financing and shortage of infrastructure to poor planning.

5.1.5 ICT vision

As stated by the participants, the existence of an ICT vision in the universities can influence instructors' educational use of ICT. It is essential for instructors to know what their university desires to realize by using ICT. For this to happen, it is decisive to have visionary leaders. Instructors desire to be aware of what their university thinks and needs to achieve in the areas of teaching and learning by using ICT so that they know what is expected of them and work to their fullest potential.

5.1.6 Infrastructure

Infrastructure comprises internet connectivity, ICT equipment, electricity, and classroom set-up (Table 3).

5.1.7 Internet connectivity

Internet was widely shared among the participants as a critical determinant of ICT use. Without internet, ICT use is very limited. The participants stated that the availability, accessibility and capacity of internet are challenges in the universities studied. Moreover, where internet is accessible, the signal strength was so weak that they had to stay in the office for long hours to search teaching and learning resources. Limited

access to internet is attributed to weak management commitment and restrictions from the government preventing access to relevant websites due to political reasons.

5.1.8 ICT equipment

ICT equipment mainly encompasses computers and LCDs. The availability, accessibility, functionality and processing capacity of computers were also mentioned by the participants as determining factor for instructors' ICT use. There was a shortage of computers in the universities and, hence, only a few instructors had their own PCs. The instructors mentioned that though they needed to have high capacity computers, they often received computers and laptops having low processing capacity. It was also evident from the discussions that some ICT equipment is dysfunctional due to misuse by instructors and poor maintenance services.

5.1.9 Electricity

Electricity is another basic infrastructural component that determines ICT use. Participants stated that their ICT use is mainly contingent upon availability of electricity. From the FGDs, it became clear that instructors had been challenged when their class was interrupted while using ICT because of a sudden electricity disruption.

5.1.10 Classroom set-up

The participants stated that the majority of classrooms were not convenient for ICT use. Large class size, inappropriately designed halls, and poorly installed electrical and internet networks were some of the challenges in relation to classroom setup (Table 3).

Table 3 Instructors perception of infrastructure

Theme	Examples of quotations
Internet connectivity	A3: <i>"Internet is the most important factor determining the use of ICT for learning and teaching process."</i> C1: <i>"I do not have access to internet all the time."</i> A5: <i>"Internet speed is important. You can sit in your office the whole day without browsing what you want"</i>
ICT equipment	C6: <i>"Surprisingly, for a department that has thirty teachers, the university gave only one computer."</i> A5: <i>"The other one is shortage of computers with high capacity [...] We often receive computers with low processing capacity."</i> C5: <i>"There are ICT resources which are not functioning due to lack of qualified ICT experts. Printers and computers are not functional due to absence of maintenance."</i>
Electricity	B1: <i>"The first thing is interruption of electric power. The voltage is low to run the available computers for teaching learning process."</i>
Classroom setup	C2: <i>"The first thing is the classroom design; the sitting arrangement is not convenient. The class is not suitable for LCD usage because the sitting arrangement is not in the proper manner."</i>

In sum, participants in the three universities highlighted the decisive role of ICT infrastructure in order to ensure ICT use in education. However, they complained that shortages, accessibility and limited capacity of ICT infrastructure affected the enhanced use of ICT in the universities.

5.2 Individual characteristics

The findings of this study showed that both instructors' and students' characteristics (a new determinant which emerged from the data analysis though it was beyond the scope of the study) determined ICT use.

5.2.1 Instructors' ICT attitude

The participants expressed that an attitude determines instructors' ICT use. Conversely, ICT attitude is also determined by ICT use. A positive attitude is the result of interest in and continuous use of ICT. It was indicated during the discussion that when a person stays away from using computers, he/she may be discouraged from using them. This situation may eventually result in rejecting the technology altogether.

5.2.2 Instructors' ICT competences

ICT competences encompass both technical ICT use and skills to integrate ICT into teaching. Participants expressed that instructors' know-how determines their ICT use. The instructors explained that they have limited knowledge and skills (which they developed through self-learning) in using ICT for teaching and learning purposes. Moreover, instructors indicated that they needed the skill of ICT use specific to teaching and learning. This competence encompasses the skill and knowledge of integrating ICT into teaching and learning based on pedagogical theories and principles. The above descriptions indicate that though ICT competence is one of the prerequisites for using ICT, instructors perceive that they are not proficient in using ICT.

5.2.3 Students' access to ICT infrastructure

Though not in the original framework, student characteristics were found to be important themes emerging from the data. During the FGDs, instructors referred to students encountering difficulties due to a lack of access to laptops, desktops and internet. Due to the continuous increase in students as a result of HE expansion, there is a shortage of ICT resources. Consequently, students are obliged to pay per page for their assignments at commercial computer centers. This situation seems to limit instructors' ICT use in teaching and learning. There are also situations in which students prefer not to attend ICT-supported classes. This is the case when instructors rush with PowerPoint presentations to cover lessons and students fail to keep up with the instructors' pace (Table 4).

