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ICT in Education: Innovation, Implementation, Perceptions and Experiences

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The International Journal of Education and Development using Information and Communication Technology (IJEDICT) is an e-journal that provides free and open access to all of its content. It aims to strengthen links between research and practice in ICT in education and development in hitherto less developed parts of the world, e.g., developing countries (especially small states), and rural and remote regions of developed countries. The emphasis is on providing a space for researchers, practitioners and theoreticians to jointly explore ideas using an eclectic mix of research methods and disciplines. It brings together research, action research and case studies in order to assist in the transfer of best practice, the development of policy and the creation of theory. Thus, IJEDICT is of interest to a wide-ranging audience of researchers, policy-makers, practitioners, government officers and other professionals involved in education for development in communities throughout the world.

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  In this way, information technology can be seen to effect and influence changes in organisational structure (Orlikowski & Robey 1991).

  Edwards (1995, p.250) views the globalising of distance education as "invested with the uniform cultural messages of modernity".

  Globalisation, especially in relation to open and distance education, will reduce the tolerance of difference and so "how can local issues and contexts be addressed?" (Evans 1995, p.314).
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Principal Contact and Mailing Address
Professor Stewart Marshall
Managing Editor, IJEDICT
The University of the West Indies Open Campus
Cavehill, Bridgetown, BARBADOS, West Indies
Email: stewart.marshall@open.uwi.edu

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Editorial: ICT in education: Innovation, implementation, perceptions and experiences

Stewart Marshall
The University of the West Indies, Barbados, West Indies

Wal Taylor
The Information Society Institute (TISI), South Africa

Welcome to Volume 11 Issue 1 of the *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*. This issue brings articles from or about Australia, Botswana, Ghana, Hong Kong, Netherlands, Nigeria, Philippines, Saudi Arabia, Sweden, Tanzania, Uganda, and United Kingdom.

The article “Blended learning innovations: Leadership and change in one Australian institution” by Negin Mirriahi, Dennis Alonzo, Simon McIntyre, Giedre Kligyte and Bob Fox reports on the current experience of one higher education institution in Australia embarking on the path towards mainstreaming online learning opportunities. The threefold professional development strategies reported in this paper provide teaching staff with an opportunity to interact, mentor, and share knowledge with one another, alongside experiencing online and blended learning to effectively meet the challenge of improving the digital literacy of teaching staff and enhancing effective online and blended learning opportunities for students.

In their article “Evaluating the implementation of international computing curricular in African universities: A design-reality gap approach”, Salihu Ibrahim Dasuki, Peter Ogedebe, Rislana Abdulazeez Kanya, Hauwa Ndume and Julius Makinde employed the OPTIMISM concepts of the design reality gap framework to focus on the match or mismatch of implementing such curricula in a developing country setting. Their analysis shows that significant progress has been made, but that important gaps between design and reality exist, hence, challenges persist.

Sultan Albugami and Vian Ahmed investigated “Success factors for ICT implementation in Saudi secondary schools: From the perspective of ICT directors, head teachers, teachers and students”. Their results showed that ICT was perceived as an important tool in improving performance, collaboration, learning experience and learning outcomes. However, some challenges that affect the application of ICT in Saudi schools are, for example, the lack of space, resources, maintenance, a lack of ICT skills among school along with a lack in ICT training and a lack of clear ICT policies.

In the article “Community outreach projects as a sustainable way of introducing information technology in developing countries”, Irina Zlotnikova and Theo van der Weide propose a theoretical framework for the sustainable introduction of IT, comprising: (1) the model of a knowledge bridge, (2) the managerial model of the interactions between key stakeholders, and (3) the model of impact of a Community Outreach Project (COP) on target schools. The proposed models have been mapped to the widely adopted DPSIR framework used in sustainable development studies. As a case study, the authors discuss the E-readers Project run in two primary schools in Northern Tanzania.

In their article, Samuel Gyamfi and Patrick Gyaase assess “Students’ perception of blended learning environment: A case study of the University of Education, Winneba, Kumasi-Campus, Ghana”. The blended learning environment was designed on a Moodle platform using an

adaptation of the practical enquiry model. The findings showed positive perceptions of student on the blended learning environment. However, the problem of slow Internet connectivity and lack of Internet access for some of the students outside the university campus hindered the effectiveness of the blended learning environment for a few students.

Most e-learning activities are available to participants through learning systems such as learning content management systems (LCMS). In their article "MLCMS actual use, perceived use, and experiences of use", Edgar Napoleon Asiimwe and Åke Grönlund identify challenges pertaining to use and discuss how to improve LCMS use on mobile phones. Data were collected by means of focus group discussions, an online survey designed based on the Technology Acceptance Model (TAM), and LCMS log files of user activities. The results indicate positive attitudes towards use of LCMS on phones but also huge challenges which are content-related and technical in nature.

The article "Information and communication technologies to raise quality of teaching and learning in higher education institutions" by Chris Prince Udochukwu Njọkụ aims to help higher education teachers know, and be able to deploy, certain ICTs towards shifting from teacher-centred pedagogy to learner-centred instruction. It lists ICTs that can be used successfully in higher education, explains what they are, and shows how and evidence of use.

The literature review "Reviewing and constructing categories for educational technology professionals" by David Woo, highlights the tension between cohesiveness and incoherence in operationalizing categories of educational technology professionals. Literature on learning technologists, educational technologists, e-learning technologists, information and communications technology coordinators and information technology coordinators was analyzed through a multilevel model of comparative education to address to what degree these educational technology professionals are similar units of analysis.

"EmergingEdTech's 2013 Free Education Technology Resources eBook" by Reynald Maravilla Cacho reviews a digital booklet of 15 chapters, mostly contributed and/or originally published as blog posts by teachers, education bloggers (via guest posting) and technology enthusiasts on EmergingEDTech.com. This free eBook provides an overview and access links to many free and non-free applications and resources on the Internet for teachers and students to use inside and outside the classroom for teaching, management and productivity purposes.

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- *Communication, Education and Development using ICT* - http://cedict.blogspot.com/

Stewart Marshall and Wal Taylor
Chief Editors, IJEDICT

Original article at: http://ijedict.dec.uwi.edu/viewarticle.php?id=1993

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Blended learning innovations: Leadership and change in one Australian institution

Negin Mirriahi, Dennis Alonzo, Simon McIntyre, Giedre Kligyte and Bob Fox
University of New South Wales, Australia

ABSTRACT

This paper reports on the current experience of one higher education institution in Australia embarking on the path towards mainstreaming online learning opportunities by providing three complementary academic development initiatives that can inform strategies undertaken by other institutions internationally. First, an academic development program was redesigned and delivered in blended mode to provide teaching staff with the experience of learning in a blended environment to raise their awareness of effective strategies. Second, an accredited postgraduate course for teaching staff on the subject of educational design was redesigned to focus on strategies for online and blended course design and delivered fully online to raise awareness of online learning benefits. Third, a Massive Open Online Course (MOOC), entitled Learning to Teach Online (LTTO), was developed to offer professional development opportunities to teaching staff at the higher education institution, as well as to a wider international audience of educators. The threefold professional development strategies reported in this paper provide teaching staff with an opportunity to interact, mentor, and share knowledge with one another, alongside experiencing online and blended learning to effectively meet the challenge of improving the digital literacy of teaching staff and enhancing effective online and blended learning opportunities for students.

Keywords*: academic development; professional development; course design; blended learning; online learning; MOOC*

INTRODUCTION

Teaching staff technology adoption continues at a slow pace and often does not involve effective, transformative practices (Torrisi-Steele & Drew, 2013). As noted in the New Media Consortium's (NMC) recent regional and global reports (Johnson, Becker, Cummins, & Estrada, 2014; Johnson, Becker, Estrada, & Freeman, 2014), there is strong international pressure to mainstream online learning methodologies alongside the growing demand for learner-centred online learning opportunities and the rapid growth of Massive Open Online Courses (MOOCs) across the higher education sector. However the challenge lies in addressing the low digital literacy amongst teaching staff. A recent study (Mirriahi & Alonzo, 2015) has shown that, while educational technology integration in course design in some higher education institutions remains conservative, students continue to prefer more technology-enhanced learning experiences. Further, the rise in demand for online learning opportunities has led to a range of issues in relation to accreditation that need to be addressed, such as: the examination of appropriate curriculum development and pedagogical approaches for online delivery; capacity for monitoring rates of progression and completion, and the support and development of staff in online course delivery (TEQSA, 2013).

The move towards online learning opportunities is evident amongst both developed and developing countries (for example, Rabayah, 2008; Kabilan & Rajab, 2010; Ming, Hall, Azman, & Joyes, 2010). Hence the future of learning and teaching across the world will require digital literacy of teaching staff, which at the moment needs to be improved (Johnson, et al., 2014).

Educational institutions around the world are adopting blended learning (a combination of face-to-face in-class and online course delivery) (Graham, Woodfield, & Harrison, 2013). This paper discusses the strategic approach taken by the University of New South Wales, Australia (UNSW Australia) to develop the capacity of its teaching staff to design and deliver their own online and blended courses in order to increase the adoption of online and blended learning practice across the institution. While the strategies deployed are not unique to UNSW Australia, as other universities in Australia have similar objectives and approaches, this paper contributes to existing literature by reporting on strategies currently underway at UNSW Australia specifically, which other institutions, particularly those in developing countries, could adopt and apply to their own contexts.

LITERATURE REVIEW

Teaching staff technology adoption and student technology use

The ever-changing landscape of higher education brought about by the advent of technology and its affordances to offer more personalised learning, calls for an action to mainstream online learning methodologies (Johnson, Becker, Cummins, & Estrada, 2014; Johnson, Becker, Estrada, & Freeman, 2014). The issue of low digital literacy amongst teaching staff must be addressed if effective online learning is to become a critical component of a conventional higher education. The limited use of educational technology in higher education can be attributed to teaching staff low digital literacy (Johnson et al., 2014) contributing to minimal effective integration of technology in course design. The reasons that teaching staff may be hesitant to adopt educational technology range from unfamiliarity with the tools (Handal, MacNish, & Petocz, 2013) to concerns about the availability of technological support, and their perception about the relevance of technology to enhance student learning (Kennedy, Jones, Chambers, & Peacock, 2013). These attitudes of teaching staff towards technology acceptance were found by Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, and Sendurur (2012) to have the greatest influence on the success of technology adoption and use in the classroom. Hence, to enhance technology adoption amongst teaching staff, it is critical to assist them in valuing the affordances it provides for delivering flexible and personalised learning, coupled with enhanced student engagement (Chen, Lambert, & Guidry, 2010).

Changing teaching staff practices through online and blended learning

As outlined above, facilitating a mind shift amongst teaching staff to take advantage of the online environment is one of the critical problems in implementing online or blended learning initiatives. It has been argued by Korthagen and Lagerwerf (2001) that personal experience, supported by concrete examples, are needed for knowledge to have a strong influence on teaching behaviour, and ultimately on one's routine practices,. In the case of blended learning, teaching staff beliefs and attitudes formed from their experience with educational technology can contribute greatly to its successful adoption and integration in their own course design. Hence, providing teaching staff with authentic blended and online learning experiences, using the same technologies that they could use in their actual teaching practices, can be an effective professional development strategy (Ertmer et al., 2012). Professional development programs for teaching staff offered in online or blended learning modes have the potential to build their confidence and awareness of effective flexible learning and teaching strategies (Atkinson, Fluker, Ngo, Dracup, & McCormick, 2009). In particular, they can provide a flexible, reflective and personally relevant learning experience, and the opportunity to establish online communities that can encourage ongoing access to resources, support, and sharing of knowledge (Glitz, 2013). To encourage the integration of online technologies into course design, and to minimise barriers to the actual use of

the technologies, higher education institutions need to raise awareness of the benefits of effective online learning strategies by providing a range of opportunities for professional development and establishing institutional policies and strategic initiatives (Garrison & Vaughan, 2011).

Theoretical basis of an effective blended or online professional development program

The design of effective professional development programs has been widely argued to embrace a supportive environment, job-embedded tasks, instructional-focused content and methodology, collaborative in nature, and on-going engagement of teaching staff (Hunzicker, 2010). Apart from these characteristics, one important aspect of a useful professional development program is the availability of a range of program designs where teaching staff can select which one best suits their needs and interests. Teaching staff who have greater autonomy in selecting a specific professional development program tend to gain greater benefits and have higher satisfaction of their experiences (Berry, Daughtrey, & Wieder, 2010). Also, critical to the success and impact of professional development programs is the degree of choice available to teaching staff for selecting their learning pace and navigation of content (Porter, Garet, Desimone, & Birman, 2003). However, regardless of blended or online learning initiatives, the design of such programs should be underpinned by theories of learning, which have been widely documented to have significant impact in improving learning gains (Fouser, 2010; Michael, 2006; Poelmans & Wessa, 2013). Specifically, the design of professional development programs should be rooted in constructivism (Dewey, 1916; Bruner, 1996) and social-constructivism (Vygotsky, 1978; Maddux, Johnson & Willis, 1997) alongside with the principles of adult learning (Brookfield, 1995; Knowles, Holton and Swanson, 1998) as demonstrated in the study of Huang (2002).

The constructivist theory of learning allows teaching staff to construct their knowledge and skills in blended or online learning and teaching through their actual experience in a professional development program that allows them opportunity to experience blended and online learning first hand. The use of technology to facilitate the construction of knowledge (Muir-Herzig, 2004) and their actual engagement in blended and online learning enables them to see connections between their learning experiences and their actual teaching responsibilities as facilitators of blended and online courses (Flores, 2005). In addition, following the tenets of social-constructivism, teaching staff are encouraged to share their experiences with one another using online technologies. This interaction allows them to understand each other's unique context and experience in blended or online learning, which consequently expands their knowledge. Social interaction in the online environment helps people to share knowledge, develop and evaluate meanings, and hence enrich their understanding (Garrison & Vaughan, 2011).

The effectiveness of online or blended professional development programs lies primarily on the use of technology to form a community of learners where teaching staff actually learn (Schlager, Fusco, & Schank, 2002), and it should facilitate the social-construction of knowledge (Lloyd, 2000) through online discussion and peer support (Ellis & Phelps, 2000). In addition, technology use should facilitate reflective practice amongst individual participants, which has been found by Prestridge (2014) to transform their pedagogical beliefs and practices. Further, as Hanson and Carlson (2005) argue, teaching staff must be digitally literate to maximise their use of technology and must have a high level of understanding of how technology can support teaching and learning in an online environment. Further, their digital literacy needs to be supported to be at the required level of the program design to ensure that they can navigate and engage with the online environment (Childs, Blenkinsopp, Hall, & Walton, 2005).

CASE STUDIES IN PROFESSIONAL DEVELOPMENT IN ONLINE AND BLENDED LEARNING AT UNSW

In response to these imperatives, three complementary professional development opportunities are offered at UNSW Australia to provide opportunities for teaching staff to develop their confidence and capability in designing online and blended learning courses. Two of these academic development opportunities were existing programs that were significantly redesigned to be offered in a blended or fully online mode while the third is a new strategy as a complement to the other two. These three strategies are discussed below as three separate case studies that demonstrate the effective complementation of blended or online professional development programs where teaching staff can choose which one suits their learning needs well.

Case Study 1: Foundations in University Learning and Teaching

The Foundations in University Learning and Teaching (FULT) course is a professional development program aimed at developing the foundational knowledge, skills and attitudes of UNSW teaching staff necessary to inform effective and scholarly teaching approaches. Similar introductory teaching development programs are offered by most Australian universities to their teaching staff (Hicks, Smigiel, Wilson, & Luzeckyj, 2010). FULT has been offered at UNSW Australia for over 25 years in different forms and traditionally, up until last year, delivered primarily face-to-face. However, in 2013 FULT was redesigned to better align with the university's strategic intent to develop teaching staff capabilities to teach in blended learning mode, incorporating a 'flipped classroom approach' as outlined in UNSW Australia's Learning and Teaching Strategy 2014-2018.

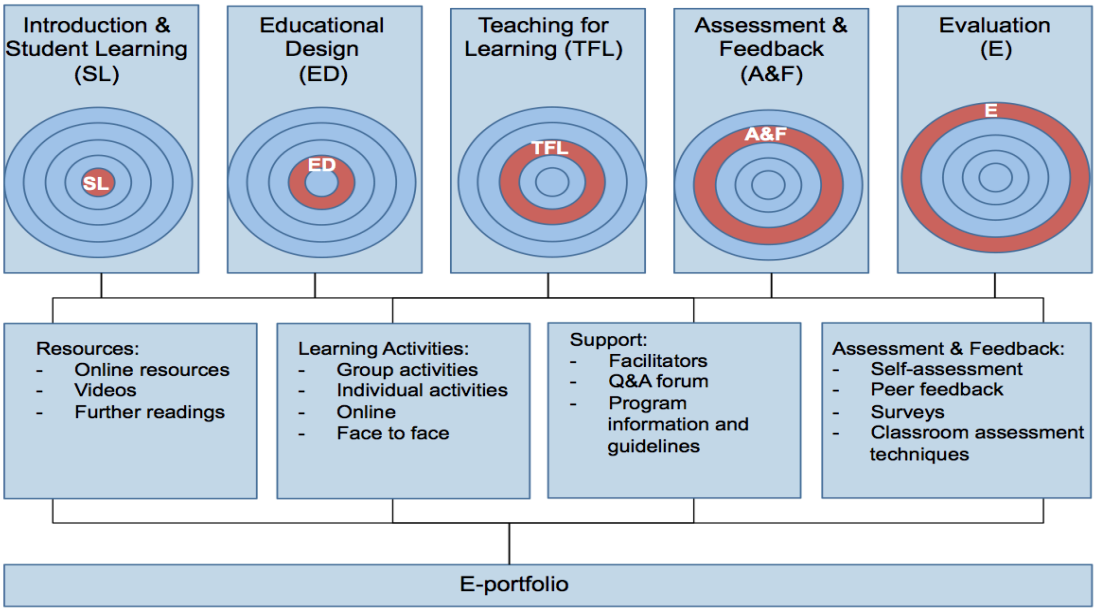

Figure 1: *The Foundations in University Learning and Teaching (FULT) course. FULT comprises five modules that combine individual and group learning activities online with interactive face-to-face sessions.*

This approach is based on the work of Baker (2000) and Lage, Platt, and Treglia (2000) where the passive component of the course, such as reading textbooks, listening to podcasts and watching videos are individually done by students whilst the more active components of the course are used to engage students through problem solving, case studies and discussions. This flipped classroom can help students to increase their motivation and manage cognitive load (Abeysekera & Dawson, 2014), maintain their class attendance (in blended learning) and sustain their out-of-class effort (He, Gajski, Farkas, & Warschauer, 2015), and increase their participation and interactions with teaching staff (Roach, 2014).

FULT's course design is underpinned by the beliefs about when learning is most effective (see Table 1).

Table 1: *Implications for program design when learning is most effective*

Principle	**Implications for program design**
1) Active engagement	Teaching staff have an opportunity to engage in an active process of making sense of new ideas or experiences. This involves action (trying out of new ideas) and reflection (based on feedback).
2) Draw on own practice and prior knowledge in authentic environments	Teaching staff have an opportunity to reflect on their own practice, work with authentic scenarios and own examples emerging from their practice, and the practice of their colleagues.
3) Build connections	Teaching staff have opportunities to build connections with content, with peers, and with teachers (e.g., Anderson, 2008; Garrison et al., 2000) in disciplinary and cross-disciplinary contexts.
4) Understand expectations	The various options and paths through the program are made explicit to teaching staff. Program facilitators are available to provide guidance.
5) Are challenged and supported	The program models a climate of enquiry where teaching staff are challenged, while being supported to take sensible risks in their teaching. The misconceptions of teaching staff are identified, and they have an opportunity to review their conceptions / practice based on the feedback provided.
6) Respect and cater learner diversity	The program models inclusive learning environment where teaching staff feel valued and respected.

The following design principles guided the redesign of FULT from fully face-to-face delivery to the blended mode undertaken in 2013-2014:

1. Flexibility: The program moved from a five-day workshop to a modularised approach with five distinct modules spanning approximately two to three weeks each. In this mode, the teaching staff who are enrolled in FULT choose to complete all modules in the program or enrol in individual modules based on their preference and interest.

2. Modelling outcomes-based approach: The program shifted from mandatory attendance to an evidence-based completion model. At the conclusion of FULT, the teaching staff submit an e-portfolio containing evidence of their engagement with and completion of the learning activities associated with all five of the modules, to receive a *Certificate of*

Completion. Teaching staff receive peer feedback on their work throughout the program, and facilitator feedback upon submission of their completed e-portfolio.

3. Modelling blended learning and 'flipped classroom': The program was redesigned from a largely face-to-face model to a blended learning and 'flipped classroom' approach, to provide teaching staff with access to Moodle-based resources and tools supporting engaging online and face-to-face learning activities. By modelling a 'flipped classroom' approach, the face-to-face class time is dedicated to highly interactive group discussions and collaborative authentic learning activities, while tasks requiring reflection and conceptualisation are completed outside class time as pre- and post-activities. Through engagement in online activities on Moodle, such as annotating videos, discussion forums, and stimulating face-to-face activities, teaching staff are exposed to various tools and teaching strategies both face-to-face and online, and are able to experience the benefits of a 'flipped classroom' from the perspective of a learner.

4. Inclusivity and scalability: The program originally capped enrolment at 25 participants owing to limitations inherent in the earlier program design, which included a face-to-face micro-teaching session requiring substantial facilitator involvement and supervision. After the redesign to blended delivery, it can now accommodate up to 200 teaching staff (restricted only by teaching spaces available for face-to-face sessions). This allows for the program to be more inclusive and accept enrolments from previously under-represented cohorts, such as casual tutors, post-doctoral staff and higher degree research (HDR) students with a teaching role. The modularised structure of FULT gives teaching staff the flexibility to choose the modules that address their own learning and teaching needs based on their own specific teaching contexts.

5. Efficiency and cost-effectiveness: Owing to the scalability of the program described above, FULT moved from being a resource-intensive program offered four times a year to an efficient program offered twice a year, with one academic lead designing and facilitating each module with the support of an educational developer. Peer assessment is embedded throughout the program to ensure that teaching staff are exposed to, and have opportunities to, critique other's work. In this way teaching staff are able to self-reflect and receive adequate feedback on their conceptualisation and their learning and teaching practice throughout the program, preparing them to complete the final e-portfolio evidencing their progress and learning.

While FULT is primarily a professional development program, it is also the coursework component of the first course in UNSW Australia's Graduate Certificate in University Learning and Teaching (GCULT) described below. This has also been recently redesigned to be offered in blended and online learning modes.

Case Study 2: Post-Graduate Course Redesign

UNSW Australia has offered the GCULT primarily for teaching staff at the university for a number of years. Initially it was delivered as a fully face-to-face program focusing on a variety of topic areas such as student learning, curriculum and assessment design, and leadership in higher education. Recently, the program has been redesigned to align with the university's new blended learning strategy and provide teaching staff with first-hand online and blended learning experience in order to inform their own teaching strategies. Three of the four courses in the program are delivered in blended mode adopting 'flipped classroom' approaches. These include a combination of face-to-face sessions and online activities, limited face-to-face time is more effectively used, being dedicated to collaborative activities. Some content is delivered online prior

to the in-class sessions; in-class conversation is extended through online discussion, online peer feedback and review of course work.

The fourth course has been redesigned for full online delivery to provide teaching staff in the program with an opportunity to experience the flexibility of online learning while continuing to be part of a learning community with other teaching staff enrolled in the same course. In addition, while this course has always focused on curriculum and assessment design, as part of the redesign the focus has shifted to explore the use of online technologies to enhance course design. Teaching staff in the course are encouraged to consider how online technologies, whether in fully online or blended mode, could enhance their own students' learning experience or make their own teaching more efficient and effective. While the three other courses in the program provide an opportunity for teaching staff to experience blended learning, the shift in focus in this fourth course, provides an opportunity to critic the advantages, challenges, and considerations of online technologies through exploring key literature, frameworks, and case study videos of various teaching staff sharing their own experiences with online learning technologies.

With no required face-to-face sessions, the course relies heavily on guided discussion forums to help build and maintain a community of teaching staff learning together. Key questions are posted in the discussion related to the course content, asking teaching staff to provide convincing arguments or raise questions and considerations related to their own teaching practice, helping them to construct and develop their understanding of online and blended learning. This design is based on a socio-constructivist theoretical approach (need reference) where the course is designed to foster discussion around the key concepts to support teaching staff development of understanding and knowledge of technology-enabled course design. To encourage the sharing of ideas and ongoing conversation, assessment in this course requires the teaching staff to ensure that their arguments are based on multiple perspectives, including that of their peers. Following an 'assessment as learning' approach, where assessment tasks are explicitly used as learning tasks, the assessments in the course are designed to build the teaching staff understanding by applying the concepts introduced in the course to their own teaching context. For example, the first assessment asks students to explore learning and teaching strategies and policies specific to their own faculty or school related to open and institutionally-supported technologies, in order to ensure that their teaching and course design adheres to any specific requirements or expectations. The second assessment subsequently then focuses on the review of teaching staff own course design in order to identify areas that could be enhanced by online technologies, while the third and final assessment asks teaching staff to apply changes to their course based on content explored in the course, their own literature exploration, and discussions with one another. While it is not required that they redesign their course using online technologies, it is expected that they provide an evidence-based argument for their informed decisions. Finally, while not required, the teaching staff in the course are encouraged to enrol in a massive, open, and online course (MOOC) offered during the same time, providing an opportunity to explore the same weekly concepts, engage in discussion with international educators, and be exposed to further other resources and online activities. The following section describes the design and intent of this particular MOOC.

Case Study 3: Building capability and confidence via a MOOC

In 2014, UNSW developed a massive open and online course (MOOC) called Learning to Teach Online (LTTO), based upon the award winning open educational resources of the same name http://bit.ly/ZbQfmK. The original resources received the 2012 MERLOT Award for Exemplary Online Learning Resources and the 2011 Ascilite Innovation and Excellence Award. Whilst the LTTO MOOC was open for all, it was also designed to provide professional development in online

course design to UNSW teaching staff. The eight-week open course was aimed at teaching staff with little or no online teaching experience, or those wishing to expand their existing knowledge. The course was designed to help teaching staff to develop an understanding of effective pedagogic principles related to online and blended teaching practices, rather than focusing upon instruction in the use of specific technologies. In this way, the MOOC enabled teaching staff to adapt the knowledge and skills explored to their own teaching contexts via a flexible, reflective and personally relevant learning experience. Specifically, the LTTO MOOC design was underpinned by principles derived from the process of narrative inquiry (Chase, 2008; Webster & Mertova, 2007) and constructivism (Girvan & Savage, 2010; Gold, 2001), both of which focus on the importance of personal experience in the learning process. The structure of the MOOC was such that it encouraged teaching staff to define their own learning goals and to reflect and draw upon their own personal stories about their teaching practice and contexts. In effect, their stories became central to how they constructed their learning, and how they engaged with the course and one another.

The course was broken into eight modules, each exploring fundamental strategies and pedagogical principles of online learning and teaching practice.

1. Why is online teaching important?
2. Open and institutionally supported technologies
3. Planning online learning
4. Online learning activities
5. Online assessment strategies
6. Online resources
7. Engaging and motivating students
8. Evaluation strategies

Each module comprised a video introduction explaining the learning outcomes, a video and a more detailed document examining the key concepts being discussed, along with supporting case studies demonstrating how different teaching staff apply the principles in practice. Teaching staff were also guided to specific discussion forums and resources that support each module. They could choose to undertake all modules of the course at any time or in any order that suited them, as they did not need to engage with the course sequentially. Teaching staff were also not required to undertake all modules and could simply focus upon topics that related to their interests or needs. As long as they undertook enough activities and assignments (as explained below) to achieve a passing grade, they could complete the course with a high degree of flexibility and freedom as to which content they engaged with.

Each module had a set of three multiple-choice and short-answer activities designed to facilitate self-reflection about their existing skills, confidence, perceptions and understanding of key pedagogical concepts. The activities were designed to help teaching staff to develop strategies to apply the knowledge they gained in the course to their own teaching practice. At the conclusion of each activity, teaching staff were provided with feedback containing explanations to reinforce their learning with data visualisations of their individual responses comparing their answers to those of the rest of the cohort. Finally a series of personalised resource suggestions were based on individual answers to questions. In this way, the activities were highly personalised and not content driven, but centred on their personal experiences and knowledge, allowing them to build their professional capacity in ways that were relevant to them.

The MOOC also contained a series of three assignments designed to enable teaching staff to apply their knowledge to the design of an online learning activity that they could use in their own teaching practice. Through these assignments, teaching staff analysed their existing teaching practice or course design, applied new knowledge to develop supporting online teaching

strategies, and reflected upon the benefits and risks associated with their final design. Teaching staff were also asked to demonstrate their understanding of the principles involved by undertaking reviews of peers' assignments and providing feedback. It was through participating in these assignments, that teaching staff were truly able to personalise their learning experiences by introducing and analysing their own teaching stories, then evolving these personal narratives through the synthesis of new knowledge about online teaching practices.

PRINCIPLES OF EFFECTIVE ONLINE AND BLENDED PROFESSIONAL DEVELOPMENT

The following principles of effective professional development for blended and online learning emerged from our experiences in redesigning and implementing professional development (PD) programs to address the need to enhance the digital literacy of teaching staff and to develop their capability in designing and delivering blended and online learning:

1. PD should embody the principles of blended and online learning. The design and process should provide opportunities for teaching staff to gain understanding of the theoretical rationale and practical applications of blended and online learning.

2. The PD course activities should provide authentic blended and online learning opportunities for teaching staff to give them first-hand experience of the benefits of integrating technology in their learning, which can eventually be transferred and applied to the design and delivery of their own courses.

3. The design of PD programs should be theoretically underpinned by constructivism (Dewey, 1916; Bruner, 1996) and socio-constructivism (Vygotsky, 1978; Maddux, Johnson & Willis, 1997) to allow for the co-construction of knowledge whereby teaching staff learn from one another and collectively develop their understanding of online and blended teaching strategies and approaches. As one of the major issues in blended and online learning is the sustainability of interaction (Wang, 2010), the design of the PD program should embrace collaborative problem-solving and sharing of best practices, thereby encouraging teaching staff to engage with one another to discuss and collaboratively overcome the challenges associated with designing their own online and blended learning courses.

4. PD should be aligned with criteria and standards for effective blended and online learning course design and delivery to model best practice. The authors are currently developing and validating criteria and standards to guide a more personalised blended and online learning course design to ensure quality and to form the basis for professional development and practice.

5. Multiple complementary PD programs for blended and online learning should be available to give options to teaching staff in terms of topics, modalities, and skill levels to provide a more personalised approach.

CONCLUSION AND FUTURE DIRECTIONS

By designing and offering three complimentary yet distinct teaching development opportunities, UNSW Australia demonstrates its commitment to fostering technology acceptance amongst teaching staff alongside developing their digital literacy skills, knowledge, and perceptions of effective technology-enabled course design to meet the global challenge of delivering effective online learning opportunities for students. While the three case studies reported in this paper are

currently being evaluated, (*against criteria on personalisation of blended or online learning which looks into the delivery of the content, availability of course resources and formative assessment, selection of learning activities, utilisation of technology to meet teaching staff needs and expectations, provision of learning and digital literacy support, design of assessment tasks, and teaching staff engagement in self and peer assessment*), the intent of this is paper is to disseminate the strategic approach at one higher education institution to implement a threefold, multifaceted online and blended learning approach across the campus to help inform the strategies that other institutions may adopt. The results of the evaluations will inform future review and redesign of all three initiatives as needed by offering insights on the effectiveness of the initiatives for enhancing online and blended learning practice. The evaluation strategies use a range of data collection methods as appropriate for each unique case study such as learning analytics on teaching staff actual engagement with the online resources and activities, surveys and focus groups to better understand their experience and change in perceptions and teaching approaches, and the course instructor's or program leader's own critical reflection on the professional development opportunity from multiple lens or perspectives.

While the road towards the realisation of UNSW Australia's move to mainstreaming online and blended learning through enhancing the digital literacy of teaching staff still has a long way to go, other institutions and countries, both developing and developed, can learn from its experience in redesigning professional development programs and courses that embody the principles and practices of blended and online learning.

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Evaluating the implementation of international computing curricular in African universities: A design-reality gap approach

Salihu Ibrahim Dasuki, Peter Ogedebe, Rislana Abdulazeez Kanya, Hauwa Ndume and Julius Makinde
Baze University, Abuja, Nigeria

ABSTRACT

Efforts are been made by Universities in developing countries to ensure that it's graduate are not left behind in the competitive global information society; thus have adopted international computing curricular for their computing degree programs. However, adopting these international curricula seem to be very challenging for developing countries having in mind that they were developed for developed rather than developing countries realities. In this paper, we use Heeks (2002) design-reality gap as an evaluative space for an international computing curricula assessment. We employed the OPTIMISM concepts of the design reality gap framework to focus on the match or mismatch of implementing such curricula in a developing country setting. We based our evaluation on the design and implementation of an international (British) computing degree programs in a private university in Nigeria. Our analysis shows that significant progress has been made, but that important gaps between design and reality exist, hence, challenges persist. The study concludes with some recommendations for policy makers advancing an agenda for "ICTs for Development" in the education sector.

Keywords: *ICTs; Development; Education; University; Developing Countries; Nigeria; Design Reality*

INTRODUCTION

Governments of developing countries have invested tremendously on ICT projects for socio-economic development. However, the developmental impacts of these investment is hard to pin point. The assessment of ICT for development (ICT4D) projects on development has been faced with limited focus and analysis in terms of sustainable development impact (Madon, 2004; Kamel et al., 2009). The few evaluation reports available have been criticized for lacking a strong methodological foundation, being descriptive and lacking rigor (Heeks, 2010). Hence, there is a need for a more theoretically focused approach to understanding the impact of ICT4D projects in developing countries (Heeks, 2010).The majority of the world's population resides in developing countries and are faced with inadequate access to resources such as education, water, health and electricity required for satisfying basic human needs. Furthermore, the majority of the people in developing countries are denied political liberty which has resulted in their lack of freedom to make choices in their own lives (Sen, 1999). According to Walsham et al. (2007), this situation presents moral circumstances in which all actors advancing an agenda in ICT4D need to be concerned with (Walsham et al., 2007).

In this study, we concentrate on human capacity building which Nissanke (2006) describe as the competency profile of knowledge, skills and attitude that indirectly links the relationship between ICTs and development. The notion of human capacity building using ICTs has been identified as vital to facilitating socio-economic development which in turn, is a significant pre-requisite for advancement towards the millennium development goals (Hakura & Nsouli, 2003). As such, the education sector in developing countries have adopted ICT as a tool for poverty alleviation and

capacity building, therefore contributing to the efforts of the country to meeting the millennium development goals. Today many universities in developing countries offer computing degree programs in order to produce ICT savvy workforce to drive socio-economic development (Rhee, 2009). However literature shows that the computing curricular founded in many developing countries are outdated thus producing graduates that lack the skills required by employers seeking to apply ICTs; hence damaging the link between ICT and human development (Bass & Heeks, 2008; Soriyan et al*.,* 2005).

