Determinants of Information and Communication Technology Integration in the Teaching-learning process at Aksum University: Instructors' Perspective

Befekadu Zeleke[1] and Shimelis Mesfin[2]

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Abstract: This study explored factors that determine the integration of ICT in the teaching-learning process at Aksum University using a descriptive survey design. A total of 385 instructors drawn from 5 colleges were selected using proportionate stratified and simple random sampling procedures. A self-made questionnaire was used to collect data. The quantitative data were analyzed using descriptive and inferential statistics such as an independent t-test, Pearson product-moment correlation, multiple regression analysis, one-way ANOVA and two-way ANOVA. The findings unveiled that instructors' attitudes towards the use of ICT, accessibility of ICT facilities, instructors' self-efficacy and competencies, and technology characteristics highly influenced ICT integration while technical support, the nature of the curriculum, administrative support, and ICT policy less strongly influenced ICT utilization. Besides, the result of Pearson product-moment correlation indicated that ICT integration had a positive relationship with all the independent variables included in the study while stepwise regression analysis showed that 88.1% of ICT integration was predicted by the combination of instructors' self-efficacy, their attitude, the characteristics of technologies, accessibility of ICT facilities, instructors' competencies, ICT policy and administrative support at the significant model at; $F(7, 377) = 400.393$, $p<0.05$. It was thus concluded that both personal and institutional factors determine ICT integration in teaching-learning practices at Aksum University. The study indicated policy implications to improve the current status of ICT utilization to support the teaching-learning process at the University.

Key Words: ICT, Determinants, ICT Integration, Teaching-learning process

[1] Associate Professor, College of Education and Behavior Studies, Addis Ababa University, Email: befekaduzk@gmail.com
[2] Lecturer, Aksum University

Introduction

Information and Communication Technology (ICT) is a foundation of modern society that has fundamentally changed the practices and procedures of nearly all forms of endeavor within academics and governance. It is also thought that educational systems around the world are under increasing pressure to use ICT (Yuen, *et al.*, 2008). With the rapid development of science and technology in the era of globalization, higher education plays an essential role in reflecting learning environments and enhances lifelong learning processes. In this regard, ICT creates a powerful learning environment that transforms the teaching-learning process in which students deal with knowledge in an active, self-directed, and constructive way (Volman *et al.* 2001). Hence, ICT is not just considered as a tool that can be used as a replacement for existing teaching methods but rather as an instrument that supports new ways of the teaching-learning process.

Effective integration of ICT into the curricula with the intent of positively influencing teaching and learning has been in a state of evolution over the past years (Dockstader, 1999). This can be realized by changing the way people access, gather, analyze, present, transmit, and simulate information. Technology should be used as a tool to support educational objectives such as skills for searching and assessing information, cooperation, communication, and problem-solving which are important for the preparation of children for the knowledge society (Voogt, 2003; Drent and Meelissen 2007). Learning approaches using contemporary ICTs provide many opportunities for constructivist learning through their provision and support for resource-based, student-centered settings, and by enabling learning to be related to context and to practice (Barron, 1998). Using ICT, university instructors generate meaningful and engaging learning experiences for their students to enhance learning, flexibility of content and delivery.

Information Communication Technology can also enhance teaching and learning through its dynamic and interactive approach which provides real opportunities for individualized instruction. Innovative use of ICT can facilitate student-centered learning (Drent, 2005). It has also the potential to accelerate, enrich, and deepen skills; motivate and engage students in learning; strengthens teaching and provides opportunities for linking the school and the world (Davis and Tearle, 1999). Hence, every instructor should use technologies to enhance student learning so that it can encourage thinking, decision making, problem-solving, and reasoning capacity of students (Grabe and Grabe, 2001). The use of ICT as a tool of everyday life is enhancing the quality of student learning and the development of a new learning culture. Along with a shift of curricula from content-centered to competence-based, the mode of curricula delivery has now shifted from teacher-centered to student-centered supported with ICT (Sharma *et al*., 2011).

Nowadays, ICT is not only an option but also an undeniable necessity since it is considered as an important step in changing the educational system. ICT provides different opportunities that are now creating competitive edges for students through the choices it offers. Law, *et al.* (2008) state that the acquisition of ICT skills includes the ability to become a lifelong learner within the context of collaborative inquiry and the ability to work and learn from experts and colleagues in a connected global community. ICT has radically changed the traditional method of information delivery and usage patterns in the domain as well as offering a contemporary learning experience for instructors and students (Webb and Cox, 2004). Unless other simultaneous innovations brought in pedagogy, curriculum, assessment, the time and effort expended on implementing these devices produce few improvements in educational outcomes (Cross and Adam, 2007). Thus, ICT can necessarily improve student learning outcomes if it is integrated meaningfully and properly with the education system (Wang, 2001; Cartwright and Hammond, 2003; Herzig, 2004; Lim and Chai, 2004).

One of the most vital contributions of ICT in the field of education is easy access to learning. The application of ICT in education creates a new kind of learning in such a way that learning takes place in environments other than the classroom so that the information can be easily shared with other learners. This implies that ICT increases the flexibility of delivery of education so that learners can access knowledge at anytime anywhere. Nwosu and Ugbomo (2012) and Lowther, *et al.,* (2008) stated that ICT helps to expand access to education, strengthen the relevance of education to the workplace, and enhance educational quality by creating an active process connected to real life. This flexibility has heightened the availability of just-in-time learning and provides learning opportunities for many learners who were constrained by other commitments (Young, 2002).

