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# ICT Integration Efforts in Higher Education in Developing Economies: The Case of Addis Ababa University, Ethiopia

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# ICT Integration Efforts in Higher Education in Developing Economies:
## The Case of Addis Ababa University, Ethiopia

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## ABSTRACT

*A situational modified version of Tearle's model (2004) is utilized in this study to understand the integration of ICTs in the educational process. The study evaluated self efficacy beliefs, institutional support and policy in the context of developing economies where challenges of inadequate resources and insufficient skills persist. We assess the state of affairs, and the challenges faced by teachers and management at Addis Ababa University, Ethiopia. The results show that educators are generally appreciative of ICTs role in the teaching/learning process.* [Article copies are available for purchase from InfoSci-on-Demand.com]

*Keywords:*    *Africa; Classroom Technology; Developing Countries; Developing Economies; Ethiopia; Higher Education; ICT Integration*

## INTRODUCTION AND MOTIVATION

Today's networked economy is information and knowledge intensive. It is characterized by evolving global marketplaces coupled with business processes and sophisticated work environments. Competitive economic capabilities and success factors are now more centered on knowledge than ever. In order to remain effectively integrated in the global economy, a country's priorities should include education and training to increase the skill sets of their workforce.

Higher education (post secondary education) has been attempting to provide training to an ever increasing audience, to ensure that their graduates have the necessary knowledge and skills for the networked economy and generally prepare them for lifelong learning. To meet these challenges, educational institutions have concurrently aimed on expanding access, improving internal efficiency, and promoting the quality of teaching and learning (Haddad &

Jurich, 2002). Information and Communication Technology (ICT) is used by many educational institutions to increase the quality of teaching and learning in a cost effective manner (Means and Olson, 1995). In this networked economy higher education graduates are expected to be versatile in a world of communications that includes email, Intranet, Internet, and the world-wide web, and be able to apply higher cognitive skills (analyzing, summarizing and synthesizing information) in order to engage in creative and critical thinking (Vogel and Klassen, 2001). It has also been argued that higher education should incorporate proven pedagogical strategies such as group work, cooperative learning, peer teaching, idea sharing and reflection (Ramsden, 1992 in Lockyer, et al., 2001). ICTs have been found useful in facilitating these strategies (Lockyer, et al., 2001) and their implementation has become an indispensable part of educational reform (Law, 2004 in Sabaliauskas and Pukelis, 2004).

The potential benefits of ICTs in education have been extensively researched. The benefits of integrating ICT in the teaching/learning process has been found to be layered, multifaceted, and comprehensive as shown in Table 1.

ICT integrated benefits of wider access, quality processes, facilitated delivery, and enriched learning and teaching experiences come with challenges. Such challenges are more accentuated for a low income country (LIC). There are major obstacles to ICT integration in schools and the wider community in LICs (IDRC, 1995) and there are economic, technological, and educational (contextual) factors that constrain the potential impact of ICT integrated education programs in LICs (Kozma & Wagner, 2005).

Cross sectional studies point out common challenges faced by LICs, however, there are specific factors that are different between countries. Thus there is a general need to identify

*Table 1. Opportunities from ICT integration in education: Research findings*

| ICT Impact Attributes in Education | Finds full/partial support in |
|---|---|
| Brings positive changes in the social organization of the classroom; achieves higher student-centric focus and delivery | Capper, 2003; Cradler and Bridgforth, 2005. |
| Enhances teaching and learning through dynamic, interactive, and engaging content | Davis and Tearle, 1999; Capper, 2003; Yusuf, 2005. |
| Develops, enriches, accelerates, and deepens student skills | Davis and Tearle, 1999; Capper, 2003. |
| Relates school experience to work place, provide opportunity for connection between school and world | Davis and Tearle, 1999. |
| Enhances learning opportunities and resources to the students and teachers | Byron and Gagliardi, 2001; OTA, 1997 in Cradler and Bridgforth, 2002; Department of Education and Skills, 2002 in Tearle 2003; Becta 2003a. |
| Enhances student motivation in the learning process which then<br>• Accentuates enjoyment and interest in the learning process,<br>• Achieves higher commitment, increases independence, self esteem and confidence in students. | Cox, 1997 in Cox et al. 1999; OTA, 1995 in Cradler and Bridgforth, 2002; Capper 2003. |
| Stimulates, motivates and sparks students' appetite for learning and helps to create a culture of success | Becta, 2003c. |

and understand the specific contextual factors higher education faces in LICs. There is a dearth of academic research on the challenges faced by higher education when integrating ICT. In this study we attempt to recognize these challenges. In particular, we study the challenges faced by Addis Ababa University (AAU), a large public institution in Ethiopia, and bring the insights of context specific manifest difficulty as experienced there. The goals of this study as well as the questions that we asked to delve these inquisitions are presented in Exhibit A.

We have selected African continent as the backdrop of this study primarily because of the large concentrations of LICs. The selection of Ethiopia is congruent with our best ability to conduct detailed on-site research. We select AAU in Ethiopia because of the following reasons:

• AAU is the Flagship University of Ethiopia (ranked 32 in African Continent[1]), located at the capital city of Addis Ababa, and likely mirrors the concerns and intents of the LIC with minimum time delay.

• AAU is the most comprehensive university in Ethiopia, and likely offers the greatest heterogeneity in terms of opportunities of ICT integration and multiplicity of challenges.

• AAU is one of the forerunners among Ethiopian universities attempting ICT integration in their teaching-learning processes.

• AAU has 8 campuses and has the single largest enrolment among all the universities in Ethiopia. It thus represents the single largest group of providers in higher education, embracing the changes, and facing the myriad challenges of ICT integration in Ethiopia.

The rest of the paper is organized in the following manner: Section 2 lists and explains

*Exhibit A*

| | |
|---|---|
| **Goals of this study** | A. Assess the extent to which ICT has been integrated into the teaching and learning process at AAU<br>B. Understand the challenges encountered by teachers in the process of integrating ICT into the teaching and learning process. |
| | 1. How is ICT utilized in the teaching and learning processes at AAU? |
| | 2. Does AAU management encourage and provide apex support to the integration of ICT into the teaching and learning process? |
| | 3. What are the challenges encountered by teachers in terms of integrating ICT into the teaching and learning processes? |
| | 4. Do teachers have a positive attitude towards utilizing ICT in the teaching and learning process? |
| **Questions we asked facing the above goals** | 5. Do teachers at AAU possess adequate skills to enable them use ICT in teaching and learning? |
| | 6. Are teachers confident in their ability to use computer technologies in the teaching and learning process? |
| | 7. Do teachers receive training on how to use ICT in teaching and learning? If there are existing training programs for the teachers, to what extent are they adequate? |
| | 8. Do teachers receive support (technical and pedagogical) to help them integrate ICT into teaching and learning? |
| | 9. Are there adequate resources that could help teachers to integrate ICT in their teaching? Are these resources easily accessible? |

our basic assumptions of the study, and Section 3 provides a background of ICT integration efforts at AAU. Section-4 explains our effort in understanding and identifying the underlying factors of ICT integration from extant research, especially from the Tearle's model of ICT integration. Section-5 explains situational modification of Tearle's model and our design of experiment. Section-6 presents detailed data analysis of this study. Section-7 summarizes our observations and remarks, and section-8 provides the set of references that we have used in this work. In appendix-1, we have included the survey instrument that we have operationalized to collect data for this study.