Yet little research has been produced with understanding the issues affecting computing curriculum in developing countries despite majority of them offering computer science as a degree program (Bass & Heeks, 2000). There is clearly a need therefore for more theory driven, responsive and rigorous research into the assessment of computer science curriculum in developing countries universities. This paper suggests a broader theoretical lens to unpack the multiplicity and complexity of ICT4D interventions in nations of developing countries. Specifically, we draw upon the Heeks (2002) design reality gap framework to evaluate the implementation of an international computing curricular in a developing country university. The contribution of this paper is to give some insight into the issues impeding the design and implementation of international computing curricula in universities of developing countries.

The rest of the paper is structured as follows. The following section provides literature review on the complex link between ICTs and development. This is followed by a section providing details of design reality gap framework and its key elements upon which the authors will apply to evaluate the implementation of an International computing curricular in a Nigerian university designed to produce ICT professionals that can compete both nationally and globally. The research method, research setting and the analysis of the case are then presented. The final section concludes the paper and recommendations for policy makers and stakeholders in the education sector.

LITERATURE REVIEW

ICTs and Development

Understanding the domain of ICT4D is incomplete without unravelling the term *"development"*. The notion of development within the ICT4D literature is a highly contested notion. According to Sein & Harindranath (2004), this debate has centered towards its meaning and can be classified within three discourses, that is, dependency, modernization, and human development. The dominant conceptualization of development since the Second World War draws upon the modernization theory of economic growth. According to these theory, deficiencies in knowledge partly results in under development. From these view point, development can only occur in developing countries if they follow the process of development adopted by developed countries. Following this approach to development, ICT is argued to be a tool for industrialization or an industry itself, with emphasis placed on how technology can enhance competitiveness, mechanization and productivity (Zheng, 2009).On the other hand, the dependency approach to development argues that the process of development and economic growth in developed countries impacts negatively on developing countries. Akpan (2003) noted that these latter are predominantly ex-colonies suffer from negative terms of trade and are caught in the debt trap, hence submitting to a technology industrial dependency. An example could be seen in the outsourcing industry when it has been argued that the production of offshore computing and commodities are done to improve the societies of developed countries rather than the economies of developing countries (Sein & Harindranath, 2004)

The ICT4D literature is yet to establish a direct relationship between ICTs and economic development in developing countries (Akpan, 2003; Avgerou, 2003). Hence, it could be argued

that investments in ICTs may have failed to achieve their anticipated developmental goals (Heeks, 2002). This could be due to inappropriate intervention approach planned to guide development (Soeftestad & Sein, 2003) or failure to take into account the socio-cultural context during the design and implementation of the ICT4D interventions (Maumbe et al., 2008). As such, there has been a call for more emphasis on investigating the contextual and social aspect of ICT4D interventions given that the failure or success of ICT4D interventions will depend on their "fit" with the economic, political, social and cultural contexts in which they are implemented (Walsham, 2007, Heeks, 2008). Despite the growing number of research within the ICT4D domain, Mbarika et al. (2005) noted that research focusing on ICT4D interventions in Africa is still at a moot point in the dominant information systems research. Thompson and Walsham (2010) called for research focusing on ICT4D in Africa and the need to expand beyond the use of ICTs in Africa to include deeper developmental concentration. In this study, the authors aim to address the research question: *"What are the challenges of implementing international computing curricular in African Universities?* This is done in order to provide implications for research and policy makers advancing an agenda of "ICT for Development" in the education sector. As noted earlier, the paper is informed by the design reality gap framework to evaluating the implementation of ICT4D projects, which the following section discusses.

CONCEPTUAL FRAMEWORK

The Design Reality Gap

The design-reality gap is a broad framework that was drawn upon from the literature on contingency in organizational change (see Venkatraman, 1989) and social construction of technology (see Suchman, 1987). The framework was developed by Richard Heeks and is used to analyze organizational change and the risk associated with it. In the domain of ICT4D, the design reality gap has been adopted as assessment tool to measure the success of ICT4D projects. The model has helped to explain the mismatch between ICT4D designs and local user actuality. This gap occurs because the contexts of the project beneficiaries and the ICT4D project designers are often distant in socio-economic and cultural dimensions, hence this results in specific design assumptions which do not fit to the local realities (Heeks, 2002). Hence, ICT4D failure or success would depend on gap that is present between the design of the ICT4D project and the current realities. According to Heeks (2002), the design reality gap exists around seven dimensions abbreviated as ITPOSMO: Information, Technology, Processes, Objectives and values, Staffing and skills, Management systems and structures, and other resources such as time and money.

In the discourse of ICT4D, the framework has been criticized for focusing on *"point"* implementations of ICTs in developing countries with lack of an explicit developmental focus (Thompson and Walsham, 2010). Despite the criticisms, there has been much progress and efforts by ICT4D researchers in applying the design-reality gap model in IS in developing countries studies to understand why majority of ICT4D projects fail (see Heeks, 2003, Heeks, 2002; Dada, 2006; Bass & Heeks, 2008). Specifically, in the studies of ICT in the institutions of higher education in developing countries, very few authors have applied the design reality gap (see Bass and Heeks, 2008). Bass and Heeks (2008) extends the original design reality gap to include milieu which address the issues of politics and legislation in order to the failure or success of the implementation of an international computing curricula in Africa using a case study of Ethiopian higher education. This paper further constitutes an effort of operationalizing the extended design reality gap by using its basic concept to analyze the design and implementation of an international styled computing degree program in Nigeria. The contribution of this paper is in two folds: operationalizing the design-reality gap framework by showing its theoretical and practical significance and drawing up implications for stakeholders in the higher education sector

by providing recommendations for practice. The following sections will introduce the extended design reality gap and its core dimensions that is applied in this paper.

Dimensions of the Design Reality Gap

The extended dimensions of the design reality gap can be summarized with the OPTIMISM mnemonic (Heeks, 2008):

- Objectives and values (both formal strategies and culture, and informal goals)
- Processes (from individual tasks up to broader business processes)
- Technology (not just ICTs but other relevant technologies)
- Information (data stores, data flows, etc.)
- Management structures and systems
- Financial Investment
- Staffing and skills
- Milieu (the external political, economic, socio-cultural, technological and legal environment)

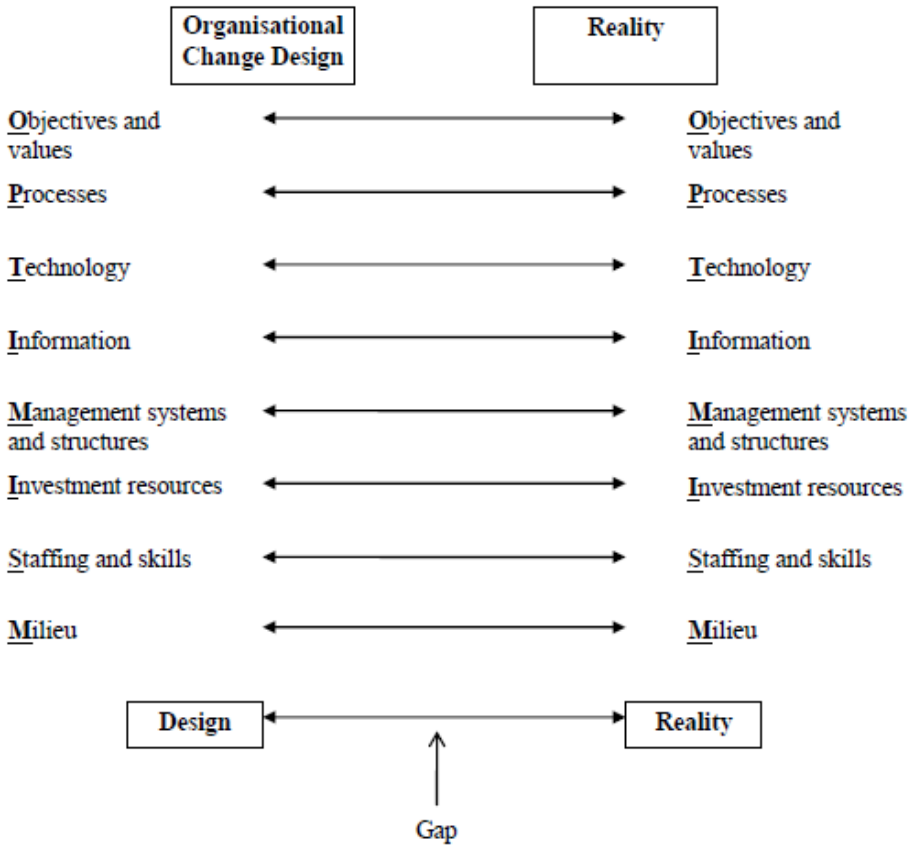

***Figure 1**: The Design Reality Gap Model*

Putting these dimensions together with the notion of gaps produces the model for understanding success or failures of IS in developing countries, that is shown in Figure 1. In this paper, we apply the design-reality gap to evaluate the implementation of a European computing curriculum in Africa. We will explain next how this was specifically applied in our particular study.

***Table 1**: Interpretation of the design reality gaps in terms of Research Issues*

Elements of the design-reality gap model	**Interpretation of the framework in terms of research issues**
Objectives and values	-What are the objectives of the computing degree programs and how do they meet the requirements of the stakeholders affected by this degree programs? -What are the values embedded within this international degree programs? How do these values match the underlying values of the stakeholder's realities?
Processes	-What teaching and assessment methods are available to support these degree programs? -Are these teaching and assessment methods effective to support these degree programs?
Technology	-What Infrastructures are available to cater for the students taking these computing degree programs? -Are these infrastructures enough to cater for all the computing staff and students? Are there enough infrastructures to also support teaching and learning?
Information	-What Information flow is available to support the implementation of the degree programs? -Do students and staff have access to student information? -Do student and staff have access to teaching materials? -Do students and staff have access to external stakeholders?
Investment resources	-What considerable investment has been made to support the implementation of these degree programs?
Staffing	-What are the required staff capacity needed to support the degree programs? Are there enough staff to support these degree programs? Do these staff have the right skills to teach the individual subjects?
Management system and structures	How is the management and structure of the university and its faculties? Can the design of the international computing degree programs be embedded within the structure and management of the university?
Milieu	What are the legal and political requirements for the successful implementation of these degree programs? How do they affect the successful implementation of these degree programs?

In the following section, the research methodology and methods of data collection is presented.

METHODOLOGY

Research Approach

This research followed a broad interpretive approach. According to Walsham (2006), the interpretive research aims to understand social setting and realities of ICTs in use. A case study design was adopted in this study due to its strength in allowing various methods of data collection (Benbasat et al., 1987). The case study followed an explanatory line (Yin, 2003) with the purpose of evaluating the issues surrounding the implementation of international computing curricula in a private African university in Abuja, Nigeria. Multiple data collection sources which includes interviews, observation and document analysis was carried out between June and July, 2014. A total number of 17 interviews was conducted with several stakeholders who were involved in the implementation of this international curricular. Majority of the interviews lasted about an hour and all were done in English. Staff ranged from existing lecturers to newly qualified lecturers to Faculty Deans. The interviews were conducted using an interview guide based on the OPTIMISM model and were tape recorded. Interviewees were asked probing follow-up questions on new and emerging topics as well as given opportunities to raise any other issues they considered relevant.

On the whole, approximately 15.4 hours from the transcript of the interviews were gathered, organized and analyzed later. Interviews were often accompanied by observation. Four of the authors acted as practitioner researchers who Oates (2006) described as someone who already has a job and decides to put on a researcher's 'hat' to investigate their own work organization. In this study, observation was very important as the authors could observe how the degree programs were designed and the surrounding challenges affecting its implementation especially during classes, and departmental and faculty meetings. We compiled two pages of observation notes in this study. Furthermore, we analyzed the Nigeria ICT policy, university education legislation, the faculty student handbook and the faculty set up guidelines that contains all information on the course curriculum. The Nigeria ICT policy and university education legislation was downloaded over the internet while faculty student handbook and the faculty set up guidelines were provided by the university.

Table 2*: Sample of Coding Process*

Sample Theme	**Sources**	**Sample-coded excerpts from transcripts/ field notes**
Objectives and Values Reality	Sources: Pre-reading of transcript and Theoretical Concepts	*"We are currently achieving the objective of our faculty, as you know the department just got an NUC accreditation of 87% and after interviewing our students, they were impressed that we have developed students that possess a wide range of transferable skills including analytic and synthetic reasoning, problem solving, individual and team working, project and time management, and verbal and written communication skills" (Acting Dean)*
Information flow about course content	Sources: Pre-reading of transcript and Theoretical Concepts	*"This semester I have been assigned to teach Introduction to World Wide Web to second year students. At the moment, I don't know what course I am teaching next semester, I have to wait for the dean to assign the courses I will be teaching" (lecturer)*

All data collected were analyzed using set of principles of thematic analysis (Braun and Clarke, 2006) in order to capture the main themes discussed by the interviewees. This allowed, in the first instance, the classification of similar material and insights to be captured. Next, a set of themes were produced following the OPTIMISM model, but with careful consideration given to emergent topics as described in Table 2. The results of the case study analysis are presented in the discussion and analysis section illustrating the challenges in implementing an international curricular in Africa. The following section provides an overview of the higher education system in Nigeria.

Higher Education in Nigeria

The National ICT policy was drawn up in line with nation's vision 20:2020 agenda. The vision of the policy document is *"Nigeria as a knowledge-based and globally competitive society*" (NPFIT, 2012, pg. 12). The policy focuses on the application of ICTs in sectors of education, job creation, accountability, public administration, health, sport, transportation and agriculture. One of the key objectives of the policy is the design and implementation of an appropriate ICT curriculum in all levels of education. Thus Nigeria presents a good example of a developing country who has prioritize the use of ICTs within its education sector. Currently there are 129 universities in Nigeria which include 40 federal universities, 39 states universities and 50 private universities. The federal and state universities are public universities funded solely by the government. The National Universities Commission (NUC) which was established in 1962 and is the governing body that enforces uniform standard and sets admissions capacity of every university in Nigeria. However, institutions of higher education in Nigeria especially the public ones are confronted with several challenges such as lack of funding, poor infrastructure, corruption, shortage of lecturers, periodic strike and closure (PunchNG,2013). The challenges facing the public universities has resulted in individuals and private bodies establishing universities in the country. The first private universities in Nigeria were licensed in 1999 and they are Babcock University, Igbinedion University and Madonna University. More private universities have since been approved by the federal Government. However, many of these universities have been characterized with high tuition cost even though many students seek admission into them due to the challenges faced by the public universities.

Computer Science Programs at Institutions of Higher Education in Nigeria

Currently about 99 universities both public and private have been approved and accredited by the Nigeria University Commission to offer computer science degree programs (NUC, 2012). Based on the NUC's benchmark minimum academic standards (BMAC) for undergraduate programs in Nigerian universities, the admission requirements to study computer science requires a student to have a minimum credit level passes in five subjects including Mathematic, Physics and English. The computer science degree programs in Nigeria is a four year program (See Table 3 for course description).

However, success has not been achieved in administering computer science degree programs in Nigeria universities due to more emphasis on theory with little focus on practice. This could be due to the lack of infrastructures to support the practical aspect of these courses and also the limited experience in running practical lab sessions hence exposing instructors who have been educated through a system that had a paucity of such learning opportunities (Bass and Heeks, 2008). Hence, many of the Nigeria universities produce insufficient and ill-prepared science graduates necessary for driving the economic development of the nation (Uwaifo, 2010).

Table 3: **Course Description for Four Years Computer Science Degree Program in Nigeria**

Course Description			
First Year	**Second Year**	**Third Year**	**Fourth Year**
Introduction to Computer Science 3 Introduction to Problem Solving 3 General Mathematics I 3 General Mathematics II 3 General Mathematics III 3 General Physics I 3 General Physics II 3 General Physics III 1 General Biology I 3 General Chemistry I 3 Use of English 2 Library Skills 1 Electives 6 Units to be selected from Mathematics and Physics Courses.	Course Tile Credits Computer Programming I 3 Computer Programming II 3 Foundation of Sequential Program 3 Fundamentals of Data Structures 3 Operating Systems I 3 Discrete Structure 3 Computer Hardware 3 Foundations of Sequential Programme 3 Mathematical Methods 3 Electronics 3 Industrial Training 3 Entrepreneurship Studies 2 Communications Skills 2 Electives 8 Units to be selected from Course Tile Credits Linear Algebra I 3 Linear Algebra II 3 Modern Physics and Statistics courses 3	Course Tile Credits Structured Programming 3 Object-Oriented Programming 3 Algorithms and Complexity Analysis 3 Operating Systems II 3 Architecture and Organization I 3 Architecture and Organization II 3 Data Management I 3 Compiler Construction I 3 Systems Analysis and Design 3 Survey of Programming Language 4 Computational Science & Numerical Methods 3 Formal Methods and Software Development 3 Industrial Training II 3 Entrepreneurship Studies II 2 Electives 6 Units from Course Tile Credits Operations Research 3 Numerical Analysis 3 Statistical Computing 3 Theory of Computing 3	Course Tile Credits Software Engineering 4 Data Management II 3 Net-Centric Computing 3 Organization of Programming Languages 3 Artificial Intelligence 2 Human Computer Interface 2 Computer Networks 3 Communications Project 6 Electives 9 Units to be selected from Course Tile Credits Compiler Construction II 3 Computer Graphics and Visualization 2 Modeling and Simulation 3 Information Technology Law 2 Optimization Techniques 3 Queuing Systems Performance Evaluation 3 Project Management 3 Special Topics in Software Engineering 3 Computer System Performance Evaluation 3 Distributed Computing System 3 Formal Models of Computation 3 Special Topics in Computer Science 3

Source: NUC Minimum Benchmark 2007

Other issues affecting the provision of computer science degree programs in Nigeria include issues ranging from non-availability of adequate human capacity, poor funding, poor staff training, brain drain and retention profiles, poorly equipped laboratories and inadequate ICT environment. Recently, many private universities have evolved in Nigeria in order to address the challenges that are faced by the public institutions. Many of these private universities offer computer science degree programs and have adopted international computing curricula in order to produce graduates that not only can compete locally but also internationally in the technology driven society. This paper explores one of those efforts where a private university within the capital of Nigeria introduced an international curricular (British) in its Faculty of Applied Sciences and Computing in order to produce graduates that will understand the principles that lie behind the current computing technology and also develop the ability to adapt their skills to the new technology.

Baze University, Abuja

Baze University was granted its license by the Nigeria Universities Commission (NUC) to operate as private university in 2011 and in the same year, it opened its doors to its first students. Founded by a former senator in Nigeria, it is located in federal capital territory, Abuja, the state capital of Nigeria. Having benefited from the UK education system of instruction, the founder sought to make this style of education - focusing problem solving, small classes, and a British style general education program. Currently, the VC of the university is a British Professor whose experience has been an educationist across the globe and a former VC to a university in Eastern Africa. The University is home to about 1300 students and 98 faculty members and consists of three Faculties: Applied Sciences and Computing, Business and Law.

In this study, we concentrate on the Faculty of Applied Sciences and Computing, specifically the Department of Computer Science. The Department consist of a Head of Department and 16 academic staff. Currently the degree program offered by the department can be seen in table 4.

Table 4: **Baze University faculties and degree programs**

Faculty of Applied Sciences and Computing	Faculty of Business	Faculty of Law
B.Sc. Computer Science B.Sc. Chemistry (Petroleum Chemistry) B.Sc. Physics (Physics with Computing) B.Sc. Mathematics (Financial Mathematics) B.Sc. Biology (Biological Sciences)	B.Sc. Accounting B.Sc. Banking and Finance B.Sc. Economics B.Sc. Management B.Sc. Marketing B.Sc. Government Public Administration B.Sc. International Relations and Diplomacy B.Sc. Psychology	LLB Jurisprudence & International Law LLB Business Law LLB Private and Public Law

DISCUSSION AND ANALYSIS

In this previous section, the authors have discussed the higher education sector in Nigeria and the context of computer science degree programs. The authors have also examined the ICT and education policy documents in order to understand the motivation and process behind the provision of computer science programs in Nigeria universities. We have also provided an overview of the case study. Now we examine the implementation of an international (British) curricular of computer science at Baze University using the design reality gap model. Using the model, we focus on the match and mismatch of implementing this curricular using eight OPTIMISM dimensions of the model.

OBJECTIVES AND VALUES

Design Expectations

The objectives of Baze university states *"to establish and maintain a most suitable academic environment synergizing world-class human capital and best technology for creating and imparting knowledge to develop and modernize the Nigerian society".* The faculty of applied sciences and computing was designed to develop graduates that will possess theoretical and technical knowledge of computer science and IT, sound practical and algorithm skills, and an appreciation of computing in society, business, medicine education, industry and government, and an understanding of the social, legal and ethical aspects of computing (Baze University Student Handout). The programs within the faculty are guided by *Benchmark Minimum Academic Standards (BMAS)* Science 2007 for the accreditation of Computer Science programs in Nigeria and by the requirements of the British Computer Society (BCS) for the accreditation of Computer Science programs in British Universities.

Reality

The core value and objectives of faculty of computing did appear to be shared in reality by key stakeholders. Many interviewees spoke of the new focus on graduate capabilities in terms of subject-specific skills. They appreciated the pressing need for graduates to be confident and be able to engage responsibly and productively in the computer industry at whatever level they propose to undertake as illustrated in the quote below:

> *"We are currently achieving the objective of our faculty, as you know the department got an NUC accreditation of 87% and after interviewing our students, they were impressed that we have developed students that possess a wide range of transferable skills including analytic and synthetic reasoning, problem solving, individual and team working, project and time management, and verbal and written communication skills" (Acting Dean)*

Design-Reality Gap

The interviews and observations in the study appears to have shown that there is a relative good match between the design expectations and individual stakeholder realities.

INFORMATION

It was agreed that the success of the design of degree courses within the faculty was based on the fact that effective learning and teaching required effective information flows between a network of stakeholders which include students, staff and external stakeholders.

Reality

Access to teaching and research materials

Usually the dean of the faculty always makes sure that the books needed by the staff are made available in order to allow them prepare lecture materials especially for new courses introduced in the curriculum for the first time. Lecturers have access only to free online journals and the faculty is yet to subscribe to any of the e-library channels. Normally, lecturers contact colleagues or friends who have access to online materials. The lack of staff access to updated online materials impact course preparation by encouraging inheritance of old lecture materials and also affected the output of research work as shown in this quote:

> *"Publishing and preparation of teaching materials have been a little bit challenging here in Baze because we don't have access to journals like the UK University. You know subscribing to this journals requires millions of naira which is so expensive. So for me what I do is just contact my colleagues who are in the UK in order to access this journal libraries" (Lecturer A)*

Information flow about course content

We found evidence that the new course structure within the computing faculty had not been sufficiently disseminated to both teaching staff and student. Our interview with the lecturers show that some of them do not know what courses they will be teaching in the following semester:

> *"This semester I have been assigned to teach Introduction to World Wide Web to second year students. At the moment, I don't know what course I am teaching next semester, I have to wait for the dean to assign the courses I will be teaching" (Lecturer B)*

We also found evidence that at the end of the semester, many of the students are unaware of the courses they will be taking in the following semester. Many of the students become aware of the courses they are taking at the point of their registration.

Information dissemination with external stakeholders

One of the major objectives of the faculty is to prepare graduates that would be attractive to employers. Yet there appears to be little communication with external stakeholders. One of the first priorities of the newly designed Faculty of Applied Sciences and Computing was the need to communicate with potential employers of the graduates. Many large employers in the public and private sector would benefit from understanding the various degree programs the faculty was offering and the various job roles suited for these various degree programs. By interacting with employers, students will be provided with opportunities to develop the skills that employers are looking for. Although during their 3rd year, it's mandatory for all students to undergo industrial training in external organizations, thus providing opportunities to gain real-world perspective and exciting opportunities. It was observed during the research that it was the duty of the students to find this organizations on their own and those students who are unable to find a place are attached to the IT department within the university. We also found out that there was no formal link between students and external stakeholder such as the Nigeria Association of Computer Science Students (NACOSS). However during the course of writing this paper, the Faculty had started making strides in interacting with external stakeholders by organizing an international

conference on science and technology. Many of the lecturers had started making formal links with old colleagues and corporate bodies in order to have them attend the conference. This effort will boost the image of the Faculty and the University at large.

Design Reality Gap

While the university has been successful in setting up a computing faculty, our study has shown that there are still some few challenges to deal with. However, the Faculty's plan for an international conference has helped to reduce the design reality gaps in terms of information.

PROCESSES

Generally, public institutions have tended to rely on traditional lecture methods and student assessments. This echoes a didactic attitude of lecturers in developing countries, who see teaching processes as restricted to purely theoretical information transfer to students (Bass & Heeks, 2008). However, during the design of the computing courses at the Baze University, the policy design included assessment and lecture diversity. The design envisaged new teaching and learning processes that included lecture hours, interactive lectures, case study presentations, laboratory sessions, group project, class test, and continuous assessment of project work and assignments. The design on the teaching and learning methodologies puts priority more on providing opportunities for students to have both theoretical and practical engagement with the subject matter.

Reality

The faculty has completely embraced assessment and lecture diversity. The process of teaching and assessment has moved from the traditional methods which are more theory focus to a students' oriented teaching as shown in the quote:

> *"The diversity in the teaching and learning method is for students to do critical thinking which will lead to better understanding and should involve problem solving. That's what you do when you are working. You are thinking about problems and trying to find ways around it. They need to understand what the difference is, that is why critical thinking is so important. They should be aware of their problems and be able to address them especially in computer science courses" (Acting Dean).*

The Faculty of Computing has embraced the need for continuous and practical assessment in order to continuously engage the students. Usually the faculty prescribes a 40% weighting for continuous assessment and 60% for final examination that should be applied to all courses.

Design-Reality Gap

For now, there has not been so much of a design reality gap with regards to the faculty processes in terms of assessment and teaching diversity. Teaching in the faculty has been more student oriented with diverse methods of assessment hence broadening the base for practical work.

MANAGEMENT SYSTEMS AND STRUCTURES

The faculty of computing was designed to have a Dean in charge of the whole faculty, a faculty secretary and its various academic staff. The Dean subsequently reports to the Vice-Chancellor of the university. In 2012, the school was granted the license to run science degree courses in Financial Mathematics, Physics, Petroleum Chemistry and Biology. Thus the university

restructured the Faculty of Computing to accommodate these sciences courses and it's was renamed the Faculty of Applied Sciences and Computing in 2012.

Reality

With the proliferation of courses, the structures of the faculty was not in line with the requirements of NUC. The NUC policy required a faculty to have a dean, and heads of Department within the Faculty. Each of this department is headed by a head of department (HOD) who reports to the faculty dean. The faculty undertook a major business process re-engineering about teaching and learning across all courses in order to get its degree programs accredited. During the business process reengineering stage, it was found out that during the design for the computing faculty, there was little or no consideration of quality assurance procedures for faculty courses. There were also no staff promotion and welfare review during the faculty design process. However, the NUC accreditation process in the faculty led to a detailed commitment to quality assurance, institutional and individual course reviews.

Design Reality Gap
In terms of management systems and structures there is a relatively small design-reality gap due to the ability of the university to be more flexible in its structuring.

INVESTMENT RESOURCES

The availability of funding has always been an issue in institutions of higher education in developing countries. In Nigeria, just like public universities, private universities have equally complained of funding and have clamored for funding and investment from the government. They argue that they are playing an identical role to public universities in producing much-needed skills for the country, and thus deserve state funding (Fatunde, 2013). As a new University, the need for investment to support the Faculty and its curriculum was given sufficient attention by the university board members.

Reality

Baze University has enjoyed a considerable amount of funding and investments from the founder. The steady increase of investment by its founder has enabled the development of its new, modern teaching labs, infrastructure and its science library. The faculty recently subscribed to Microsoft dreamspark hence providing professional developer tools and software in the hands of faculty staff and students with a low-cost subscription from Microsoft. However, the study shows that there was need for further investment on computing textbooks to support teaching and learning. The purchasing process is hampered by a shortage of good quality textbooks in the country. We observed that the textbooks in the science library could not cater for the growing number of students within the computing department. When asked with regards to this issue and how it affects teaching and learning, one of the lecturers noted that:

> *"In the department, when a lecturer is in need of a textbook, we make a request directly to the Dean who orders some few copies when he travels to the UK. One is given to the instructor and the rest to the libraries. Usually, due to its limited availability of copies in the library, our students usually download the textbooks online and sometimes not all this books are available for free download, so it's an issue to be dealt with" (Lecturer C)*

The inadequate computing textbooks and materials have resulted in faculty members investing a considerable amount of personal time to the preparation of course and teaching materials. This include spend evenings and weekends in order to prepare lecture materials.

Design-Reality Gap

In summary, the issue of funding seems to affect the whole university sector in Nigeria which includes not only public institutions but also private institutions. We found evidence that with the huge amount of money that was involved in setting up the university, every investment that will be made on an existing department usually depends on the amount of profit that the faculty returns based on the amount of students enrolling to that department. This has resulted in private universities in Nigeria also asking for funding from the government on the bases that they are also contributing their quota to the development of the country even though some argued that private universities are created as profit-making ventures and are therefore not entitled to taxpayers' money, which should be invested in public institutions.

TECHNOLOGY

Design Expectations

The design of the Department of Computer Science guidance framework draws out the importance of having adequate IT infrastructure to support teaching and learning. These include library and computer classrooms and labs.

Reality

The university has sufficient air-conditioned teaching class rooms equipped with wireless internet and a projector. Also, the university has three IT laboratories to teaching specialist topics such as database, web programming, word processing applications and programming languages. During the inception of the faculty in 2011 there were no labs with networking capabilities to support advanced studies in networking. However in 2013, a network lab was established with adequate facilities to support network and operating system courses as shown in this quote:

> *"When I came in, I noticed we didn't have a network lab to illustrate to the student the practical aspect of networking. I followed it up with the dean and in less than a month, the lab was up and running. You know we are trying to give our students the best experience their friends and families are also getting in the United Kingdom". (Lecturer D)*

There were also some challenges such as poor internet connectivity, poor infrastructures and limited amount of computers hindering a good level of access to the IT labs as illustrated in this quote:

> *"Sometimes when we get into the lab to do our course works only to notice that some computers don't have internet access or the software are not properly working. That is why most students get their personal computers." (Student B)*

Design-Reality Gap

Our study indicates that the relationship between a supporting teaching and learning environment and the ICT subjects is still at a moot point. The study shows that a design reality gap exists and constitutes a hindering factor to the newly implemented ICT courses in the university. The study shows that general purpose computer classroom is not enough to cater for the student population. Furthermore, there is inadequate internet access around the university campus. All academic and administrative building are fully connected with both LAN and wireless internet connections with the exception of the school accommodation and cafeteria. When students want to use the internet, they will have to go to these buildings or use their own private internet modems.

STAFFING AND SKILLS

The design of the new faculty and degree programs highlighted the importance of having adequate university teaching staff with appropriate qualifications and experience. Having the right amount and quality of both academic and administrative staff were significant for getting a full accreditation of its courses from the NUC. However, student's skills in terms of gaining practical industrial experience during their study was not stated and discussed in the policy guideline regarding the formation of the faculty.

Reality

In reality, the faculty started with only 4 academic staff and 16 students in 2011. Some of them had none or little experience in the academia, amongst the new staff, one was a Professor and the other was a PhD holder. The other two lecturers were building up their skills and expertise over time on the job, but this could not yet reach the design expectations. Some of the instructors were finding it challenging to teach core programming courses because of their lack of experience in academia. The number of staff was generally regarded as being inadequate due to growing number of students. However, for the university to get its computer courses adequately taught, the university needed to employ more experienced academics which it did even though there was a shortage of suitably qualified and experienced staff from which to recruit. The shortage of skills is particularly felt in the computer science stream which requires core programming. Also, the NUC had a problem with the design of the computing curriculum. In Nigeria, all students undergoing a science course are required to take a mandatory three month industrial training. As such, the Faculty was obliged to introduce the compulsory industrial training for its student during their third year. With such policy, the faculty couldn't implement the British style curriculum for achieving a BSc in computer science in three years.

> *"We are trying to implement a British style educational system where our students can obtain a computer science degree in three years just like the UK. But I don't think we can achieve that with the mandatory industrial training policy of the NUC here in Nigeria unlike the UK where placement is optional" (Acting Dean)*

MILIEU

Design

In the previous session of this paper, the authors already discuss the contextual factors that affect the design and the implementation of the degrees within the computing faculty. They include economic in the discussion on funding and investment, socio-cultural in the discussion on objectives and values, technological in the discussion on technology. In this section, we concentrate on the legal and political context which are both usually sensitive topics that participants shy away from.

Reality

In terms of politics, the present government under the watch of President Goodluck Jonathan has been supportive of private sector investment in the education sector. Politically, the establishment of the university and its various degrees is in line with the economic transformation agenda of the President. Since the assumption of office by the president in 2011, the president has established 12 federal universities and he has issued license to nine private universities including Baze University and three state universities. During the former Minister of Educations tour at Baze University after paying a courtesy call, while touring the network lab of the faculty, she stated:

> *"I must say that we are impressed with what we have seen. I have already said kudos to the university management and students that the university has been established both in terms of improving access at the same time with the requisite qualities that we require" (Former Minister of Education)*

In this study, the legal context of the design of the computing faculty and its degree courses is centered on the NUC accreditation. According to NUC, all universities in Nigeria must comply with approved Benchmark Minimum Academic Standards (BMAS) and other quality assurance instruments required for Nigerian universities to meet national needs and global competiveness based on the Nigeria education law of decree 49 of 1988. The NUC visited Baze University between February to March 2014 for the accreditation exercise of the degree courses within the Faculty of Applied Sciences and Computing. The review focused on course curriculum, staffing, research, infrastructure, and an acceptable standing of teaching and learning. After the three day process, the Department of Computing received an Interim accreditation.

Design-Reality Gap

Our study shows that both the legislative realities and political requirement appear to be largely met. It can be concluded that the design-reality gap with regards to milieu is at an extinct point.

CONCLUSION AND RECOMMENDATION

In this paper, the authors have further shown that design reality gap framework can be applied to the implementation of ICT curricular programs in developing countries. As ICT4D researchers, our aims is to study the relationship between ICT and development. However by adopting the design-reality gap, we are forced to do that by providing a comprehensive evaluation of the implementation of an international ICT curricular in a developing country and exposing many issues that are pre-requisite for the successful implementation of the western computing curricular. The importance of the choice aspect in the design reality gap means that it is crucial to understand the social, cultural and political context, and evaluate the ICT curricular towards that.
In this study, we also suggest some recommendations based on the mismatch associated with implementing this international curricular. To address the large gap identified in the staffing and skills area, the university should provide in house training to its existing and newly appointment staff in order to address the shortage of technical skills especially in the areas of programming. This can be done by going into private and international organizations such as NIIT, APTECH, Microsoft, Google and others for ICT technical manpower development. Also, there is need for the university to increase its internet bandwidth in order to provide wireless internet access across the whole campus in order to support meaningful academic activity. The university should liaise with bigger telecommunication providers such as MTN, GLO, and ETISALAT in order to setup its own secure wireless network that will provide a fast and uninterrupted wireless internet across the whole campus.