Numerous researches have been conducted to assess the determinants of ICT integration in the teaching-learning processes (Norton, *et al.*, 2000). According to findings of various researches, personal, technological, and institutional factors highly influence the integration of ICT into the teaching-learning process. Instructors' attitudes and beliefs towards technology influence their acceptance of the usefulness of technology and its integration into teaching (Huang and Liaw, 2005; Hew and Brush, 2007). When instructors' attitudes are positive toward the use of ICT, they can easily provide useful insight into the integration of ICT into the teaching-learning processes. Besides, instructors' competence was also the major predictor of integrating ICT in teaching activity (Summers, 1990; Berner, 2003). Research has also shown that instructors' competence with computer technology is a key factor of effective use of ICT in teaching (Knezek and Christensen, 2002; Peralta and Costa, 2007). It was also proved that instructors' self-efficacy influences the use of ICT in teaching practices (Liaw, *et al.* 2007). In the same way, Yuen and Ma (2008) revealed that ICT utilization was dependent on the simplicity of computer use and perceived instructors' self-efficacy. Although some research findings showed that instructors' experience is unrelated to ICT integration in teaching (See Niederhauser and Stoddart, 2001.), many others unveiled that teaching experience

highly influenced the integration of technologies in teaching (Giordano, 2007).

Moreover, access to ICT facilities is a necessary condition for the integration of ICT into education (Yildrim, 2007; Plomp, *et al*. 2009). Effective integration of ICT into teaching depends on the availability and accessibility of access to computers, updated software, and hardware. Without technical support, instructors become frustrated and reluctant to use ICT (Tong and Trinidad, 2005). Research has also shown that various levels of administrative support and technology leadership influence the successful integration of ICT in teaching (Anderson and Dexter, 2005). This aspect of leadership will help administrators to share tasks with subordinates while focusing on the integration of technology in teaching activities. Similarly, the characteristics of technology determine the dissemination of the utilization of ICT in teaching. Evidence suggests that innovation attributes, relative advantage, compatibility, complexity, trialability, and observability as perceived by individuals influence ICT integration into the teaching-learning process (Rogers, 2003). Concerning curriculum, Stockdill and Morehouse (1992) also identified content characteristics as a factor influencing ICT integration into teaching.

In a nutshell, instructors' attitudes, self-efficacy, competency, technical support, administrative support, accessibility of ICT facilities, the nature of the curriculum, ICT policy, and the characteristics of technologies can determine the integration of ICT into teaching. In this study, therefore, the extent to which these factors determine the integration of ICT into the teaching-learning process was examined at Aksum University. This study is, therefore, guided by the following conceptual framework.

As indicated in Figure 1, ICT integration in teaching largely depends on a multitude of factors. Teachers' attitude toward ICT integration is one of these factors that determines the level and magnitude of ICT utilization. Besides, teachers' self-efficacy determines their level of ICT integration in teaching, while their competencies affect the level of ICT utilization in

teaching. In a similar vein, the remaining variables such as accessibility of ICT, administrative support, and technical support rendered to the staff, ICT policies in the institutions, the nature of the curriculum, and features of technology all affect and determine the level of ICT integration in teaching in the higher education institutions.

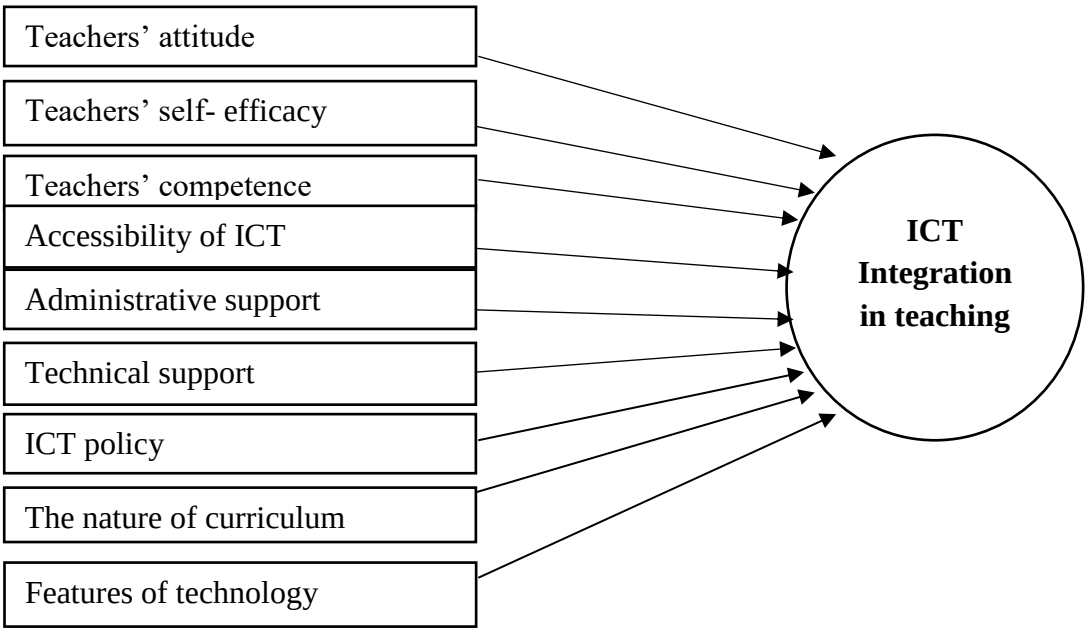

Figure1. Conceptual Framework

Statement of the problem

There has been an increasing interest given to the integration of ICT to support the teaching-learning process. Though ICT plays an important role in improving the quality of student learning, different barriers affected its integration with the education system. Most educational institutions in different countries are in the early phase of ICT adoption characterized by irregular uncoordinated provision and some enhancement of the learning process and development of e-learning, but

without deep improvements in the teaching-learning process (Balanskat *et al*., 2006). Similarly, Chigona and Chigona (2010) found that inadequate training, lack of access to computer laboratories, lack of technical support, and inadequate technology discourage teachers from using ICT in teaching.