## ASSUMPTION OF THE STUDY

### Positive Impact of ICT on AAU Student Learning

Inline with the initiatives that we have observed at AAU (e.g. ICTDO[2]), our discussion with numerous university officials, and from our readings of the body of research in high and low income countries that report positive impact of ICT on student achievement (Table-1), this study presumes that AAU actively believes that ICT would impact the teaching-learning processes.

### ICT as Enabler and Integrator at AAU

The roles of ICT in education have been identified by researchers. For instance, Pelgrum & Law (2003: 23) identify three distinctive roles[3] for ICT in education: from being a subject of learning to integral part of higher education. Anderson (1996, in Miller, 1997) note that computer assisted education means using the computer where it is the best medium to support the learning goal. Evidence suggests that ICT can contribute significantly to changes in teaching practices (Wagner, 2005). Kozma & Wagner (2005) emphasize that the way ICT is used in

the classroom can make a big difference in the impact of an ICT-augmented program or project. In discussing integration of ICT into teaching and learning at AAU, we make the assumption that ICT is used **not** to support 'learning about ICT' but to support 'learning with ICT' and 'learning through ICT'. Integration of ICT into teaching and learning in this study is, therefore, defined as utilizing the power and ability of the computer and communication technologies to support teaching and learning.

## THE BACKGROUND OF ICT INITIATIVES AT AAU

Higher education in Ethiopia has experienced slow penetration of ICT. Schools, colleges and universities in the country do not adequately utilize ICT in teaching and learning. Dzidonu (2006) notes that the Ethiopia's higher education currently faces a number of challenges in facilitating the process of development, deployment and exploitation of ICT in assisting teaching and learning processes. However, the promise of ICT in education is recognized by policy makers including the Ethiopian ICT for Development Agency (Dzidonu, 2006). The role of ICT in the national development and poverty reduction process of the country is widely accepted, and has gained high considerations from the government of Ethiopia. Similarly, AAU endeavors to integrate ICT into its education system.

AAU is the oldest multi-campus comprehensive university offering undergraduate and graduate programs in Ethiopia. It has over 40,000 students. AAU has installed a university-wide network infrastructure, AAUNet, in 2001 to enable ICT resource sharing, cooperation, and information. Three of the eight campuses (Sidist Kilo, Amist Kilo and Arat Kilo campuses) have implemented the first phase of the project. ICT Development Office (ICTDO) at AAU was established in 2003 to benefit from AAUNet by integrating it to future projects. The ICTDO mandate is to facilitate the integration of ICT into the curricula and administrative

functions; supporting distance learning through platforms, efficient maintenance and support on ICT infrastructure; building staff capacity; providing ICT research and consultancy; promoting good governance; and nurturing democracy within AAU (ICT Development Office of AAU, 2004).

ICTDO has strategic objectives and priority areas implemented and managed by three units: i) Network and Communication Services has the responsibility of carrying out the central system administration and helpdesk, including expansion plans to provide a better internet and e-mail services, ii) The Computing Services is responsible for providing all computing services including procurement, and management of software and applications, iii) Training, Research and Consultancy has the responsibility on overall coordination of training, consultancy and research, and supports the planning, budgeting and revenue management of the office.

Under this general backdrop we study the challenges that AAU stakeholders face while integrating ICT in their teaching and learning process. In our effort, we recognize and emphasize the significant role faculty members' play in integration of ICT education to support teaching/learning in and outside the classroom. Although we make a conscious choice to focus our study on teachers, neither do we suggest that teachers are the only key stakeholders in the university, nor do we opine that ICT integration in registration and other university administrative activities are any less important or desirable outcomes.

## UNDERSTANDING CONTRIBUTING FACTORS TO ICT INTEGRATION AT AAU

We adopt a simplified version of Tearle's model (2004) to operationalize the factors that contribute to ICT integration at AAU.

Tearle extensively review literature and propose a set of coherent issues that are important to implement ICT in education. While developing the framework, she categorized the literatures on two fields: Literatures which directly address ICT implementation in education systems and those which focus on change management, both from within and outside education in recognition of the view that the introduction of ICT into a school setting is a specific example of a change. Across these two fields of literature, she studied 424 relevant documents and proposes a comprehensive framework for ICT implementation (Tearle, 2004). Tearle then conducts a hold-out case study in a school where ICT is adopted and is in regular use by most teachers. Finally, she maps the case study outcomes back to the theoretical framework to identify areas of agreement, additional features, and inconclusive elements in the framework. Tearle's final model (Figure-1) shows validated factors for successful ICT implementation (Tearle, 2004).

In Tearle's model the outer ellipse has five factors that represent the whole school characteristics; these are organizational environment factors that affect the ICT implementation. The inner ellipse has five factors that represent the nurturing environment of the ICT implementation process. Actual ICT usage is characterized by the five individual factors at the center of the model, highlighting their central importance.

In the following section, we first review the whole school characteristics (outer ellipse), ICT implementation process (inner ellipse) and individual factors (constructs at the center) from Tearle's model (2004) vis-à-vis our case study at AAU, and propose our simplified research model.

## Whole School Characteristics: The Outer Ellipse

Tearle (2004) reviews literature (Kennewell *et al*, 2000; Ridgeway & Passey, 1995; McCormick, 1992) on whole school culture and ethos which are influential in effective ICT implementation. Factors thus considered important in whole school characteristics for effective ICT implementation in the model include i) strong whole school leadership, ii) the culture

of the school as one which promotes and encourages learning and could be described as both adaptive and collaborative, iii) the change orientated culture of the whole school, iv) the positive and proactive attitude to external influences, and v) well-established whole school internal processes. Tearle categorizes these as organizational factors which are related to the characteristics, culture and ethos of educational institutions.

In our simplified research model we have concentrated only inside the outermost ellipse and did not include organizational environment. Our conscious decision in this stems from the facts that AAU does not have a history of technology integration: culture and ethos of technology integration at AAU do not appear to have congealed, and that we do not intend to compare and contrast the challenges faced at AAU with educational institutions. Thus we assume that organizational environment factors are implicitly manifest on the 'Implementation Characteristics' (the inner ellipse) which we do include in our model framework.

## ICT Implementation Process: The Inner Ellipse

Tearle's model depicts resources, time, support and training, planning and management, and quality of key people as the practical/material factors in ICT implementation process. These factors find support in numerous research findings.

Williams, et al (2000) emphasize that appropriate training in terms of skills, knowledge, delivery; ready access to ICT resources; and ongoing support and advice are essential for effective ICT integration in teaching and learning. Pelgrum and Law (2003) point out access to computers, network and Internet; appropriate training of teachers; resources for ICT-based curriculum; and technical support for the academic staff as essential conditions to successfully integrate ICT into the teaching and learning process. The Office of Technology Assessment (1995) in Cradler and Bridgforth (2002) emphasizes that i) suiting technology to education goals and standards, ii) having a vision for the use of technology to support curriculum, iii) providing both in-service and pre-service training for teachers, ensuring access

*Figure 1. Tearle's model (2004) for ICT integration factors*
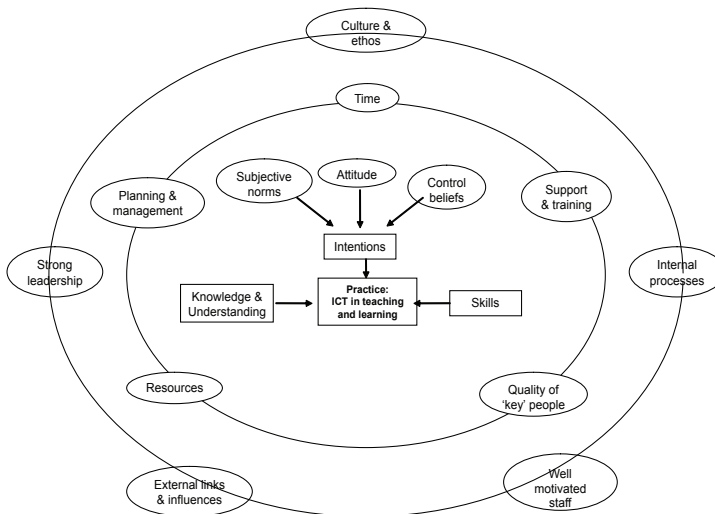
to appropriate technology, providing administrative support for technology use, allowing time for teachers to plan and learn how to integrate technology and iv) ensuring ongoing technical support are some of the requirements for effective use of technology in education.