Also, with regards to the shortage of international computing textbooks, preferable the ones in use in UK Universities since the university is following the British standard, the university can improve the situation through interlibrary loan and document delivery service with a couple of UK universities where the students can have access to read the e-books by logging into the partner UK university library. This will also give the students and lecturers not only access to e-books but also online academic journals the UK universities could have been subscribed to, hence encouraging learning, teaching, research and university partnership. To enable urgent address to all the gaps identified, funding needs to be given a key priority to enable capital investment in

support of curriculum development. Most private universities solely rely on the founder for funding and the bulk of such fund goes to servicing the overhead cost. The faculty should source from donors and private organizations such as Mac Arthur Foundations, Shell, and Google etc. For example in 2010, the Mac Arthur Foundation awarded grant to Bayero University Kano to complete it ICT Centre (McFound, 2010).

In summary, the implementation of any western designed ICT curricular in a developing country needs to shift beyond the directly as-it-is implementation of such curricular to adapting it to the cultural, institutional, social and political context where it is to be implemented in order to encourage success. In suggesting the potential for future research, the limitation of this study is recognized. The study was limited in that only a single focused case study was undertaken under severe time limitations; however there is scope for undertaking a longitudinal study on the basis of the current results to provide more insight on implementation issues as the university continues to expand in regards to student size and also computing courses. Lastly, the findings of this study cannot be generalised due to the choice of research strategy but can give insights by drawing specific implications for actors involved in the implementation of international ICT curricula as well as researchers that plan to investigate similar subjects in different context

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Success factors for ICT implementation in Saudi secondary schools: From the perspective of ICT directors, head teachers, teachers and students

Sultan Albugami and Vian Ahmed
Salford University, UK

ABSTRACT

The role of Information Communication and Technology (ICT) in education is undisputed globally. Therefore, many developed and developing countries have invested heavily in the ICT sector in education. Saudi Arabia is one of these countries. However, although it has invested massively in the ICT sector in education, the progression has often been disappointing – resulting in a number of serious questions being raised for decision-makers and educators alike. One of the most important of these questions is ***'what factors affect the successful implementation of ICT in schools'.*** Hence, the importance of this paper is to find an answer to this question and related questions from the participants' perspective. Consequently, the study is primarily concerned with qualitative data, collected in semi-structured interviews with two ICT directors, four headmasters, four teachers and four students, in Saudi secondary schools. Generally, the results showed that ICT was perceived as an important tool in improving performance, collaboration, learning experience and learning outcomes. However, some challenges that affect the application of ICT in Saudi schools are, for example, the lack of space, resources, maintenance, a lack of ICT skills among school along with a lack in ICT training and a lack of clear ICT policies. However, the overcoming of these obstacles could turn these barriers into positive factors to aid in the success of ICT implementation.

Keywords: *ICT Directors, Headmasters, Teachers and Students' Perceptions; Saudi Arabia schools; ICT in Education; successes factors; barriers.*

INTRODUCTION

In a global context, ICT is increasingly accessible and influential. Therefore, most countries see ICT as a gateway for the raising of educational standards (Noor-Ul-Amin, 2013). Today, both developed and developing countries recognize the value of ICT tools for their economic development. Developed countries, The US, for instance, spends more than $10 billion annually in educational technology in public schools (Brunk, 2008), while Australia spends approximately AUD$8 billion (Lane, 2012).

Developing countries, for example India, which has adopted a program aimed at reconstructing the existing system of tertiary and vocational education through the integration of ICT tools to reinforce the acquisition of human capital (Halewood & Kenny, 2008). Likewise, Uganda's developmental policy relies strictly on ICT and the use of considerable ICT tools to act as a sufficient driver and enabler to boost the country's economy and education (Ssewanyana & Busler, 2007).

Saudi Arabia has not been left behind in the development of ICT. The Saudi government has made huge investments with a view to developing public education. For example, in 2007 the Saudi government invested almost £2bn in reforming and improving education using modern technologies. Furthermore, public education was improved by revising the curriculum and

introducing electronic devices to facilitate teaching. This project also introduced training and developmental programs for educators to ensure sufficient use of ICT in education (Tatweer, 2015). Furthermore, about 25% of the overall Saudi government budget for 2015 is dedicated to the educational sector(more than £36 billion), which adds to the already massive funding being pumped into the educational field towards the implementation of technology in the school curriculum and improving ICT facilities (Ministry of Finance, 2015).

However, in spite of this massive spending and governmental support, Saudi Arabia still lags behind the countries that lead the world in the educational sector, especially in ICT (Ageel, 2011; Almadhour, 2010). There is still a real gap between the availability of ICT technology in Saudi schools and methods of implementation. For example, some recent studies related to ICT in Saudi schools (Oyaid, 2009; Almadhour, 2010; Almalki & Williams, 2012; Al-Harbi, 2014), revealed that the Saudi government needs to develop an effective strategy for ICT in education and to implement it in practice. Almadhour (2010) concluded in his study, 'Unfortunately although the Saudi Arabian government has lots of funding, there is no clear strategic framework towards equipping ICT in schools'. From a more global context, studies conducted in North America have actually shown that greater investments or the availability of technological resources in the classroom do not necessarily translate to improved academic achievement, mainly as a result of poor implementation (Wozney et al, 2006; Ungerleider & Burns, 2002; Balanskat et al., 2006).

Consequently, this paper aims to explore the success factors for the effective incorporation of ICT into instructional practices by answering the research question, ***'what factors affect the successful implementation of ICT in Saudi schools'*** by examining relevant ICT strategies**,** models and frameworks used in education, In addition to the barriers that hinder ICT in education. The words model and framework are used interchangeably in this paper. Varied components of the framework are referred to as elements.

SUCCESS FACTORS AND HINDERING FACTORS FOR ICT IN EDUCATION

There are a number of strategies and frameworks, which have been applied in developed countries to allow the effective use of ICT in education. For instance, the research published by The Ministry of Education in New Zealand (2006), *'ICT Strategic Framework for Education',* offered ICT tools to direct and manage ICT input with the goal of enhancing educational objectives for the government. The study commenced with the question: 'why an ICT strategic structure for learning?' The cooperation of educational centres and government institutions was assumed to be essential in the efficient application of ICT in the learning sector. The framework takes into consideration the issues of those working and studying in educational environments. On top of this, it is in line with the country's E-government and National Digital Strategies offering the basis for dynamic E-education to be integrated into New Zealand learning practice. Therefore, there is a need to establish and maintain partnership between all parties engaged in the educational process in order to handle all ICT issues effectively (Bingimlas, 2009).

Using a similar concept, the Department of Education in Australia established a national framework for ICT aimed at providing maintainable and significant change to educating and learning within Australian institutions to train pupils for additional teaching and learning and for existing in a digital age. In addition, this aimed to reduce barriers by addressing leadership factors by facilitating leadership; responding to student needs by individualising and expanding pupils' education; linking learning further than the institution; enhancing pupil appraisal and reporting; advancing, quantifying and observing pupil ICT proficiencies and obtaining and employing pupil information. The framework also addresses the technical and expert protocols in place to ensure they are offering, obtaining and controlling education procedures; maintaining expert instruction; mechanising commercial procedures; and offering dependable infrastructure (Alhawiti, 2013).

Though the Australian framework had crucial elements that address student factors and technical barriers, it has limited focus on headmaster and teacher's factors. There are, also, elements of this framework that may pose limitations on implementation in the Saudi educational system. For example, the current systems and policies 'enabling the environment and curriculum' are not developed enough in Saudi Arabia (Hakami *et al*., 2013). The framework has however structured, and recognised ten essential elements for effective ICT application, these key components can enhance the implementation and development of ICT in the Saudi Arabian context especially for rigid and structured education systems. A good example of this is enabling leadership, which is vital in ensuring the implementation of ICT at ministerial and educational establishments. This is currently not streamlined well in Saudi Arabia and there is a clear gap in policy and practise, along with failing to link the school head teachers and the Saudi Ministry. (Al-Miman, 2003; Oyaid, 2009; Robertson & Al-Zahrani, 2012). It has been seen that some head teachers lack leadership due to the various barriers experienced in ICT use and implementation, as a result, the adoption of this can enhance the current research (Bingimlas, 2009).

The need to provide frameworks, processes and systems that can evaluate the learning process, as well as manage and support professional learning as identified by Almadhour (2010), makes the Australian national framework very relevant to Saudi Arabia in the context of the learning processes. This study therefore investigates some of these elements such as the current infrastructures, leadership roles and ICT capabilities, not only of students as in this framework, but those of teachers and head-teachers as well.

(Lee et al., 2009) a study in South Korea explored how the e-learning practices established altered the learning concept from teacher to pupil-focussed (see Figure1).

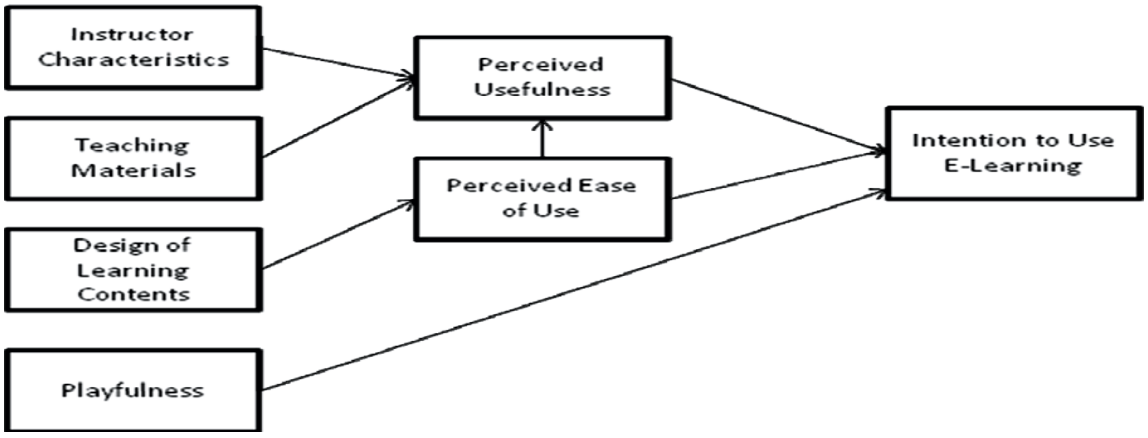

Figure 1: *The relationship between E-learning and satisfaction (Lee et al, 2009).*

In contrast, the current system in Saudi is largely teacher focussed, although in actuality, this South Korean model facilitated the efficient reaction of teachers to critical matters like the dense pupil population in Korea and elevated learning standards. Lee and company see ICT through e-learning as cost effective, efficient and an alternative to traditional learning as it bridges the space and time barriers to learning. The success of the model is however alluded to addressing the learners and educational objectives in the design, which requires an approach that is multidisciplinary, and task driven

As in South Korea, Saudi Arabia has had a rapid growth in ICT however; the adaptation of e-learning and its acceptance has not been fully explored as an implementation strategy and there are limited empirical studies that show learner acceptance (Al-Harbi et al, 2013). Aspects of this model can help address access, lack of space and environmental barriers faced by Saudi schools. The key variables that are vital in this model are centred on teacher characteristics, learning material and design. There is need to ensure the resources developed fit the needs of the student (Eyitayo, 2013). However, for the acceptance of the technology the perceived usefulness of the material by the learner is crucial (Kaur, 2011). In addition, one element of this model is to measure participants' perceptions of ICT, in order to be compatible with one of the study's objectives. Therefore, this model could be useful. In this matter, for instance, Oyaide (2009) emphasizes the importance of investigating teachers' characteristics (Views, beliefs and attitudes) and the extent to which they are helpful, cooperative, and accommodating to students. In addition, the availability of ICT tools is crucial; to understand which learning contents are designed for consistent and accurate delivery (Bingimlas, 2009). The extent to which students enjoy learning and believe that e-learning will enhance learning outcomes is an additional factor (OECD, 2000). Finally, to what extent students intend to participate in e-learning is also important. However, a proper strategy, planning and an implementation framework needs to be in place. The ability of learners and instructors are also critical for the success of this model (Lee *et al,* 2009).

Lim and Khine, (2006) examined the strategies employed by four Singapore schools, two primary and two junior colleges in order to manage barriers in and out of the classroom to ICT implementation. They found six operating strategic elements, based on the observations of ICT lessons and face-to-face interviews with teachers, directors of ICT and school headmasters. These included: technical support staff; training of student ICT helpers; time for teachers to prepare for ICT; collaboration among teachers; support provided by headmasters in addressing teachers' ICT concerns; and training for teachers on how to use ICT in the classroom. This framework is central to the questions and gaps in knowledge addressed by the current study. The current study will evaluate these factors in terms of ICT application by teachers and students, and assess the availability and roles of technical support, the training and skill of teachers in ICT and support provided by the headmaster in addressing teachers' ICT concerns in Saudi schools. For the effectiveness of ICT, the challenges are not only limited to technical issues.

Other aspects have been critical and according to Newhouse (2002), the most important factor is ICT resources. Newhouse framework argues that resource availability or lack thereof has a strong relation to the curriculum. That, in turn, supports influences and provides logistics of how to deliver in terms of content, learning outcomes and pedagogy. However, Newhouse framework also emphasizes the thinking of Lim and Khine (2006), which pointed out that the availability of resources without technical support, makes ICT tools hard to integrate at school level. Newhouse adopts a systematic approach with a view that all relationships have an impact on each other. For instance, the availability of resources, with technical support but no skills or knowledge to implement ICT in classrooms implies there will be no positive outcome (Newhouse, 2002).

Interestingly, Newhouse's framework identifies key issues that are relevant to this study. Newhouse's systematic framework approach has not addressed issues regarding policies and strategy, integration of ICT in the school curriculum and the head teacher's role as a key implementer. It does however look at the role of the wider community in relation to the schools, and emphasises the teacher and student elements in ICT implementation. This framework presents a number of interacting factors that are similar to current study objectives. (See Figure 2). Therefore, the framework assumes an already established system in terms of curriculum, learning environment and availability of resources and supporting environment (Newhouse, 2002). In the Saudi context, the framework presents core elements, which the study shall review, but it has not taken a systematic or linear approach, as ICT is still in the development stage in Saudi schools (Almalki and Williams, 2012).

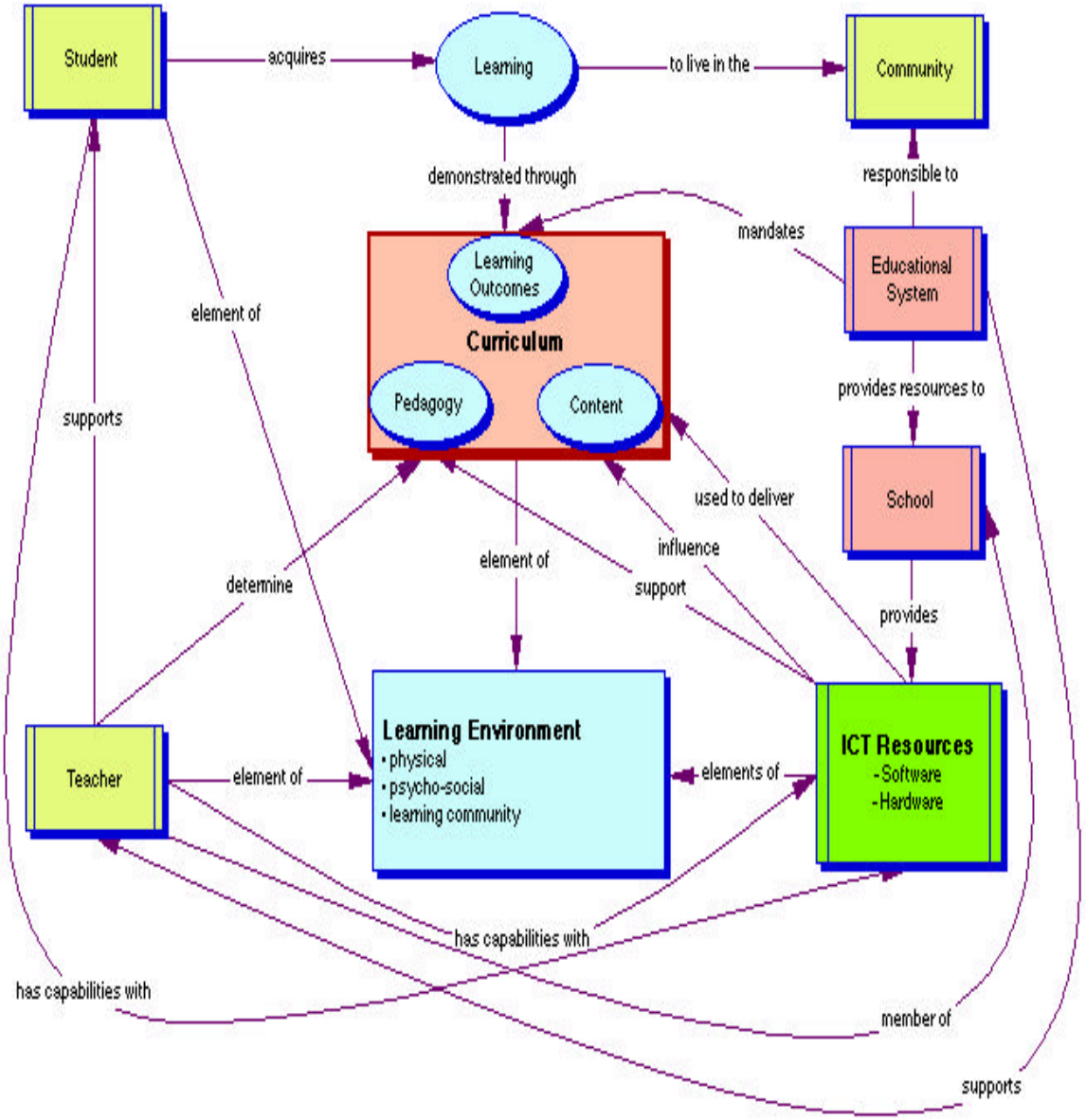

Figure 2: *Concept map indicating relationships between learning environment entities and external entities (Newhouse, 2002:p15)*

However, on the other hand, the shortage in these factors could turn them from positive factors to negative factors (barriers). Ertmer (1999) categorised factors that hinder ICT application in schools, into two main categories - internal and external obstructions. In this concept, Al- Al-Alwani (2005) described internal obstructions as barriers associated with people, in an organisation, such as headmasters and various teacher roles, views and attitudes. On the other hand, external obstructions are those associated with factors outside of the organisation, like lack

of ICT resources, lack of technical support, and lack of policy, which are all related to the Ministry of education. How these barriers could negatively affect the implementation of ICT in education is discussed below.

A study conducted by Oyaid (2009, p154) showed that 39.8% of teachers saw a lack of explanation of ICT in Saudi educational policy. In addition, studies conducted by (Almadhour, 2010; Almalki & Williams, 2012; Al-harbi, 2014), highlighted the need to develop an effective strategy for ICT in education and to put it into practice in Saudi schools. Furthermore, Almadhour (2010) concluded in his study:

> *"Unfortunately although the Saudi Arabian government has lots of funding, there is no clear strategic framework towards equipping ICT in schools"* (p62).

AL-Harbi (2014) and Ghamrawi (2013) found that the headmaster plays a major role in ICT implementation. For example, if the headmaster does not provide adequate support and encouragement to teachers, a good working environment cannot be created to motivate teachers to experiment with ICT in their classrooms. In addition, Levin and Wadmany (2005) confirm if headmasters and teachers attitudes and beliefs are not constructive with regard to ICT implementation, it is likely that ICT will not be accepted or applied in schools.

In relation to the role of the teacher, several researches were carried out to examine the relation between ICT and teacher roles (Erdemir et al., 2009; Oyaid, 2009; Alhawiti, 2013). The outcomes of these researches showed that teachers play a vital role in making the ICT implementation more successful. It is apparent that the integration of ICT in education is a highly comprehensive process requiring changes at all system levels. Teachers as the providers of information and knowledge should adjust to new strategies to make their contribution to the learning process relevant. If this is not the case, teacher resistance to change can be another barrier to their utilization of technological advances in education. Individual teacher beliefs and attitudes towards ICT can have a significant influence on their performance in the classroom (Bingimlas, 2009). However, teacher reluctance or resistance to change are other barriers to using ICT and can be due to a number of factors such as teacher competence, school digital infrastructure, technophobia, and access to ICT tools. Hence, such teacher reluctance can mean they are unenthusiastic about using computers in their teaching practices and integrating supplementary learning, thus hindering full-scale ICT integration in education (Bingimlas, 2009).

In addition, Saudi teachers as started by Al Asmari (2011) suffer from a lack of time to prepare ICT materials for lessons. In other words, the additional time required must be given to use ICT tools appropriately in order to successfully integrate technologies into the classroom. Therefore, the implementation of ICT tools can be successful if there is constant collaboration between all participants – teachers, schools, as well as the educational system. (Al Asmari, 2011).

Bingimlas (2009) highlighted in his research several obstructions that may limit ICT incorporation in learning institutions. For example, the growing number of students in classrooms, insufficient amounts of ICT recourses along with technical support and maintenance, and the absence of incentives for the teachers regarding the employment of ICT in their classrooms.

The previous relevant literature, showed some barriers that may hinder the utilization of ICT in education. In addition, the literature revealed that the successful implementation of ICT in education requires paying attention to certain factors. Figure 3 illustrates some of these factors.

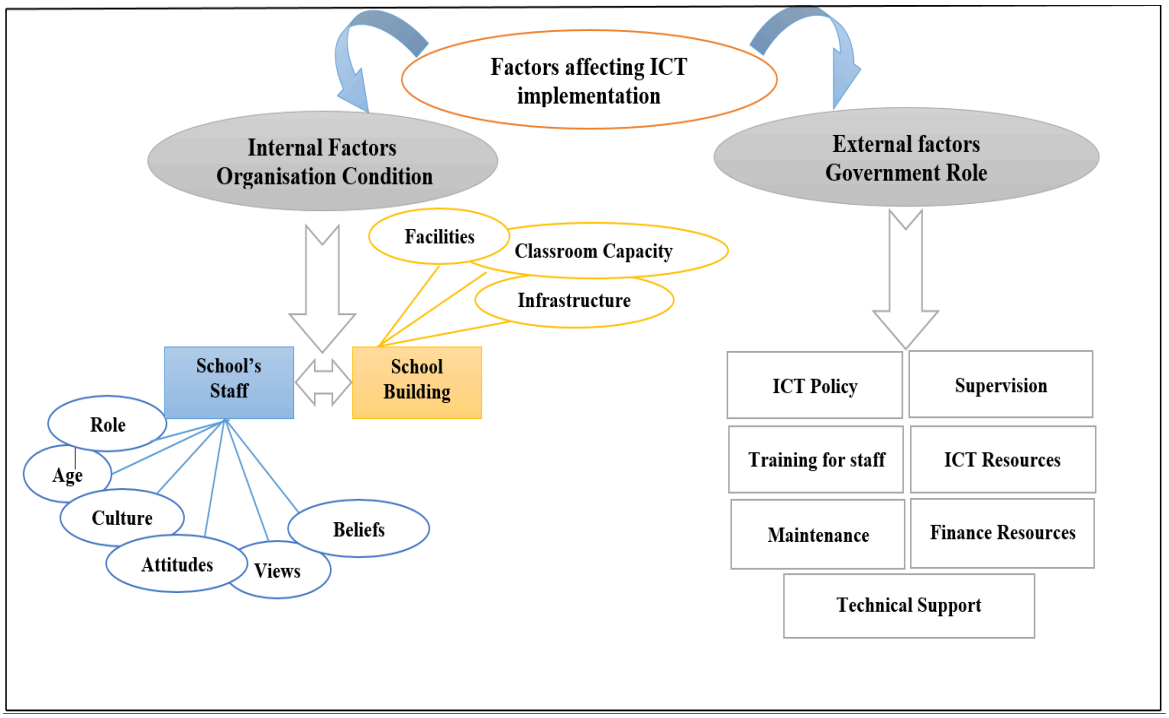

Figure 3: *Internal and external Factors affecting ICT integration in Education (Adapted from the previous literature review)*

METHODOLOGY

The study followed the 'Onion Design', which was developed by Saunders et al (2012, p160). This design is divided into six parts

Research philosophy

Since this study seeks to understand participants' perception towards the research phenomena under investigation and to answer the research question, the study complies with the interpretivism philosophy, which puts more emphasis on the development of knowledge that is socially constructed (Sexton, 2003).

Research approach

Based on the research phenomenon, this study, primarily, is exploratory research and somewhat tends to be explanatory and descriptive. The combination of these three approaches help researchers not only to explore the phenomenon but also to explain and describe why it is occurring. For example, this study tends to explore the success factors of ICT implementation in Saudi schools; it focuses on describing the problems (barriers) towards ICT, as well as explaining all the dimensions of the problem and its causes (Saunders, et al, 2012).

Methodological choice

According to Saunders et al (2012, p164), in choosing research methods the researcher will either select 'Mono method' (single method), or 'Multiple methods', (more than one data collection technique and analysis procedure). Accordingly, this study has selected single method (qualitative analysis choice). See figure 4

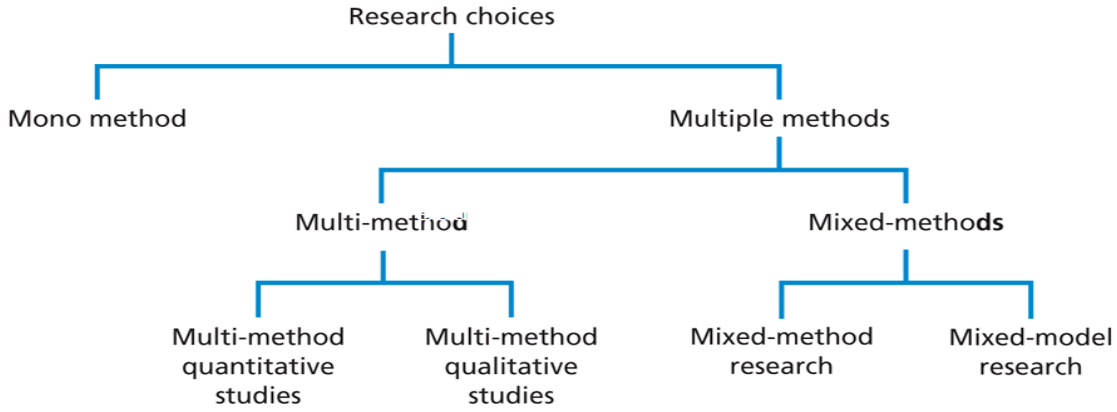

Figure 4: *Methodological Choice (Adapted from Saunders et. al, 2012.pp 165)*

Research strategies

The research strategy is based on three conditions, one of them is the types of research questions being used such as "what", and "how" used through a number of research strategies such as experiments, surveys, case studies and archival analysis (Yin, 2003:p5) . Thus, case studies have been used in this research. For example, what factors make ICT implementation more successful in education, what are the obstacles that prevent the application of ICT and how these obstacles can be overcome.

Time horizons

According to time horizons, research projects may be cross-sectional or longitudinal. Cross-sectional research is described as research investigating a phenomenon at a particular time, whereas a research investigating a change and development over a time is called Longitudinal (Saunders et. al, 2012). In this study, the time horizon is cross sectional. It was also not possible to access all Saudi schools for a longitudinal study. Furthermore, there were time limitations and a schedule for the completion of the study.

Data collection tools, sampling, techniques and procedures

Interviews

There are many ways of collecting responses from participants. For example, the common data collection methods in qualitative research are interviews, observations and focus groups (Mason,

2004). According to Harris & Brown (2010), the study selected semi-structured interview, which is often used in qualitative research to generate positive results.

Sample

The 'purposive sampling technique' also referred to as 'judgment sampling', was adopted; key informants were targeted for sampling (case studies). The participants were strategically taken from various institutions, qualifications and encounters to mirror the present ICT circumstances in Saudi secondary schools. The interview questions and choice of facets were chosen and arranged carefully in order to deal with different aspects under investigation (Gillham, 2000)

The testing of questions was done before the actual interviews to review the length of the questions and also to test their applicability and the recording tools. Trialling of questions reduces interview bias and improves quality through moderation before the final interview (Gillham, 2000). In the current study, theoretical methods, data collection and analysis were triangulated at various levels of design, sampling, data collection and data analysis. Data from different cases from policy level with two ICT directors were triangulated with four head-teachers, four teachers and four students at ICT end-user level. Semi-structured interviews and funding from the literature review were triangulated aiming to strengthen reliability and validity (Todd, 1997).

Table 3: *sample information in qualitative phase.*

Coding	Participants Position	Gender	Age	Experience In education	Training In ICT	Qualification	ICT Skills Level
H[1]	Headmaster	Male	43	19 years	Formal Training	Bachelor	Intermediate
H[2]	Headmaster	Male	38	13 years	Formal Training	Bachelor	Expert
H[3]	Headmaster	Male	39	14 years	Self-Training	Bachelor	Intermediate
H[4]	Headmaster	Male	58	33 years	No Training	Bachelor	Poor
T[1]	Teacher 1	Male	25	2 years	Self-Training	Bachelor	Poor
T[2]	Teacher 2	Male	33	8 years	Self-Training	Bachelor	Intermediate
T[3]	Teacher 3	Male	46	21 years	Formal Training	Bachelor	Intermediate
T[4]	Teacher 4	Male	28	4 years	Self-Training	Bachelor	Expert
S[1]	Student 1	Male	17	----------	No Training	High School	Intermediate
S[2]	Student 2	Male	17	----------	No Training	High School	Intermediate
S[3]	Student 3	Male	18	----------	No Training	High School	Expert
S[4]	Student 4	Male	17	----------	No Training	High School	Expert
D[1]	The Director of IT tools	Male	56	23 years	Formal Training	Bachelor	Expert
D[2]	The Director of IC	Male	43	18 years	Formal Training	Bachelor	Expert

Data techniques and procedures

The study used the constant comparative method. In this method, the data break down into discrete 'units' (Lincoln and Guba, 1985) or 'incidents' (Glaser and Strauss, 1967) then coding them to 'themes' and 'sub-themes' (Braun and Clarke, 2006). Taylor and Bogdan (1984) summarised this method:

> *"in the constant comparative method the researcher simultaneously codes and analyses data in order to develop concepts; by continually comparing specific incidents in the data, the researcher refines these concepts, identifies their properties, explores their relationships to one another, and integrates them into a coherent explanatory model"* (p126).

The study followed the Braun and Clarke (2006) strategy, which suggests six stages (each based on the previous one) that should be followed by the researcher to reach the aim of qualitative data analysis. In the first stage the researcher should be familiar with the data, after which the initial codes are created and then the themes are searched for. Data themes are reviewed in the fourth step followed by the explanation of the themes and finally the writing of the report.

Therefore, the interview texts were transcribed and then read several times with the aim of becoming deeply immersed in the data. After reviewing category indicators in the interviews' text, the next step was to identify those indicators by coding them to create 'initial codes'. This coding categorisation continued until it achieved either 'informational redundancy' or 'theoretical saturation' (Glaser, 1978). The data was organised and managed by using manual methods within Microsoft Word 2010 programs. Figure (5), gives a summary of the study design.

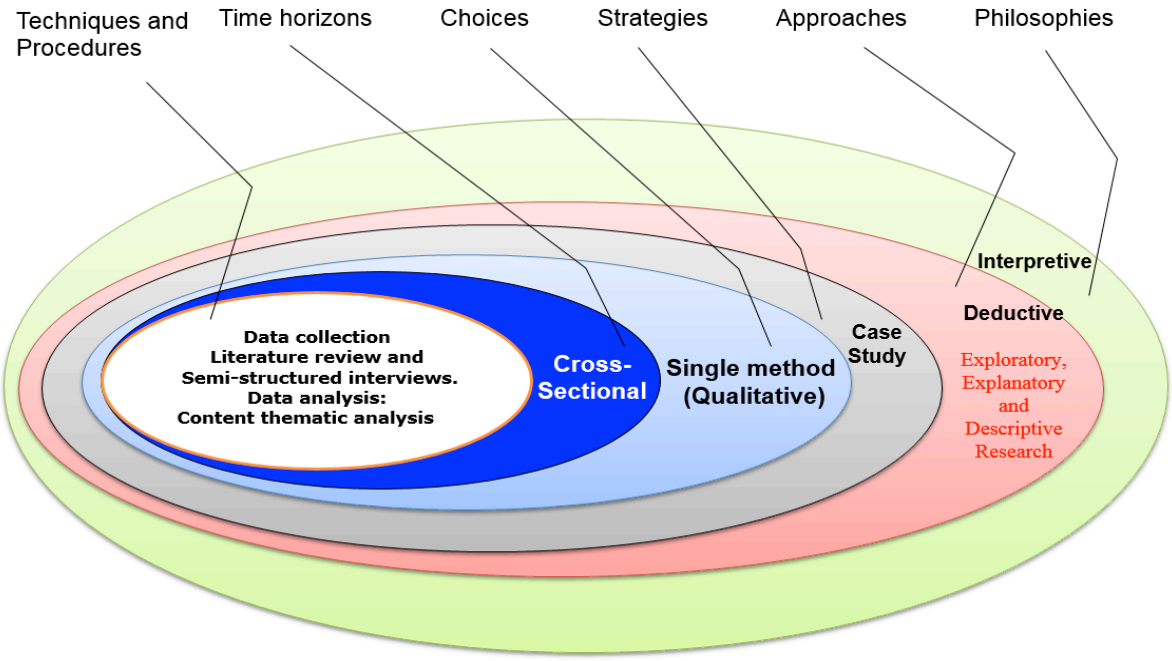

***Figure 5**: Summary of the Research Design. Adapted from Saunders et al (2012 pp. 160)*

FINDINGS AND DISCUSSION

In this section, the results of qualitative data will be presented and discussed in parallel with the literature review outcomes. Internal and external factors will be also discussed in this section (Randolph, 2009).

School's culture (views, attitudes and beliefs) towards ICT

The results showed there were positive views and attitudes from all participants towards integrating ICT tools in education. The research established that these aspects encompass most matters and could assist ICT application in institutions. For instance, (Seyal, 2012; Yuen, Law, & Wong 2003; Schiller 2003) indicated that the key element in successful ICT implementation in lessons is the perspective of the headmaster and their staff. It could be argued that their beliefs and attitudes are critical in ensuring the success of the implementation of ICT. Furthermore, the results showed negative views towards using internet at schools. In general, the need to improve student attitudes towards ICT as a learning tool and using internet for educational purposes as identified by ICT directors, headmasters and teachers is crucial.