Few local studies such as those by Birhanu (2014) and Kwacha (2007) indicated shortage of electric power supply and appropriate classrooms, insufficient facilities, lack of qualified ICT personnel, and management attitude as the main challenges deterring the successful integration of ICT into the teaching-learning process. Similarly, instructors' attitudes and resistance to change were found to be significant barriers to integrating ICT into the education system (Becta, 2004).

The use of ICT in teaching requires competent instructors to retain knowledge for a long time (Mewcha and Ayele, 2015). The findings by Mewcha and Ayele (2015) further indicated that shortage of resources and qualified personnel were the major barriers that hindered the use of ICT in the teaching-learning process. In addition to these, the integration of ICTs in education systems may face various challenges concerning attitude, policy, planning, infrastructure, learning content and language, capacity building, and financing. Though some instructors may have positive attitudes towards ICT but abstain from using it in the teaching-learning process due to low self-efficacy and tendency to consider themselves as unqualified to use technology (Birhanu, 2015). While numerous researches had been conducted in different areas, a study has not been conducted on the practices of ICT at Aksum University. Thus, this study investigated factors determining ICT integration in the teaching-learning process at the university.

The following key questions were raised to guide this study:

1. What are the different factors that determine ICT integration in the teaching-learning process at Aksum University as perceived by instructors?

2. Are there statistically significant relationships among the list of factors and ICT integration into teaching-learning practices at Aksum University as perceived by instructors?
3. Which of these factors is significantly predicting ICT integration into the teaching-learning process at Aksum University as perceived by instructors?
4. Are there statistically significant differences in instructors' perceptions of the determinants of ICT integration into the teaching-learning practices across their colleges, qualifications, and work experiences at Aksum University as perceived by instructors?

Delimitation of the study

This study specifically focuses on the determinants of ICT integration into the teaching-learning practices. Although it is important to study the status of ICT integration into the Ethiopian higher education institutions, this study is geographically delimited to Aksum University. Thus, the findings of this study may not be generalizable to other universities. Concerning the variables, this study focuses on instructors' attitudes, self-efficacy, competency, technical support, administrative support, accessibility of ICT facilities, the nature of the curriculum, ICT policy, and the characteristics of technologies.

Operational definitions

Determinants - refers to both personal and institutional factors that support or hinder the integration of ICT into the teaching-learning process as perceived by instructors and rated using a questionnaire.

ICT Integration **-** is the process of using any ICT tool to assist the teaching and learning process as measured by the mean rating of instructors using a questionnaire.

Research methodology

Since this study involved a large number of samples to gather data concerning ICT utilization in the teaching-learning process, a descriptive survey research design was found suitable since the research aims are to identify characteristics, frequencies, trends, and categories.

Sampling techniques

In Aksum University there were three campuses containing seven colleges and three schools. In these colleges/schools, there were a total of 1596 academic staff members with different levels of qualification, experience, and sex category. Out of 1596, a sample size of 429 at a 95% level of confidence was taken for this study based on Cohen, *et al*. (2007). Then, using stratified proportionate sampling, the number of individual respondents from each college/school was determined and participants were identified using simple random sampling. Then a questionnaire was distributed to all 429. Of these, 385 (89.7%) were correctly filled in and returned and thus used for this study.

Data collection tools

A self-made questionnaire was employed to collect data from sample respondents. It consisted of 85 items in which a five-point Likert scale ranging from ‘very low’ represented by a score of ‘1’ to very high designated by a score of ‘5’ was employed. Generally, items in the questionnaire were used to gather data from sample instructors on the determinants of ICT integration into teaching-learning.

Pilot Study

A pilot test was conducted on 50 instructors not included in the main study. The distribution of samples for the pilot test followed the same procedures as in the main sample. Cronbach Alpha (r) was used to test the internal consistency of the items. The reliability coefficients of the

instruments measured using Cronbach Alpha (r) were 0.82, 0.75, 0.84, 0.77, 0.91, 0.85, 0.87, 0.79 and 0.89 for items on instructors' attitude, self-efficacy, competency, technical support, administrative support, accessibility of ICT facilities, curriculum, ICT policy and the characteristics of technologies respectively. That is, items with the value of Cronbach Alpha (r) = 0.70 is above the lower limit of acceptability to judge the instrument as reliable for the study (Orodho, 2009). These results indicated high reliability of the items in the questionnaire and the instruments were thus used in the study.

Data analysis

The quantitative data gathered through the questionnaire were analyzed with the help of both descriptive and inferential statistical techniques using SPSS 24. Before data analysis, different tests were used to check whether the data met the assumptions of the analysis techniques concerning the adequacy of sample size, missing values, outliers, multi-collinearity, normality, and linearity across dependent and independent variables. After testing the assumption of each analysis technique, the actual data analysis was conducted.

Specifically, a one-sample t-test was used to assess factors that influence ICT integration into the teaching-learning process; Pearson product-moment correlation was employed to determine whether there are significant relationships between the list of factors and ICT integration in the teaching-learning process, and multiple regression was used to analyze factors that significantly predict ICT integration into student learning. Moreover, ANOVA was used to decide if there were significant differences between instructors in integrating ICT into the teaching-learning process due to variation in colleges; and Factorial ANOVA was used to determine whether instructors differed in integrating ICT into teaching-learning practices based on qualification and work experience.