Granger, et al., (2002) conduct qualitative case studies of four schools and their findings suggest that appropriate training, supportive and collaborative relationships among teachers, a commitment to pedagogically sound implementation of new technologies, and principals' encouragement of teachers to engage in their own learning as highly useful factors for successful implementation of ICT into teaching and learning. A nationwide survey of teachers in the USA finds teachers' motivation and commitment to their students' learning, support from schools, and sufficient access to technology as the three major factors in teachers' successful integration of computers into teaching practices (Sheingold and Hadley (1990) in Mumtaz (2000).

That quality of key[4] people is important in the integration of ICT into teaching and learning has been identified in several studies. Sandholtz et al., (1997) in Wilmore & Betz, (2000) report that one of the key factors of teachers' successful integration of technology in classroom was the level of support they received from school administrators. The International Society for Technology in Education (ISTE) point out that vision with support and proactive leadership from the education system, and policies and standards supporting new learning environments are among the most essential conditions for successful use of technology in teaching and learning (ISTE, 2000 in Capper, 2003).

In our simplified model we consider that all the factors of the implementation process (Tearle, 2004) are important and pertinent for AAU, and we adopt the inner ellipse of Figure-1 in its entirety. Additionally, we elaborate the unified construct 'Support and training' into three independent factors 'technical support', 'pedagogical support' and 'training' in our simplified research model. We make this choice because although technical support, pedagogical support and training are considered as equally

important in successful ICT integration in the literature, our document analysis at AAU could not clarify whether ICTDO has the mandate to provide differentiated pedagogical support to teachers at AAU, or who is responsible for planning and implementation of specific training programs to different faculty bodies. That such support and training could come from more than one source, makes it essential for us to identify the component factors of the construct of 'Support and training' separately, and in an explicit manner.

## Individual Characteristics: The Central Factors

In line with Tearle's model (2004) we include the triad of knowledge and understanding, skills and intentions leading to the actual practice of ICT integrated teaching practices at AAU. However, in our proposed model intention is a function of attitudes, and control beliefs. We do not include subjective norms. Tearle (2004) defines subjective norms as perceptions of the teachers in the way other peers have used ICT in their teaching, and their reflections of esteem. However, the impact of this construct on integration of ICT in teaching and learning is not adequately supported by other research findings and (as we have argued before) AAU does not have a history of technology integration, and our initial discussions with the stakeholders at AAU also suggested that teachers had barely started ICT integration in their teaching-learning process. Thus we argue that it is premature to consider that AAU faculties share subjective norms in the sense that Tearle defines it. Note that this exclusion of subjective norms is also consistent with the exclusion of the outer ellipse of environmental influence in our proposed model.

Moreover, we have renamed control beliefs, as self-efficacy beliefs in our proposed model. Although control belief and self efficacy share similar connotation, self-efficacy belief is a more familiar and well documented construct in the literature of the use of ICT in teaching and learning (Bandura, 1977, in Kinzie, et al.,

1994; Albino, 1999; Wang, Ertmer, & Newby, 2004, in Pierson and McLachlan, 2004; Collins, 1982; and Lent et al., 1984, in Johnson & Wardlow, 2004).

# OUR RESEARCH MODEL

Our research model as explained above is depicted in Figure 2.

## Research Design

In this section we describe the descriptive survey research methods employed including the sampling and mechanistic aspects of the study.

### Participants of the Study

The primary target group in this study was the teachers of AAU, while ICTDO personnel and the management staff of AAU were sampled as a secondary (support) group.

## Sampling Technique and Instruments

AAU is composed of 17 entities[5]. The ICTDO report suggests that only 4 out of these 17 entities have reasonable ICT network facility. The four campuses with ICT facilities were i) the Main Campus, ii) faculty of Business and Economics (FBE), iii) faculty of Technology, and iv) faculty of Science. Accordingly, we used only these four campuses in our study. The number of departments and instructors in the selected four campuses, as obtained from AAU's 2004/05 Academic Staff List bulletin, are shown in Table 2.

Because teachers belonged to different programs with unequal total populations, we employed a proportional stratified sampling technique in this study. First, the participants were categorized into 4 strata with each campus as a stratum, see Table 1. All colleges within the sample campuses had more than one department except the Faculty of Law. Thus, to ensure that each instructor in the departments within the sample gets equal chance of being chosen as a participant, proportional number of instructors from each department was selected using simple random sampling technique. Accord-

*Figure 2. Our simplified research model for factors in ICT integration at AAU*
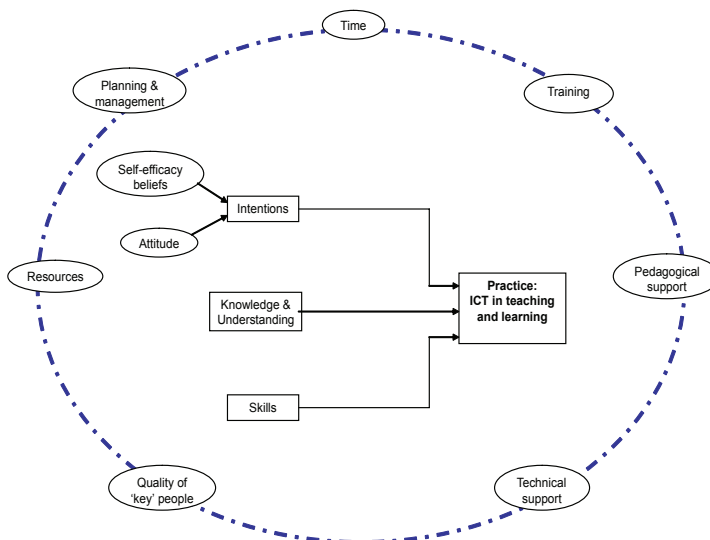
*Table 2. Distribution of full time teaching faculties in the selected campuses*

| No. | Campus | Faculty/College/Institute | No. of Instructors |
|---|---|---|---|
| 1. | Main | College of Education | 122 |
| | | College of Social Sciences | 50 |
| | | Faculty of Law | 20 |
| | | Faculty of Informatics | 46 |
| | | Institute of Language Studies | 67 |
| 2. | FBE | Faculty of Business and Economics | 80 |
| 3. | Technology | Faculty of Technology | 151 |
| 4. | Science | Faculty of Science | 133 |
| | Total number of Instructors | | 671 |

ingly, a total of 234 instructors, 35% from each stratum, were taken as representative sample of the population of interest. We utilized survey questions to assess the input of this primary group of participants.