In relation to the use of the internet in schools, the results highlighted that most headmasters and teachers tend to restrict the use of the internet at school due to moral and religious perspectives. However, The limitation of Internet access in Saudi schools may be attributed to religious or cultural beliefs (Barzilai-Nahon and Barzilai, 2005). For example, over 2,000 sites containing pornography or information on faiths other than Islam have been restricted by the Saudi Arabian authorities (Burkhart and Older, 2003). Instead of restricting the use of the internet, some solutions have been suggested, for example, The Virginia Department of Education (2007), published guidelines relating to internet safety instruction in schools. For example, the importance of learning via the internet should be convinced to both educators and students. Furthermore, the use of the latest internet security must be installed on school computers to monitor and filter student internet use (The Virginia Department of Education, 2007).

However, in Saudi Arabia there is hope as attested to by Albugami (2008) who has expressed that despite the initial resistance of religious organisations, they still do use ICT in educational practises to cope with contemporary times. Therefore, headmasters who still have conventional beliefs about ICT and its adverse effect on religion may be made aware of the fact that technologies like the internet can be modified based on the culture that uses them, and can become localized by the systems, control, and rules employed by their users.

School's staffs roles

The majority of participants mentioned the importance of the headmaster's role. They emphasized that the headmaster should be a facilitator for using ICT tools. In addition, they pointed to the importance of encouragement and support to instil change. These results are compatible with some other studies. For example, Schiller (2003), in his study of *'The Elementary School Principal as a Change Facilitator in ICT Integration'* referred to headmaster's functions of developing supportive environments, arranging training, providing consultation and promotion, monitoring and evaluating. Thus, headmasters should be regarded as the facilitators of ICT implementation at the school level.

Regarding the role of teachers, headmasters and ICT directors as well as students, the first responsibility in the implementation of ICT tools in classrooms belongs to the teachers. However,

the issue of teachers' competence in computer use is crucial; proper competence is likely to provoke confidence and positive attitudes towards the change. Today's teachers frequently explain their reluctance to use ICT tools in classrooms by referring to their belief that their skills are poorer than their students' skills. Teachers' anxiety about their potential failure evokes their denial of the usefulness and effectiveness of ICT in education. In contrast, teachers' confidence in using technologies supports their beliefs in technologies' contribution to teaching and individual development and the need to expand the application of ICT in the future (Bingimlas, 2009).

The subject of resistance to change arosed during the interview with the headmaster:

> *"Some teachers are not welcoming to this change (using ICT); they do not have any idea on how to run devices. So they prefer traditional methods".*

Teachers' resistance to undergoing changes is another barrier to their utilization of technological advances in education. Teacher's beliefs regarding ICT-based learning are important, since their perceptions affect their performance in classrooms (Bingimlas, 2009). Teachers' reluctance to use computers in classroom activities is explained by a variety of other obstacles, including their competence, school digital infrastructure, as well as access to ICT tools. Hence, teachers lacking ICT skills are unenthusiastic about using computers in their teaching practices and integrating supplementary learning, which creates a vicious cycle precluding full-scale ICT integration in education (Bingimlas, 2009).

ICT policy

Regarding external factors, the study found that the Saudi educational policy was not clear and there is a contradiction in the instructions and responsibilities. For, example, the support from the Ministry of Education is not sufficient. With regard to this concept, the director of ICT said:

> *''I admit that there is a shortage within our department to support and supervise ICT use in schools, the reason, as what I said, the lack of sufficient supervisors"*

Furthermore, the headmasters pointed out that the Ministry of Education has not committed to providing sufficient ICT tools, proper infrastructure and training for all staffs, even though it emphasizes the use of technology at schools. Accordingly, in light of the lack of clarity in ICT policy, identifying the tasks and the application of policies on the ground by the ministry is crucial.

In Saudi Arabia, further studies have also established that although there is a Saudi ICT educational policy, it is not well communicated, implemented and re-enforced. Its application is also weak at classroom level. This agrees with the studies of (Almaghlouth, 2008, Oyaide, 2009, Mulkeen, 2003). These results are interesting, because if the headmasters or teachers do not understand the ICT policy they will not apply it on ground level. In line with this concept, Al-Habeeb (2013), stressed that the Saudi government should review its policy regarding ICT in education.

Lack in ICT Training

Another factor that relates to the role of government is training. The results showed that training plays a significant role in ICT implementation. In this regard, one headmaster said;

> *"About 90% of the school's teachers are not qualified for using ICT, they need training"*

While the results showed there is an interest in training among teachers, the training times are sometimes inconvenient. Most participants agreed that planning training outside of working hours without any incentive, results in no attendance. Similarly In Western studies, training time was identified as a barrier (Jones, 2004, Tearle, 2003) that negatively affects ICT integration in classrooms (Bingimlas, 2009; Mumtaz, 2000).

To seek a solution to surmount the implementation obstacles, it is important that training should concentrate on all facets of the case, fundamental proficiency training and the methods of application of ICT in the teaching and learning procedure (British Educational Communications and Technology Agency, 2003; Scrimshaw, 2004). In this context, many have proposed solutions to help teachers' requirements and to improve their experiences in ICT employment. For instance, Snoeyink and Ertmer (2001) proposed that the primary phase of training should concentrate on fundamental ICT skills and employment of broadly utilised software and hardware applications. Once teachers have attained the necessary proficiencies, they can move on to academic instruction. In this research, teachers' demands were to have constant training in ICT to help them apply it effectively.

Lack of resources, maintenance and technical support

The lack of ICT resources was viewed as one of the main barriers that hinder ICT application in schools. There are various reported resources either available or lacking in schools that create a number of problems. This was not far off in agreement with the some teachers and headmasters who reported:

> *"Devices are not enough and most of the equipment was brought by teachers' self-efforts, some devices broke down and were abandoned in the warehouse and the school administration does not have sufficient resources to fix them, we share (four or five students) on one computer."* Also, ‘'*there is no Internet".*

All the participants regarded the absence of maintenance and technical assistance as a hindrance, which has a direct impact on teachers' confidence because of their constant fear of technical breakdowns or failures. Kozma (2008) stated that teachers will have no interest in using ICT if they feel they will face technical problems that require a long time to fix. (Jones, 2004). Ensminger (2004) stressed the significance of full time technical support to aid in the process of ICT incorporation. Furthermore, management leadership is crucial in building the ICT infrastructure through finding necessary resources, determining technological structures, and establishing partnerships with other educational institutions (Stensaker et al, 2007).

Lack of Infrastructure and financial resources

The results showed differences between schools in ***Infrastructure***. The reason for this problem is related to the types of buildings, because the government—buildings schools have a good infrastructure and more opportunity to facilitate ICT within them. Whereas, rented buildings still suffer from lack of Infrastructure because these buildings were prepared in advance for housing. The solution to this problem, as the Saudi government plans, is to dispense rented buildings in 2015 (Ministry for Education, 2013). The participants suggested another solution:

> *"The schools should be built for the future and should be ready in advance to receive this equipment".*

Finally, Moon (2002) emphasizes that the lack of financial resources is seen as a significant barrier for ICT implementation in many countries. Moreover, several studies have confirmed the shortage in ICT infrastructure is one of the main obstacles in Saudi Arabia schools (Al-Sobhi and Al-Harbi, 2008; Al-Ghaith et al., 2010; Al-Sobhi et al., 2010).

5. CONCLUSION

The results of this study show mixed feelings of both optimism and fear. Policy makers, school leaders, teachers and students face numerous problems in the attempt to integrate ICT into Saudi secondary schools. The results present some barriers regarding ICT in education. However, despite all the highlighted challenges, there is a general feeling that ICT has a future in schools in Saudi Arabia, but there is a need to improve on the present situation. Accordingly, this study presents some factors that might hinder the implementation of ICT in Saudi Arabian schools:

- Lack of ICT policy and strategy;
- Lack of proper infrastructure and access to ICT resources;
- lack of management roles
- Lack of teachers role
- lack of school staff training;
- lack of technical support and maintenance; and
- Negative attitudes, beliefs and behaviour towards ICT tools.

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Community outreach projects as a sustainable way of introducing information technology in developing countries

Irina Zlotnikova
Botswana International University of Science and Technology, Botswana

Theo van der Weide
Radboud University, Nijmegen, Netherlands

ABSTRACT

The paper describes an approach to the sustainable introduction of IT in developing countries based on international collaboration between students taking the form of a knowledge bridge. The authors consider the challenges for introducing information technologies in developing countries; one of these is lack of reading materials ultimately leading to lack of reading skills in pupils and poor overall performance. A theoretical framework for the sustainable introduction of IT is proposed. It comprises the following components: (1) the model of a knowledge bridge, (2) the managerial model of the interactions between key stakeholders, and (3) the model of impact of a Community Outreach Project (COP) on target schools. The proposed models have been mapped to the widely adopted DPSIR framework used in sustainable development studies. As a case study, the authors discuss the E-readers Project run in two primary schools in Northern Tanzania. The paper also demonstrates how interaction and collaboration between Tanzanian and Dutch students was organized during preparatory stage and project implementation. The paper concludes with general recommendations on how to run a sustainable IT-based COP. These recommendations have been drawn from the analysis of the COP experience in the developing country, namely Tanzania.

Keywords: *Community Outreach Project; knowledge bridge; e-readers; sustainability; information technology; developing country*

INTRODUCTION

Outreach is an effort by individuals in an organization or group to connect their ideas or practices for the benefit of other organizations, groups, specific audiences or the general public, while a community consists of people with a common interest, usually living in a particular area. A Community Outreach Project (COP) is a project carried out by organizations or groups in order to transfer their knowledge and skills for the benefit of a deprived community (Weide & Zlotnikova, 2013). There are many examples of COPs run all over the world, a classification is provided by Weide and Zlotnikova (2013). In this paper, the focus is on COPs which involve the introduction of Information Technology (IT) in developing countries. Our particular interest is in COPs that are based on cooperation between students from universities in developed and developing countries. We refer to this cooperation as a knowledge bridge. The concept of a knowledge bridge is explained later in this paper.

According to IFAD (2009), sustainability means ensuring that the institutions supported through projects, as well as the benefits realized, are maintained and continued after the end of the project. Carroll and Rosson (2006) define sustainability as a dynamic process in which IT professionals, designers, and researchers work with community groups in ways that give them greater control over technology in their organization. Sustainable IT projects are those that can

pay their own way, generally without reliance on government funding (Hearn et al., 2005; Lennie et al., 2005).

Researchers identify several kinds of project sustainability:

1. Technical sustainability (Etta & Wamahiu, 2003; Young et al., 2001);
2. Financial/commercial/economical sustainability (Etta & Wamahiu, 2003; Ripamonti et al., 2005; Young et al., 2001): breaking even, profit-making, etc.;
3. Social sustainability (Hearn et al., 2005; Lennie et al., 2005; Mayanja, 2006; Simpson, 2005);
4. Organizational/institutional sustainability (Mayanja, 2006; Ripamonti et al., 2005): matters related to the running and management of the project, including capacity building, infrastructure maintenance, etc.;
5. Managerial sustainability (Etta & Wamahiu, 2003; Young et al., 2001);
6. Policy-related sustainability (Mayanja, 2006): a conducive policy environment, related to connectivity, IT infrastructure, etc.

In this paper, we restrict ourselves to technical and organizational sustainability of the IT introduction in a low infrastructure situation. The general objective of this study is to develop an approach to the sustainable introduction of IT in developing countries through COPs. This general objective is broken down into specific objectives as follows.

1. Objectives related to the Introduction of IT:
    a. To propose a framework for the sustainable introduction of IT in educational organizations in developing countries.
    b. To develop a mechanism for ensuring technical and organizational sustainability of the IT introduction.
2. Objectives related to the Community Outreach Project:
    a. To identify the content of the COP course to be delivered to young professionals as part of their training.
    b. To develop mechanisms and tools of coordinating activities between young professionals from developing countries and their counterparts in developed countries.
3. Objectives related to linking the sustainable introduction of IT and Community Outreach Projects:
    a. To propose a model of a knowledge bridge between developing and developed countries.

In achieving the stated specific objectives 1a, 1b and 3a, the dominant method used is extensive literature review and analysis. The literature sources included both published papers and unpublished documentation on the E-readers Project. To achieve specific objectives 2a and 2b, the following methods have been employed: questionnaires; face-to-face interviews; direct observation; group discussions; experimental teaching.

We also have considered a case study of a COP aiming at supporting the introduction of e-readers in Tanzania — a cooperation between the Nelson Mandela African Institution of Science and Technology (NM-AIST), Tanzania, and the Radboud University Nijmegen (RUN), the Netherlands — by organizing a joint course in their curricula. This COP was built upon the E-readers Project.

The structure of this paper is as follows. First we explain the approach to choosing appropriate technology, based on comparison of different sustainable IT devices. Secondly we describe the theoretical framework for the sustainable introduction of IT in developing countries, and the concept of a knowledge bridge. Then we present the case study of a COP aiming at supporting the introduction of e-readers in Tanzania. Finally we give recommendations and draw conclusions.

CHOOSING APPROPRIATE SUSTAINABLE TECHNOLOGY

Community Outreach Projects, as the name suggests, are intended to serve communities. The content and structure of the projects, as well as chosen technology, should address community needs (as identified through questionnaires, interviews, surveys, observations, discussions with community leaders, etc.). The E-Readers Project, used as a case study in this paper, was launched after a thorough community needs assessment (Arusha EcoLab, 2013b; Mwanga et al., 2013). Communities, however, are not always able to make a right choice of sustainable IT devices (due to lack of information) and purchase these devices (due to financial constraints), so they need help from governmental, non-governmental, or international organizations or as in the case under consideration, from institutions of higher education.

Project sustainability is one of the general challenges facing communities (as noted, for example, by Pouezevara, Mekhael and Darcy (2014)). There is a direct link between sustainability of the introduced IT itself and technical sustainability of the project introducing this technology. Technical sustainability of a project means that technical problems, even severe ones, do not lead to the termination of the project. Ideally, sustainable IT devices should not require any repair or replacement during the project lifetime and afterwards. Maintenance should be very easy and not require special skills. However, this ideal device does not exist yet. So technical sustainability does not necessarily mean that the project does not experience any technical problems at all, but those problems can be quickly and easily solved. This can be achieved through technical staff capacity building and selection of sustainable IT devices.

Sustainable IT is a technology that can work throughout the years without the need for repair or replacement. Sustainable IT currently mostly is understood as green IT. Murugesan (2008) states that green IT benefits the environment by improving energy efficiency, lowering greenhouse gas emissions, using less harmful materials, and encouraging reuse and recycling. Green IT refers to environmentally sound IT. Green IT also strives to achieve economic viability and improved system performance and use, while abiding by our social and ethical responsibilities. Thus, green IT includes the dimensions of environmental sustainability, the economics of energy efficiency, and the total cost of ownership, which includes the cost of disposal and recycling.

Computers, laptops and mobile devices with lower energy consumption and a longer life cycle would, a fortiori, be a right choice for projects run in the communities where resources (money, energy, learning/reading materials, etc.) are scarce. These are challenges other than project sustainability facing Tanzanian public schools, being part of a community, as identified by Nyirenda (2012): inadequate resources, lack of teaching and learning facilities, and inadequate infrastructure. The list of challenges facing schools was extended by members of Arusha EcoLab (an initiative group within Nelson Mandela African Institution of Science and Technology) at the preparatory stage of the project. Later on, this list was refined by the NM-AIST students as part of their exercise in needs assessment. The list of identified challenges faced by two primary schools — Nambala and Nganana — and proposed solutions, is shown in Table 1. Although the identified challenges (as shown in Table 1) are well-known to anyone who ever ran educational projects in Tanzania or came into contact with public schools, the requirements to IT devices to be introduced in two public schools were refined after discussions with some of the stakeholders.

Table 1: *Identified challenges and proposed solutions for two primary schools in Tanzania*

S/N	Challenge	Solution	Proposed IT device
1.	Limited access to reading materials for both teachers and students	To provide reading materials as soft copies in an unlimited number of copies	IT device which allows to download and read texts, preferably also supporting graphics, audio and interactivity
2.	Numerous power cut-offs or lack of power supply	To use IT devices which do not require stable and permanent power supply	"Green" IT device
3.	The work environment is not conducive for both teaching staff and pupils	This problem cannot be solved only by introducing IT devices, however, using IT devices may increase motivation of teachers and pupils	IT device with a user-friendly interface which is easy to use
4.	The number of teachers is not enough	Open, Distance and E-learning	IT device which allows interactivity and Internet access
5.	Teachers are challenged with professional development	Open, Distance and E-learning, self-study using downloaded materials	Ideally it has to be an IT device which allows interactivity and Internet access. However, if such a device is not available/affordable, it could be any IT device allowing to download materials

However, even modern, energy-saving, laptops need to be charged every several hours, which is not always possible given the conditions in developing countries. Thus there is a need for alternative devices that can be operational for several weeks without charging.

Candidate Devices

In this section, we provide a description and comparison of the most popular IT devices to support the educational process of schools in rural communities and evaluate them in terms of sustainability. Comparison of IT devices with traditional print books is left out of consideration, since each of the IT devices described in this section can carry thousands of books, as well as other educational materials, and, once purchased, can work for several generations of pupils. In the long run, IT devices will appear more cost-effective than traditional print books (WorldReader, 2012).

Laptops

The first known attempt to create a sustainable IT device specifically for developing countries has been undertaken in the One Laptop Per Child project (OLPC, 2014). The OLPC aims at providing children in developing countries with "a rugged, low-cost, low-power, connected laptop" (OLPC, 2014), giving them access to modern education. Laptops are sold to governments who then deliver them to schools. This computer is referred to as the XO computer.

The project is mostly run in Latin America (roughly two million children and teachers involved), with another 500,000 in Africa and the rest of the world. Although there are several African countries involved, this project is not supported by the Tanzanian government.

Internet kiosks

Internet kiosks is a widely applied model for the delivery of IT services to rural and poor populations, initially introduced in India and then extended to other developing countries. The important feature is ruggedness of these kiosks which helps to avoid destroying them by vandals. This feature also allows for minimum intervention to maintain kiosks. Services provided by these kiosks are delivered at a cost.

Internet kiosks are also found in countries of sub-Saharan Africa. The Rural Internet Kiosk (RIK) is an independent, self-contained, 100%-solar-powered kiosk, featuring three industrial-design computer terminals, an administrator terminal, and broadband wireless Internet connectivity (Kigoni & Ervin, 2010). The RIKs can provide the following development solutions to communities: eAgriculture, eCommerce, eHealth, eGovernment, eBanking, eLearning, relief services, local content creation, skills training, employment opportunities, independent local media, and knowledge exchange between developed and developing countries.

Mobile phones

The rapid growth of mobile communications and high penetration rates in Africa inevitably has led to the idea of using mobile phones in schools as a cheap and sustainable alternative to computers.

As it is indicated in the UNESCO guidelines (2013), given the ubiquity and rapidly expanding functionality of mobile technologies, they have a potential to improve and facilitate learning, particularly in communities where educational opportunities are scarce. Initiatives on mobile learning in African countries are numerous (see, for example, Brown, 2005; Kasumuni, 2011; Mafenya, 2011; Otto, 2011).

Tablet computers

Tablet computers are thought by many as perfect IT devices for schools. While schools in developed countries choose to buy iPads, schools in countries of sub-Saharan Africa are in obvious need for cheaper options. There was also an attempt to develop a tablet computer specifically for Africa (OLPC, 2014), the cost of which is still around 200 Euros. OLPC also recently introduced tablet computers as an alternative to their XO computers.

Main advantages of tablet computers, as compared to notebooks and netbooks, are a relatively long battery life (eight to 10 hours) and lightweight, while its screen size allows for easier input and reading than smart phones. However, the main issue here is that tablet computers still require to be charged every few hours, they are costly and not robust (can be easily destroyed).

E-readers

E-readers are electronic devices displaying digital texts such as books, pdf files, word processing documents, and a variety of other text formats (Barron, 2011). E-readers use e-Ink technology which, in contrast to a backlit screen, emits no radiation and achieves a level of text clarity and readability comparable with printed books. They can be used as an alternative to both traditional books and fully-functional computers in schools in developing countries if the main goal is to develop reading skills in pupils.

Comparing the various devices

Table 2 presents a weighted comparison of the IT devices considered in the previous subsection, based on the following sustainability parameters: (1) energy consumption, (2) robustness, (3) weight, (4) functionality, (5) ease of use, and (6) cost. Each parameter was weighted on a 5-point scale, with 0 being worst and 4 being best.

Table 2: *Comparison of sustainability parameters for different IT devices*

S/N	Device	Energy Consumption	Robustness	Weight	Functionality	Ease of Use	Cost	Total
1.	XO computers	4	3	4	2	3	2	18
2.	Internet kiosks	4	4	0	2	3	0	13
3.	Mobile phones	3	0	4	2	3	3	15
4.	Tablets	1	0	4	4	2	1	12
5.	E-readers	4	3	4	1	4	3	19

From this table we conclude that e-readers exhibit the best value for technical sustainability and cost. XO computers are slightly more expensive, but possess better functionality. However, in case of Tanzania, the OLPC project supplying XO computers to schools has not been supported by the government. Thus, the most technically sustainable and cost-effective supporting technology for schools in Tanzania was e-readers. Additional advantage of e-readers is the ease of their use. They require less adaption from teachers and pupils than tablets, smart phones, laptops or even XO computers. Everybody, who could handle a simple mobile phone, could operate an e-reader.

Parameters given in the last column of Table 2 are only indicative. The exact choice of IT devices depends on the clearly identified community needs and might change from one community to another. In the case of two primary schools in Tanzania (considered in detail in the described case study), e-readers appeared to be the best choice.

FRAMEWORK FOR THE SUSTAINABLE INTRODUCTION OF IT

In this section, we provide a framework for the sustainable introduction of IT. A theoretical framework (Merriam-Webster, 2014) is a set of ideas or facts that provide support for something (in our case, the sustainable introduction of IT). The general purpose of using frameworks is that these may be effectively used to represent conceptual procedures for understanding, modeling and managing decisional issues (Paoletti, 2014). Since the main focus of this paper is on sustainability of the IT introduction, the aim of this section is not only to propose models of the sustainable introduction of IT, but also to investigate how these models fit into one of the broader frameworks dealing with sustainability — the Driving forces-Pressures-State-Impact-Responses (DPSIR) framework (EEA, 2007).

The DPSIR causal framework adopted by the European Environment Agency (EEA) is used for describing the interactions between society and the environment. The DPSIR represents a systems analysis view: social and economic developments exert pressure on the environment and, as a consequence, the state of the environment changes. This leads to impacts on, for example, human health, ecosystems and materials that may elicit a societal response that feeds

back on the driving forces, on the pressures or on the state or impacts directly, through adaptation or curative action (EEA, 2007). The original DPSIR model is shown in Figure 1.

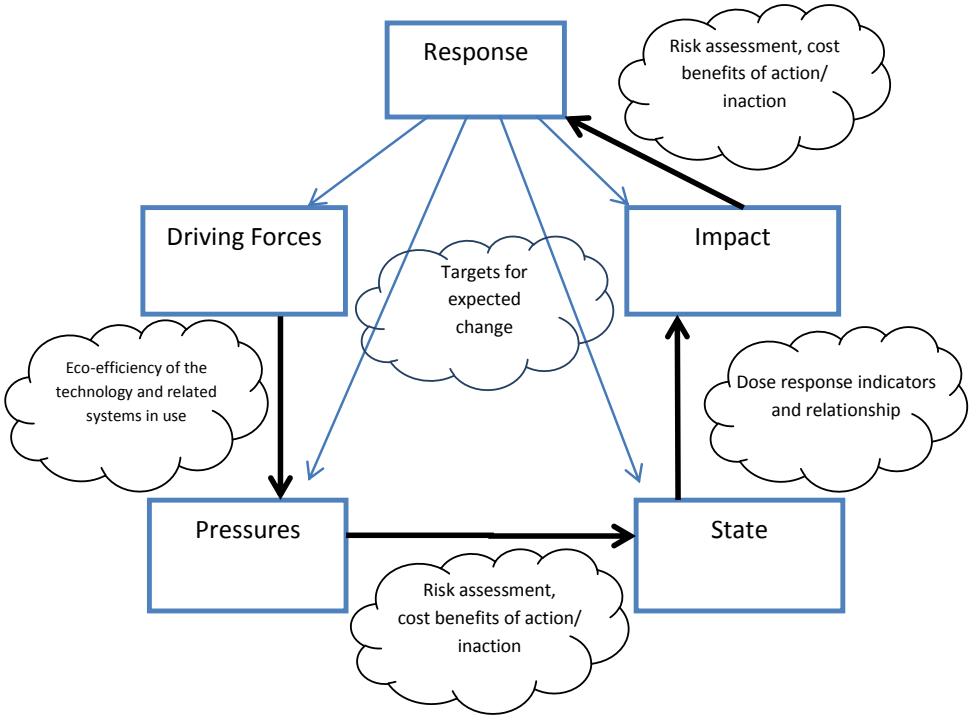

***Figure 1**. Original DPSIR framework (EEA, 2007).*

Components of the DPSIR framework were described by Paoletti (2014); we added the context of our study to this description, as follows.

1. Driving forces (D) are the major social, demographic and economic developments in society and the corresponding changes in lifestyle. In the context of our study, the driving force is the sustainable IT technology being introduced.
2. Pressures (P) are the effects of the driving forces, affecting the resources. In our context, the sustainable IT has to be introduced fast to achieve the best results in a short time. However, there are factors preventing the fast introduction, such as poor IT infrastructure, lack of technology knowledge, insufficient resources, lack of competent staff, organizational resistance to change, etc. Thus, the introduction of IT might put pressure on the project coordinators as well as on the benefitting partners.
3. State (S) is the state of the resources. The core input indicators for evaluation of the initial state of resources in ICT in Education projects are proposed by Wagner et al. (2007).
4. Impact (I) is evaluation of the state changes; in our case, evaluation of state changes is being done using core outcome indicators proposed by Wagner et al. (2007).
5. Response (R) is preventing, compensating or mitigating the negative outcomes of state changes. In our case, the response to the possible negative outcomes of the sustainable introduction of IT is a Community Outreach Project using the expertise from inside and outside the country. It takes the form of a knowledge bridge, as described in detail in the next subsection.

In the following three subsections, we describe the following models: (1) the model of a knowledge bridge, (2) the managerial model of the interactions between key stakeholders in a country where IT is being introduced, both inside and outside the beneficiary partnering organization, and (3) the model of impact of COP on target schools. The latter is a combination of the model of a knowledge bridge and the managerial model of the stakeholder interactions.

The model of a knowledge bridge

The main assumption made in this research is that we consider a COP as a knowledge bridge between two (or more) partners in developed and developing countries. The concept of a knowledge bridge is introduced by Pscheidt and Weide (2010). We also assume that the transfer of knowledge happens mostly in one direction — from the more experienced partner to the less experienced partner. This does not necessarily mean that the knowledge is transferred from a partner in a developed country to a partner in a developing country; however, it holds in many cases, including the case of the E-readers Project which is described in our case study. Our last assumption is that successful establishment of a knowledge bridge contributes to sustainability of IT introduction.

We further assume that, at the initial stage of the IT introduction, the partner on the receiving end may demonstrate a lack of knowledge of the technology to be introduced (its maintenance, effective usage, impact, etc.), especially if the technology is introduced by leapfrogging. Thus, there is a need for skills and knowledge being effectively transferred from the more experienced partner (which we call "a knowledge partner") to the less experienced partner ("an intermediary partner"). The intermediary partner then further transfers knowledge to target schools (serving as an intermediary). We refer to this transfer mechanism as a knowledge bridge (Pscheidt & Weide, 2010). The model of the knowledge bridge is shown in Figure 2.

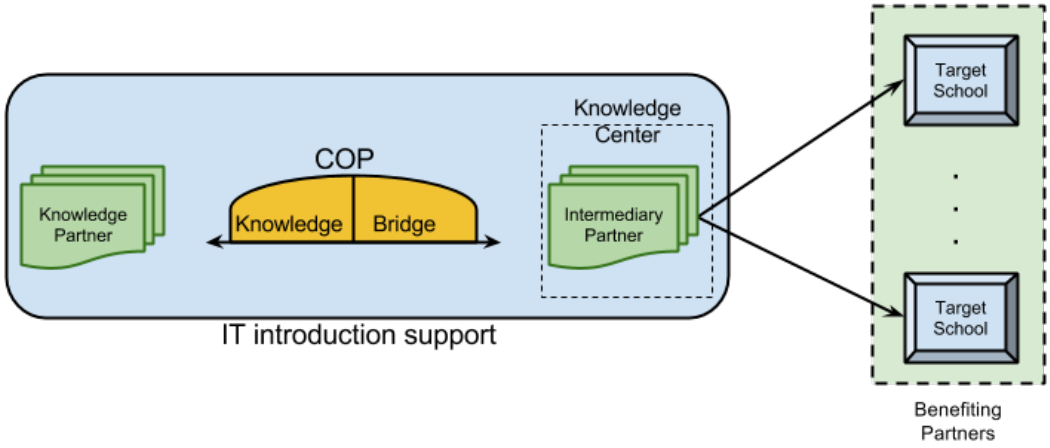

Figure 2. *The model of a knowledge bridge.*

The knowledge bridge is intended for situations where, besides the actual introduction of IT (for example, at schools), there is also an overarching infrastructure to be build. The knowledge bridge connects two partnering organizations which may stand at totally different levels of development. Although knowledge is mainly transferred in one direction — from the knowledge partner to the intermediary partner — there is also feedback coming from the intermediary partner,

as well as country/ organization-specific information which cannot be obtained from outside the country. Many people in both countries are involved; we identified them as stakeholders.

The link between the model of a knowledge bridge and the DPSIR framework is identified in the later subsection “Mapping of the proposed models to DPSIR.”

The stakeholder interaction model

Identification of key stakeholders and their full awareness and involvement contributes to project sustainability. Knowing key stakeholders' interests, interdependencies, influence and potential impact helps to understand better how each of them can ensure that the project will continue after the financing stops.

For the introduction of IT in an educational environment, the following groups of key stakeholders have been identified: (1) the educational staff, (2) the learners, (3) the technical staff, (4) the product developers, (5) the donors, (6) the school management and (7) the government.

Our proposed model of stakeholder interaction describes an ideal situation where interactions between stakeholders are smooth, and stakeholders never fail to perform their tasks. This is not normally the case in real-life situations, but we assume it for the sake of modeling. In this ideal situation, the educational staff contributes to sustainability of the project by continuous professional development, increasing their ability to use IT in teaching, subject expertise and motivation. The learners contribute to sustainability by developing positive attitudes to learning, specifically, learning with the use of IT. The technical staff's capacity to maintain and repair the IT equipment ensures technical sustainability. The product developers contribute to project sustainability by providing relevant educational content and applications. They might also wish to provide their content and applications at a discounted cost or at no cost at all, thus contributing to financial sustainability. The donors might continue supporting the project in different ways (not limited to financial support) after the financing stops. The school management is to provide a systemic approach to ensuring project sustainability through capacity building, continuous training and professional development of teachers, providing incentives, encouraging and motivating teachers and learners to continue using IT, and taking care of school IT infrastructure. The function of the government (if it is not directly involved in the IT introduction) is to provide general support, to monitor content development (to be relevant to curricula) and to develop an IT educational framework.

The interactions between various stakeholders are depicted in Figure 3. Here the arrows indicate the causal influence relations. The figure shows that school management is influenced by the government, while the school management influences the educational staff, the IT department and the technical staff.

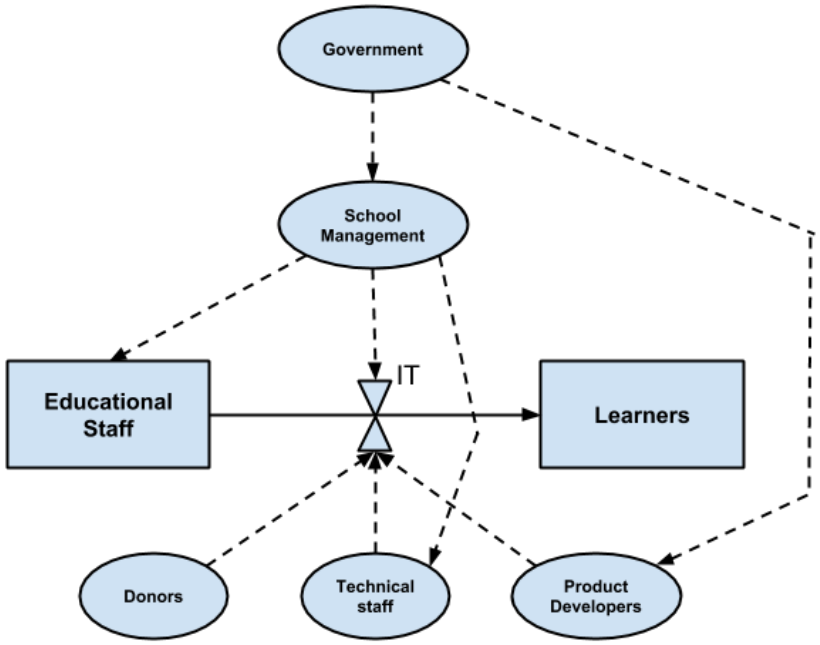

Figure 3. *The managerial model of the interaction between stakeholders.*

IT support is modeled as a valve that monitors the transfer rate of knowledge and skills from the teaching staff to the learners. Via this valve, school management monitors the quality of the educational staff, support of the IT introduction and the supporting technical staff. School management is influenced by the governmental rules and policies. Support of the IT introduction is further influenced by the technical staff and the developed product/content. Product/content development, as it was mentioned before, is monitored by the government.

The donors play an important role in introducing ICT, running COP and providing sustainability. This role is not limited to financial support. In this paper, we concentrate on young professionals — namely students — who would donate their labor rather than their money. Support of the IT introduction by young professionals takes the form of a knowledge bridge. These young professionals can work on different levels as shown in Figure 4. This figure describes the standard abstraction levels of administration (Juran, & Godfrey, 2000).

Figure 4. *The various levels of administration.*

During and after the project, at the strategic level the young professionals influence the school management by providing their recommendations on how to introduce and maintain IT, which leads to long term sustainability of the process as a whole. At the execution level the young professionals are involved in teaching classes and workshops. Later the young professionals will also grow into the managerial level and into the strategic level.

The link between the stakeholder interaction model and the DPSIR framework is identified in the later subsection “Mapping of the proposed models to DPSIR.”

The COP impact model

In Figure 5, we show how a COP impacts the target schools.