Results and discussions

Instructors' perceptions of the determinants of ICT integration in teaching

Table 1: A one-sample t-test result on determinants of ICT integration into the teaching-learning process at Aksum University

Factors of ICT Integration	N	Mean	SD	Mean difference	t-value	df	Sig(2-tailed)
Attitude towards ICT	385	3.590	.4024	.59065	28.799	384	.000
Accessibility of ICT	385	3.290	.4029	.29039	14.140	384	.000
Teachers' self-efficacy	385	3.773	.3801	.77299	39.893	384	.000
Teachers' competence	385	3.101	.4119	-.00877	12.165	384	.000
Technical support	385	2.316	.4041	-.68312	-33.163	384	.000
Nature of curriculum	385	2.161	.6251	-.83822	-26.308	384	.000
Administrative support	385	2.643	.2635	-.35609	-26.508	384	.000
ICT Policy	385	2.444	.4881	-.55584	-22.344	384	.000
Characteristics of ICT	385	3.458	.4678	.45844	19.226	384	.000

* <3 = Low, 3 = Medium, and >3 = High

As depicted in Table 1, the results of a one-sample t-test indicated that the mean scores of instructors' attitudes towards the use of ICT (3.59) were significantly higher than the expected mean value (3) at ($t = 28.799$, $df = 384$, $p < 0.05$). This result showed that instructors had a positive attitude to use ICT for teaching-learning practices. The findings of Almusalam (2001) and Lawton and Gerschner (1982) also proved that instructors' attitudes have been found as a major factor to determine the use of new technologies in instructional settings. Instructors with a positive attitude towards instructional technologies can foster their integration into the classroom (Braak, *et al*., 2004). However, instructors

with a negative attitude towards technologies were less likely to use them than those with positive attitudes (Harrison and Rainer, 1992).

Data in Table 1 further indicated that the mean scores of instructors' responses on the accessibility of ICT (3.29) were higher than the expected mean value (3) at ($t = 14.140$, $df = 384$, $p < 0.05$). In this regard, the findings of Cowie and Jones (2005) indicated that the accessibility of ICT facilities encourage instructors to utilize in teaching practices. Similarly, ICT infrastructure can be one of the factors that influence the use of technology among instructors (Krysa, 1998; Shiue, 2007, Yildrim; 2007).

In addition to this, the results of a one-sample t-test revealed that the mean scores of instructors' self-efficacy to apply ICT for teaching-learning activities (3.77) was higher than the expected mean value (3) at ($t = 39.893$, $df = 384$, $p < 0.05$). This result showed that instructors were confident to apply ICT in the teaching-learning process. The results of this study were consistent with previous research findings in that the effective and efficient use of ICT in teaching practices depends on instructors' level of self-efficacy (Knezek and Christensen, 2002). In line with this, instructors may be unable to use ICT to support the teaching-learning practices due to a lack of confidence (Jones, 2004; Balanskat, *et al.,* 2007).

Concerning instructors' competence, the results of a one-sample t-test indicated that the mean scores of their competence to use ICT (3.1) was slightly higher than the expected mean value (3) at ($t = 12.165$, $df = 384$, $p < 0.05$). This implies that instructors were competent in integrating ICT into the teaching-learning process. This result was similar to findings by Berner (2003) and Summers (1990) that indicated instructors' competence as a major factor for integrating ICT into teaching. In addition to this, instructors' didactic competence was considered as a significant factor for effective and efficient utilization of ICT in teaching-learning practices (Pelgrum, 2001).

Moreover, data in Table 1 showed that the mean scores of instructors' response to the characteristics of ICT (3.45) were higher than the expected mean value (3) at ($t = 19.226$, $df = 384$, $p < 0.05$). This result showed that instructors tend to use technologies for educational purposes based on simplicity, compatibility, practicability, relevance, and observability. In line with this, the integration of ICT into teaching-learning practices depends on the relative advantage, compatibility, visibility, ease of use, results from demonstrability, and trialability (Jebelie and Reeve, 2003). Smarkola (2007) also proved that perceived usefulness and relative advantage of technologies determine their integration into the teaching activities. The findings from this study showed that instructors would use ICT for teaching practices easily if they perceived it as important. These results showed that instructors' attitudes, self-efficacy, competence, accessibility, and the characteristics of technologies highly influence the integration of ICT into the teaching-learning process more than others do.

On the other hand, technical support, the nature of the curriculum, administrative support and ICT policy were less likely to determine ICT utilization in teaching activities. Specifically, the result of a one-sample t-test showed that the mean scores of instructors' response on technical support (2.31), the nature of curriculum (2.16), administrative support (2.64) and ICT policy (2.44) were lower than the expected mean value (3) at ($t = -33.163$, $df = 384$, $p < 0.05$), ($t = -26.308$, $df = 384$, $p < 0.05$), ($t = -26.508$, $df = 384$, $p < 0.05$) and ($t = -22.344$, $df = 348$, $p < 0.05$) respectively. Concerning technical support, some findings indicated that a lack of technical support staff in a school results in a higher risk of technical breakdown (Becta, 2004). Korte and Husing (2007) also confirmed that a lack of technical support discourages instructors from integrating technology into teaching practices.

Concerning administrative support, instructors are unable to integrate technologies into teaching-learning due to lack of appropriate administrative support (Lim, 2007). In contrast to the findings of the current study, though infrastructure support is imperative, leadership is

a stronger predictor of instructors' use of computer technology in teaching (Anderson and Dexter, 2005). Likewise, lack of appropriate course content and instructional programs hindered the integration of ICT into the teaching-learning process (Yildirim, 2007).