For the secondary target (support) group, one key official each from ICTDO and AAU management were selected as participants to this study. However, because this secondary group was fundamentally different in terms of their role in ICT implementation at AAU, and also because of the dissimilarity in the sizes of the primary and secondary groups, these individuals' inputs were received through semi-structured interviews.

In addition, supplementary input was accessed through document analysis of ICTDO and AAU management bulletins and communiqués in the public domain.

## The Questionnaire

Barring a few open-ended ones, the questionnaire predominantly consisted of closed type questions. Based on the types of information required, the final questionnaire comprised three sections:

1.  The first part was intended to collect background and demographic information about the participants, and consisted of 6 items.

2.  The second part was designed to assess information regarding respondents' perception of ICT resource availability at AAU, their levels of ICT skills/knowledge, their practices with different ICT components, and their perception of the challenges to ICT integration in their teaching and delivery. This part contained 22 items.

3.  The third part of the questionnaire has 2 parts (A, and B), elicited information on respondents' attitude and perceived confidence/self-efficacy beliefs towards using ICT in teaching and learning. These were adopted from Kinzie, Delcourt & Powers (1994). Section-A (9 items) and Section-B (29 items) each utilized a 4 point rating scale, and measured teachers' attitude towards computer technologies and teachers' perceived self efficacy towards the use of computer technologies in teaching and learning processes respectively.

The above questionnaire was pre-processed through the following steps before finalization:

1.  A separate pilot testing was conducted on items located in part three of the questionnaire. This was felt necessary in view of our

selective adoption of items from Kinzie, Delcourt & Powers (1994):

- Section-A, Part-3 of the original questionnaire had 19 items. To ensure suitability for AAU teachers, and in line with our pruning strategy, we calculated the Cronbach Alpha coefficient of reliability of each of the 19 items separately, and then successively compared each alpha value with that of the rest of the items. Finally we included 9 items, each with alpha greater than 0.77, to measure the teachers' attitude towards computer technology.
- Similarly, section B, Part-3 of the questionnaire originally had 46 items distributed in 6 sections. For the purpose of this study, only four sections[6] were chosen for inclusion in our questionnaire. Acceptable values of internal consistency (alpha) estimates of all the items in each section were available from the instrument developers. Accordingly, 5 items from 'word processing', 10 items from 'electronic mail', 6 items from 'spreadsheet' and 8 items from 'presentation tools' sections with Cronbach Alpha coefficient of reliability of 0.81, 0.79, 0.76, and 0.77 were selected for inclusion in the final questionnaire.

2. Before administering to the research participants, the questionnaire was given to 5 individuals to examine the extent to which the items were appropriate in eliciting relevant information to serve the purpose of the study[7]. Our final questionnaire, which was administered to the primary target group, incorporated suggestions from the pilot study.

The administered questionnaire had 60 items, excluding demographic questions from Part I. The survey was accompanied by a letter of solicitation to the participants[8].

## The Interview

Items for the interviews were constructed based on the proposed research model. Before administering the interviews Feedback on appropriateness and clarity of questions was solicited from three AAU graduate students.. The interviews were conducted with one official each from ICTDO and the management of AAU.

The goal of the interview with the official at ICTDO was to gather information on ICTDO initiatives towards utilization of ICT in the University's education system and to uncover the challenges encountered by the office during such initiatives.

The purpose of the interview with the official at the AAU management group was to assess the University's awareness of the role of ICT in education, the elements and modes of support that AAU extended to ICTDO and to investigate the management's view of the challenges faced by the University in their way of integrating ICT.

The semi-structured format was chosen to enable a free flow of perceptions and ideas from the interviewee.

## The Document Analysis

The document analysis confirmed much of the responses we received from the questionnaire and interviews. It also provided additional insights complementing the questionnaire and interviews.

## Data Collection Procedure

The survey questions were sent to the department office. The department office administered the survey to the instructors and collected the responses.

The interview was conducted in two halves. In the first half, the primary investigator explained the purpose and mode of the study to the interviewee. A semi-structured interview was conducted in the second half. The interview session (second half) with the ICTDO official was recorded with permission.

## DATA ANALYSIS AND RESULTS

In what follows, we analyze the collected data from the survey questionnaire, interviews, and document analyses.

## Survey Demographics

Out of a total of 234 surveys, 169 were received complete (response rate 72.2%). Demographic data of the respondents are presented in Table 3.

The number of male respondents, 92.9%, reflects the low number of female Ethiopian teachers in higher education. This is in line with the low number of female teachers in Ethiopia's higher education[9].

Female instructors teaching on a regular basis at AAU stand at 11.1 % (Education Management Information Systems, 2005). A slightly higher proportion of the males in our respondents (compared to average gender proportions at AAU) can be attributed to the selection of the departments/faculties for the survey: technology and business areas are traditionally lopsided in male population.

The demographics suggest that a great majority (97.6 %) of the teachers at AAU had Master's or Doctoral degrees; 32 % of the

*Table 3. Background information of the respondents*

| Characteristics | Category | No. | % |
|---|---|---|---|
| Gender | Male | 157 | 92.9 |
| | Female | 12 | 7.1 |
| | Total | 169 | 100 |
| Qualification | Bachelor's | 4 | 2.4 |
| | Master's | 103 | 60.9 |
| | Doctoral | 62 | 36.7 |
| | Total | 169 | 100 |
| Teaching Experience | 1-5 years | 54 | 32.0 |
| | 6-10 years | 34 | 20.1 |
| | 11-15 years | 34 | 20.1 |
| | 16 years & above | 47 | 27.8 |
| | Total | 169 | 100 |
| College/Faculty/Institute | Education | 34 | 20.1 |
| | Social Science | 15 | 8.9 |
| | Informatics | 10 | 5.9 |
| | Language Studies | 18 | 10.7 |
| | Law | 6 | 3.6 |
| | Business & Economics | 18 | 10.7 |
| | Science | 35 | 20.7 |
| | Technology | 33 | 19.5 |
| | Total | 169 | 100 |

teachers had 1-5 years of teaching experience, 20.1 %  each had 6-10 and 11-15 years of teaching experience, and 18.3 % had teaching experience of 16 years and above. Majority of the participants, 68 %, had more than 6 years teaching experience.

## Current Level of ICT Use at AAU

In order to evaluate the extent to which ICT is utilized in teaching and learning, teachers were given a list of activities (in four point rating scale[10]) and asked to provide feedback on their frequency of application of ICT tools to accomplish those activities. Assuming that a general level of ICT integration could involve utilization of ICT tools often (i.e. 2.0 as the test value) we have conducted one sample $t$ test. T-test results are presented in Table 4.

The respondents showed higher ICT utilization in two activities: finding information and educational material (item #3 in Table 4) and furthering professional development (item #8 in Table 4). In contrast ICT utilization is significantly lower for activities like creating presentations/lectures, preparing lessons, communicating with students and colleagues, teaching specific subjects, publishing lecture notes and reference materials, and monitoring and evaluating students' progresses. Table 4

indicates that with the exception of ICT enabled information gathering, teachers at AAU inadequately employ ICT in the teaching-learning process.

More specifically, we asked teachers about their frequency of general Internet usage in teaching responsibilities (Table 5). The mean value of 2.47, which falls in between once a week and several days a week, suggests significantly lower level[11] of Internet utilization by AAU teachers (referencing several days a week, i.e. 3.0 as the test value).