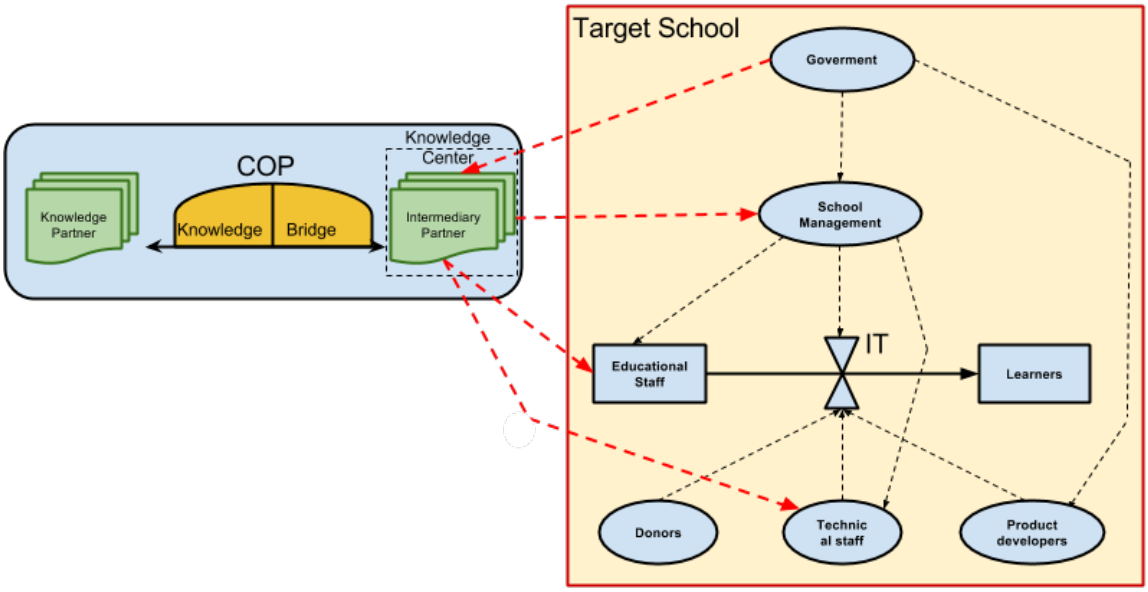

***Figure 5**. Model of the impact of the COP on target schools.*

The source of the impact is the intermediary partner, which then transfers knowledge to target schools. The government (if involved in the project) not only provides the context and budget for the project, but also the overall legislation, specifically educational policies. The intermediary partner directly influences school management, educational and technical staff. This allows the intermediary partner to have an impact at the strategic level (see Figure 4) via the school management, at the managerial level via the educational staff and at the execution level via the technical staff.

The link between the COP impact model and the DPSIR framework is identified in the next subsection “Mapping of the proposed models to DPSIR.”

Mapping of the proposed models to DPSIR

Table 3 shows mapping of the context of our study which is the sustainable introduction of IT to the DPSIR framework. It summarizes what was discussed in the section "Framework for the sustainable introduction of IT."

Table 3: *Mapping the Sustainable Introduction of IT to the DPSIR framework*

DSPIR	Sustainable Introduction of IT
Driving forces (D)	Sustainable IT
Pressures (P)	Pressures experienced by project partners and beneficiaries, when IT are introduced too fast and with insufficient resources
State (S)	The initial state is evaluated through core input indicators (Wagner *et al.*, 2007)
Impact (I)	The impact (state changes) is evaluated through core output indicators (Wagner *et al.,* 2007)
Response (R)	Community Outreach Projects taking a form of the knowledge bridge

Driving force (D) is the sustainable IT introduction of which leads to the major social, demographic and economic developments in society and the corresponding changes in lifestyle.

Pressures (P) are the effects of the introduction of the sustainable IT. It might put pressure on both the project coordinators and the benefitting partners, especially if the sustainable IT has to be introduced quickly. There are also some other factors which might add to the experienced pressure, such as poor IT infrastructure, lack of knowledge of technology, insufficient resources, lack of competent staff, organizational resistance to change, etc.

State (S) is the initial state of the resources before the sustainable introduction of IT. It could be, for example, evaluated using the core input indicators for ICT in Education projects as proposed by Wagner et al. (2007).

Impact (I) is evaluation of state changes as a result of the sustainable introduction of IT. It could be done, for example, using core outcome indicators proposed by Wagner et al. (2007).

Response (R) is preventing, compensating or mitigating the possible negative outcomes of the introduction of the sustainable IT. One of the responses is a Community Outreach Project using the expertise from inside and outside the country. It takes the form of a knowledge bridge.

Table 4 shows the links between components of the models proposed in three previous subsections. The COP impact model is not included into the table since it combines components of other two models. The identified link is denoted as "X". If the link is not identified, the cell is left blank. Detailed descriptions of the identified links are given below.

The knowledge partner supports the sustainable introduction of IT through the knowledge transfer, but in some cases also financially (then they are also called *donors*). The knowledge partner experiences pressure due to lack of resources and expertise in the country where IT have to be introduced, especially if the introduction has to be quick. Normally, the initial state of the knowledge partner is not evaluated. It is assumed that the knowledge partner is able to introduce IT. The impact on the knowledge partner is not evaluated. In some cases it is the responsibility of the knowledge partner to evaluate the initial state of the beneficiary organization and the impact

of the sustainable introduction of IT on it. The response of the knowledge partner is to transfer the knowledge to the intermediary partner as part of the COP. The COP takes a form of the knowledge bridge.

Table 4: *Identification of links between components of proposed models and DPSIR framework*

S/N	Components of the proposed models	DPSIR Framework				
		D	P	S	I	R
The Model of a Knowledge Bridge						
1.1	Knowledge Partner	X	X			X
1.2	Intermediary Partner	X	X	X		X
1.3	Target Schools	X	X	X	X	X
The Stakeholder Interaction Model						
2.1	IT	X		X	X	
2.2	Government	X	X	X	X	
2.3	School Management	X	X	X	X	X
2.4	Educational Staff	X	X	X	X	X
2.5	Learners	X	X	X	X	X
2.6	Donors	X	X			
2.7	Technical Staff	X	X	X	X	X
2.8	Product Developers	X	X			

The intermediary partner helps to introduce sustainable IT in target schools. The intermediary partner experiences pressure due to lack of resources and expertise. The initial state of the Intermediary partner might be evaluated in order to ensure that they are able to support the sustainable introduction of IT; however, the intermediary partner is not the main target of it. Thus, the impact is not evaluated. The response of the intermediary partner is to receive the knowledge from the knowledge partner and then pass it to the target schools.

The target schools benefit from the sustainable introduction of IT. At the same time they experience pressure due to lack of resources and expertise. The initial state of the beneficiary must be evaluated. The impact is evaluated as part of the monitoring and evaluation plan. The response of the target schools is to receive the knowledge and support from the intermediary partner within the country.

IT are the driving forces, and they are being introduced sustainably. The initial state of IT in the beneficiary partnering organization must be evaluated; however, in many cases, before the introduction, IT are not present at all. The impact must be evaluated as part of the monitoring and evaluation plan.

The government may do the following: (1) introduce sustainable IT, (2) sponsor the sustainable introduction of IT, (3) support the sustainable introduction of IT and (4) provide legal framework for introducing IT. It may experience pressures due to lack of resources and expertise. Intentions of the government may be misunderstood by beneficiaries and the general public, thus adding pressure on it. Some national educational and socio-economic indicators might be used to evaluate the initial state and impact, as suggested by Wagner et al. (2007). However, the government is not a part of a COP, thus there is no link with the response.

The school management helps to introduce sustainable IT and benefits from its introduction; however, they might resist change. They experience pressure due to lack of resources and expertise. The initial state of competences and the impact are evaluated as part of the monitoring and evaluation plan (Wagner et al, 2007). The school management receives knowledge and support from the intermediary partner.

The educational staff benefits from the sustainable introduction of IT; however, they might resist change. They experience pressures due to lack of resources and expertise. The initial state of competences and the impact are evaluated as part of the monitoring and evaluation plan (Wagner et al, 2007). The educational staff receives knowledge and support from the partner within the country.

The learners are the main beneficiaries of the sustainable introduction of IT. They experience pressures due to lack of resources and expertise, but to a lesser degree than other stakeholders (since they do not have to introduce IT or support this introduction). The initial state of competences and the impact are evaluated as part of the monitoring and evaluation plan (Wagner et al, 2007). The learners are on the receiving end of the knowledge bridge.

The donors support the sustainable introduction of IT by donating their money, equipment, expertise/knowledge or labour. They experience pressures due to lack of resources and expertise; sometimes their intentions are misunderstood by beneficiaries and the general public. Their initial state and impact are not evaluated. If only money or equipment is donated, donors are not considered as a part of the response. If donors provide their knowledge, they are considered as knowledge partners.

The technical staff supports the sustainable introduction of IT technically and also benefits from it. They experience pressure due to lack of resources and expertise. The initial state of technical competences and the impact are evaluated as part of the monitoring and evaluation plan (Wagner et al, 2007). The technical staff might receive knowledge and support from the intermediary partner.

The software developers support the sustainable introduction of IT by providing relevant software. They experience time pressures if software is to be developed fast. Their initial state and impact are not evaluated, and they are not a part of the Community Outreach Project.

The identified links between the widely adopted framework for sustainable development, such as DPSIR, and proposed models for the sustainable introduction of technology prove that those models “may be effectively used to represent conceptual procedures for understanding, modeling and managing decisional issues” (Paoletti, 2014).

SUSTAINABLE INTRODUCTION OF TECHNOLOGY: CASE STUDY OF TANZANIA

There are several programs that offer schools in developing countries an opportunity to obtain a technology "push" from either inside or outside the country. Examples of such a push include mass establishment of computer labs undertaken by governmental or non-governmental organizations (Farrell & Isaacs, 2007) and the introduction of the 4G mobile technology (Deign, 2013). In this section, we discuss another example of a push, a substantial donation of e-readers in primary schools. As discussed before, e-readers are a reasonable choice for the introduction of IT in schools in developing countries. They require a rethinking of the teaching process but do not impose strong requirements on the infrastructure. Part of this introduction was done as a COP by Dutch and Tanzanian students.

As it was shown earlier, the introduction of technology will have a significant impact on education only if it is sustainable, meaning that organizations and individuals will continue with the projects on their own after financing stops. It requires a certain level of organizational maturity from the intermediary partner.

Background of the E-Readers Project

In order to address its motto "Academy for Society and Industry," the Nelson Mandela African Institution of Science and Technology (NM-AIST) located in Arusha, Tanzania, runs a number of projects, including the one which introduces e-readers in primary schools. The project was initiated by the members of Arusha EcoLab. The target schools in this project are two rural primary schools — Nambala and Nganana — located in the Arumeru district in close vicinity of NM-AIST.

Project goals and measures

The project activities included a community needs assessment, delivery of e-readers to two primary schools, uploading the relevant content, teacher training, and development and implementation of a sustainability plan. The implementation of a sustainability plan was done by the Dutch volunteers from Radboud University Nijmegen (RUN) who came after the project launch in August 2013. In future, those activities will be continued by further generations of Tanzanian and Dutch students.

Table 5: *The project goals and measures to achieve them*

S/N	Project Goal	Measures
1.	To improve overall performance of teachers and pupils in subjects included into the primary school curriculum, leading to the better performance at Standard Seven, and, later, at Form Four and Form Six exams.	1.1 To introduce the use of e-readers in primary schools as an alternative to traditional textbooks 1.2 To develop basic skills of using e-readers in primary school pupils 1.3 To provide relevant digital content in accordance with the curriculum
2.	To increase teachers' capacity to teach and pupils' capacity to learn	2.1 To give teachers the knowledge and skills to use e-readers in teaching the primary school curriculum 2.2 To develop basic skills of using e-readers in primary school pupils.
3.	To achieve sustainability of the project	3.1 To develop basic skills of safe using and maintenance of e-readers in primary school teachers and pupils 3.2 To involve parents and other members of the local community and create awareness on the use of e-readers among them
4.	To overcome a negative impact of shortage of learning materials, lack of the Internet access and poor infrastructure in primary schools.	4.1 To introduce the use of e-readers in primary schools as sustainable IT devices with reduced energy consumption 4.2 To identify and download relevant learning content (if necessary, to develop relevant content) and incorporate it into the primary school curriculum.

The overall project goals and measures to achieve them as identified by the project coordinators are shown in Table 5.

These goals define phases and milestones in the E-readers Project long-term lifecycle.

The initiation of the E-readers Project

After assessing the needs of the two primary schools and choosing e-readers as most suitable and sustainable IT device, the members of the initiative group started the process of raising funds and purchasing e-readers (with the help of the non-profit international organization WorldReader). By joint efforts, the projects coordinators were able to purchase 300 e-readers. On April 23, 2013, the e-readers arrived at NM-AIST. Members of the initiative group, representatives of WorldReader, students and staff of NM-AIST started preparation for the project launch.

The project preparation stage included a detailed training needs assessment and training of the teachers and pupils. In the beginning of May 2013, questionnaires addressing the training needs were delivered to teachers in the two pilot primary schools. The total number of the respondents was 35, including 22 teachers in the Nambala primary school and 13 teachers in the Nganana primary school. Face-to-face interviews have been conducted with the school headmasters. This exercise was performed by NM-AIST students as part of their course on ICT and Development. The data collected from teachers and headmasters included their personal data (age, gender, qualifications, etc.), ICT literacy levels, subjects taught and training needs. Collecting and analyzing this data helped to tailor the training content to schools' needs.

The project preparatory stage culminated in the project inauguration on May 10, 2013. The two primary schools received 300 e-readers with 120 books each. The e-books were textbooks, story books, religious books and reference materials, some written in English and others in Swahili. The updates of the E-readers Project were disseminated via a weblog (Arusha EcoLab, 2013a).

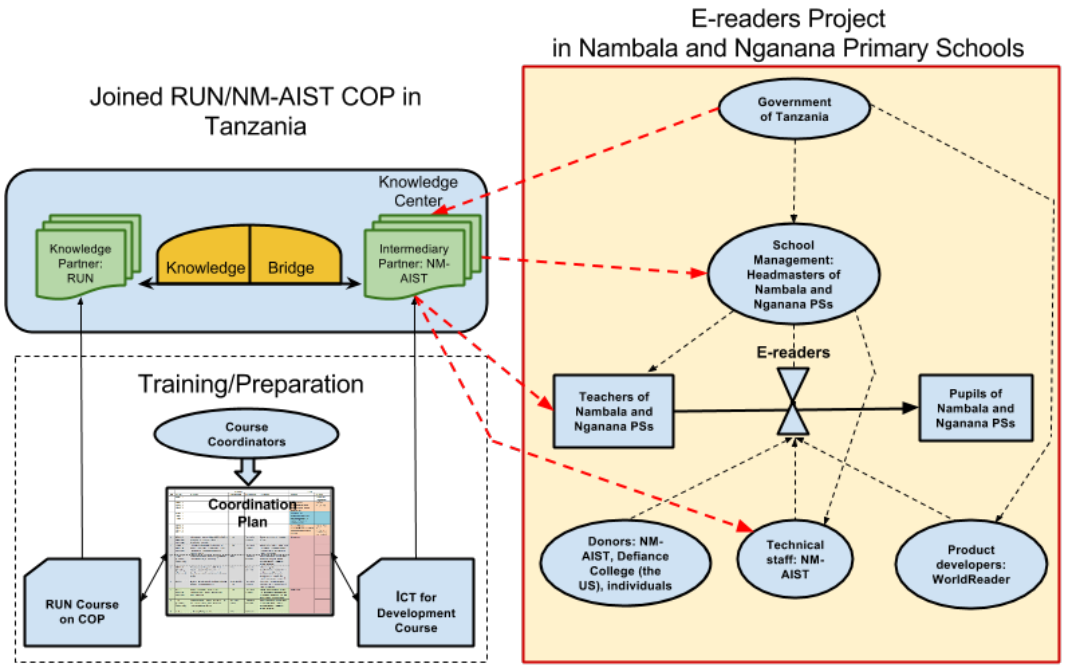

Figure 6. Application of the COP impact model to the case study of Tanzania.

In order to achieve better understanding of the interactions between stakeholders in the E-Readers Projects and joint RUN/NM-AIST COP, as well as links between these two projects, the general COP impact model (Figure 5) was applied to the case study of Tanzania. The result of this application is shown in Figure 6.

Figure 6, unlike the general model, includes preparatory courses which were important part of the RUN/NM-AIST. These courses are described in the next section, "Training for the sustainable introduction of IT."

Training for the sustainable introduction of IT

In the following three subsections, we describe the courses delivered at both universities at the preparatory stage of the COP. Not only were the time frames and planned activities different for students from the two countries; courses delivered in NM-AIST and RUN were different by their nature. While the ICT and Development course (NM-AIST) was mostly practice-oriented, the COP course in RUN combined theory and practice.

The ICT and Development course (NM-AIST)

While both universities are research-based, NM-AIST has only Masters' and PhD programs. The level of social conscience, motivation and ambitions of NM-AIST graduate and postgraduate students are very high as they prepare themselves to the role of champions of social change, technopreneurs and leaders. They are likely to question delivered learning materials as they always want to know how the delivered material will contribute to the development of their country as well as to their personal success. Thus, the students commonly demonstrate negative attitudes towards purely theoretical courses (especially those in humanities) which they consider useless. To keep students motivated, the course should be predominantly practical, touch upon sound social problems and include hands-on experience. Unfortunately, the majority of lecturers in NM-AIST has not yet grasped student-centered teaching approach and innovative teaching methods. They see their mission in delivering theoretical knowledge to be memorized by students. So the prevailing model of teaching and learning in NM-AIST is still lecturer-centered, in spite of the efforts to become a research-based university.

The ICT and Development course represents a different, student-centered, model. It involves problem- and project-based learning, active methods of teaching and learning, and learning-by-doing. It also requires a high degree of interaction between students and the lecturer, as well as between students and members of the communities.

The objectives of this course are as follows: (1) introduce the students to the idea of transforming people's lives through the usage of ICT; (2) introduce the students to the importance of the international cooperation; (3) identify the components of a successful ICT project; (4) identify factors influencing success and sustainability of ICT initiatives in developing countries; (5) introduce the students to the importance of monitoring and evaluation while running ICT projects, and (6) give the students practical skills for carrying out ICT4D projects, including monitoring and evaluation. All these objectives can be achieved through direct students' involvement in COP. Thus, the most important part of the course is practical — contributing to the E-readers Project.

The topics delivered in this course included: (1) the overview of existing Community Outreach Projects and their classification; (2) the role of ICT in transforming people's lives in developing countries; (3) the overview of recent ICT initiatives in developing countries; (4) the sustainability of ICT initiatives; (5) the critical success factors of ICT initiatives and components of a successful ICT project; (6) the importance of monitoring and evaluation of ICT projects and the practical

skills of monitoring and evaluation; (7) the emerging technologies in developing countries; and (8) ICT interdisciplinary projects.

The practical assignments given to NM-AIST students in 2013 and 2014 years were as follows: (1) situational analysis; (2) training and content needs assessment; (3) school teacher and pupil training; (4) uploading educational content to e-readers; (5) preparing the E-readers Project launch; (6) identifying factors contributing to project sustainability; and (7) monitoring and evaluation of the project.

The RUN course on Community Outreach Projects

The COP course at RUN focuses primarily on intercultural aspects of COP, with the Hofstede Cultural Model used as a main theoretical framework. The three week mini-internship in developing countries is considered mainly as a practicum for validating the Hofstede Cultural Model.

The first objective of this course is to make students aware of how they can add value to other people's lives and improve their situation by sharing and transferring knowledge and skills to those who are deprived of resources. The second objective is to teach students to appreciate a different culture by doing a project in another country, where circumstances are totally different, and values and traditions have another meaning than those values and traditions the students are familiar with. It gives them a deeper insight into their own values and stimulates reflection on their own position in society as future professionals.

The structure of the course is as follows (Zlotnikova & Weide, 2011). The theoretical part includes weekly lectures and workshops in which technological (IT), educational, entrepreneurial and cultural issues are discussed. Experienced speakers from the field (COP leaders) are invited as guest lecturers and trainers. This information helps students to formulate their own project plans. Then, during their summer vacations, students go to different locations for three weeks to implement their projects.

The RUN course consists of a number of blocks: (1) the cultural block, where the students learn to be able to interpret, understand and handle other cultures; (2) the educational block, in which the students learn to be able to define an educational program for another culture in a sustainable way; (3) the financial block, in which the students learn to be able to write a business plan for a small company; (4) the technical block, in which the students learn to understand IT maintenance policies and acquire some practical skills; and (5) the gender block, in which the students learn to understand different gender roles in the context of another culture.

At RUN, IT-based COPs not only are considered as a way of improving people's lives but also as an important tool for training students of different specialties — especially prospective computer engineers — to develop their professional soft skills. COPs have been run in RUN since 2006. Examples of the projects are (1) IT training and content development for secondary schools in the townships of Lusaka, Zambia, and (2) digitizing the archives of the City Hall in Gondar, Ethiopia. Some other countries where RUN students have participated in COPs are: South Africa, Uganda, Zimbabwe, India, Papua New Guinea, Nepal, Ghana and India.

Coordination of the two courses

Although coordination of the activities was rather complicated due to differences in course contents, delivery timeframes, connectivity problems (at the Tanzanian side), and even time difference between the two countries, these efforts paid back when the Dutch students came to Tanzania. They started working immediately after arrival, since they already were aware of the current situation in schools. Interaction with NM-AIST students added a practical facet to the

mostly theoretical course on COP run in RUN. Fragments of the activity coordination plan are given in Appendix A.

Results and recommendations

Based upon lessons drawn from the experience of running COPs in Tanzania, by joint efforts of NM-AIST and RUN students, we have formulated the following general recommendations on running a sustainable IT-based COP:

1. The contents of an IT-based COP must be socially sound and address the most pressing issues within local communities. These issues have to be identified long in advance before a visit of the international volunteers (needs assessment). This is one of the reasons why it is so important that the international participants have their local counterparts. Social soundness of a project is a guarantee that it will be continued by the members of local communities (social sustainability).
2. COPs, if possible, should be a part of a bigger project introducing IT. It could be not just one COP, but many of them run subsequently, by generations of students.
3. One of the factors contributing to sustainability of the COP is geographic location. The geographic location of a COP run jointly with a local university should be chosen, if possible, in a close vicinity of this university campus. First of all, running such a project will help create a positive image of the university among members of the local communities. Secondly, it will help with safe accommodation for international students (which is always the issue in developing countries). Lastly, if there is no need for travelling far from campus, the project sustainability will be ensured by continuous participation of generations of the university students.
4. The coordination of the project activities between local and international participants is a very important issue, especially if the time frames are different. Communication by e-mail and phone must be complemented by videoconferences. It helps to create the link between local and international participants. All project materials developed by one group of the participants must be made available to other group immediately. The easiest way to ensure the fast update of the materials is to upload them into a cloud.
5. Other recommendations for ensuring sustainability of a COP include increasing internal motivation of participants, distribution of functions between participants, peer-coaching teachers (or other categories of participants if a project is not educational) and getting parents — or other members of communities — involved.
6. To ensure the technical sustainability of an IT-based COP, it is necessary to come up with the sustainable technical solution. Our research shows that currently there is no IT device which is completely sustainable — that is, possesses all of the following properties: reduced energy consumption, longer life cycle, robustness, easy recycling, inexpensive, easy to carry and easy to take care of.

The project's future

The NM-AIST students and staff will continue working on the E-readers Project. If funding is available, the E-readers Project will be extended to other primary and secondary schools of the Arumeru district, and, later on, to other regions of Northern Tanzania. Monitoring and evaluation exercises will be continued on a regular basis. More students/volunteers from developed countries are expected to come this and following years.

The pilot project has shown that e-readers are not actually sustainable IT devices, since they can be easily broken. The other issue is the relatively high cost of the device. Thus there is a need for creating a truly sustainable device. This could be a research agenda for Tanzanian and Dutch students of computing specialties.

The limited functionality of e-readers is still an issue and may put up obstacles to their sustainable introduction in schools. Thus, there is a need for a both sustainable and fully-functional IT device which currently does not exist, but due to technological advances may appear any time soon.

CONCLUSION

Based upon our experiences of running Community Outreach Projects, we have developed an approach to the sustainable introduction of IT in developing countries based on international collaboration between students taking the form of a knowledge bridge.

We have identified challenges for introducing information technologies in developing countries: the limited access to reading materials for both teachers and students, numerous power cut-offs or a lack of power supply; the work environment is not conducive for both teaching staff and pupils; the number of teachers is not enough, and teachers are challenged with professional development. Lack of reading materials ultimately leads to lack of reading skills in pupils and poor overall performance. We have presented a weighted comparison of the sustainable IT devices based on the following parameters: energy consumption, robustness, weight, functionality, ease of use and cost. The e-readers thus have been identified as the most sustainable option for schools in developing countries. However, as our research shows, up until now there has been no truly sustainable IT device; thus, there is a need for creating it.

We have proposed the theoretical framework for the sustainable introduction of IT comprising the following components: the model of a knowledge bridge, the managerial model of the interactions between key stakeholders, and the model of impact of COP on target schools. We also identified the links between the proposed framework and the widely adopted DPSIR.

As a case study, we have discussed the E-readers Project run in two primary schools in Northern Tanzania. In this project, e-readers have been used as a sustainable alternative to printed books and fully functional computers. The paper also has demonstrated how interaction and collaboration between Tanzanian and Dutch students was organized during the preparatory stage and project implementation. We have given our recommendations on how to run a sustainable IT-based Community Outreach Project. These recommendations have been drawn from the analysis of the COP experience in the developing country, namely Tanzania.

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APPENDIX A. FRAGMENTS OF THE ACTIVITY COORDINATION PLAN

		NM-AIST				RUN	
Wk	Date(s)	Activities	Responsible	Participants	Outcomes	Activity	Product
	04.02.13						Admission Assignment
	11.02.13 18.02.13 25.02.13					Culture Block *To be able to interpret, understand and handle other cultures*	Explorer Document
	07.03.13 14.03.13 21.03.13					Education Block *To be able to define an education program in another culture in a sustainable way*	
	28.03.13 18.04.13 25.04.13					Financial Block *To be able to help to write a business plan for a small company*	Project Plan Ch 1: Introduction and Context
1	29.04.13 (Monday, morning)	Introductory lecture #1 on COP including examples of RUN COPs done in developing countries	Irina	Tanzanian students	Tanzanian students are aware of COP	No lecture	
1	29.04.13 (Monday, morning)	Lecture and practical assignment on Needs Assessment (Assignment 1, Part I "Developing interview guides and questionnaires"	Irina	Tanzanian students	Tanzanian students know how to develop interview guides/ questionnaires and perform needs assessment		
1	30.04.13 (Tuesday, afternoon)	Presentation on E-readers Project from Dina Machuve (30 minutes)	Dina	Tanzanian students	The students are aware about E-readers project; ***Dina's presentation is sent to the Dutch students***		
1	30.04.13 (Tuesday, afternoon)	Finalization of Assignment 1, Part I on Needs Assessment, discussion of developed questionnaires and interview guides	Irina	Tanzanian students	Interview guides and questionnaires are developed and discussed; Tanzanian students are ready to do needs assessment in schools		
1	2.05.13	Visits to Nganana and Nambala primary schools, needs assessment	Dina, Patrick, Irina	Tanzanian students	Interviews are carried out, questionnaires are delivered, data is collected		
2	6.05.13 (Monday, morning)	Needs assessment analysis and presentation of results (Assignment 1, Parts II and III)	Irina	Tanzanian students	***Needs assessment is carried out, results are analyzed and presented; presentations are sent to the Dutch students***	No lecture	
2.	7.05.13 (Tuesday, afternoon)	Presentation of COP run in NM-AIST by Ms. Liliane Pasape, HoD, Business Studies and Humanities	Ms Liliane Pasape	Tanzanian students	The students are aware about COP in NM-AIST; ***Liliane's presentation is sent to the Dutch students***		
2	7.05.13	Lecture 2; Assignment 2	Irina	Tanzanian			

	(Tuesday, afternoon)			students			
2	8.05.13 (Wed, morning)	Assignment 3	Irina	Tanzanian students			
2	9.05.13 (Thursday, afternoon)	***Videoconference with Dutch students. Introductions. Q &A session. Discussion of the results of needs assessment.***	Irina, Theo, Augustino	Students (all)	***The Dutch and Tanzanian students introduced themselves. The Dutch students aware of the current situation in schools***		
2	10.05.13 (Friday)	Launch of the E-reading project in Nganana and Nambala Schools	NM-AIST	Tanzanian students	***The report on the launch to be sent to the Dutch students***		
3.	13.05.13 (Monday, morning)	Lecture 4. Sustainability of ICT Projects. Assignment 4. ***Project descriptions for COPs to be run in Nganana and Nambala primary schools***	Irina	Tanzanian students	***Project descriptions to be sent to Dutch students***		
3.	14.05.13 (Tuesday, afternoon)	Assignments 4 (cont'd) and 5 (Presentation of Project Descriptions)	Irina	Tanzanian students	***Project description presentations are sent to the Dutch students***		
3.	15.05.13 (Wednesday , morning)	Lecture 5, Assignment 6	Irina	Tanzanian students*			
3	16.05.13 (afternoon)	***Videoconference between Dutch and Tanzanian students. Discussion of presentations. Dutch students ask questions about schools, prospective projects, NM-AIST, Arusha and Tanzania in general.***	Irina, Theo, Simone, Augustino (ICT)	Students (all)	***Dutch students have received answers to their questions. Current situation in schools is discussed. The project topics and content are outlined.***		
4	20.05.13 (Monday, morning)	Lecture 6, Assignment 7	Irina	Tanzanian students			
4	21.05.13 (Tuesday, afternoon)	Assignment 8	Irina	Tanzanian students			
5.	22.05.13 (Wed, morning)	Lecture 7, Assignment 9	Irina	Tanzanian students			
4	23.05.13 (Thursday, afternoon)	***Videoconference. Inputs from Dutch students on how to improve project descriptions. Outlining further actions***	Irina, Theo, Augustino (ICT)	Students (all)	***Dutch and Tanzanian students improved project descriptions based upon inputs for Dutch students***		
5	27.05.13 (Monday, morning)	Assignment 10	Irina	Tanzanian students		HIV/AIDS lecture *To be able to understand the HIV/AIDS problematics,*	

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Students' perception of blended learning environment: A case study of the University of Education, Winneba, Kumasi-Campus, Ghana

Samuel Adu Gyamfi
University of Education, Winneba, Ghana

Patrick Ohemeng Gyaase
Catholic University College of Ghana, Fiapre, Ghana

ABSTRACT

The increasing utilization of Information and Communications Technology (ICT) in addressing various societal needs has catalysed the need to deploy this all important tool in education in developing countries to address the need of the increasing student enrolment in universities. This study was conducted to assess students' perception of blended learning environment. The blended learning environment was designed on a Moodle platform using an adaptation of the practical enquiry model. This intervention was designed to ensure that the benefits of both online and face-to-face learning environment were harnessed for the achievement of set pedagogical goals. The study used formative experiment with 75 first year university students who were studying Communication Skills (CS) and their lecturers as the participants. The experiment was carried out over two semesters at the University of Education, Winneba – Kumasi Campus in Ghana. The findings showed positive perceptions of student on the blended learning environment. However, the problem of slow Internet connectivity and lack of Internet access for some of the students outside the university campus hindered the effectiveness of the blended learning environment for a few students. Improvement in ICT infrastructure and capacity building for lecturers to adopt blended learning approach were recommended.

Keywords: Blended learning environment, formative experiment, intervention, perception

INTRODUCTION

The metaphor of the information age has generated an unprecedented desire for educational reforms to accommodate information and communications technology tools for teaching and learning (Sarfo & Ansong-Gyimah 2010). In addition to making the teaching and learning of Information and Communications Technology (ICT) a compulsory subject across all levels of education in Ghana there exist national programmes that have been created to integrate ICT into teaching and learning especially in the universities to mitigate problems resulting from the large enrolment of students at that level (Sarfo & Ansong-Gyimah 2010).

ICT is credited with facilitating students' collaborative writing processes and interactions (Amir, et al. 2010); fostering creative, analytical and critical thinking skills, creating social interaction and good relationships between writer and reader and supporting learning community (Noytim 2010). However, many educational researchers have highlighted the limitation of using e-learning alone in the teaching and learning of soft-skills based course such as Communication Skills (Sarfo & Ansong-Gyimah, 2010; Garrison & Vaughan 2008). A combination of the traditional classroom setting and the ICT enabled teaching and learning platform referred to in this paper as blended learning environment, has therefore, been suggested for the improvement in the teaching and learning of Communication Skills (Bañados, 2006 & Calabrese & Faiella 2011). The question for this paper therefore is how would students who are used to face to face classroom teaching and

learning respond to the incorporation of ICT tools in the teaching and learning environment? A formative experiment was therefore carried out to evaluate students' perception of a blended learning environment implemented in the University of Education, Winneba – Kumasi campus in Ghana.

BLENDED LEARNING ENVIRONMENT

Blended learning environment refers to the blend of the effectiveness of the face-to-face teaching environment and ICT-mediated teaching and learning environment (Driscoll 2002). Graham & Allen (2009) thus, describe blended learning environment as the combination of instruction, both methods and delivery media from two archetypal learning environments, the traditional face-to-face learning environment and the ICT-mediated or e-learning environment. This is the preferred working definition of blended learning environment for this study since it captures all the relevant issues being considered.

MODELS OF BLENDED LEARNING ENVIRONMENT

Three models of blended learning have been identified in literature (Sharpe, Benfield, Roberts, & Francis 2006). These are:

1. Transmissive pedagogy model which incorporates the provision of supplementary online resources for learning programmes conducted along predominantly traditional lines with institutionally supported virtual learning environments (VLEs). Actual teaching and learning follows the traditional face-to-face modes of lectures and seminars, but provide extra support to the students through placing lecture notes on the web.

2. Transformative model facilitates extensive utilization of ICT tools beyond VLEs to enhance and alter students' mode of interaction, studying and learning and it is underpinned by radical course redesign. It transforms teaching and learning environment from where learners are just recipients of knowledge to where learners are actively involved in the construction of knowledge through dynamic interactions. This type of blend promotes intellectual activity that is practically impossible without the use of technology (Graham 2006). The transformative model is currently on the ascendancy in higher education and is often developed from the application of the principles of constructive alignment where assessment strategies are constructively aligned with the learning objectives of the course (Biggs 2003).

3. A holistic model of technology use to support learning. This is a newer characterization of blended learning where most learners do not distinguish between learning with or without technology. Faculty facilitates learning by using the learners' own technologies such as mobile phones, online communities and instant messaging to support the students' learning at any place and at any time (Sharpe, Benfield, Roberts, & Francis 2006).

This research study therefore, argues that a blended learning environment where the best of face-to-face learning environment and that of e-learning are pedagogical designed would meet the learning needs of these diverse group of learners to improve their skills and knowledge in the course (Ryberg & Dirckinck-Holmfeld 2010).