Concerning ICT policy, the result of this study is similar to findings by Yusuf (2005) that the national policy for information technology gives little emphasis to integrate ICT into the education system. Educational institutions are required to develop an ICT strategy that incorporates the goals of their institution and how this will be met using ICTs, provide a supporting framework for the development of ICT in the institution and outline how the full potential of ICT is to be exploited to support all aspects of teaching and learning. This shows that technical support, the nature of the curriculum, administrative support, and ICT policy are less likely to influence the integration of instructional technologies into the teaching-learning process as perceived by instructors.

The relationship among list of factors and ICT integration into teaching

Table 2: Inter-correlation among the determinants of ICT integration into the teaching-learning process

Factors		Attitude	Accessibility	Self-efficacy	Competency	Technical support	Curriculum	Administrative support	ICT policy	Features of Technology
Attitude	Pearson (r)									
	Sig. (2-tailed)									
	N									
Accessibility	Pearson (r)	.194**								
	Sig. (2-tailed)	.000								
	N	385								
Self-efficacy	Pearson (r)	.417**	.580							
	Sig. (2-tailed)	.000	.000							
	N	385	385							
Competency	Pearson (r)	.306**	.083	.370*						
	Sig. (2-tailed)	.000	.103	.000						
	N	385	385	385						
Technical support	Pearson (r)	.076	.022	.032	.288*					
	Sig. (2-tailed)	.136	.668	.536	.000					
	N	385	385	385	385					
Curriculum	Pearson (r)	.235**	.008	.123	.160*	.042				
	Sig. (2-tailed)	.000	.872	.866	.002	.406				
	N	385	385	385	385	385				
Administrative support	Pearson (r)	.149**	.335	.054	.093	.075	.021			
	Sig. (2-tailed)	.003	.000	.288	.069	.140	.678			
	N	385	385	385	385	385	385			
ICT policy	Pearson (r)	.100	.022	.059	.317*	.532*	.060	.219**		
	Sig. (2-tailed)	.050	.771	.245	.000	.000	.239	.000		
	N	385	385	385	385	385	385	385		
Features of Technology	Pearson (r)	.119*	.140	.563*	.410*	.084	.051	.160**	.260	
	Sig. (2-tailed)	.020	.006	.000	.000	.101	.323	.002	.000	
	N	385	385	385	385	385	385	385	385	

***. Correlation is significant at the 0.05 level (2-tailed)*

Multi-collinearity and singularity are problems with a correlation matrix when variables are highly correlated with each other. With multi-collinearity, the variables are very highly correlated with the coefficient of correlation (r) = .90 and above; with singularity, the variables are redundant - one of the variables is a combination of two or more of the other variables. However, as shown in the table above, there was no multi-collinearity among the predictor variables because of the low coefficient of correlation observed among them.

Table 3: Pearson's product-moment correlation between the factors and ICT integration in teaching

Independent variables	ICT integration into teaching		
	N	Pearson Correlation(r)	Sig. (2-tailed)
Attitude towards ICT	385	0.712	0.00**
Accessibility of ICT	385	0.584	0.00**
Teachers' self-efficacy	385	0.783	0.00**
Teachers' competence	385	0.553	0.00**
Technical support	385	0.303	0.00**
Nature of curriculum	385	0.245	0.00**
Administrative support	385	0.420	0.00**
ICT Policy	385	0.451	0.00**
Characteristics of ICT	385	0.603	0.00**

**. Correlation is significant at the 0.05 level (2-tailed)

As indicated in Table 3, a positive relationship between independent variables and ICT integration into the teaching-learning process was observed. The results of Pearson's product-moment of correlation show that the use of ICT in teaching had high positive coefficients of correlations with instructors' self-efficacy (r**=** .78) and attitude towards ICT (r=.71) while moderate positive correlation with the characteristics of technologies (r=.60), accessibility of ICT facilities (r=.58) and instructors' competences to use ICT (r= .55) at $p<0.05$. In addition to this,

ICT integration had low but positive coefficient of correlation with the nature of curriculum (r=. 25), technical support (r= .30), administrative support (r= .42) and organizational policy (r= .45) at $p<0.05$.

These imply that factors related to instructors' attitude, self-efficacy, competence, accessibility and characteristics of ICT, ICT policy, the nature of curriculum as well as administrative and technical support had positive relationship with the integration of ICT into the teaching-learning process.

Based on the findings of this study, all the variables had a positive relationship with ICT integration into the teaching-learning practices. Specifically, the findings revealed a positive correlation between instructors' competence and technology integration in teaching practices (r = .55). This result is consistent with Sorgo *et al.* (2010) who found a positive correlation between the frequency of ICT utilization and instructors' competence. They concluded that instructors' competence is positively correlated with ICT integration into teaching. In addition to this, instructors' attitudes had a positive relationship (r=. 71) with the use of ICT. This result is consistent with the previous research findings which showed that instructors' actual ICT use is related to their attitude (Keengwe and Onchwari, 2008; Lau and Sim, 2008). Eugene (2006) and Woodrow (1992) also found that the attitudes of instructors towards technology greatly influence their adoption and integration of computers into their teaching. Instructors' attitude plays an important role in the teaching-learning process that utilizes ICT. This indicates that positive attitudes often encourage less technologically capable instructors to learn the skills necessary for the use of technology-based activities in the classroom.

Regarding self-efficacy, instructors' level of self-confidence had a positive relation (r=.78) with ICT integration in the teaching-learning process. This result is consistent with the findings by Yuen and Ma (2008) who revealed that ICT utilization is dependent on perceived instructors' level of self-efficacy. Also, innovative instructors linked the

perception of confidence in using ICT with fear of damaging the technologies. Although some instructors may have positive attitude towards the technology, they refrain from using it in their teaching due to low self-efficacy and the tendency to consider themselves unqualified to teach using technology.