## Teachers' Attitude, Skill and Self Efficacy Beliefs in ICT

One of the major purposes of this study was to assess the extant level of the teachers' ICT skills. Towards that end, we asked teachers on their levels of proficiency in selected ICT skills, and the specific activities that they perform utilizing these ICT tools. Analysis of the survey data suggests that teachers' expertise on spreadsheets, presentation tools, database management, statistical tools and web page designing are significantly below the expected[12] (average) value. Three ICT skills: word processing, e-mail, and Internet browsing were found significantly above[13] the expected value (Table 6). Skill deficiency in presentation tools is noteworthy

*Table 4. Teachers' utilization of ICT in teaching activities*

| No. | Activity/Purpose | Mean | SD | t test (One sample) | df |
|-----|------------------|------|-----|---------------------|-----|
| 1. | Teaching specific subjects | 0.52 | 0.861 | -21.477* | 155 |
| 2. | Teaching computer skills | 0.28 | 0.735 | -29.686* | 159 |
| 3. | Finding information and educational materials | 2.23 | 0.603 | 4.716** | 159 |
| 4. | Making presentations/lectures | 1.18 | 0.619 | -16.834* | 159 |
| 5. | Preparing lessons | 1.62 | 0.708 | -6.810* | 159 |
| 6. | Publish lecture notes and reference materials | 0.14 | 0.384 | -60.41* | 155 |
| 6. | Communicating with students and colleagues | 1.28 | 0.626 | -14.519* | 159 |
| 7. | Monitoring and evaluating students' progress | 0.62 | 0.512 | -33.59* | 155 |
| 8. | Further professional development | 2.22 | 0.597 | 4.604** | 161 |
| *Owing to omitted responses, number of respondents for each of the activities does not add up to 169.* | | | | | |

*Table 5. Teachers' utilization of the Internet in teaching activities*

| Item | Every day (4) | | Several days a week (3) | | Once a week (2) | | Once a month (1) | | Never (0) | | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % | |
| If you have access to the Internet, how often do you use? | 23 | 13.6 | 44 | 26.0 | 97 | 57.4 | - | - | 5 | 3 | 2.47 |

*Table 6. Teachers' expertise on selected technology applications*

| No. | Basic ICT skills | Mean | SD | t-test (One sample) |
|---|---|---|---|---|
| 1. | Word Processing (e.g. MS Word) | 2.33 | 0.86 | 4.903* |
| 2. | Spreadsheet (e.g. MS Excel) | 1.53 | 1.11 | -5.556* |
| 3. | Presentation Tools (e.g. MS PowerPoint) | 1.50 | 1.31 | -5.009* |
| 4. | Database Management (e.g. MS Access) | 1.22 | 1.15 | -8.777* |
| 5. | E mail (e.g. Yahoo mail) | 2.29 | 0.96 | 4.002* |
| 6. | Internet browsing (e.g. Internet Explorer) | 2.25 | 0.97 | 3.410* |
| 7. | Statistical Tools (e.g. SPSS) | 0.64 | 0.95 | -18.589* |
| 8. | Web page designing (e.g. Page Maker) | 0.48 | 0.84 | -23.571* |
| | *p < 0.05. Criterion value of 2.0, good level of skill, for one sample t-test* | | | |

because this is the primary ICT enabled vehicle to disseminate knowledge in class.

Because successful application of skills requires professional confidence i.e. self efficacy beliefs (Compeau and Higgins. 1995), we also inquired about teachers' perceived self efficacy. We grouped self efficacy questions in four ICT aspects. Table 7 depicts the results, including our criterion value and *t*-test results. Consistent with the results from Table 6, teachers' self efficacy in word processing and e-mail were higher than the criterion values while their self efficacy towards use of spreadsheets and presentation tools in teaching and learning were significantly below the criterion values. In order to test whether teachers' self efficacy beliefs were realistically pegged on to their actual levels of ICT skills, as opposed to other incidental/environmental factors, we have checked ICT (symmetric) correlations between skills and self efficacies of the teachers at AAU (Table 8).

Positive correlation was found between teachers' skills and self-efficacy beliefs in word processing, presentation tools and e-mail. This suggests intrinsic relationships, significant at $\propto=0.001$. We were, however, surprised by the low, albeit positive correlation, between teachers' spreadsheet capabilities and efficacy beliefs, r = 0.3. An inspection of the raw data suggests that one reason for this surprising outcome in spreadsheet technologies could be a relatively high number of teachers who expressed lower self efficacy belief yet pointed out adequate skills in spreadsheet.

Although skills and self efficacy beliefs are critically important for integrating ICT in the teaching learning processes, propensity of actual utilization of ICT skills requires a positive attitude and hopeful expectation of outcome from ICT integration (Chau 2001). Delving

*Table 7. Teachers' perceived self efficacy towards computer technologies*

| Variable | N | Test Value | Mean | SD | t |
|---|---|---|---|---|---|
| Word processing | 169 | 12.5 | 16.4 | 1.42 | 35.7* |
| E-mail communication | 169 | 25 | 26.72 | 6.54 | 6.54** |
| Spreadsheets | 169 | 15 | 10.69 | 3.18 | 17.56* |
| Presentation Tools | 169 | 20 | 14.32 | 4.28 | 17.23* |
| * => (p < 0.001),  ** => (p < 0.01) | | | | | |

*Table 8. Relationship between skill in technology applications and self efficacy*

| Skill Variables | Word processing | Spreadsheet | Presentation tools | E mail |
|---|---|---|---|---|
| Self efficacy in word processing | 0.74* | --- | --- | --- |
| Self efficacy in spreadsheets | --- | 0.31** | --- | --- |
| Self efficacy in presentation tools | --- | --- | 0.71* | --- |
| Self efficacy in e-mail | --- | --- | --- | 0.77* |
| *p < 0.001 **p< 0.01 | | | | |

this aspect, items in the questionnaire assessed attitudinal preferences of the teachers towards ICT integrated teaching/learning processes (Table 9). The mean score of teachers' composite attitude towards computer technologies, mean = 25.66, was found significantly above the test/ criterion value of 22.5[14]. This suggests that teachers' at AAU generally share a positive attitude towards using computer technologies in teaching/learning.

## Challenges of Integrating ICT into Teaching and Learning

The main purpose of this study centers on identifying the challenges encountered by teachers in their attempt to integrating ICT into teaching and learning processes at AAU. In order to uncover those challenges faced by teachers, we obtained responses from teachers, ICTDO director, and management representative from the academic program office. In this section we present the challenges of ICT integration as reported by the respondents.

## Availability and Adequacy of Pre-service and In-service Trainings given to Teachers on ICT Related Issues

Inadequacy of critical skill sets (e.g. presentation technologies) can be a definite inhibitor of actual integration of ICT in teaching/learning processes at AAU. In order to analyze such absence of essential skill sets, we further investigated whether teachers received adequate pre-service and in-service training on utilization of ICT.