METHODOLOGY

This study was carried out as a formative experiment. Bradley & Reinking (2011) describe formative experiment as a research strategy for studying promising interventions in real instructional environments. Formative experiment is among closely-related methodological approaches which are often collectively referred to as design-based research (Reinking & Bradley, 2008). Design-based research is defined in this study as a systematic but flexible methodology with the aim to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually-sensitive design principles and theories (Wang & Hannafin, 2005).

Maintaining methodological rigor in formative experiments requires a careful selection and justification of a research site. Such a site must possess initial conditions that suggest that the success of the intervention will face some hurdles but with conditions not so overwhelmingly challenging as to doom the intervention to failure (Reinking & Bradley, 2008).

DESCRIPTION OF THE SITE OF THE EXPERIMENT

The experiment took place at the Kumasi Campus of the University of Education, Winneba where Communication Skills course was used for first year students over two semesters. The Kumasi campus hosts three faculties, namely Business Education, Vocational and Technical Education and Education and Communication Sciences. The student population of the campus as at the time of the research study was 6,282, made up of 4,311 male and 1,971 female students.

Communication Skills course was used because available research on the course at other universities suggested relative high referral rate of students in this course (Coker & Abude 2012). Again there is stakeholders' suggestion that current graduates from the universities are deficient in Communication Skills (Tagoe, 2009). The site for the study was also influenced by the long association of the principal researcher, which facilitated easy access to the University's ICT infrastructure, lecturers and the students for the conduct of the formative experiment.

THE BLENDED LEARNING ENVIRONMENT USED FOR THE EXPERIMENT

A Blended Learning Environment for Collaborative and Active Learning (ABLECAT) model was designed and implemented for the study. This is a learning process model that combines information and communication technologies and the traditional face to face classroom settings. The blended learning environment was a transformative blended learning model which utilized Moodle learning content management platform with an improved user interface. The enactment process was inspired by the practical inquiry model (Garrison, Anderson, & Archer 2001).

Although ICT is credited with facilitating the expansion of possibilities in teaching and learning by supporting various forms of communication, the design of the experiences and the mode of students' engagement are known to directly affect the quality of the learning experience which a blended learning environment provides (Garrison & Vaughan 2008). Figure 1 presents the enactment model of the intervention for the Communication Skills course.

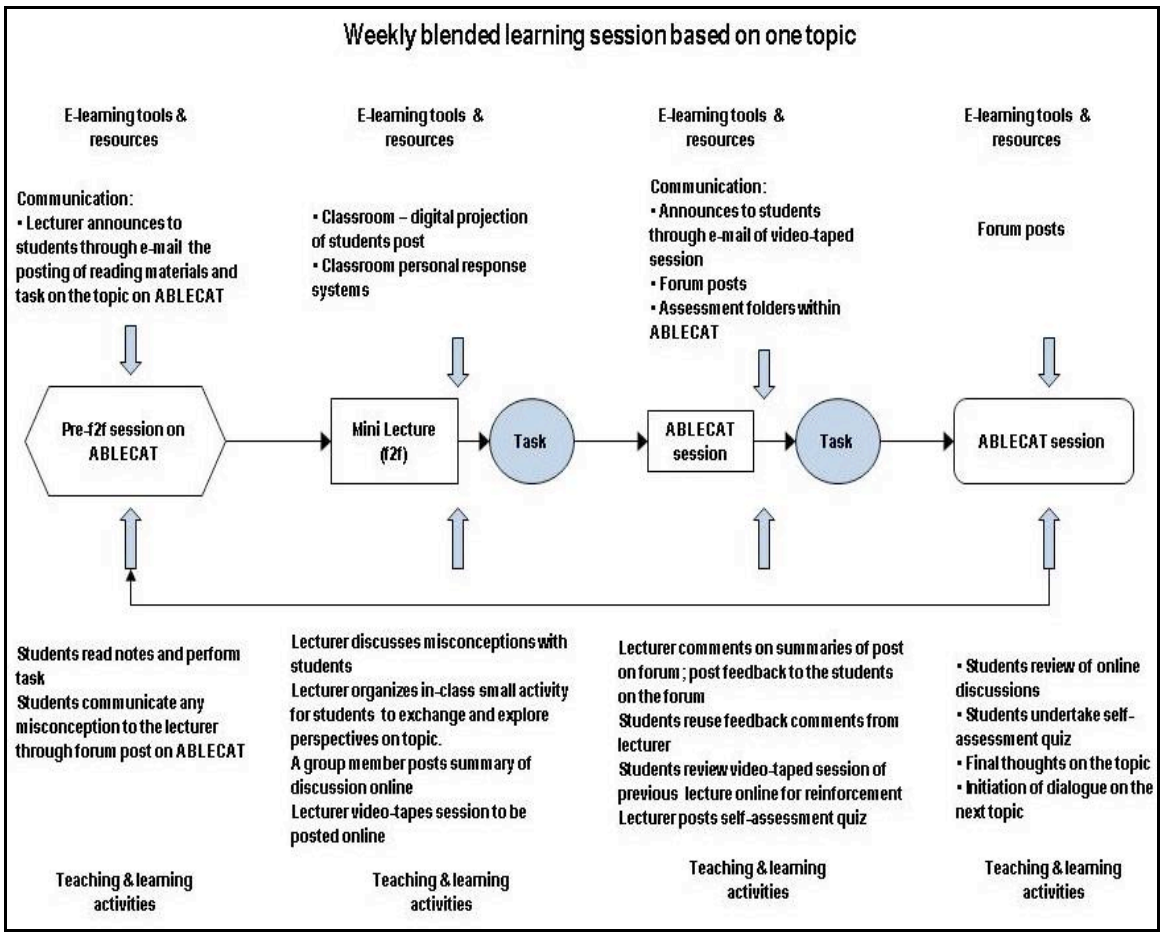

Figure 1: *The Enactment Process Model*

PRE- INTERVENTION DATA COLLECTION AND ANALYSIS

For the blended learning environment intervention of this study, pre-intervention data, both quantitative and qualitative were collected and analysed to identify the benchmarks with which the post-intervention data would be compared to assess the students' perception. For the preparation and determination of the suitability of the study subjects of the formative experiment and to determine their suitability for the study, focused interview and classroom observation were used to determine the state of the current teaching and learning environment. Document analysis was also used in assessing the ICT infrastructure and other supporting policies governing teaching and learning in the University.

Available ICT Infrastructure

The document analysis indicated that there was Wi-Fi on the campus; there were 190 networked computers in the computer laboratories with Internet access of 10mbps broadband connectivity. This facilitated students' access of online materials from the library. A policy document which was aimed at embracing the teaching and learning with ICT was also identified.

Demographics and Entrance Qualifications

Seventy-five (75) students made up of sixty-three (63) male and twelve (12) female students whose ages ranged between eighteen (18) to fifty (50) years took part in the survey (Figure 2). The survey was meant to determine the demographic characteristics of the students and their readiness to use ICT tools in learning so as to aid the design of the instructional environment.

Figure 2 shows that 13.3% were direct applicants with Senior Secondary School Certificate Examination results (SSSCE/WASSCE), 57.3% had diploma certificate. 23% had teacher's diploma certificate, 5% possessed Higher National Diploma programme whilst one student (1.3%) had 4-year post-secondary certificate.

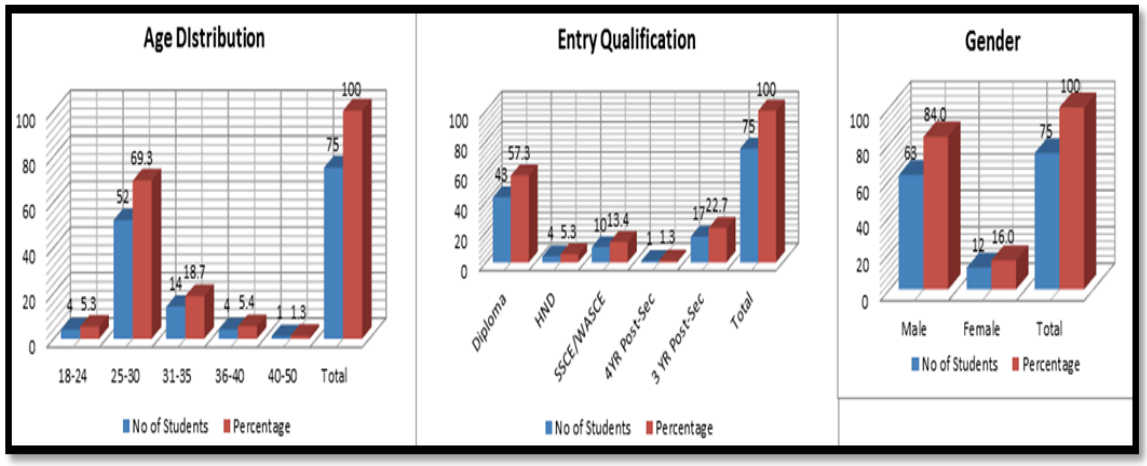

Figure 2: *Demographic Data of Students*

Classroom Observation

To identify the current problems faced by both students and lecturers, focused interviews were conducted for both students and lecturers. Among the problems identified by the students were their inability to access study materials electronically and lack of interaction among students and between students and lecturers after face to face classes. To corroborate the responses from the focused interviews and identify how teaching and learning took place in the Communication Skills classes, classroom observation was undertaken, using passive observation technique during the first lecture of the semester. The responses from the focused interview and the classroom observation identified the need for adopting a new ICT-mediated learning environment giving the number of students per class and the students' desire to access learning materials anytime to facilitate their learning. Table 1 represents the outcome of the classroom observation.

Table 1: *Findings from Classroom Observation*

Object for Observation	Description	Observations
Space	The physical setting where the CS course took place	A large Lecture room, Large class size, no public address systems. Not a big enough space for such number of students
Actors	The students and the lecturers in the CS teaching and learning session	75 freshly admitted students. 1 experienced lecturer.
Activities	Sets of related acts taking place during the teaching and learning sessions of the CS course;	The lecturer teaching and the students listening and taking down notes.
Objects	Artefacts and physical things available in the space facilitating the teaching and learning process	White board and markers where the teacher occasionally writes for emphasis
Acts	The specific actions of the actors in the course of the session	Very few questions were asked including request for repetition from the lecturer since the students at the back of the class could not hear the lecturer well. More students came in late.
Events	the sets of activities that took place in the course of the observed session	Students at the back not paying attention, notes taking
Time	When specific sequence of acts, activities and events took place that impacted of the teaching and learning session	Class started at 5pm and ended at 8 pm.
Goals	The efforts of the actors to achieve the learning objective of the session.	The lecturer was constantly asking the students if they understood what was being taught. Students were seen taking notes and asking colleagues what the lecturer said anytime they missed something.
Feelings	The feeling of the actors as they expressed them.	The lecturer was exasperated and complained about trying his best to shout loud enough for the students to hear. The students who came late and had to sit at the back of the class were disappointed because they could not hear most of the lectures that took place.

ICT Skills Data

The relevant characteristics of the ICT skills survey instrument had a statistical significance of 0.95 (where reliability co-efficient of 0.70 or higher is considered acceptable in most social science research situations for reliability of a psychometric test).

The data in table 2 shows that 88% of the participants can perform the basic computer skills very well all by themselves; 8% can perform the basic computer skills with the help from someone; whilst 4% of the participants cannot perform the basic computer skills. When it comes to the basic Internet skills, 76% of the participants can perform the basic Internet skills; 19% can perform the basic Internet skills with the help from someone; whilst 5% cannot perform those skills at all. Specifically and quite significantly, within the age groups of the participants, one person within the 41-50 year olds has no Internet skills, two participants aged between 25 and 35 years do not have Internet skills and four participants aged between 18 to 35 years do not have basic computer skills.

Table 2: *Characteristics of ICT Skills of Students*

Characteristics - How well can you do the following?		I can do this very well by myself					I can do this with the help from someone					I know what this means but I can't do it					I don't know what this means				
	Age group	18-24	25-30	31-35	36-40	41-50	18-24	25-30	31-35	36-40	41-50	18-24	25-30	31-35	36-40	41-50	18-24	25-30	31-35	36-40	41-50
1a. Start a computer	No.	2	46	9	2	0	1	5	3	2	1	1	1	0	0	0	0	0	2	0	0
	%	2.7	61.3	12	2.7	0	1.3	6.7	4.0	2.7	1.3	1.3	1.3	0	0	0	0	0	2.7	0	0
b. Open a file on a computer	No.	2	50	13	2	1	2	1	0	2	0	0	1	0	0	0	0	0	1	0	0
	%	2.7	66.7	17.3	2.7	1.3	2.7	1.3	0	2.7	0	0	1.3	0	0	0	0	0	1.3	0	0
c. Create or edit a file on a computer	No.	2	48	10	3	1	2	3	3	1	0	0	0	0	0	0	0	1	1	0	0
	%	2.7	64	13.3	4	1.3	2.7	4	4	1.3	0	0	0	0	0	0	0	1.3	1.3	0	0
d. Scroll a document up and down on a screen	No.	2	48	12	4	1	2	2	2	0	0	0	0	0	0	0	0	2	0	0	0
	%	2.7	64	16	5.3	1.3	2.7	2.7	2.7	0	0	0	0	0	0	0	0	2.7	0	0	0
e. Copy a file from a computer drive	No.	3	48	9	3	1	1	3	2	1	0	0	0	2	0	0	0	1	1	0	0
	%	4	64	12	4	1.3	1.3	4	2.7	1.3	0	0	0	2.7	0	0	0	1.3	1.3	0	0
f. Save a document or file on a computer	No.	3	52	12	4	1	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0
	%	4	69.3	16	5.3	1.3	1.3	0	1.3	0	0	0	0	0	0	0	0	0	1.3	0	0
g. Print a document or file from a computer	No.	3	44	7	2	0	1	6	6	2	1	0	2	0	0	0	0	0	1	0	0
	%	4	58.7	9.3	2.7	0	1.3	8	8	2.7	1.3	0	2.7	0	0	0	0	0	1.3	0	0
h. Move files from one place to another on a computer	No.	3	48	12	3	1	1	3	1	1	0	0	1	0	0	0	0	0	1	0	0
	%	4	64	16	4	1.3	1.3	4	1.3	1.3	0	0	1.3	0	0	0	0	0	1.3	0	0
2a. Get on to the Internet	No.	3	48	13	2	1	1	3	0	2	0	0	0	0	0	0	0	1	1	0	0
	%	4	64	17.3	2.7	1.3	1.3	4	0	2.7	0	0	0	0	0	0	0	1.3	1.3	0	0
b. Copy or download files from the Internet	No.	3	43	8	2	0	1	7	5	2	1	0	1	0	0	0	0	1	1	0	0
	%	4	57.3	10.7	2.7	0	1.3	9.3	6.7	2.7	1.3	0	1.3	0	0	0	0	1.3	1.3	0	0
c. Download music, pictures or movie from the Internet	No.	2	42	6	2	0	2	7	5	2	0	0	2	2	0	1	0	1	1	0	0
	%	2.7	56	8	2.7	0	2.7	9.3	6.7	2.7	0	0	2.7	2.7	0	1.3	0	1.3	1.3	0	0
d. Write and send e-mails	No.	2	46	12	2	0	2	5	1	2	1	0	1	0	0	0	0	0	1	0	0
	%	2.7	61.3	16	2.7	0	2.7	6.7	1.3	2.7	1.3	0	1.3	0	0	0	0	0	1.3	0	0
e. Attach a file to an e-mail message	No.	3	35	7	2	0	1	14	4	1	1	0	2	2	1	0	0	1	1	0	0
	%	4	46.7	9.3	2.7	0	1.3	18.7	5.3	1.3	1.3	0	2.7	2.7	1.3	0	0	1.3	1.3	0	0

THE ENACTMENT OF THE BLENDED LEARNING ENVIRONMENT

The first phase of the enactment of the intervention took place at the beginning of the first of the two semesters required to complete the Communication Skills syllabus. The students for the experiment were registered to provide them access to the online learning environment by assigning them usernames and passwords as well as creating email addresses for them.

A two-hour orientation exercise was organised for the participants to explain the rationale behind the formative experiment, to obtain the students' consent and co-operation in the project and explain to the students how to work with the online learning environment. The students were assured of their privacy and confidentiality, noting that the experiment was solely an academic exercise. The students were taken through the process of the website navigation and the use of various tools such as forums and e-mails on the website and the online help facilities. Additionally, a print-out of these instructions was provided to the students.

The Enactment Process

The Pre face-to-face (f2f) component of the enactment process model (Fig.1) provides the initiation of the weekly activity to spur the students' curiosity and define the key tasks and activities for the students on the topic of the week. The sub-components in the pre-f2f include the provision for the students to undertake pre-reading and writing activities which are meant to 'jog' the students into taking the centre stage in the learning process. This was facilitated by the provision of tasks and activities meant to test the students' understanding of the pre-reading and

writing activities. The students are offered the medium to communicate any misconceptions to the lecturer through the forums set up for each topic allowing the students to take centre stage of the learning process and the line of communication between the students and lecturer is then opened.

The second phase of the enactment process model involves the actual face-to-face teaching and learning where ICT tools and resources are provided in preparation for the mini lectures and tutorials and to address issues posted online earlier in the pre-f2f session, promote dialogue between participants and the lecturer and among the participants on the week's topic. This is aimed at increasing collaboration and communication in the CS course which ultimately would improve their skills and knowledge in the course. This session is videoed and posted online to enable the participants who are present and those who inadvertently would miss the mini- lecture to review the sessions. Hence, the f2f sessions are no longer used for lecturing but as an avenue to promote dialogue between the lecturer and the students and among the students which was a novelty.

The third phase of the enactment model serves as an avenue for the students to reflect on the knowledge and skills stated as the objectives of the topic. This includes the re-use of the lecturer's comments and the review of the video-taped session for reinforcement by the students. This is what has been referred to as the "integration" phase of the 'practical inquiry model' of (Garrison & Vaughan, 2008). There is the provision of self-assessment quiz meant to provide an avenue for the students to apply their knowledge and skills on the topic. The lecturer makes use of e-mail and forum to provide feedback to students whilst the assessment folders are used to record the results of the quiz session.

The final phase involves individual and group assignment that is posted online to enable the students to assess their understanding of the topic and to compare their work and learning with each other. Finally, the participants are offered the opportunity to express their thoughts on the topic. This strategy is meant to improve knowledge construction and initiate a dialogue on the next topic. Garrison & Vaughan (2008) refer to this phase as 'resolution' in their practical enquiry model.

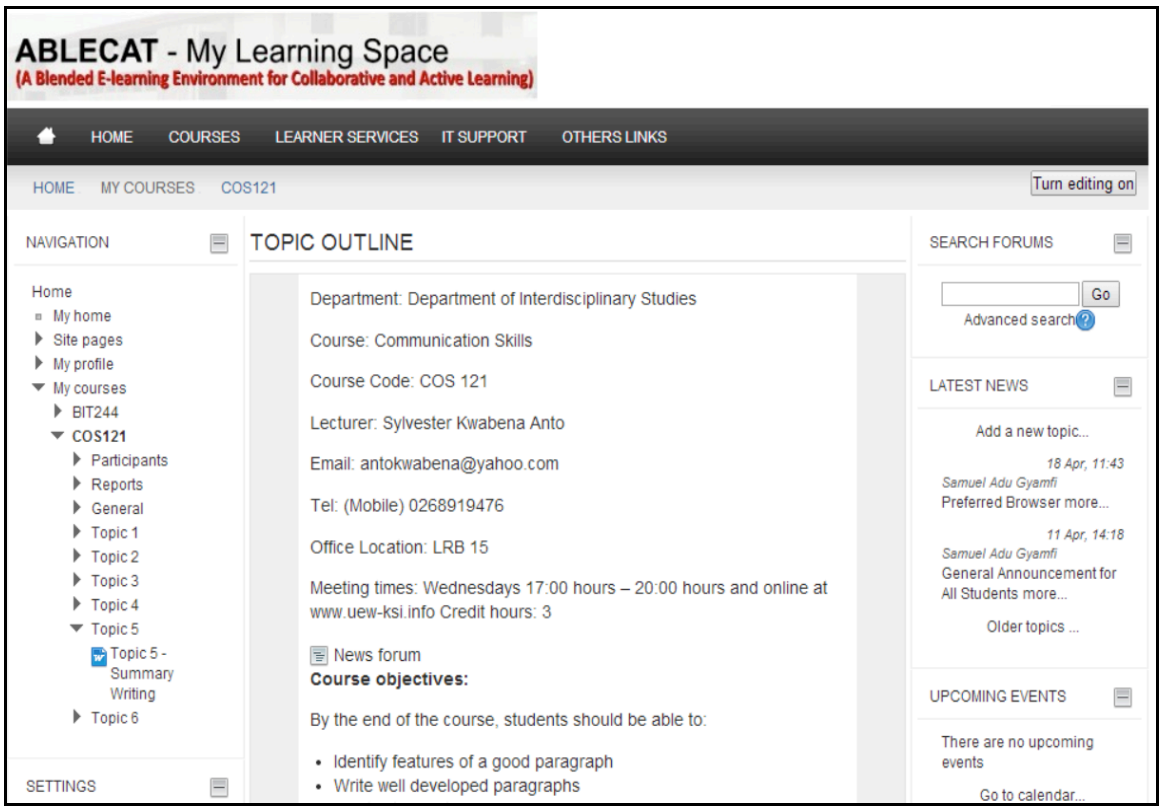

Figure 3: *Online Learning Environment Intervention (ABLECAT) Interface*

The blended learning environment performs the functions of content delivery, as well as promotes communication and construction of knowledge by the students. The unidirectional arrows in the enactment process model (Fig.1) show the students' interaction with the blended learning environment in each of the four components in the model. Furthermore, the model illustrates blended learning teaching and learning situation for a course where both tasks and activities are used to enhance knowledge construction.

Analysis of the Enactment Phase

The classroom observation, informal conversational interviews with students and the lecturer, and online activity logs of students were used to determine the factors that enhanced or inhibited the effectiveness of the intervention towards achieving its pedagogical goal.

Classroom Observation- Enactment Phase

During the enactment phase of the experiment, passive participant observation was used to observe and evaluate the mini-lecture as to how the lecturer dealt with the students' misconceptions about the pre-f2f assigned reading and writing activities; whether this generated dialogue between the lecturer and the students; how the video-recording of the mini-lecture affected the teaching and learning situation and the students' utilisation of the small group activity. The table below provides the summary of the observation during the enactment phase.

Table 3: *Summary of classroom observation at the enactment phase*

Object for Observation	Description	Observations
Space	The physical setting where the CS course took place	A new larger theatre was used with the same number of students as the pre-intervention phase. The room could comfortably accommodate the students
Actors	The students and the lecturers in the CS teaching and learning session	The same lecturer and the same class of students.
Activities	Sets of related acts taking place during the teaching and learning sessions of the CS course;	Students discuss their misconceptions and the lecturer responds to their concerns.
Objects	Artefacts and physical things available in the space facilitating the teaching and learning process	White board and markers where the teacher occasionally writes for emphasis. There was also the use of electronic projector and a video recording.
Acts	The specific actions of the actors in the course of the session	Students attended lectures with prepared questions and comments and references from material sourced from ABLECAT
Events	The sets of activities that took place in the course of the observed session	Students were divided into discussion groups. Used SRC constructed pavilions with access to Wi-Fi. Some students helping group members with difficulty of accessing online materials
Time	When specific sequence of acts, activities and events took place that impacted of the teaching and learning session	Class started at 5 pm and ended at 8 pm with 1 hour pre-lecture group discussions
Goals	The efforts of the actors to achieve the learning objective of the session.	Enhanced engagement between students and lecturer. Lecturer gains attention of students through the provision of pre-lecture reading materials
Feelings	The feeling of the actors as they expressed them	Not enough time for the lecturer to respond to all the technical support requests, the forum was difficult to e-moderate

Informal Conversational Interviews- Enactment Phase

As a follow-up to the classroom observation, the students and the lecturer of the CS course were interviewed. The interview took the form of informal conversational interviews where students were randomly selected and interviewed using open-ended question to evaluate effectiveness of the intervention towards the achievements of the set pedagogical goals. Table 3 below is a summary of the findings from the informal conversational interviews conducted.

The findings indicated that the introduction of the blended learning environment for the first four weeks of lectures had improved interactivity among students and between the students and the lecturer due to the ICT tools such the forum and emailing system that were used. However, due to the low bandwidth of the Internet service on the campus, the students experienced some difficulty in watching videos online and downloading materials from the website. Again the students were unable to access online materials from the website when they were outside the University campus thereby, restricting the online interaction to when they were on the campus.

Table 3: Summary of the responses from the Students

Parameters	Responses
	Students
Mode of Teaching	Lecture , Discussions and group activities
Setting	Lecture Theatre with Internet Connected Computers
Course Texts and Material	Online materials, videos, and digitized course materials
Teaching materials	Board and Markers, Electronic projector, Computers
Mode of Assessment	Online feedback, posts on forums and small group assignments
Interaction	Occasional classroom discussions, small group activities, forum
Use of ICT tools	Yes
Evidence of impact of intervention	Came to class prepared, with questions and comments on notes
Feedback	Yes, Lecturer answered questions posed in forums and assessed online activity
Problems identified on the new learning environment	Activities not part of continuous assessment. Slow Internet connectivity affected access to video lectures; High cost of Internet access outside the school , Challenges with email accounts,
Benefits Identified in the new learning environments	Access to course materials and teaching activities anytime anywhere. Reminding colleagues on new postings, acquisition of new ICT skills
Suggestions for improvement	Emails should be improved, expansion and increased speed of the Internet connectivity. Make online activities part of continuous assessment towards course grade.

Students' Activity Logs

At the end of the second week of the intervention, the students' activity logs on ABLECAT were checked to assess the level of participants' usage of ABLECAT (Figure 4). Records of students' logs on ABLECAT indicated that most students were able to access the course readings and notes and the activities at the pre-f2f stage. It was noted that when there was no task or activity assigned to the week's topic, students' logs on course reading materials on the online learning environment were very low. Additionally, only a few of the students made postings on the forum as well as accessed the video-taped lectures. This corroborated the informal conversational interview with the students when they suggested that they could not access the video files because of network problems.

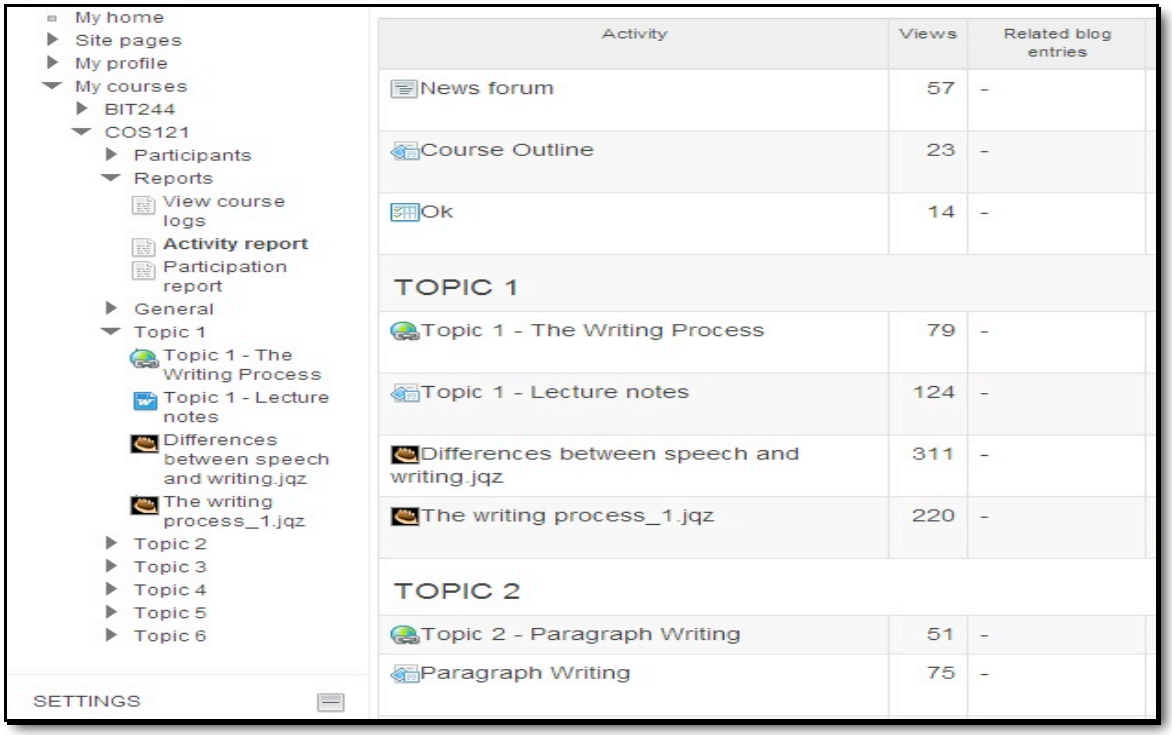

Figure 4: Students' Online Learning Environment Activity Logs

In sum, the descriptive analysis and reflection on the data that were gathered at this stage were to determine which practices on the instructional environment needed to be discontinued, adapted or transformed to achieve the pedagogical goal.

Modification and Implementation of Modified Intervention

In formative experiment, factors influencing the effectiveness, efficiency and appeal of an intervention must be identified and explained to enable modifications that could neutralize the inhibiting factors whilst capitalizing on the enhancing ones (Reinking & Bradley, 2008). To neutralise the inhibiting factors identified from the enactment phase, the intervention was adjourned after the fifth week lectures. The course however, continued with the usual face-to-face lecture method. However, teaching and learning materials were still posted online for students' reference purposes. Consequently, ABLECAT offered the participants to engage in self-directed learning (Davidsen & Georgsen, 2010) whilst modifications were made for the achievement of the set pedagogical goals.

First, the problem with the e-mail was fixed to enable effective communication between the lecturer and students and among students. The initial e-mail system used was hosted on the Universities Intranet hence, the students could only access their mails when they were on campus. The students were asked to create additional e-mail accounts by using ***Gmail, ymail*** or ***yahoo mail***.

Secondly, the new lecturer for the second semester of the Communication Skills course was asked to score students' activities on ABLECAT such as quizzes, group activities and coursework assignments and included them in the final assessment grade of the students.

Implementation of the Second Cycle of ABLECAT

The changes above resulted in a modified enactment model to enable an effective implementation of ABLECAT in the second semester (Figure 5). The only change in the new enactment model was the schedule of the video-recorded lectures which is now found in the third phase of the model as presented in Figure 5.

The intervention was re-enacted with the same students in the second semester of the academic year for the second component of the Communication Skills course.

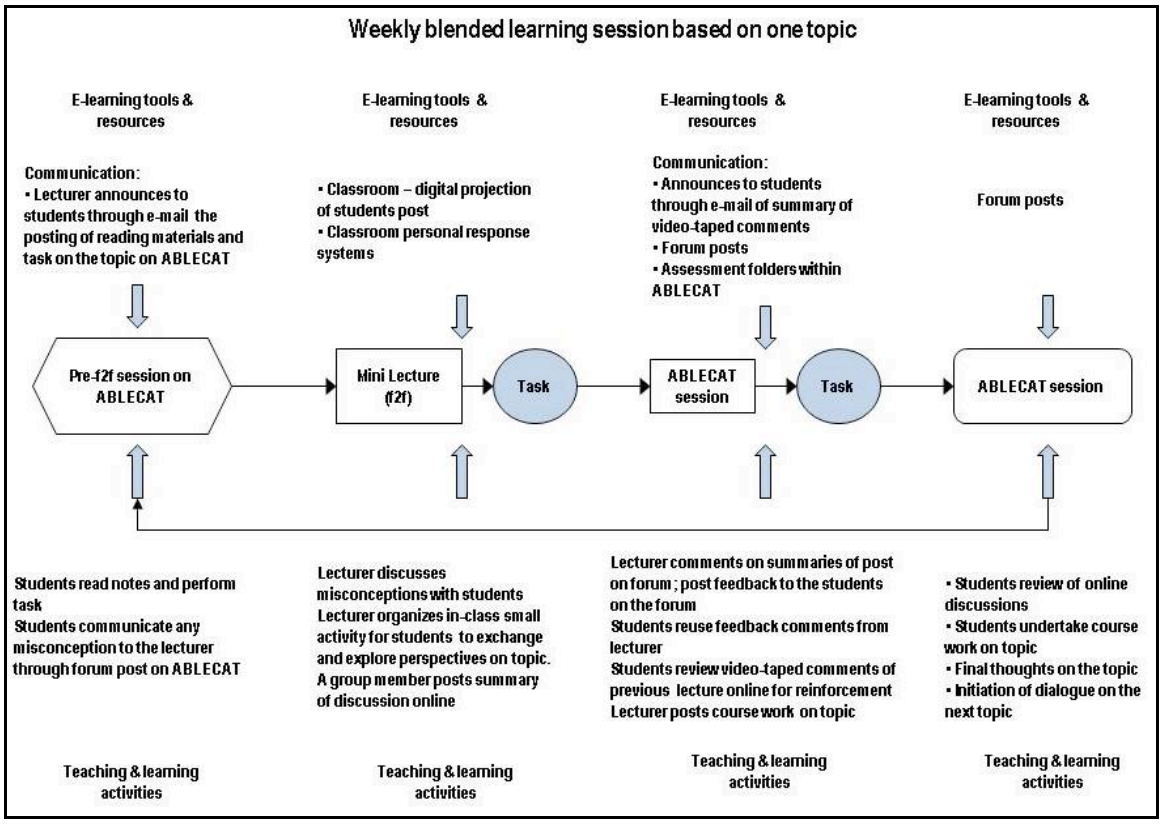

Figure 5: *Modified Enactment Process Model*

During the second cycle of the intervention, data was gathered to help identify and seek explanations for unanticipated effects and outcomes through informal conversational interviews and the students' online activity logs.

The students' online activity logs were used to examine the frequency of the students' use of ABLECAT prior to the face-to-face sessions, the use of the video-recorded lectures, performance of assigned activities, and postings on the forums.