In the same way, access to technology had a positive relationship (r=.58) with ICT integration. The finding of this study was consistent with Yildrim (2007) who found that access to ICT facilities was one of the effective means to open up instructors' pedagogical use of ICT. Technical support is also another factor that had a positive but weak relationship (r=.30) with the integration of ICT into teaching-learning practices. In this respect, ICT support in educational institutions influences instructors' application of ICT in their classrooms without wasting time troubleshooting hardware and software problems (Korte and Husing, 2007). For this reason, it is essential to provide guidance, support, and services as parts of the technology applications (Haslaman, *et al.*, 2008). In the integration of ICT, technical support is needed for technology use throughout the curriculum because the lack of it may create difficulties and result in diminished support for the curriculum (Resta, 2002).

Regarding the characteristics of technologies, the findings of the current study showed that ICT integration into teaching practices had a positive correlation (r=.60) with the features of the technologies based on its practicability, compatibility, observability, simplicity, and relative advantage for teaching preparation tasks. Similarly, the work of Dillon and Morris (1996) confirmed that relative advantage, complexity, observability, and image had a more widespread and rapid rate of technology integration. Therefore, if instructors perceive that innovation has an advantage over the existing technology, is compatible with their social needs, easy to use as well as trialable before use, it is more likely that they integrate it with teaching practices. There is also a positive but weak relationship between technology utilization and the nature of the curriculum (r=.24). This result is consistent with the work of Hue and Ab Jalil (2013) in which the nature of course content was found to be crucial

in determining the integration of technology and had a positive relationship with ICT integration in the teaching-learning process.

Finally, a positive correlation (r=.42) was also observed between administrative support and ICT utilization in the teaching-learning process. The finding of this study is consistent with those of the previous studies that showed the importance of transformational leadership in improving the integration of ICT into teaching and learning processes (Afshari, *et al.,* 2009). This aspect of leadership will help to share tasks with subordinates while focusing on the adoption and integration of technology. Institutions exemplified by executive involvement and decision-making, strengthened by ICT plan effectively adopt ICT integration curriculum.

The contribution of independent factors on the integration of ICT in teaching

All the nine independent variables (factors) were entered into regression equation without precondition to identifying variables that significantly predict the dependent variable. The results are shown in the table below.

Table 4: Stepwise regression analysis on the factors determining ICT integration in teaching

Model	Dependent variable	Independent variables		Unstandardized Coefficients		Standardized Coefficients		
			R Square	B	Std. Error	Beta	T-value	Sig.
	ICT integration in teaching	Constant	.881	.168	.056		2.981	.003
		Instructors' self-efficacy		.071	.018	.131	4.001	.000
		Attitude towards ICT		.161	.009	.362	18.537	.000
		Characteristics of ICT		.097	.011	.183	8.738	.000
		Accessibility of ICT		.186	.017	.225	10.679	.000
		Instructors' competence		.159	.012	.277	13.242	.000
		ICT Policy		.134	.014	.249	9.579	.000
		Administrative support		.095	.012	.205	8.144	.000

As indicated in Table 4, the result of stepwise regression analysis revealed that a total of 88.1% of ICT integration in teaching was determined by the combination of seven predictor variables of this study. The model using a stepwise regression method revealed that there was a significant model; $F (7, 377) = 400.393$, $p<0.05$. The values of coefficient of determination are found as (.131, .362, .183, .225, .277, .249, and .205 at $p<0.05$) for instructors' self-efficacy, attitude towards ICT, the characteristics of technologies, accessibility of ICT facilities, teachers' competence, ICT policy, and administrative support respectively.

This result is consistent with those of previous studies in that different factors appeared to influence the integration of ICT into teaching practices. Specifically, teachers' attitude towards ICT (Clausen, 2007; Garland and Noyes, 2004), instructors' competence (Rosenfield and Martinez-Pons, 2005), technology characteristics (*Yi et al*., 2006), self-efficacy (Yuen and Ma, 2008), access to ICT facilities (Yildrim, 2007),

administrative support (Yee, 2000) and ICT policy (Yusuf, 2005) have been found to be the most significant factors in predicting ICT integration into the teaching-learning process.

In a nutshell, regression analysis shows that the rest 11.9 % of ICT utilization is predicted by other factors that were found outside this regression. However, factors related to technical support and the nature of the curriculum were excluded from the regression equation because of their little contribution to predicting ICT integration into teaching-learning practices. This is supported by Goktas *et al.* (2009) who had similar findings.

As shown in Table 4, 88.1 % of ICT integration into teaching was predicted with the combination of seven predictor variables; however, it does not show the unique contribution of each independent variable. As a result, it was imperative to employ stepwise regression using R squared change to know the unique contribution of independent variables on the dependent variable.

Table 5: Unique contribution of factors on ICT integration into teaching using R squared change

Model	R	R Square	Adjusted R square	std. Error of estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.620[a]	.385	.383	.17079	.385	239.563	1	383	.000
2	.811[b]	.657	.655	.12766	.272	303.508	1	382	.000
3	.867[c]	.752	.751	.10862	.095	146.704	1	381	.000
4	.899[d]	.808	.806	.09581	.055	109.659	1	380	.000
5	.919[e]	.844	.842	.08634	.036	88.903	1	379	.000
6	.928[f]	.861	.858	.08184	.021	66.324	1	378	.000
7	.939[g]	.881	.879	.07557	.016	43.831	1	377	.000

From the results in Table 5, one can see the contribution of each factor in determining the integration of ICT into the teaching-learning activities. That is, ICT utilization predicted with instructors' self-efficacy (38.5%) at F (1, 383) = 239.563, attitude towards ICT (27.2%) at F (2, 382) = 303.508, the characteristics of ICT (9.5%) at F (3, 381) = 146.704, accessibility of ICT (5.5%) at F (4, 380) = 109.659, instructors' competence (3.6%) at F (5,379) = 88.903, ICT Policy (2.1%) at F (6, 378) = 66.324, and administrative support (1.6%) at F (7, 377) = 43.831. This shows that instructors' self-efficacy, attitude towards ICT, the characteristics of technologies, accessibility of ICT facilities, instructors' competence, ICT policy, and administrative support uniquely contributed to predicting ICT integration into the teaching-learning process across the models. This technique of analysis helps to reduce the limitation of stepwise regression by indicating the contribution of each factor in predicting ICT integration.