Responses on pre-service ICT training indicate that only a small section, 28.4%, of the teachers had some pre-service ICT training before joining the profession (Table 10). Detailed (segmented) analysis suggests that among those who had responded receiving pre-service training, a very high percentage, 85.4%, were concentrated in the faculties of Business and Economics, Informatics, Science and Technology. A rather small section, 14.6%, of the teachers in other disciplines had received pre-service training at all. This suggests a lopsided distribution of ICT skill sets

*Table 9. Teachers' attitude towards computer technologies (ATC)*

| Variable | No. | Mean | Test value | SD | t |
|----------|-----|------|------------|------|--------|
| ATC | 169 | 25.66 | 22.5 | 1.94 | 21.17* |
| *p < 0.001 | | | | | |

*Table 10. Teachers' pre-service training on basic ICT Skills*

| No. | Item | Response | Frequency | % |
|-----|------|----------|-----------|-----|
| 1 | Did you receive any training on ICT before you joined the teaching profession (pre-service training)? | Yes | 48 | 28.4 |
| | | No | 121 | 71.6 |
| 2. | If your answer is 'Yes', was the training sufficient to help you use ICT in your teaching? | Yes | 5 | 10.4 |
| | | No | 42 | 87.5 |

among AAU teachers. We also inquired about the perceived adequacy of pre-service training among teachers who responded positively to receiving pre-service training. Among those who reported receiving some pre-service training, 87.5 % felt that their pre-service trainings were not adequate for any effective utilization of ICT in the teaching processes. In essence, a very insignificant section (only 3%, i.e. 5 out of 169) of the teachers at AAU had actually begun their profession with some effective ICT training to help them integrate ICT in the teaching/learning process.

Because such initial deficiencies of ICT skills could be mitigated on-the-job at an institutional level, we then asked teachers on the availability and adequacy of in-service ICT trainings at AAU. In every ICT application we listed, less than half of the respondents noted that they had received any training; and barring word processing, close to ¾ of the respondents never received any training at all (Table 11).

Beyond the penetration of in-service training initiatives at AAU, we also inquired about the adequacy of ICT training conducted at AAU. An overwhelming majority, 95.5%, of the respondents felt that the in-service trainings were inadequate to enable them utilize ICT in teaching/learning processes. We also asked teachers whether they had received any in-service training on pedagogical integration

of ICT in teaching, and an even larger section, 97%, reported that they had never received any pedagogical training on how to integrate ICT in teaching.

Our follow-up interviews with the ICTDO officials and the University management provided little insight. However, our documents analysis in the public domain did bring out such additional facts:

•   Right after the completion of the first phase of AAUNet project (2002), training on selected contents were given to both academic and administrative staff in the Main Campus

Principal beneficiaries of these trainings were the faculties of Business and Economics, Science and Technology .The trainings were largely technical and aimed at introducing the academic staff on what they could do with using the AAUNet (Table 12)

•   The ICTDO office had not organized any ICT training for the academic staff since its establishment in 2003.
•   Training related to pedagogical use of ICT was non-existent. ICTDO did not have designated staff to provide, coordinate, and support ICT pedagogical training initiatives.

*Table 11. Availability and adequacy of ICT related technical and pedagogical in-service training*

| No. | Items | Response | Freq. | % |
|-----|-------|----------|-------|---|
| 1. | Have you taken In-service training in which you learned to utilize the following technologies in teaching and learning? | | | |
| | Word Processing | Yes | 75 | 44.4 |
| | | No | 85 | 50.3 |
| | | Missing | 9 | 5.3 |
| | Spreadsheet/MS Excel | Yes | 39 | 23.1 |
| | | No | 120 | 71.0 |
| | | Missing | 10 | 5.9 |
| | MS PowerPoint | Yes | 20 | 11.9 |
| | | No | 130 | 76.9 |
| | | Missing | 19 | 11.2 |
| | Database/MS Access | Yes | 25 | 14.8 |
| | | No | 131 | 77.5 |
| | | Missing | 13 | 7.7 |
| | Internet browsing | Yes | 21 | 12.4 |
| | | No | 132 | 78.1 |
| | | Missing | 16 | 9.5 |
| | E mail | Yes | 28 | 16.6 |
| | | No | 132 | 78.1 |
| | | Missing | 9 | 5.3 |
| 2. | Do you think that the in-service trainings that you have taken are adequate to help you utilize ICT in your teaching? | Yes | 7 | 4.1 |
| | | No | 145 | 85.8 |
| | | Missing | 17 | 10.1 |
| 4. | Have you taken in-service pedagogical training on the use of ICT for teaching-learning? | Yes | 5 | 3.0 |
| | | No | 164 | 97.0 |
| 5. | Do you have sufficient time to attend ICT related in-service training, experiment with the technology, and prepare lessons using different technologies? | Yes | 89 | 52.7 |
| | | No | 80 | 47.3 |

As a whole, it was revealed that the vast majority of teachers did not receive any training on the technical or pedagogical aspect of ICT integration in teaching/learning processes. Even if training could be organized by the University, given existing workload, almost half of the teachers, 47.3%, believed that they could not have attended them. Teachers complained about paucity of time to attend ICT related in-service training, experiment with the technology and prepare lessons using different ICT applications. The teachers also had the opportunity to explain why they thought that they did not have sufficient time; a significant number, 62.5%, of them

*Table 12. AAUNet training of academic staff*

| No. | Training Content | No. of Trainees | Duration |
|-----|-----------------|-----------------|----------|
| 1. | Network Concept | 252 | 2 hrs |
| 2. | Internet browsing | 252 | 4 hrs |
| 3. | E mailing | 252 | 4 hrs |
| 4. | Web publishing | 252 | 6 hrs |
| *(Source: ICTDO of AAU)* | | | |

reported that they had too much teaching load and almost one-third, 31.3%, of them reported being burdened with additional administrative tasks. During our informal discussions, many wanted to be relieved from extra teaching loads and administrative tasks if they were to attend in-service trainings on ICT related issues.

## Availability of Technical and Pedagogical Support to Teachers

We asked teachers whether they were getting technical and pedagogical supports upon request to help them use ICT in the teaching/learning process. Table 13 summarizes their response.

Teachers' response on the frequency of getting technical support had a mean value of 1.03 which is close to 'sometimes' in our relative scale. The frequency of getting pedagogical support, on the other hand, had a mean value of 0.06, meaning almost never. This suggests that ICT support at AAU is almost non-existent. In order to identify whether teachers actively sought technical and pedagogical support in their effort to utilize ICT, they were asked the extent to which they failed to use computers or other ICT tools due to lack of support, item 3 in Table 12. The mean value of 2.04 ($\overline{X}$=2.04) suggests that teachers often failed to utilize computers and other ICT tools due to lack of technical and pedagogical support.

*Table 13. Availability of technical and pedagogical supports*

| No. | Items | Responses | | | | | | | | Mean |
|-----|-------|-----------|---|---|---|---|---|---|---|------|
| | | Very often (3) | | Often (2) | | Sometimes (1) | | Never (0) | | |
| | | No. | % | No. | % | No. | % | No. | % | |
| 1. | How frequently do you get technical support from staff at the University in your attempt to use ICT in teaching and learning? | - | | 24 | 14.2 | 112 | 66.3 | 19 | 11.2 | 1.03 |
| 2. | How frequently do you get pedagogical support from staff at the University in your attempt to use ICT in teaching and learning? | - | | - | | 10 | 5.9 | 145 | 85.5 | 0.06 |
| 3. | How often do you fail to use computers or other ICT tools due to lack of technical & pedagogical support? | 51 | 30.2 | 65 | 38.5 | 44 | 26.0 | - | - | 2.04 |

## Availability of ICT Resources on Campus and at Home

Survey items aimed at assessing the different ICT resources available on campus and at home were included. Table 14 depicts the summary statistics of the responses received.