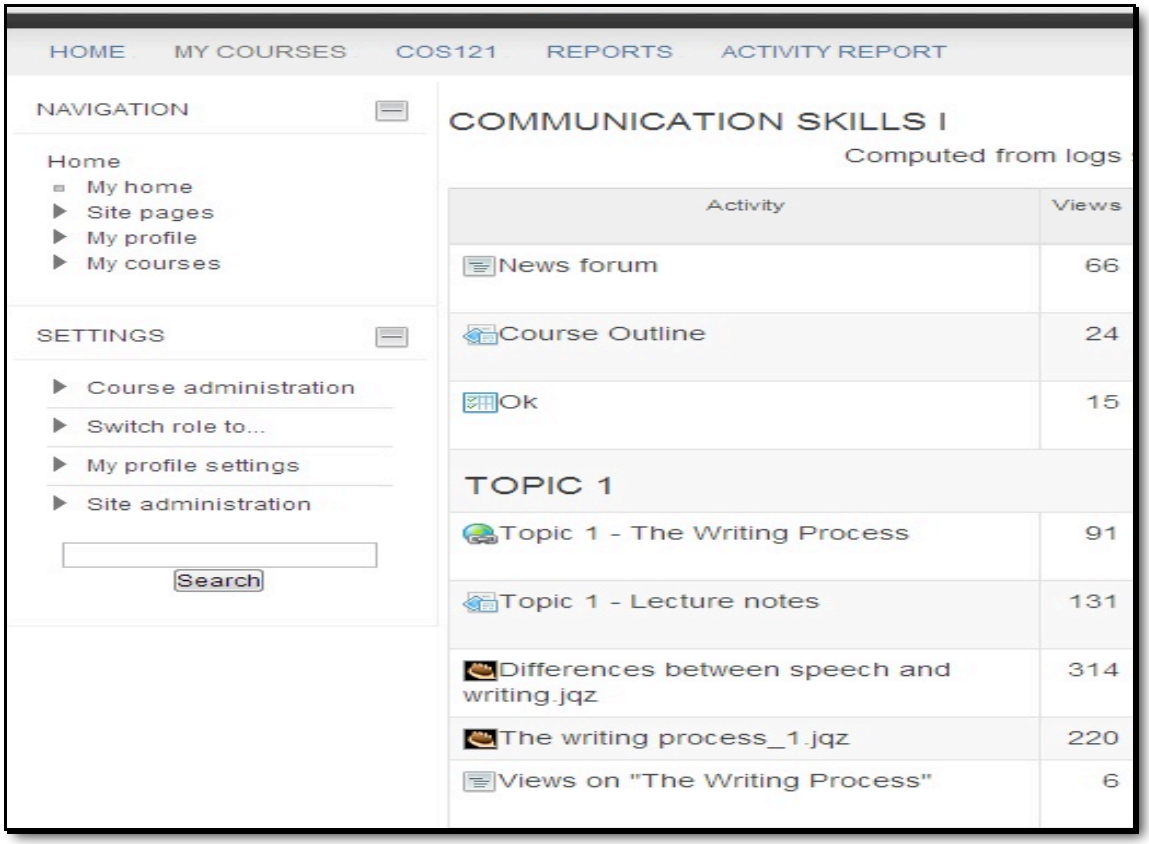

Figure 6: *Students' Online Activity Logs in the Second Cycle of Implementation*

The data from the activity logs of the students (n=75) on ABLECAT showed that, 66 students viewed and or made postings on the first task to the forum that was created for the topic; there were 131 views or readings of the lecture notes posted by the participants on the first topic and 314 attempts or views by the participants on the task and quiz that were set for the topic (Figure 6). The trends in the data showed that the marginal increase in activity on ABLECAT could be attributed to the e-mail communication with the students that announced the course topic and the tasks assigned. This satisfied the design objective of the intervention of establishing the initial interaction between the lecturer and the students which could also make the lecturer become more accessible to the students (Ogata & Yano, 2004).

Focused group interview in the form of informal conversational interview was used to assess the reaction of the participants to the modification made to the learning design and the lecturer's impressions on the incorporation of the assignment and activities as part of the students' end of course grades, and how that had translated into the students' learning. The responses are summarised in Table 4.

Table 4: *Summary of Informal Conversational Interviews: Second Cycle Implementation of Intervention*

Indicators	Students	Lecturer
Impact of the modified email system	Use email to initiate interaction with course lecturer	Use email to provide students feedback and response to questions and concerns
Modified video format and size	Improved download , videos are short and to the point	Video recording environment has improved and the time needed for recording has been shortened
Knowledge of the incorporation of scores of online activities	This is motivating and driving the use of online activities and group activities	Student participate better in online activities and face to face group activities

Post-Intervention (ABLECAT) Analysis

Formative experiments require the collection of quantitative data identifying conditions under which an intervention works or otherwise in order to develop theory and or improve practice (Reinking & Bradley, 2008). At the end of the intervention, a researcher-designed questionnaire was used to gauge the students' perceptions of the use of the blended learning environment (ABLECAT) that was used in the experiment. The questionnaire sought to find out from the participants their perceptions in terms of the quality of the content, learning, communication and the level of engagement they experienced with ABLECAT.

Sixty-four students answered the Likert-type questionnaire consisting of 11 statements with the options to state their agreement on a scale of 5 to 1 (strongly agree, agree, neutral, disagree and strongly disagree). Statistical Package for Social Sciences (SPSS v.16) software was used to perform a descriptive analysis of the data obtained.

Perception of students on the use of ABLECAT

The tables below shows the results of the students' perceptions of the blended learning environment (ABLECAT) towards achieving the pedagogical goals in the teaching and learning of Communication Skills in the university.

Pedagogical Goal 1: Provision of multiple learning resources on ABLECAT would sustain leaners interest and promote cognitive engagement in Communication Skills.

Table 5: *Responses on Design Proposition One*

Multiple learning resources on ABLECAT would sustain learners interest and promote cognitive engagement in CS	Strongly Agree %	Agree %	Neutral %	Disagree %	Strongly disagree %	Std. D	Mean
Item							
1. The learning materials on ABLECAT explain the concepts in CS very well.	40.6	40.6	10.9	3.1	4.7	1.03	1.91
2. The learning materials on ABLECAT were relevant to the needs of the CS course.	46.9	39.1	9.4	0.0	4.7	0.97	1.77
3. ABLECAT was a very useful extra source of information and resources for the CS course.	39.1	43.8	10.9	4.7	1.6	0.91	1.86
4. The learning resources on ABLECAT enabled me to gain good understanding of each lecture before attending them.	26.6	46.9	17.2	3.1	6.2	1.06	2.16
5. The learning resources on ABLECAT enabled me to revise more effectively.	35.9	48.4	7.8	3.1	4.7	1.00	1.92
6. The learning resources on ABLECAT helped me to perform better in assignments/course work	32.8	39.1	18.8	6.2	3.1	1.03	2.08

From table 5, more than 80% perceived that the learning materials on ABLECAT explained the concepts in CS very well and were therefore relevant to their needs; more than 70% perceived that ABLECAT helped them to perform better in assignments and coursework. It can therefore, be concluded that the provision of multiple learning resources in the design and implementation of ABLECAT contributed to sustain the leaners' interest and promoted their cognitive engagement in the course as expressed in the survey.

Pedagogical Goal 2: Provision and use of communication tools on ABLECAT would encourage learners' collaboration and promote the cognitive engagement in Communication Skills.

From table 6, more than 70% of the students perceived ABLECAT as having improved their communication with their lecturer whilst more than 68% perceived that ABLECAT has helped them to understand the course content on CS due to the discussions they had in the forums on ABLECAT.

Computer-mediated communication (CMC) – both synchronous and asynchronous, is considered the most revolutionary development in computer-assisted language learning since it involves direct human-to-human communication rather than human-to-machine (Warschauer & Kern 2000). It could therefore, be concluded that the provision and use of the communication tools in the design and implementation of ABLECAT contributed to the perceived collaboration that the students enjoyed in the CS course, and hence the enhancement of their cognitive development and improvement in the course.

Table 6: *Responses from design proposition 2*

Provision and use of communication tools on ABLECAT would encourage learners' collaboration and promote their cognitive engagement in CS	Strongly Agree %	Agree %	Neutral %	Disagree %	Strongly disagree %	Std. D	Mean
Item							
1. ABLECAT has improved the communication I had with the lecturer	20.3	59.4	15.6	4.7	0.0	0.744	2.05
2. I felt discussions with my colleagues in the forums on ABLECAT helped me understand the course content on CS.	23.4	45.3	23.4	4.7	3.1	0.957	2.19

Pedagogical goal 3: provision of learning tasks and coursework assignments on ABLECAT would engage and build learners' understanding and use of the concepts in Communication Skills

From table 7, more than 60% agreed that discussions on the forum on ABLECAT helped them to understand the course content better. More than 80% of the students agreed that the quizzes and coursework on ABLECAT were very helpful for their understanding of the concepts in the CS course. Furthermore, more than 70% of the students agreed that the feedback/answers they received on the tasks and quizzes were very helpful in the course.

Table 7: *Responses from design proposition 3*

Learning tasks and coursework assignments on ABLECAT would engage and build learners' understanding and use of concepts in CS	Strongly Agree %	Agree %	Neutral %	Disagree %	Strongly disagree %	Std. D	Mean
Item							
1. Discussions on the forums helped me understand the course content better.	17.2	46.9	18.8	15.6	1.6	1.00	2.38
2. The quizzes and coursework on ABLECAT were very helpful for my understanding of the concepts in CS	40.6	37.5	10.9	9.4	1.6	1.022	1.94
3. The feedback/answers I received on the tasks/quizzes were very helpful in the CS course	37.5	37.5	15.6	6.2	3.1	1.039	2.00

Feedback has been found to be central to learning and improving performance, and therefore, students need appropriate feedback on performance to benefit from courses. It has also been observed that if coursework is taken away from a course due to resource constraints, students do not perform the associated studying. It could therefore, be deduced from the participants' responses that the learning tasks and coursework assignment provided on ABLECAT engaged and built their understanding and use of the concepts in the course.

Unsurprisingly quiet substantial number of students either were indifferent or disagreed that the learning task and the online learning tool contributed to the improvement of their performance. This was attributed to the slow Internet connectivity on campus and lack of access for those students who lived outside the campus.

Therefore, the data suggested that the value of *effectiveness* was achieved with the intervention, because the students who have a stake in the intervention have expressed positive perception about its suitability for the development of their skills and knowledge in the CS course (Reigeluth & Frick 1999).

In sum, even though the perceived threat to internal validity does not make the intervention highly generalizable to other similar situations, the design theory that underpins the intervention suggested that ABLECAT was effective, efficient and appealing to the improvement of the students' knowledge and skills in CS.

FINDINGS AND IMPLICATIONS

Against the backdrop of the controversy that surrounds the traditional classroom vs. Computer-assisted language learning comparisons (Chapelle 2003) the findings in this study are drawn from the students' perceptions in terms of the quality of the content, learning, communication and the level of engagement experienced by their using the blended learning environment in a University setting that is characterised by large class sizes and face to face teaching and learning environment. In a developing country such as Ghana, the students' acceptance of blended learning environment would go a long way to improve teaching and learning outcomes in the higher academic institutions.

The findings from the classroom observation, informal conversational interviews with the students and the survey of the students corroborate the findings of previous research (Chapelle 1998); Kupetz & Ziegenmeyer 2005 & Harker & Koutsantoni 2005) that when learners are provided with multiple formats of learning materials in blended learning environment it could sustain the students' interest and thereby promote their cognitive engagement. From the activity logs on ABLECAT, it was discovered that most of the students logged in to view the course materials (lecture notes, lecturer's video explanations and comments, links to websites on CS) every week. The activity logs on course materials were higher when the students were asked to undertake course work or assignment on the topic for the week. This indicated that the students utilised the course materials for their coursework and assignments. This could be attributed to the fact that the course materials were accessible all the time (24/7) and at any place (at home as well as on campus) provided the students had access to the Internet (Boyle, et al. 2003).

This finding notwithstanding, the use of web-based materials for blended learning programmes was problematic giving that some students encountered problems with Internet access and the slow speed of the connectivity on the university campus. This implies that any adoption of the blended learning environment in a university-wide situation would require investment in Internet infrastructure to make it successful. The status quo could not support such innovations in teaching and learning.

Again, the results from the classroom observation, informal conversational interviews of the students and the survey of the students indicated that when learners were provided with adequate and appropriate communication tools in blended learning environments it could enhance interaction and collaboration with their peers and instructors and thereby enhance their development of knowledge and skills in the course, further corroborating (Aycock, Garnham, & Kaleta 2002; Chen, Belkada, & Okamoto 2004 & González-Lloret 2003). Findings from both the

qualitative and quantitative data suggested that these tools enhanced communication among the students as well as between the students and the lecturer. However, an analysis of the activity logs of the students on ABLECAT showed that a few 'ardent' students regularly posted their misconceptions on the forums that were created for the topics. Much of the interaction that took place was by the use of the e-mail and the forums, which created an avenue for the students to regularly exhibit their knowledge and writing skills in the course.

In conclusion, although the findings from this study show the transformative potential of the intervention, there could be an issue with the generalization of the findings to all courses in the University setting. It is therefore, pertinent for future research endeavours to study the effects of making use of the intervention across various courses in different situations.

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MLCMS actual use, perceived use, and experiences of use

Edgar Napoleon Asiimwe and Åke Grönlund
Örebro University, Sweden

ABSTRACT

Mobile learning involves use of mobile devices to participate in learning activities. Most e-learning activities are available to participants through learning systems such as learning content management systems (LCMS). Due to certain challenges, LCMS are not equally accessible on all mobile devices. This study investigates actual use, perceived usefulness and user experiences of LCMS use on mobile phones at Makerere University in Uganda. The study identifies challenges pertaining to use and discusses how to improve LCMS use on mobile phones. Such solutions are a cornerstone in enabling and improving mobile learning. Data was collected by means of focus group discussions, an online survey designed based on the Technology Acceptance Model (TAM), and LCMS log files of user activities. Data was collected from two courses where Moodle was used as a learning platform. The results indicate positive attitudes towards use of LCMS on phones but also huge challenges which are content related and technical in nature.

Keywords: Mobile learning; LCMS; MUELE; TAM; Mobile phones

INTRODUCTION

Information and communications technology (ICT) mediated learning has increasingly become important in higher education (Simkova et al. 2012; Fu 2013). Electronic learning tools, especially online tools, allow teachers and learners to share educational resources, work on assessments, communicate and collaborate smoothly (Lonn et al. 2011; Lonn et al. 2009; Liaw et al. 2008). Increasingly, mobile technologies are being used for ubiquitous access in learning. There are various meanings of mobile learning. Tagoe and Abakah (2014) demonstrate how mobile learning has been defined over time and further shows that, some of the definitions are technology oriented, e-learning oriented, location oriented, or learner-centered, and are contextualized based on social and cultural perspectives. Wang et al. (2009) takes a technology stand to define mobile learning as:

> *"the delivery of learning to students anytime and anywhere through the use of wireless Internet and mobile devices" (p. 92).*

Considering the perspectives in this paper, the above definition was expanded to encompass the divergent views on mobile learning that are cited in Tagoe and Abakah (2014), we use "mobile learning" to mean the process of exchanging and acquiring knowledge, and delivering learning instructions and content to students through the use of wireless Internet, mobile devices, web and mobile applications.

The backbone for mobile learning includes a mobile communication infrastructure and mobile devices such as cell phones which can support technologies that assist individuals and groups to learn anywhere anytime (Sharples et al. 2002). Johnson et al. (2011) name mobile devices as a priority technology for next generation learning and note that they:

> *"enable ubiquitous access to information, social networks, tools for learning and productivity...are capable computing devices in their own right — and they are increasingly a user's first choice for Internet access" (p. 5).*

Mobile learning uses supporting applications such as Mobile Learning Content Management Systems (MLCMS). Such applications provide simplicity in content management, and ensure proper display and functionality for various mobile devices to enable efficiency in data transmission (Simkova et al. 2012). Gleason (2002) and Mohmoud (2008) suggest that learning system components should include MLCMS that support downloading and managing repositories for mobile content. Besides other m-learning application solutions available, MLCMS solve device constraints such as size that limit content access.

Attractive factors of mobile devices include mobility and portability that provide the capability to carry or move the devices easily. Sariola et al. (2001) describe mobile learning from technological and educational theorist perspectives and note that mobility is the most interesting aspect since matters of who is moving (tutor or learner), where they are moving (environment) and why they are moving are important in understanding the context of learning. The mobility factor, for example, comes along with convenience, faster communication, flexibility and full time connectivity (Ducut & Fontelo 2008). Alvarez et al. (2011) note that such opportunities have made mobile learning attractive to educational institutions.

Therefore, in terms of flexibility, collaboration and communication, mobile technologies can play a critical 'freedom of choice' role regarding how and where to learn, which is core in distance education (Parsons 2009). However, there is a need to re-conceptualize learning for the mobile age through understanding the essential role of mobility and communication in the learning process (Sharples et al. 2005). Understanding the importance of context in establishing meaning and supporting virtual communities that transcend barriers of age and culture is equally important.

In pursuit of the "anywhere and anytime" ideal, different researchers have investigated issues related to mobile learning. Most areas addressed in the literature are problems of use, access, design and infrastructure (Westera 2011; Chu et al. 2005), communication and collaboration (Alvarez et al. 2011), content delivery (Macdonald & Chiu 2011), and many more. However none of these researchers discuss the technical aspects of MLCMS. Research either discusses mobile phone use in learning or learning management systems separately, but not together (Asiimwe & Grönlund 2014). We define MLCMS as LCMS that can store and deliver learning content and services to mobile computing devices. The aim is to identify ways of adapting LCMS services for mobile phone users. This aim is pursued by:

- Studying actual use, perceived ease of use and usefulness of MLCMS (mobile LCMS)
- Investigating challenges involved in use of MLCMS and suggest remedies

The main research questions of this study are:

- What are user perceptions and actual experiences of MLCMS use on mobile phones?
- What affects MLCMS use?

There are various theories that discuss use of technology. This study uses TAM (Technology Acceptance Model) as a reference model (Davis et al. 1989; Venkatesh et al. 2000). TAM helps to explain perceived usefulness and usage intentions of an information system.

There are several models that have been created for analyzing the relationship between technology and users; TAM is one of the oldest and most used. While models differ in details and scope, they all in some way or another draw on the idea that ease of use and usefulness, as perceived by the user, are the basic factors that lead to use of information systems. We therefore used the TAM general framework to formulate our research instruments.

Factors affecting actual use of learning technology

Information systems research that discusses technology adoption and acceptance e.g., Davis et al (1989), retain that perceived ease of use and perceived usefulness determine use. Task performance is stimulated when a system is easy to use; at the same time for the user to be at all interested in using it, s/he must see some point in doing so – the system must be perceived as being potentially useful. Perceived ease of use is further linked to intentions to use (Venkatesh 1999). The linkage is both direct and indirect via its impact on perceived usefulness (Venkatesh & Davis 2000, p.192).

The TAM framework focuses on particular aspects, which in this paper are referred to as "TAM keywords" i.e., "behavior intentions," "attitudes," "usefulness," "ease of use" etc., all seen in the context of a "system," an information system. From a perspective of learning and pedagogy, this focus of user-to-system may be criticized as many learning studies suggest a rather different direction i.e., focusing on the learner (Ramsden 2003; Light 2001). Although some of the contemporary Information system studies have re-constructed TAM, it should be remembered that TAM was constructed in the 1980s when computer use was very different from now. Then, most use was professional and task-oriented; today computer use is more open; a palette of tools is available, the user often has a choice, and many design features supporting ease-of-use are incorporated in industry standards as well as in the thinking and experience of users. Even so, any new technology requires revisiting the interaction between users and technology as the preconditions change. Mobile technologies are very much an example of such change. While many general functions of mobile technology are already well established, many specialized ones are not. One of the yet unexplored functions is the integration of mobile technologies in teaching and learning environments and processes. For this reason we revisit the TAM factors in the context of m-learning.

User experience of information and communication technology (ICT) is an enabling factor for continuous use of ICT (Liu, et al. 2010). Past online learning experience, for example, shapes perceived interaction and perceived usefulness of online learning programs which subsequently motivates intentions for using online learning resources, thus,

> *"the greater the online learning experiences of users, the stronger their intention to use an online learning community" (p.603).*

Experience is also mentioned as an empowerment tool in terms of enjoyment and concentration during learning discourse. Learning requires a focused and attentive mind driven by interest – what Csikszentmihalyi (1997) describes as a "flow state"; a feeling of complete involvement in an activity. This learning state of mind can be affected by user skills and ambitions as well as by perceptions of ease of use and usefulness of the system.

Faith in ICT efficacy is a significant factor shaping intentions to integrate technology in learning and teaching (So et al. 2012; Fanni et al. 2013). ICTs emerge as effective, efficient and productive tools for supporting the performance of a variety of tasks, and this perception can be improved by training (Fanni et al. 2013). Ming-Chi Lee (2010) empirically validates the hypothesis that confirmation of expectations of users is positively related to perceived usefulness of e-learning tools. ICT efficacy raises expectations and when expectations are met it leads to positive learner experiences and satisfaction. Empirical studies by Sun, et al. (2008) and Lee & Lehto (2013) show a positive relationship between perceived usefulness and user satisfaction on electronic learning. Conversely, unsatisfactory perceptions hamper students' motivation. User satisfaction has,

> *"...a direct impact on the formation of behavioral intention. In educational settings, it is considered a prerequisite for the users' intent to use a learning system"* (Lee & Lehto 2013, p.195).

Thus behavioral intentions or attitude shapes perceived usefulness and ease of use (Venkatesh et al. 2003) leading to increased ICT efficacy.

There are also other factors that affect ease of use and usefulness, including good interface design, good content design, and technical support (Cheung & Vogel 2013).

Content and interface design affect learners' perceptions, particularly mobile learners as mobile systems introduce more restrictions to the design. User Interface Design (UID) is an important factor in computer applications development (Liu et al. 2010). Good UID enforces compatibility across different devices. Compatibility has an "influence on ease of use associated with a new technology" (Cheung & Vogel 2013, p.165).

All in all, both system and content design affect users' perception towards technology acceptance and use.

MLCMS technology: impact and challenges

Several advantages and challenges of mobile phone use with LCMS are discussed in the literature. An empirical study on course content distribution using mobile technology by Mohmoud (2008) used a case to show how access to online learning resources via mobile phones is a preferred learning solution, but notes that the solution requires fast Internet connections and must be affordable. Mohmoud also notes that mobile technology is "the most complex solution" (p. 281) since a website has to be designed for different screen layouts and file formats.

Parsons (2009) categorizes challenges of using mobile devices into three fields:

- specification and usability i.e. qualities of the device such as screen size, battery life, storage space, flash application capabilities etc.;
- lifecycle of the devices; and
- diversity and lack of standards.

The lifecycle of the device refers to the continuous development of new devices that leads to demand of responsive applications, which is challenging in that content creation is also affected and new requirements must be met. This rapid process of making changes, however, affects the ability to create and adhere to standards and may or may not prompt learning content creators and e-learning website designers to follow standards and instructional design guidelines. Casany et al. (2012b) mention challenges such as lack of teacher confidence and training on technology use and technical difficulties with mobile devices which affect the attitudes towards use. These limitations can be overcome by user training and providing supporting information in the form of a manual.

Mobile learning also faces challenges with integrating mobile applications with mainstream e-learning applications. Casany et al. (2012b) suggest that these challenges can be overcome by integration of learning content management systems. This integration can facilitate interoperability improvements across various devices. However, Casany et al. (2012a) note that integrating external m-learning applications into the learning content management systems is a disadvantage due to difficulties in maintaining and extending the integrated external systems.

Despite the challenges, literature suggests the existing challenges are contemporary and can be overcome given constant advancements in technology. Thus, MLCMS remain necessary tools for e-learners due to their positive contribution towards learning performance and collaboration.

THE MUELE CASE

MUELE is an online learning management system used as the default e-learning platform at Makerere University (http://muele.mak.ac.ug/). MUELE is customized based on Moodle (Modular Object-Oriented Dynamic Learning Environment). Moodle is an open source learning management system (LMS) developed and supported by the Moodle Project (http://moodle.org). MUELE provides tools to manage and support learning in a virtual environment. Functions of the system include: learners' activity reporting, creation of online quizzes, content/learning material management, chat rooms, discussion forum, wikis, communication (e-mailing), course creation and management and user management (teachers, students and administrators).

MUELE was set up at Makerere University in 2009 because it is open source and hence served to avoid license costs that were incurred on the LMS that was previously in use (Blackboard; blackboard.com). The main purpose of having an LMS is to facilitate e-learning. Most users are students and teachers at all university campuses. The system is hosted and managed locally by DICTS (Directorate of Information and Communications Technology Support; http://dicts.mak.ac.ug/). DICTS is responsible for ICT implementation and support services at Makerere campus. Use and implementation of MUELE is an ongoing activity with no specified timeframe, and the implementation is monitored and evaluated by DICTS through performance and system usage reports. The system is updated regularly in accordance with Moodle updates. The university has 145 undergraduate programmes and 139 postgraduate ones. The estimated number of MUELE registered users is 53,000 but the actual (active) number of users was 30,000 as of April 2014.

We conducted an information search on the university intranet and webpages and found that there was no information for students and teachers on how to use MUELE on mobile devices specifically mobile phones. The information was created for desktop users. User support is given when requested. Training on how to use the system is provided for teachers only. Within the system settings, different display templates have been installed to support information access across various devices, but not all devices are supported. Besides perceptions of use, this study took the MUELE case to investigate challenges faced by users so that we could find solutions for mobile users.

METHOD

This study used focus group discussions (FGD) and an online questionnaire as the primary methods to collect data. We further examined activity logs of participants which were extracted from the learning platform. Informants in both surveys were students and teachers.

The informants were divided in three focus groups and handed the same questions (in appendix B). The groups discussed the questions and wrote down their shared views as guided by the facilitator (one of the researchers). After 90 minutes, the three groups convened for 60 minutes to share and discuss their answers to the questions. Answers from each group were recorded by the appointed group leader and answers from all groups were recorded by one of us (the researchers).

After the focus group discussions, a link to the online survey (appendix A) was sent to all participants.

System logs covering six months of user activity were reviewed. A descriptive analysis of the data collected was made, and then data from the three sources – focus groups, survey and log files were contrasted and compared.

Demographics

Survey data was collected from twenty-eight students and two teachers. Three respondents were females, 27 males. Respondents were students and teachers of two particular Information Technology (IT) courses offered during the 2013 fall semester at Makerere University main campus. These IT courses are offered to second year students in the Bachelor of Information Technology programme. The courses include BIS2104 (Introduction to Database Systems with 550 students) and BIT2108 (Advanced Information Technology with 1320 students). The courses run for a full academic semester which is six months. Respondents were between age 20 and 34 and had experience of using Makerere University Electronic Learning Environment (MUELE) on mobile phones. Table one shows the number of respondents in the online questionnaire. The survey link was sent to all 30 respondents. Reminders to fill in the questionnaire were sent to all 30 respondents and eventually 23 (77%) responded.

Table 1: *Gender and age groups of online respondents (n=23)*

		Age Group			
		18-24	25-29	30-34	35++
Gender	Female	2	0	0	0
	Male	18	0	3	0

Selection of respondents

Students and teachers in BIS2104 and BIT2108 courses were invited to participate in the survey. Teachers were included in the study because they had previously taken the same courses as students and had used the same learning platform during their studies; they thus had their individual experiences with the system as previous students despite their current teacher roles.

One requirement for participation was having a mobile phone (of any kind) that could access the Internet. Those who did not have mobile phones that could access the Internet were excluded. Many students were interested in taking part in the survey but were excluded by this criterion, which led to a sample of twenty-eight respondents. Participants who met the criterion were registered and briefed on the aim of the research and on how to access and use MUELE on their mobile phones. Among the selected participants, some had smart phones while others had semi-smart phones (mobile phones with basic functions and Internet capabilities).

Data collection

Data were collected from FGDs and an online survey. The FGDs included thirty respondents who were divided in three groups, each with 11, 10 and 9 respondents respectively. The FGDs lasted for 90 minutes in each group.

The web link to the online questionnaire (Appendix A) was sent to everyone who participated in FGDs. Twenty-three out of thirty participants responded as shown in Table 1.

We further examined respondents' activity logs (Figure 1) mined from MUELE. The purpose of examining activity logs was to identify what kind of information and tools the respondents accessed. For example, did they access and use the discussion forums, chat rooms, web mail, assignments, course content, etc.?

Course	Time	IP	User	Action	Information
BIS 2104	2013 februari 8 12:24	19	calvir	folder view	Assessment
BIS 2104	2013 februari 8 12:24	19	calvir	folder view	Lecture Notes
BIS 2104	2013 februari 8 12:24	19	calvir	course view	BIS 2104: Introduction to Database Systems
BIS 2104	2013 februari 8 10:45	19	anita	folder view	Lecture Notes
BIS 2104	2013 februari 8 10:45	19	anita	course view	BIS 2104: Introduction to Database Systems
BIS 2104	2013 februari 8 10:41	19	SILU:	course view	BIS 2104: Introduction to Database Systems
BIS 2104	2013 februari 7 18:23	19	Domi	course view	BIS 2104: Introduction to Database Systems
BIS 2104	2013 februari 7 17:49	19	sylvia	folder view	Lecture Notes
BIS 2104	2013 februari 7 17:49	19	sylvia	folder view	Lecture Notes
BIS 2104	2013 februari 7 17:49	19	sylvia	folder view	Other Resources
BIS 2104	2013 februari 7 17:49	19	sylvia	folder view	Other Resources

Figure 1: *Sample respondents' activity logs. Internet Protocol (IP) addresses and usernames are hidden for ethical purposes*

Data analysis

This paper uses descriptive analysis. Respondents' opinions and some of the TAM factors are used to analyze correspondences in opinions regarding perceived ease of use and usefulness. Descriptive analysis interprets information patterns that might emerge from data and summarizes the findings in a meaningful way. The descriptive analysis was used mainly because most of the data was qualitative. The comparisons of opinions from the online questions were compared to the views from FGDs so as to serve as a measure of triangulation (using different methods to obtain data on the same phenomenon).

The frame of reference for the study was the Technology Acceptance Model (Davis et al. 1989; Venkatesh & Davis 2000), which has been used widely by information systems researchers to explain factors that lead to acceptance of information systems (Lin & Fang 2011). The model includes six essential factors; (1) external variables such as demographic ones; (2) perceived usefulness (personal belief that a system will enhance a task performance); (3) perceived ease of use (personal belief that a system will be simple to operate); (4) attitudes towards use (personal desires to use the system) which are solely determined by perceived usefulness and perceived ease of use, and significantly affects behavioral intention (Thomas 2013); (5) behavioral intention to use the system resulting from attitude towards use and perceived usefulness; and (6) actual use of a system resulting from behavioral intention (van Biljon & Renaud 2009).

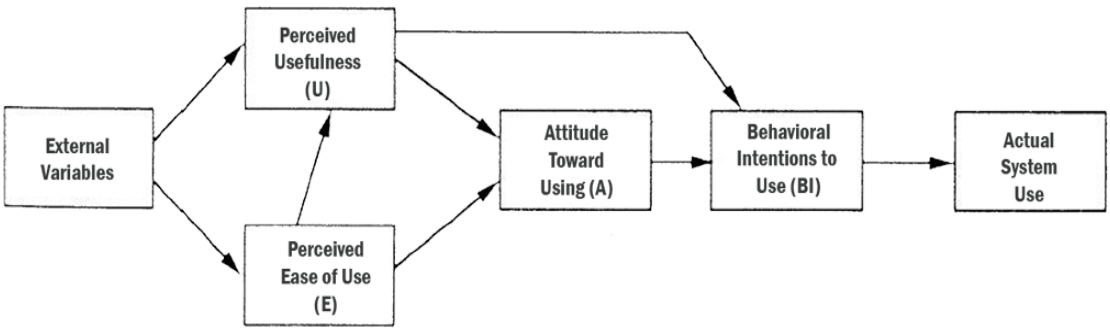

Figure 2: *Technology Acceptance Model (Davis et al. 1989, p.185)*

In this study TAM was used to frame some of the questions in the online survey. The framework helped to relate answers from the online survey to opinions discussed in FGDs as shown in results and analysis section. Subsequently we were able to analyze both responses on perceived ease of use and perceived usefulness and assess the assumption that the two factors are the primary factors that lead to actual system use. Davis et al. (1989) acknowledges various studies that discuss other factors linked to attitude and use of information systems and considers usefulness and ease of use of technology as "statistically distinct dimensions" (p. 185). In this study therefore, we identified factors linked to use as those mentioned by van Biljon and Renaud (2009).

RESULTS AND ANALYSIS

In this section we present the findings and discuss the various factors that affect perceptions on ease of use and usefulness and that influence the use of LCMS on mobile phones.

Usefulness and ease of use

In the online questionnaire, students were asked how they perceived the usefulness and the ease of use of the MLCMS functions on mobile phones. The questions were grouped under "perceived usefulness" and "ease of use" and the responses from each category were compared with the opinions expressed in the FGDs and the other answers from the online questionnaire. It is the combination of these given responses that are considered the determinants of LCMS use on mobile phones. The responses from the online questionnaire on "perceived usefulness" and "ease of use" are presented in Figure 3 and the following reflections were made on these responses in relation to focus group discussions:

Use, interaction and access difficulties affect attitudes toward and behavioral intentions to use the system. However, such difficulties do not avert continued actual system use. More than half of the respondents (53%) noted that it was frustrating for them to use and operate MUELE on mobile phones and that they could not do every task on mobile phones. However, this did not deter them from using the system because there was demand and benefits (external factors) such as "cheap costs and portability of mobile phones, instant access to Internet resources," that were mentioned by most of the respondents. Moreover, most respondents perceived the use of MUELE on phones improved their productivity (85%), gave them greater control over their learning activity (90%) and increased access to course material (100%).

The system can still attract users even if the intentions to use are not fulfilled. Although most students could not perform all tasks in MUELE on mobile phones (94%), FGDs show that they still preferred mobile phones for particular reasons. For example, one student said that "I use MUELE on my phone if I want to quickly see what updates are available from the teacher such as course materials and assignments" while most of the students recited "access to Internet" as a necessity.

Task knowledge and experience have an effect on use. Knowing how to perform a task requires knowledge i.e., 'how to,' thus an effort is needed to attain such experience (on 'how to'). Knowing how to use is crucial for users. More than half of all respondents (53%) noted that it requires a lot of effort to know how to perform tasks while 29% stated that it requires an effort to become skillful at using the system. Results on experience from the online survey further show that most of those who frequently used MUELE and had used it for more than four months indicated having had less difficulty in using the system and regarded the system to be most useful.

System efficacy shapes attitude towards use. All respondents (100%) perceived MUELE use on phone to be useful. Many reasons were given as to why MUELE on mobile phones was

perceived to be useful and continued to be used despite the challenges learners faced. Even the person who had not used MUELE on phone before considered it useful; “I think it is more flexible to use a phone compared to a PC.” This particular response shows that efficacy can shape attitude. Most perceived benefits that respondents strongly agreed to were increased access to learning materials (70 %), ability to accomplish learning tasks quickly (50 %), ability to communicate and improved productivity (45 %).