Table 4 Instructors' perception of individual determinants

Theme	Examples of quotations
Instructors' ICT attitude	B2: <i>"If a person stays away from technology use because of either frustration or skill gap, he/she eventually hates to use it [...]. The more you lack the skill to use ICT, the more you stay away from using it and, through time, dislike using it."</i>
Instructors' ICT competences	A3: <i>"The technology is fast and we fail to catch it up [...] I cannot use such applications as Excel and Access. I rather use common applications like Word and PowerPoint only."</i> C6: <i>"I need to have the skills of delivering my lesson online. [...]"</i> B2: <i>"Simple technical skill of operating ICT is not sufficient for educational use of ICT. A professional skill-pedagogy is also important. For instance, you may prepare a PowerPoint but you need to know how to use it in the classroom."</i>
Students' access to ICT infrastructure	B2: <i>"Students have limited access to ICT facilities to perform different educational activities including senior essay and projects as a requirement of training programs."</i>
Students' ICT competences	C2: <i>"Some students even do not know how to use computer mouse."</i>

5.2.4 Students' ICT competences

Instructors perceived that their ICT use is determined by the extent to which students are competent ICT users. It was clear from the discussion that, if ICT is to be used in teaching and learning, there should be a favorable environment for both instructors and the students. If instructors have to use ICT in teaching and learning, students also need to have access and competence in using ICT. Participants explained that their students are deficient in ICT use and have limited access to ICT facilities so that ICT integration is challenging.

5.3 Course factors

Two particular aspects of the course factors influence the extent to which ICT is integrated. These are the nature of course and subject matter (Table 5).

The participants stated that there are courses whose implementation demands relatively intensive use of ICT. Natural science and engineering courses are more technology intensive than social sciences. In addition, it was learned during the discussion that, in engineering disciplines, the use of ICT is more extensive. In these disciplines, it is not uncommon to run different software which demands extensive utilization of ICT.

Table 5 Instructors perception of course factors

Theme	Examples of quotation
Nature of course	B6: <i>"Most of science subjects call for ICT as a supportive tool for teaching learning process."</i>
Nature of the subject matter	C4: <i>"In Engineering, ICT use in teaching-learning is mandatory. It is not an option."</i> C1: <i>"Some courses demand us to run different software like SPSS, STATA to teach the students in the Lab using computers."</i>

There is also a difference between theoretical and practical courses in terms of frequency of ICT use. Theory-based courses - those that do not demand extensive experimentation, demonstration and other hands-on experiences - demand a relatively lower level of ICT use compared to practical courses. However, there are practical courses that demand intensive use of ICT because the courses require both students and instructors to run specific educational software. There are also courses that demand recording of different events on site and demonstrating them in the classroom for students. Such courses uniquely demand the intensive application of ICT.

6 Discussion

Results of the current study not only supported determinants in the proposed framework but also extended it by including newly emerged themes, namely, management support, classroom setup, the course-related factors and students' ICT competence and access to infrastructure. In line with previous evidence (Al-Mushasha & Nassuora, 2012; Bakir, 2015; Gillies, 2016) our study showed that instructors seek support, encouragement and guidance from the university management bodies when they decide to integrate technology into their teaching. Above all, it is expected that universities' managements organize training, allocate sufficient budget and supply users with appropriate ICT facilities such as computers and internet. Without adequate administrative support, ICT users face too many challenges.

The instructors indicated that ICT uptake varies across various courses, in particular between specific academic disciplines. Previously, such variations were also reported (e.g., Hbaci et al., 2021; Howard et al., 2015; Mercader & Gairin, 2020). A recent study of Mercader and Gairin (2020) indicated that obstacles are predominantly perceived in the arts and humanities which might lead to low levels of ICT use.

Our findings also indicated that instructors perceive the importance of considering the students' perspective as determinants of their ICT use. Although our primary focus was on instructors' ICT use, it was highlighted by instructors how important it was to consider the students' situation. Instructors would be challenged to integrate ICT into their teaching in a meaningful manner if there is no favorable environment for students to adopt ICT for their learning. Like instructors, students also require the right level of competence, attitude, support and access to ICT infrastructure (Ali et al., 2018).

7 Limitations of the study

This study has some limitations. First, collecting data at a single point in time from homogenous groups may raise a concern regarding the generalizability of its findings as respondents' perception about determinants of their ICT use may change over time. Secondly, as data originate from instructors in three Ethiopian universities may prevent generalization of its findings to all Ethiopian HE instructors.

Nevertheless, this study adds to the existing body of literature an insight on factors instructors perceive to be relevant in Ethiopian HE to determine their ICT use.

This may enable practitioners and managers of the HE institutions, especially those in DCs to have better insight into what it takes to facilitate ICT uptake, to make informed decisions and to establish strategic goals. Previous studies highlighted access to ICT infrastructure and individual characteristics as major determinants of instructors' ICT use in developing countries (e.g., Ayele & Birhanie, 2018; Bridget, 2016; Raphael & Mtebe, 2016; Kisanga & Ireson, 2015). The current study pointed towards the role of student and course-related factors as important determinants of instructors' ICT use. These are worth further research consideration.

8 Conclusions

With this study, we provided evidence about the determinants of ICT usage in the HE context of Ethiopia. On the basis of the literature review, we built a conceptual framework based upon different dimensions and categories: institutional, infrastructure and individual. Our proposed conceptual framework was, to a large extent, supported by the evidence that was generated from our study. The findings suggested that the determinants of instructors' ICT use are not limited to factors related to the instructors and institutions only. They encompass broader areas including factors related to students and courses. One of the most important lessons from this study is that the study of determinants of educational ICT use in HE provides better insight only when it is investigated from the perspectives of both instructors and students. Another lesson drawn from this study is that the multidimensional nature of ICT determinants indicates that educational ICT use programs and projects in HE in DCs like Ethiopia need to be tailored, holistic and systematic enough to address the identified determinants.

The present study has implications for future studies. Seemingly, not all ICT use determinants have equal capacity to predict instructors' ICT use (Goeman, 2008). This consideration implies the necessity of identifying determinants that have strong predictive capacity. To this end, it seems appropriate to conduct a follow-up quantitative investigation of the determinants using statistical techniques in order to calculate the effects of each of the identified determinants. In order to obtain findings that have broader application, future studies need to include more sample universities and augment instructors' perception with evidence obtained via observation on a longitudinal base.

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