Integration of ICT into teaching-learning practices across colleges

Table 6: One way ANOVA on ICT integration due to variation in teachers' colleges

Teachers' Colleges	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.486	4	.121	2.612	.035
Within Groups	17.674	380	.047		
Total	18.160	384			

*Significant at 0.05 level

The result of one-way ANOVA indicated that a significant difference was observed between instructors' perceptions of the determinants of ICT integration into teaching due to variation in colleges in which they taught at F (4, 380) = 2.612, $p<.05$. Although significant differences were observed among instructors, it does not indicate where the differences

occurred. Thus, it was imperative to run several Post Hoc comparison tests, using Scheffé's test, to find out whether or not the overall difference is due to the variation among the different groups.

Table 7: Post Hoc Tests of Multiple Comparisons

(I) Colleges	(J) Colleges	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Natural Sciences (CNS)	Social sciences	-.02024	.03096	.980	-.1161	.0756
	Education and Behav. Sc.	.07740	.05125	.684	-.0812	.2360
	Business and Economics	.05105	.04172	.827	-.0781	.1802
	Engineering and Techno.	-.04662	.02769	.586	-.1323	.0391
College of Social sciences (CSS)	Natural Sciences	.02024	.03096	.980	-.0756	.1161
	Education and Behav. Sc.	.09764	.05255	.486	-.0650	.2603
	Business and Economics	.07129	.04331	.608	-.0628	.2054
	Engineering and Techno.	-.02638	.03004	.942	-.1194	.0666
Education and Behavioral sc. (SEBS)	Natural Sciences	-.07740	.05125	.684	-.2360	.0812
	Social sciences	-.09764	.05255	.486	-.2603	.0650
	Business and Economics	-.02635	.05953	.995	-.2106	.1579
	Engineering and Techno.	-.12403	.05069	.203	-.2809	.0329
Business and Economics (FBE)	Natural Sciences	-.05105	.04172	.827	-.1802	.0781
	Social sciences	-.07129	.04331	.608	-.2054	.0628
	Education and Behav. Sc.	.02635	.05953	.995	-.1579	.2106
	Engineering and Techno.	-.09768	.04104	.228	-.2247	.0293
Engineering and Technology (CET)	Natural Sciences	.04662	.02769	.586	-.0391	.1323
	Social sciences	.02638	.03004	.942	-.0666	.1194
	Education and Behav. Sc.	.12403	.05069	.203	-.0329	.2809
	Business and Economics	.09768	.04104	.228	-.0293	.2247

As indicated in Table 7, the mean difference values accompanied by asterisks indicated that instructors across the colleges of natural sciences, social sciences, engineering and technology, business and economics, education, and behavioral sciences did not differ from each other at 0.05 level of significance. This shows that the observed

difference among instructors' perceptions of the determinants of ICT integration into teaching was the result of the overall interaction of instructors across the five colleges.

Qualification and experience as the variance of ICT integration into teaching

To determine whether instructors differ in their responses on the determinants of ICT integration into teaching due to variations in qualification and experience, a two-way factorial analysis of variance was carried out. This technique allows assessing the effects of each independent variable separately as well as the interaction of variables as illustrated in the table below.

Table 8: Two-way factorial ANOVA on ICT integration in teaching between Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Partial S
Corrected Model	.567a	8	.071	1.516	.150	.031
Intercept	1040.120	1	1040.120	22230.498	.000	.983
Qualification	.311	2	.156	3.325	.037	.017
Experience	.313	2	.157	3.347	.036	.017
Qualification* Experience	.324	4	.081	1.732	.142	.018
Error	17.592	376	.047			
Total	3399.662	385				
Corrected Total	18.160	384				

R Squared = .035 (Adjusted R Squared = .026)

Table 8 shows that both qualification and experience were found significant factors to differentiate instructors in their perceptions on the determinants of ICT integration due to qualification and experience at F (2,376) = 3.325, and F (2,376) = 3.347, p<.05 respectively. This implies that instructors differed in their perception of the determinants of ICT integration into the teaching-learning process due to variation in their academic qualification and experience. However, a significant difference was not observed among instructors in their responses to which factors determine the use of ICT in the interaction effect of qualification and experience at F (4,376) = 1.732, p >.05. This is similar to findings by Baek, *et al*. (2008) who claimed that experienced instructors are less ready to integrate ICT into their teaching.