Apparently, teachers at AAU have relatively high access to computers, 97.6%, and Internet, 85.2%, on campus. However, access to other resources like printers, scanners, appropriate software and LCD projectors was minimal. Access to different ICT resources at home was extremely limited, as low as 2.4%. This indicates the general inability of teachers to use any off-campus time to learn, design, or integrate ICT in their teaching efforts.

Although teachers at AAU pointed that they had high access to computers, our observation suggests that sometimes computer access on campus is available on a shared basis. In order, we asked teachers to denote the exact nature of their computer access at AAU to gain realistic idea of the teachers' access to computers, assess instances of shared computer usage (Figure 3). Interestingly, more than a quarter of the teachers

*Table 14. Teachers' access to ICT resources at university and home*

| No. | Access to… | Location | Response | Frequency | % |
|-----|-----------|----------|----------|-----------|---|
| 1. | Computer | University | Yes | 165 | 97.6 |
|    |          |            | No  | 4   | 2.4 |
|    |          | Home       | Yes | 66  | 39.1 |
|    |          |            | No  | 102 | 60.4 |
| 2. | Printer  | University | Yes | 36  | 21.3 |
|    |          |            | No  | 124 | 73.4 |
|    |          | Home       | Yes | 4   | 2.4 |
|    |          |            | No  | 160 | 94.7 |
| 3. | Scanner  | University | Yes | 12  | 7.1 |
|    |          |            | No  | 148 | 87.6 |
|    |          | Home       | Yes | 4   | 2.4 |
|    |          |            | No  | 160 | 94.7 |
| 4. | Internet | University | Yes | 144 | 85.2 |
|    |          |            | No  | 22  | 13.0 |
|    |          | Home       | Yes | 21  | 12.4 |
|    |          |            | No  | 147 | 87.0 |
| 5. | Appropriate Softwares | University | Yes | 15  | 8.9 |
|    |          |            | No  | 148 | 87.6 |
|    |          | Home       | Yes | 4   | 2.4 |
|    |          |            | No  | 160 | 94.7 |
| 5. | LCD Projector | University | Yes | 14  | 8.3 |
|    |          |            | No  | 150 | 88.8 |

*Figure 3. Teachers' access to computers in their office*
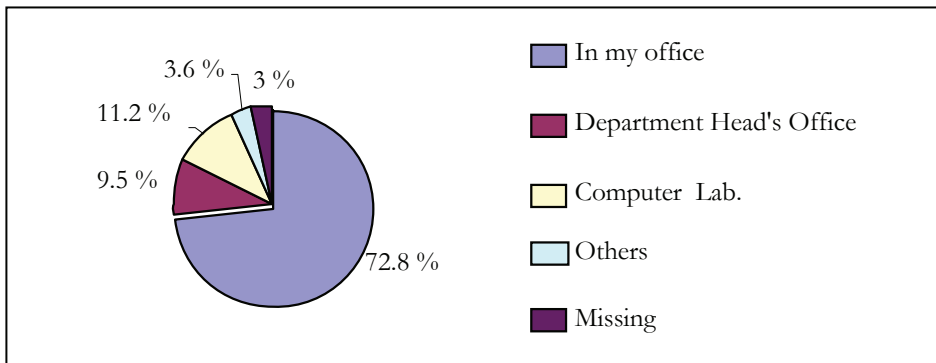


at AAU gain basic computer access outside their own offices. Of those who actually had access to a computer in their own offices, only a little over half, 55% or 68 out of 123, had Internet connection. Compared with the overall positive response on Internet availability, given the large number of respondents, 85.2%, having Internet access, a large number of teachers actually go elsewhere to access Internet services. It appears that between the barriers of inconvenience in shared resources and space, personal computer and Internet penetration at AAU is far from complete.

## Teachers Perceived Challenges in ICT Integration

In an earlier section, we have explained the challenges AAU faces to integrate ICT in the teaching/learning processes. In this section, we report the stakeholders' perceived challenges, as reported in open ended interview questions regarding employing ICT in teaching/learning. We present teacher responses followed by stakeholder responses and compare the results. Towards this goal, we asked teachers to report their perceived challenge when integrating ICT. Summary statistic ranked by frequency is presented in Table 15.

While teachers' overall perceptions are in agreement with our survey findings, we report three noteworthy observations:

- Lack of ICT resources. Lack of accessible ICT resources ranks top among the perceived challenges faced by the teachers. Specifically, teachers reported lack of access to hardware (e.g. computers, LCD projectors, and printers) and inadequate access to the Internet in this category. It appears that in the absence of resources, the need for pedagogical and other training support facilities are less felt by the teachers.
- Lack of response in ICT integration. Seventy four respondents, 43.7%, did not mention anything as a challenge when integrating ICT into the teaching/learning process. Our conjecture is that rather than absence of challenges for these teachers, it might simply mean that either they have not yet started utilizing ICT in their teaching, or they are just reluctant to give response to this open ended item.
- Lack of student ICT skills. A large number of teachers indicated poor ICT background of students as a challenge in bringing ICT enabled changes in their teaching/learning process. This indicates that teachers perceive that students are not familiar/comfortable with using ICT or do not have access to such facilities. This may limit teachers' enthusiasm about integration of ICT in their teaching/learning processes. However, this aspect is beyond the scope of our study.

*Table 15. Teachers' perception of challenges to ICT integration*

| No. | Challenges | Frequency | Rank |
|-----|------------|-----------|------|
| 1. | Lack of accessible ICT resources | 118 | 1 |
| 2. | Lack of adequate ICT skill | 89 | 2 |
| 3. | Poor ICT background of students | 68 | 3 |
| 4. | Lack of support | 42 | 4 |

During the interview, we posed questions to the ICTDO officer and the management representative on their perception about the challenges of integrating ICT into the teaching/learning process at AAU. The responses were:

- The ICTDO officer listed lack of teachers' ICT skill and awareness, lack of adequate ICT resources (teachers and students), and absence of adequately trained support staff (technical and pedagogical), and as the main challenges to ICT integration at AAU. Our discussion also revealed that there is no clear ICT policy for education at the University. It was also apparent that the university is dependent on the Ministry of Education of Ethiopia for ICT usage directives[15]. However, we were also apprised of AAU's attempts to learn experiences from other comparable universities. However, no definitive discussions in related policy formulation/implementation followed.
- The management representative, from the office of academic programs, indicated that the University management was aware of the role of ICT in education[16]. He also indicated that all necessary support have been extended to ICTDO for ensuring adequate utilization of ICT in teaching/learning. We received reasonable agreement on this claim from the ICTDO officer as well. We also inquired on the observable under-utilization of ICT in the teaching/learning process. The management representative deferred this question to the ICTDO officer.

Overall, our interviews with the ICTDO officer and management representative reveal that there is an absence of comprehensive ICT policy at AAU. We also felt that the skill set of the ICTDO staff should be enhanced to ensure effective ICT implementation, especially in the areas of designing training programs for teachers and augmenting technical, pedagogical, and sundry support to faculty members.

## CONCLUDING REMARK

Integrating ICT into the teaching/learning process is complex and time consuming. Unlike their counterparts in high-income countries, higher education institutions in low-income countries are just beginning ICT integration in education. The integration process, as we learned from the AAU case, is mired with challenges. We have attempted to understand the extent of ICT integration, and identified the challenges encountered by low-income countries. To operationalize our work we modified Tearle's original Model with situational factors and collected data from AAU stakeholders. We used survey questionnaire, semi-structured interviews, and public domain documents to conduct our analysis.

The modified model includes factors within the ICT implementation process, such as resource, time, training, technical and pedagogical support, coordination and management, and quality of key people. In addition, individual characteristics, such as knowledge and skills, attitude, and self-efficacy were found important

for integrating ICT in the teaching/learning process.

We have not identified cultural changes that result from technology introduction because we believe the current ICT environment at AAU is too fluid and may obfuscate proper identification. Instead, the identified factors in our model are interpreted as situation-pertinent.

The challenges we found at AAU, when integrating ICT in the teaching/learning process, are summarized in Table 16.

Our study did not find negative attitude and lack of management support among the challenges. However, lack of institutional ICT policy, although was not originally included in our model, stands out as another challenge to ICT integration at AAU. The study indicates that the majority of AAU teachers do not employ ICT in the teaching/learning process. As a result, students are largely unexposed to ICT mediated learning process. This may limit the competitive ability of graduates in the 21st century economy, a dynamic and information intensive world. We learned that teachers positively appreciate and realize the importance of ICT, share a positive attitude towards ICT utilization in teaching and learning, and are confident in at least some of the technology application in education. This, we believe, is a good foundation for a successful future integration of ICT in the teaching/learn-

ing process at AAU. We have summarized the above findings in a set of recommendations that may work as a planning template for ICT intervention/implementation at AAU.

We have investigated the expositional case of ICT integration in the teaching/learning processes at Addis Ababa University. Many Situational factors notwithstanding, this study provides certain generalizability of challenges that plague similar efforts in higher education among other low-income countries. This study is undertaken in an environment where ICT initiatives are nascent, and the implications for ICT integrated education processes are not well understood. We encourage other researchers to expand on this work by analyzing similar higher education institutions in low-income countries to better understand their ICT integrated education processes.

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*Table 16. Summary of ICT integration challenges*

| | ICT Integration Challenges at AAU |
|---|---|
| 1 | Lack of adequate teacher skills in ICT |
| 2 | Low self efficacy beliefs among teachers in using computer applications |
| 3 | Lack of adequate pre-service and in-service teacher training |
| 4 | Lack of technical and pedagogical support available for teachers |
| 5 | Lack of time for teachers to experiment, learn and employ different ICT tools |
| 6 | Lack of accessible ICT resources for teachers and students |
| 7 | Absence of institutional ICT policy for education |
| 8 | Lack of skilled ICT support staff |
| 9 | Absence of skilled staff in the ICT support office that can provide technical and pedagogical training to teachers |

*Exhibit B*

| Study Recommendations for ICT Integration at AAU |
|---|
| 1. Institute a clear ICT policy. ICTDO may find it useful to identify peer/comparable higher education institutions that have already integrated ICT, and bring experiential insights from them. |
| 2. Avail resources to teachers. Network infrastructure and computational facilities need be augmented, and equitably allocated to teachers. Basic access to personal computer and Internet must be available to every teacher. This needs be complemented by extensive training on different ICT applications, followed by pedagogical training. |
| 3. To effectively integrate ICT into the teaching and learning process: |
|     1. Acquire ICTDO staff capable of providing/coordinating technical and pedagogical trainings to teachers. |
|     2. Elevate teacher awareness, skill, and confidence towards ICT through differentiated training. |
|     3. Motivate teachers to participate in training sessions and encourage them to integrate ICT enabled teaching. Some incentives to motivate teachers include: reduction in workload, peer-recognition, and certification. |
|     4. Define responsibility/accountability structure for ICT implementation linking ICTDO and the University Management Board. Efficiency and efficacy of all interventions need be monitored, measured, reported and acted upon. |
|     5. Access student ICT abilities. Consider offering introductory ICT courses as part of the general requirement for all students. |
|     6. Encourage independent longitudinal studies to assess the state of affairs of ICT integration on a continued basis. |

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# ENDNOTES

[1]  http://www.webometrics.info/top100_continent.asp?cont=africa

[2]  "The University is attempting to expand, utilize and integrate ICT in its academic and administrative area" - ICT Development Office, AAU, 2004.

[3]  i) 'Learning about ICT' which refers to ICT as a subject of learning in the school curriculum, e.g. Computer (ICT) Literacy and Computer Science, ii) 'Learning with ICT', which refers to the use of ICT, including multimedia, the Internet or the web as a medium to enhance instruction or as a replacement for other media without changing the beliefs about the approaches to and the methods of teaching and learning and iii) 'Learning through ICT' which refers to the integration of ICT as an essential tool into a course/curriculum, such that the teaching and learning of that course/curriculum is no longer possible without it.

[4]  The 'key people' includes various members of the ICT team, in particular the ICT coordinator and network manager, in terms of their interpersonal skills, planning, management, and commitment to task (Tearle, 2004).

[5]  Total number of Faculties, Colleges, Institutes, and Schools located at different campuses.

[6]  Word processing, Electronic mail, Spreadsheet, and MS PowerPoint.

[7]  Three of the pilot participants were graduate students from the Masters of Education in ICT program (M. Ed. in ICT) and the remaining two were external experts in survey Measurement and Evaluation.

[8]  A link to the survey instrument is available at http://science.kennesaw.edu/~snegash/research/AAUsurvey2005

[9]  During the 2004/05 academic year, for example, the total number of female instructors in all 23 state owned higher education institutions was only 9.1% (Education Management Information Systems, 2005).

[10]  The scales were "very often (3)', 'often (2)', 'sometimes (1)' and 'never (0).

[11]  -> We stated lower level compared to the mean score of 3. Once again more than 60% of the teachers (102/167 = 60.36%) use Internet once a week (97) or never (5) times hence we say it is lower than the mean value of 3 in a scale of 1 to 5. Our results in Table 5 shows that 102 teachers were using Internet once a week (97) or never (5), compared to 23 that use every day and 44 that use several times a week. As a result, we inferred Internet use 'inadequate'.

[12]  We have used a Likert scale of 1 through 5; in a strongly disagree (1) to strongly disagree (5) scale. The average in this scale is 3. The mean (i.e. the average, as calculated and presented in Table 6) indicates results of below 3. That is what we refer to as 'expected (average) value'.

[13]  The caveat in the way these observations should be interpreted includes the fact that the database management and statistical tools are skills significantly higher than say, Word Processing.

[14]  In the ATC section of the questionnaire, there are 9 questions (4 point scale). So, at the hypothetical (overall midpoint), we expected a score of 2.5x9=22.5. This is the criterion value. The responses, as received, yielded a mean of 25.66. A sample with mean value of 22.5 would suggest that in an overall sense, the responders are at the invariance about their ATC, exactly in the middle point between 'slightly agree and slightly disagree. In essence thus, we argue that they exhibit positive ATC in an overall sense. The variance is statistically significant.

[15]  Although the interviewee from ICTDO explained that there was no ICT policy for higher education in Ethiopia, we have since discovered that there is a draft document of ICT-in-Education Implementation Strategy and Action Plan (developed by Ethiopian ICT Development Agency in May, 2006). This can be important for improving future utilization of ICT in Ethiopia's higher education.

[16]  He pointed to the establishment of ICTDO as a strong indication of the University's awareness, belief, and commitment in integrating ICT.

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