Table 9: Estimated Marginal Means on qualification and experience

Qualification	Mean	Std. Error	95% Confidence Interval		Experience	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound				Lower Bound	Upper Bound
BA/BSC	2.869	.039	2.793	2.945	1-5 years	2.989	.030	2.931	3.048
MA/MSC	2.982	.027	2.928	3.036	6-10 years	2.871	.038	2.797	2.945
PhD	2.985	.036	2.915	3.055	≥11 years	2.976	.035	2.908	3.044

From the estimated marginal means, significant differences were observed between instructors in their responses related to the factors determining ICT integration into teaching due to variations in qualification and work experience. That is, the mean scores of instructors who had a first degree (2.869) were lower than instructors with second degree (2.98) and third degree (2.99) on the integration of ICT. However, a significant mean difference was not observed between instructors who

had second degree and those with third degree. Concerning experience, the mean score of instructors who had 6-10 years of work experience (2.87) was lower than that of instructors with 1-5 years (2.989) and >11 years of work experience (2.98). This shows that instructors with few years of experience had more or less similar perceptions with those who have many years of experience on the determinants of ICT utilization in the teaching activities. These results confirmed the findings obtained through factorial ANOVA between-subjects' effects.

The result of this study was consistent with that of Russell *et al*. (2003) who found that new instructors were highly skilled with technology more than older instructors who did not incorporate ICT in their teaching. Similarly, Gorder (2008) claimed that experienced instructors are less likely to integrate ICT into their teaching. In the same way, in the United States, the U.S National Centre for Education Statistics (2000) reported that instructors with less experience in teaching were more likely to integrate computers into their teaching than those with more experience in teaching. On the contrary, Lau and Sim (2008) revealed that experienced instructors frequently use computer technology more than the younger ones. In general, a significant difference was observed between instructors on the determinants of ICT integration based on the variation in qualification and experience.

Table 10: Estimated Marginal Means on the interaction effect of qualification and experience

Qualification	Experience	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
First Degree	1-5 years	2.957	.020	2.917	2.997
	6-10 years	2.756	.088	2.583	2.930
	>11 years	2.894	.072	2.752	3.036
Second Degree	1-5 years	2.949	.042	2.866	3.032
	6-10 years	2.965	.018	2.930	3.000
	≥11 years	3.033	.068	2.899	3.168
Third Degree	1-5 years	3.062	.076	2.912	3.213
	6-10 years	2.891	.068	2.756	3.025
	≥11 years	3.001	.030	2.943	3.060

The result of Estimated Marginal Means showed the interaction effect of qualification and experience as the variance of ICT integration into teaching among instructors. Specifically, first degree holders with relatively few, medium, and many years of experience respectively had the mean score of 2.96, 2.76, and 2.89. Besides, the mean score of instructors with a second degree having relatively many years of experience was higher (3.03) than instructors with medium (2.97) and few years of experience (2.95). However, a significant mean difference was not observed among instructors who had medium and few years of experiences on the determinants of ICT integration into teaching. Likewise, the mean score of instructors with a third-degree having relatively medium years of experience was lower (2.89) than instructors with many years of experience (3.00) and few years of experience (3.06). However, a significant mean difference was not observed between instructors who had relatively many years of experience and few years of experience on the determinants of ICT integration into their teaching-learning activities.

Table 11: Independent sample t-test on ICT integration into teaching as a variance of gender

Dependent variable	Groups	N	Mean	SD	T-test for equality means			
					Mean difference	t-value	df	Sig(2-tailed
ICT	Male	277	2.9610	.2162	-.0092	-.373	383	.709
Integration	Female	108	2.9703	.2214				

Significance level, *P < .05

As shown in Table 11, the result of an independent sample t-test revealed that significant mean differences were not observed between male and female instructors in their perceptions on the determinants of

ICT integration into the teaching-learning process (t= -.373, df = 383, P >.709). Similarly, the mean score of male instructors (M=2.96) was similar to that of female instructors (M=2.97) on the determinants of ICT utilization in their teaching-learning activities. This result confirmed the findings obtained from one-way analysis of variance (ANOVA) on ICT integration. This tells that both groups are similar on the determinants of ICT integration.

Although some researchers found significant differences between male and female instructors in using ICT in teaching practices (Volman and van Eck, 2001; Markauskaite, 2006), there was no significant difference observed in this study between male and female instructors. This is consistent with findings by Norris, *et al.* (2003) and Kay (2006) that showed the absence of a significant difference between male and female instructors in the utilization of educational technologies in teaching.

Conclusions and implications

Conclusions

The main purpose of this study was to assess the determinants of ICT integration into the teaching-learning process at Aksum University. Based on the findings of the current study, it is possible to conclude that the integration of ICT into teaching practices was largely determined by instructors' self-efficacy, attitude towards ICT, the characteristics of technologies, accessibility of ICT facilities, instructors' competence, ICT policy, and administrative support. However, technical support and the nature of the curriculum were excluded from the regression equation because of its little contribution to predicting ICT integration into teaching practices. In addition to this, inadequate technical support, shortage of favorable classrooms, inadequate number of ICT-related courses, inadequate administrative support, shortage of electric power supply, lack of concrete models to use technology, and low instructors' motivation were found to be the major factors hindering the successful integration of ICT into teaching. In general, it was concluded that the

integration of ICT into the teaching-learning process at Aksum University was a function of both personal and institutional factors.

Implications

Based on the findings, the following implications were identified.

To integrate ICT into teaching practices in the university under study, there is a need to develop a concrete framework that guides the whole exercise. Besides, the university should give due attention to ICT integration to support and enhance the quality and relevance of existing educational structures. The integration of ICT into teaching practices further requires sufficient technical support with the necessary ICT skill and knowledge to assist instructors during classroom interaction. The integration of ICT into teaching practices further requires a sustainable power supply. Hence, the university ought to install generators for uninterrupted electric power supply so that instructors regularly use ICT in their teaching. Besides, attention should be given to in-service and pre-service programs and also to the newly assigned instructors in order to help them develop competence in the use of technology in educational settings. Finally, the university needs to arrange classrooms equipped with the necessary ICT infrastructures to promote learning opportunities with the help of instructional technology.

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