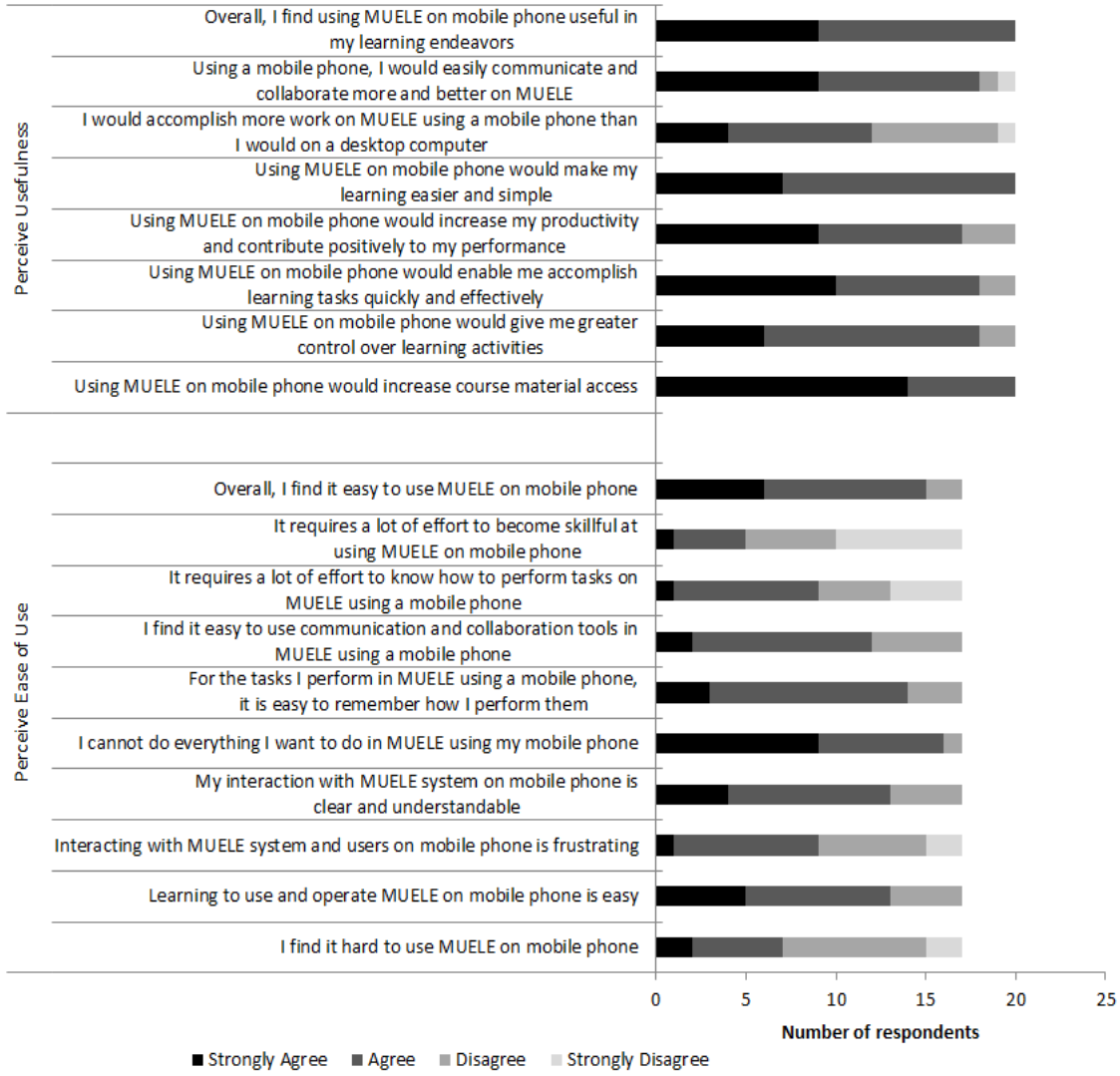

Figure 3: *Students’ perceived ease of use (n=17) and usefulness (n=20) of MUELE on mobile phone*

Overall, 45 % strongly agreed and 55 % agreed on MUELE’s perceived usefulness. As for overall ease of use, 35 % strongly agreed, 52 % agreed and 11% disagreed. Given the different responses received, the highly perceived benefit of MUELE on mobile phones was access to learning materials.

Design and Technical challenges

In FGDs respondents mentioned challenges faced when using MUELE on their mobile phones. The challenges included: (1) *ineffectiveness* i.e., the system is perceived to be too slow to load pages on mobile phones; (2) *poor design* leading to poor system pages optimization on phone screens. Students noted that, "pages become so compact on the screen and the words get mixed," (3) *need for a lot of virtual and physical memory* for the phone; (4) *upload restrictions and compatibility problems* i.e., "difficulty to attach files, images …and receiving files that are not in formats supported by the phones," (5) *high costs.* For example it was mentioned that, "it is costly to access the system using mobile Internet," (6) *communication problem,* for example course updates were not sent to students automatically, "the system lacks automatic notification functions."

It emerged that technical challenges affect perceptions of use, but do not affect use. For example, despite the technical problems students mentioned, they were confident they would continue using the system for the purposes it served. Students' desires were more focused on the user benefits rather than the technical difficulties.

Other Use Dimensions

Frequency of use

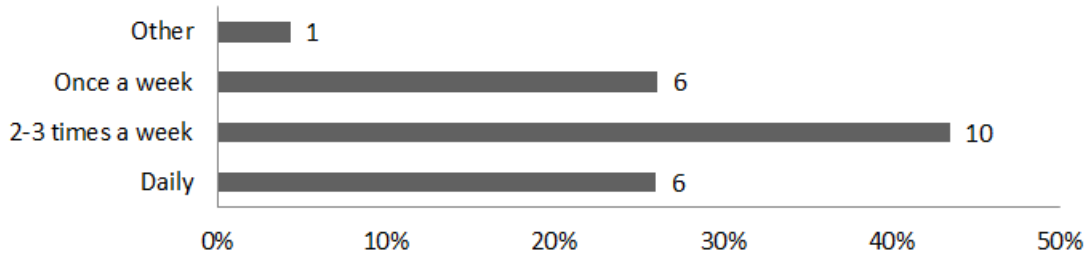

Figure 4: *Frequency of MUELE use on mobile phone (n=23)*

Frequency of use converts to experience due to navigation knowledge regularly acquired. Most of the students had used MUELE on their phones less than six months while three had used it six months or more. Figure 4 shows how often students used MUELE on their mobile phones. It also shows the "Other" category where one respondent noted not to have used MUELE on the phone on a weekly basis. Six students used it daily.

In the FDGs as well as in the online survey, respondents listed the tasks they performed in MUELE using their phones. These included (1) reading course material and downloading course content, (2) checking for communications from the students and lectures and any updates from the lectures regarding their respective courses, (3) participating in discussion forums and chat rooms, (4) accessing assignments and, (5) web-mail services. These tasks were at least performed once a week, except for forums and chats which were only used infrequently (once a month) and only by some of the students. The responses were coherent with the activity logs that were extracted from the learning platform. The logs showed that students mostly accessed course material. There were also other activities that were not mentioned, but appeared in the activity logs. For example, searching and viewing users' profiles (students viewing other students' profile information) and forum searching.

Experience affects user perceptions. Impact as well as MUELE-specific access challenges were inquired and explained during FDGs. Some students had personal experience of and knowledge on how to effectively utilize the system tools. A few students clearly said they had noticed most of the problems associated with MUELE, "so we know simple ways to overcome some of the problems, but there are other issues we have to avoid such as video." Such experience and technical know-how lead to continued use of the system. Therefore experience can affect perceptions positively or negatively, i.e., lead to continued and expanded use or to hampered use depending on the interaction experiences with the system.

Access to Internet

Students were asked what means they used to access Internet on their mobile phones and how frequently they accessed Internet on mobile phones. The access patterns varied with the largest share of students (48 %) accessing MUELE anytime of the day while others accessed it in the morning (24 %), afternoon (10 %) and evening (19 %). The variations, as mentioned in FGDs, depended on Internet peak and off peak times, and the urgency to access the learning platform.

Respondents mentioned two wireless Internet connections as the means used to access MUELE on mobile phones i.e., Wi-Fi (wireless Internet via hotspots) or mobile Internet (data packets provided by telecom service providers). All respondents used mobile Internet while ten of them mentioned they used both Wi-Fi and mobile Internet. Mobile Internet was cited as the most preferred Internet connection even though it is more costly to the users. This is probably because of the availability factor; Wi-Fi is not available everywhere. Respondents mentioned the following driving factors for LCMS use on mobile phones:

- Availability and flexibility: It is flexible to access learning material from anywhere at any time using a mobile phone.
- Improvement in communication: Chat rooms and discussion forums are great tools for interaction. Instant messaging and interactions are easily available when using a mobile phone and wireless Internet.
- Simplicity in learning: The process of sharing and accessing learning resources is convenient and user friendly depending on the phone being used, but also sharing resources is made easy by mobile Internet.
- Portability: The nature of mobile phones creates a ubiquitous environment that provides networked workspaces.
- Cost: Cost in this context refers to the affordability of bandwidth subscription and usage (management). It solely depends on the data plan a person has subscribed for.
- Efficiency: With full time access to Internet the learning platform can be accessed all the time from anywhere; "A lot of time is saved since one can use the phone to access the system from anywhere," one of the respondents noted.

The dynamics of Internet access also affect perceptions on use. Internet provides the communication infrastructure and it is one of the most expected assets for users. Depending on the kind of access such as mobile Internet, broadband and Wi-Fi the user has, access to an information system is affected. For example, students made Internet connection choices based on cost, speed, availability, location (figure 5), etc. In reference to the speed of mobile Internet, one student noted that, "When MUELE takes long to load, Internet is wasted and it is costly." For such reasons, other solutions would be sought such as using desktop computers. Therefore infrastructural assets such as Internet connections may positively or negatively affect use. For example 45 % of respondents stated that it is easy to communicate and collaborate in MUELE using a mobile phone. This perception reveals both the high dependence on Internet connectivity and capacity as well as the poor availability of that good.

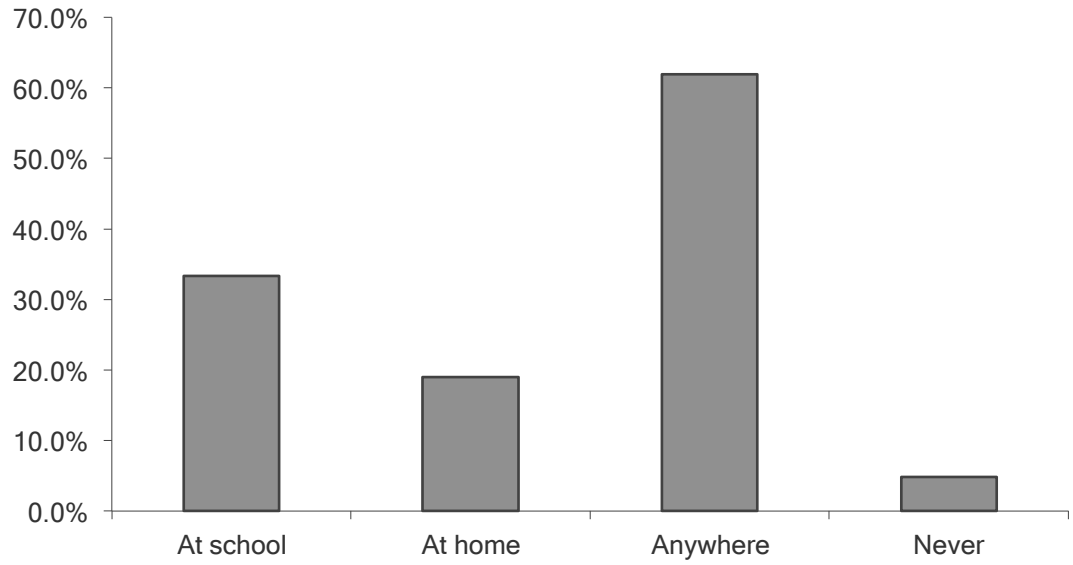

Figure 5: *Locations of access to MUELE on mobile (n=21)*

Desktops versus mobile phones

In this section we discuss the pros and cons of phone use compared to computers. The study specifically focused on mobile phones because of the mobile phone penetration rates and their potential to transform education institutions compared to other mobile devices. Despite the perceived usefulness of phone use with MLCMS, respondents noted the pros and cons of phone use as compared to computers. Convenience in terms of full time access to learning platform, low cost (for handset, and freedom to access free Internet hotspots) and portability i.e., the ability to move to different places with the mobile handset were mentioned as positive factors. Mobile Internet was considered a prelude to flexibility i.e., a means of full time access to learning resources from anywhere at any time. One of the students noted that, “Computers require many peripherals such as Internet modems.” These peripherals are acquired at an extra cost.

On the other hand, negative factors reported include; inability to read some course content due to incompatible file formats, low device memory which slows down performance, and too much scrolling due to small screens. The learning platform was reported not to be optimized for mobile devices.

In the FGDs respondents further reported situations in course tasks where desktop computers are most preferred compared to mobile phones especially in terms of learning material access, task performance and use. Desktops were perceived to be better at performing tasks that requires massive typing for example writing assignments and also better at Internet browsing and page navigation especially when multiple tabs are opened. Downloading and uploading files, especially big files via mobile phones, was mentioned as a difficult task compared to doing so using desktop computers. Students further noted that, multitasking is at times required. For example chatting and reading text from the learning platform at the same time on the same screen. Multi-tasking was perceived to be simple on desktop computers in comparison with mobile phones. Viewing videos shared on the learning platform and

performing laboratory work such as coding in computer programming were perceived to be difficult on mobile phone as compared to desktops.

There are many advantages of mobile phones that make them a preferred choice for users. However, amidst failures associated with mobile phones, for many tasks other alternatives appear more practical. Other options such as desktop computers are perceived more applicable which affects user perceptions of mobile phones. Therefore, alternative user devices affect perceptions on use of mobile phones for learning.

Improving MUELE for mobile phone use

The respondents suggested numerous solutions, both in the FGDs and in the online survey, to improve MUELE for mobile phone users so as to overcome the challenges highlighted above. Suggestions include:

Access to online resources: Allowing online viewing of all learning resources without downloading the resources. Students expressed disappointments on Internet connection speed and mentioned that "downloading files takes much Internet…mostly when the connection is slow." Some students had phones that have less memory capacity and could not read certain data files. In such cases, reading the material directly from MUELE website was the most preferred option. However, this requires optimization of the learning platform for mobile phones and designing responsive learning material that can be easily displayed on various mobile phones. Improving template design for mobile devices can also improve the system view on mobile phones as well as the navigation structure; navigation links to MUELE pages were reported to be invisible on some mobile phones.

User training: The university should provide guidelines and make users more aware of how to use the system on mobile phones. This guidance would involve creating training manuals and training users. At the time the study was undertaken, no guidelines were available for mobile phone users. FGDs respondents noted, "We need guidelines on how to use MUELE." Guidelines are very important for teachers to help them create accessible teaching material.

Access to offline material: Provide tools that allow MUELE users to access and browse through course material without Internet connection. The "Internet at campus is not available all the time" respondents mentioned. For this reason, learners suggested having an offline version of the platform or tools such as apps that can allow them have access to previously accessed resources when there is no connection. However, this may be difficult to achieve considering the various mobile devices in use.

Multi-modal communication: Enable or provide video conferencing to improve communication in chatrooms and forums. Most of the respondents noted that although they could share video links, they could not communicate to each other through video conferencing in MUELE. Whereas students expressed being comfortable with text chats and interactions, they expressed optimism in use of video as an additional tool for synchronous interactions. Therefore, multimedia (video, text, sound and images) interactions are considered to have an added value in communication.

Online storage: Increase the storage and file size capacity for uploads. Users were not allowed to upload files that are more than 5MB; "you cannot upload files bigger than 5MB. We have complained about this before" one student mentioned. This kind of restriction on file uploads is common also in other universities. This challenge can be overcome by use of free cloud services such as Google drive, Google docs, etc. and share the links to the documents instead of files.

Security and privacy: Provide security measures for controlling online discussions. Apparently, students were unable to prevent fellow students from joining private group discussions; "when you are in online discussions, other students can join the group without

permission. This would interrupt activities in the group during discussions", one of the respondents noted. Therefore more group privacy restrictions for the learning platform are required. Beside security, additional features were also proposed such as automatic notifications on course activities to those enrolled in the courses: students could not be notified once there are new course updates unless they logon to the learning platform.

Internet and technology performance: Improve Internet speed and MUELE performance, and integrate the learning platform with other knowledge management websites like Wikipedia and other websites that are frequently accessed such as Facebook, YouTube, twitter, etc. The Internet seemed to be a key factor for LCMS access, but due to the limited Internet infrastructure and the MUELE fragility, the system would become inefficient at peak hours. Students wished to have other websites such as Facebook and YouTube which they reportedly considered "simple and easy to use" to be incorporated in the learning platform enforce efficient sharing of learning resources.

DISCUSSION

The results indicate that mobile learning and specifically mobile phone use with learning content management systems has a place not only in the future, but also in today's learning activities. Users are very intent on using the mobile, to the extent that they endure several hardships in order to do so. The intention to adopt and use LCMS on mobile phones results from several factors. This section highlights these factors and relates them to those mentioned in the literature.

We identified a relationship between perceived ease of use; perceived usefulness and actual use of learning technology (MLCMS) through analytically reflecting on both responses from FDGs and the online questionnaire. Specific factors that can be considered as indicators for determining the aforementioned relationship include:

- Experience and frequency of use: How long has the user used the system?
- Accessible content: Is the content accessible/designed to suit the media and users including those with special needs?
- System simplicity: Is the system easy to use (in terms of the user interfaces and task operations)?
- Productivity: Expected and actual support (in terms of results) in task performance. Does the learning system meet the expectations of users?
- Efficiency and effectiveness: How fast and adequately functional is the system?
- Simplicity to learn and operate: How easy is it to learn and operate the system? Are there training guidelines for users?

The majority of users had only used MUELE for a short period of time, but used it frequently and found it relatively easy to use. However, they also found it hard to learn how to use it on the phone and frustrating when it came to interacting with others. Despite frustrations, all respondents perceived the technology to be useful and expressed strong desire to use it. These responses suggest that experience and user challenges can affect actual use, but may not change usefulness perceptions. This is in accordance with the findings of Al-Adwan et al. (2013) who explored acceptance of e-learning systems in universities. The authors show that students are willing to adopt and use e-learning systems based on the benefits of the systems despite any challenging experiences they may encounter.

Even though respondents clearly mentioned that they cannot do everything they want in MUELE using mobile phones, the majority liked the system because of its perceived productivity, efficiency and effectiveness. Faith in ICT efficacy is one of the factors mentioned in literature and it was confirmed in this study; ICTs are perceived as productive tools especially in areas of communication and collaboration. Technology acceptance studies that explain ICT efficacy mostly use performance expectancy as a factor that affects behavioral

intention to use a system. Mtebe and Raisamo (2014) for example studied behavioral intention to adopt and use mobile learning and note that, the more faith students have, the more increase in their behavioral intention to adopt and use m-learning. In addition to ICT efficacy, Miller and Khera (2010) add self-efficacy, which refers to the faith individuals have in themselves to use a system. The authors note that self-efficacy affects perceived ease of use because less self-efficacy translates into less positive attitudes towards use and more pessimistic behavioral intentions.

User training on how to use a system can also affect use. When users are trained and given support they get access to information that would help them to master the system. For example, some respondents noted that, they did not get any training on how to use MUELE on a phone and for this reason they often had technical problems. Such a challenge hindered their actual use, despite their motivation. They further expressed interests in user training and guidelines as a means of improving their skills (leading to ease of use) and their knowledge on the importance of the application (usefulness). Thomas et al. (2013) studied m-learning adoption in higher education and point to the importance of acquiring appropriate skills to use e-learning systems; training improves attitudes of students. Al-Adwan et al. (2013) similarly found that it helps to,

> *"encourage users (students) to more readily identify the benefits of e-learning and explore the opportunities it offers them to improve their performance. Consequently, this will motivate greater participation in e-learning with a positive and creative attitude" (p. 14).*

Beside the six factors listed above, there are other factors that can affect actual use and perceptions on ease of use and usefulness. These include: privacy and security, use of multimedia content and resources, and Internet speed. The students in our study were uncertain if their privacy was protected. It was mentioned that other users could access information of a particular online private discussion group in MUELE. In cases of ongoing assignment discussions from teachers, this would cause examination malpractice. Because of this privacy breach, students preferred not to meet online. This particular exhibit demonstrated that the perceived privacy intrusion hindered their actual use.

One of the needs mentioned in FGDs was integration of external learning or web applications and resources. Websites such as YouTube, Wikipedia and Facebook were suggested. Students mentioned that such websites would widen information access if "moved close" to them via the learning platform. Students further claimed that they could take advantage of the simple sharing tools within these web applications and websites which are rather easy to use on mobile phones, to collaborate more with their colleagues. Integration of other web applications into learning platforms can therefore be a leading factor to perceived usefulness and actual use.

Lastly, Internet dynamics such as speed affect actual use. MUELE users were precise to mention that they preferred desktop computers when it comes to Internet connection. The desktop computers are on the university's local area network which has a faster and reliable Internet connection than other wireless networks the respondents used. Reliable broadband connection is one of the necessary resources or facilitating conditions that affect students' behavioral intention to adopt m-learning (Mtebe & Raisamo 2014). Mobile broadband is thus a requirement that m-learning institutions should meet.

CONCLUSION

There are few studies that have done research on the use of LCMS on mobile phones. This paper makes a theoretical contribution in mobile learning literature by identifying and discussing factors that lead to use of LCMS on mobile phones and desktop computers through studying perceptions and experiences of MUELE users. Experience and frequency of use; accessible content; system simplicity; productivity; efficiency and effectiveness; and

simplicity to learn and operate were some of the factors identified. These factors can further be investigated for experimental purposes. As shown in results, we further make a practical contribution by identifying ways of transcending LCMS services for mobile phone users given the case of MUELE.

MUELE is perceived as useful, flexible and productively helpful for collaboration and communication. Despite these perceptions, there are many challenges for mobile phones users. These include access and ease of use, infrastructure issues, privacy and security, poor content design and lack of user knowledge about system use. The respondents in this study reported that these challenges affect actual use and perceptions on ease of use and usefulness, but the users' needs and intention to use the system still remain affirmative. Hope (of future improvements) is more important than system flaws. The intention to use mobile devices is strong.

The study was carried out at a time when respondents had not used the learning platform (MUELE) on mobile phones for a long time. We therefore believe that lack of experience is one of the factors that affected their perceptions on use and usefulness. For example, students who do not use the system often do not get to learn all the various functions or the many purposes the system can serve.

The results show that creating solutions to the mentioned problems as suggested by respondents could increase use of MUELE mobile phones compared to desktop computers and further help students in their learning activities in terms of learning material access and bridging the communication gaps. It is not mainly system usefulness and ease of use that drives the learners or users to the learning platform but also the primary reasons leaners seek to address i.e., the ambition to learn and the generally positive attitude towards mobile technologies, no doubt inherited from positive experiences of use for other, often private, purposes.

A limitation of this study is that factors such as gender and age, which previous research has found to be important, could not be investigated due to the small size and skewed age and gender balance of the sample. This in turn depended on the fact that there were very few mobile phone users of MUELE available. The study also focused on mobile phone users only, further research can study all mobile device users.

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APPENDICES

Appendix A: Online Survey Questionnaire

Demographics

1. Age Group: a.18-24 (0) b.25-29 (1) c.30-34(2) d.35++(3)
2. Gender: a. Female(0) a. Male(1)

Actual use

3. How long have you used MUELE?
4. How often do you use MUELE on your Mobile Phone?
   a. All time (0) b. Daily (1) c. 2-3 times a week (2) d. Once a week (3) e. other (4)
5. What MUELE services do you use/what do you use MUELE for? (list)
6. From where do you access MUELE?
   a. At school (0) b. At home (1) c. anywhere (2) d. Never(3)
7. How do you access MUELE on your mobile phone? (Rate your access options on a 1-10 scale)
   i. I use wireless Internet (Wi-Fi via hotspots)
   ii. I use mobile Internet (data packets provided by Telephone service provide)
   iii. Other (please specify with a rank)
8. What times do you access MUELE?
   a. Anytime (0) b. Morning (1) c. Afternoon (2) d. Evening (3) e. Never(4)

Perceived use: Perceived usefulness and ease of use [answered with ***strong agree***--***strongly disagree***]

9. Usefulness

Using MUELE on mobile phone would increase content access
Using MUELE on mobile phone would give me greater control over learning activities
Using MUELE on mobile phone would enable me accomplish learning tasks quickly and effectively
Using MUELE on mobile phone would increase my productivity and contribute positively to my performance
Using MUELE on mobile phone would make my learning easier and simple
I would accomplish more work on MUELE mobile than I would on desktop
I would easily communicate and collaborate more and better with MUELE
Overall, I find using MUELE on mobile phone useful in my learning endeavors

10. Ease of use

I find it hard to use MUELE on mobile phone
Learning to use and operate MUELE on mobile phone is easy
Interacting with MUELE system and MUELE users on mobile phone is frustrating
My interaction with MUELE on mobile phone is clear and understandable
I cannot do everything I want to do in MUELE using my mobile phone
For the task I perform in MUELE using a mobile phone, it is easy to remember how I perform them
I find it easy to use communication and collaboration tools in MUELE
It requires allot of effort to know how to perform tasks on MUELE using a mobile phone
It requires allot of effort to become skillful at using MUELE on mobile phone
Overall, I find use of MUELE on mobile phone easy use

Appendix B: Questions for focus group discussions on *Impact and challenges* (*n*=30/3)

11. State the impact and challenges of MLCMS (MUELE) use (i.e., list the challenges you face and the impact of MUELE use in your learning activities)
12. Suggest usability improvements for MLCMS? (state/list functions)
13. What are the pros and cons of using MUELE on mobile phone compared to desktop environments? And in what situations do you prefer the desktop environment? (state reasons and make any other comments you would like to mention)

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Information and communication technologies to raise quality of teaching and learning in higher education institutions

Chris Prince Udochukwu Njọkụ
University of Nigeria, Enugu State, Nigeria

ABSTRACT

This paper aims to help higher education teachers know, and be able to deploy, certain information and communication technologies (ICTs) towards shifting from teacher-centred pedagogy to learner-centred instruction for increased quality of teaching and learning. Theories and many practices have emerged that have faulted teacher-centred classrooms common in educational institutions, especially in developing countries. The argument is that teacher-centred approach to delivering subject contents does not produce the calibre of school leavers and graduates the twenty-first century society needs. This argument has necessitated a longstanding call for a shift to student-centred teaching and collaborative learning. Many ICTs play a critical role in this direction, but are either unknown for the role or unutilized. The paper highlights many benefits of integrating these technologies into teaching and learning, as proved by projects in elementary and high schools. It then lists ICTs that can be used successfully in higher education, explains what they are, and shows how and evidence of use. They include Web-blogs, wikis, e-mail, social networking Web sites, social bookmarking Web sites, mobile phones, presentation software and digital cameras. The paper concludes with suggestions of what can be done to implement their use as integral to the entire higher education effort.

Keywords: *colleges; education; e-learning; higher education; ICT; information and communication technology; information technology; learning; teaching; universities*

INTRODUCTION

Future professionals and the entire workforce in the private and public sectors of any economy deserve the sort of education that equips them and, consequently, their economy to make steady progress. This sort of education ought to be initiated and sustained with a learning model that enables students to develop the required skills for the future. In its white paper, Intel World Ahead Program (2009) mentions some of these skills, as identified by The International Society for Technology in Education (ISTE) that will help students to work and live in the twenty-first century. The skills include conducting independent research, thinking critically, solving problems, using technology to communicate and collaborate, and understanding societal issues related to digital citizenship.

All over the world, teacher-centred pedagogy is prominent. Teachers talk and students are directed to listen, as Cuban (1993) observes. The assumption is that learners are empty or are just passive observers, an observation Wilson & Peterson (2006) made of schooling in the United States of America. Yet, in explaining the way learners get, organise and apply knowledge and skills; behavioural, constructivist, developmental and social learning theories and practices reveal that teacher-centred approach to delivering subject contents as impotent for producing the calibre of graduates the twenty-first century society and beyond need. Constructivist, developmental; and social learning theories—collectively called cognitive learning theories—have been discussed by numerous authors including Kruse & Wilcox (2013), Kruse (2013), Kruse (2009), Bransford et al. (2005), National Research Council (2000), Anderson & Pearson (1984), LaBerge & Samuels

(1974), Judd (1908), and Bryan & Harter (1897). In summary, these theories point to the following: (1) Learners should be active participants in planning and evaluating what they learn; (2) Learners are most interested in subjects that are immediately relevant to personal life and employment; (3) Learners learn better when they are exposed to solving real life problems than when they are exposed only to theoretical course contents; (4) Knowledge is constructed from experiences; (5) Learners prefer learning new contents based on their existing knowledge and experiences to learning completely strange contents. All these statements place the learner at the centre of the instructional method that must enable twenty-first century students to acquire needed skills, including two advanced skills stipulated by United Nations Educational, Scientific and Cultural Organisation (UNESCO, 2007).

According to UNESCO (2007) two advanced skills required of graduates in this century were the skill of expert thinking and the skill of complex communication. Expert thinking is the ability to solve problems that lack explicit rules-based solutions, unlike algebra. The skill of complex communication is the ability to make effective oral and written arguments, eliciting information from others. These two skills are embedded in information, visual, and technological literacy which are rarely acquired through teacher-centred pedagogy. Higher education institutions (HEIs) have always strived to justify their existence as centres of excellence. To earn this justification, HEIs have a duty to guide students to adequately acquire information, visual, and technological literacy. This requires a shift to student-centred, project-based teaching and collaborative learning in all programmes. ICTs' role in this direction is critical. Before looking at particular ICTs that teachers and students in HEIs can deploy to raise the quality of teaching and learning, it will be helpful to know what are considered as ICTs generally, the scope covered by this paper, and the benefits highlighted by use of ICTs in elementary and high schools where much attention had been given.

What are ICTs?

There are numerous definitions of ICT, but the definition by UNESCO is accepted by this author as adequate. Most definitions fail to capture many ICTs. They create the impression that ICTs are only computers and computer systems, but UNESCO (2002, p. 10) defines ICT as "forms of technology that are used to transmit, process, store, create, display, share or exchange information by electronic means." This definition covers such technologies as radio, television, videotape, audiotape, tape recorder, compact disc (CD), digital versatile disc (DVD), flash drive, telephone (both fixed line and mobile), satellite systems and computer hardware, software and networks. It covers also services associated with these devices, such as video-conferencing, e-mail and blog.

Scope of and rationale for the topic of this paper

As ICTs, radio, television and tapes (audio and video, and their players and recorders) have played and are still playing visible roles in teaching and learning. This paper is, however, dedicated to computer and its associated networks (for example, the Internet), digital hardware and software that can be used in teaching and learning to achieve optimum value. Even then, space restriction has resulted in limiting discussion to only some, among many, appropriate computer-based technologies.

Indeed, much has been written about the role of ICTs in education. Cairncross & Pöysti (2014), Fisseha (2011), Kaffash *et al* (2010) and Oliver (2002) are among the many who contributed on the topic, with emphasis on computer-based technologies. Much has also been written about the use and impact of computer hardware, software and associated services in teaching and learning, but the focus is on elementary and high schools. Such works, which identified many benefits of integrating ICTs into teaching and learning, include those of UNESCO (2011); Intel World Ahead

Program (2009); Texas Center for Educational Research (2009); Aydin & Unal (2008); Escorza & Balanskat (2008); Malaysia Ministry of Education & Intel Malaysia (2008); Rodriguez (2008) and Joyce (2007). Some others are Blamire & Kefala (2006); Trucano (2005); Mitchell Institute (2004); Silvernail & Lane (2004); Ross, et al (2003); Waxman & Michko (2003); UNESCO (2002) and Mann, et al (1999). Not much has been done regarding ICTs use in HEIs that require more advanced application of ICTs. This may be because HEIs are not currently perceived to be leading the way in developing new ways people can learn. Despite that the paper is centred on computer, which is at the centre of today's ICTs, the author chose not to restrict its title to computers in order to introduce to readers other ICTs (not usually known as ICTs) that contribute tremendously to effective education. Radio, television and tapes, for example, have often not been seen as ICTs, but they can be the focus of further research and writing with regard to the use of ICTs in teaching and learning, particularly in communities that have limited access to computers and their derivatives.

Benefits of using ICTs in teaching and learning

Students' enrolment into HEIs in countries of the world is on steady increase. It is common to see an academic lecturing 500 or more students in a class. This eats into the quality of teaching and learning, if tools are not employed to aid the delivery as well as understanding and assimilation of subject contents. ICTs support project-based learning, which removes the difficulties associated with managing a large class. Learning outcomes are improved as learning becomes more interactive. In project-based learning, students try to answer—in groups—questions that have relevance for them. For example, in the social science, the question could be "What can a graduate do to beat unemployment after graduation, apart from applying for white-collar job?" and in the natural science, it could be "What are the causes of poor sanitation on our campus, and how do we tackle them?" Students can search the Internet at their own times for relevant ideas, share and discuss findings through e-mail lists or online forum or Facebook, prepare Microsoft PowerPoint presentations, and come to class to deliver their presentations for general discussion. Using ICTs in teaching and learning have many other benefits for students, teachers and society, respectively.

As revealed by UNESCO (2011), Intel World Ahead Program (2009) and others cited in penultimate paragraph, teaching and learning supported by ICTs empower pupils to, among others,

- become more motivated to learn and so be more involved in the subjects they are studying;
- develop technology-skills, team skills and other twenty-first century skills and produce higher quality work (More than 80 percent of teachers surveyed by US State of Maine discovered this gain, as reported by Sivernail & Lane, 2004);
- improve their research and problem-solving skills;
- acquire deep knowledge about a subject;
- develop creativity and higher-order thinking;
- test how what they are learning can be used in real life.

Economically disadvantaged students and children with disabilities benefit as much as others. In Bolivia, a project that equipped 235 schools with computer laboratories, and trained teachers to develop interactive educational materials, including videos and CD-ROMs—for math and languages—brought about students achieving 10% improvement in performance at the end of the school year (International Institute for Communication and Development, 2010).

For teachers, some of the benefits of integrating ICTs into education are:

- Quick creation and circulation of locally relevant teaching graphics;
- Increased effectiveness and efficiency of lesson planning and delivery.
- Interaction with students anytime and anywhere they are outside the semester, and consequently they gain more time to execute management tasks;
- Better teaching.
- Attending to all other crucial duties and still not missing any teaching session. It is provable that missing class owing to other inevitable engagements and rescheduling them, or not having time at all again for them, badly affects learning. With certain kinds of ICT, when a HEI teacher is in an administrative meeting or in a conference or workshop or any other academic meeting at the particular time he/she is to be in classroom, he/she can still engage students. With the various features ICTs provide, the teacher will even deliver the teaching more profitably than he/she will when present in an ICT-disabled class.

Most importantly, with ICT, teachers have a more positive attitude toward their work and are able to provide more personalized learning. They are as well more effective in administrative tasks. Also, as elementary school teachers experienced in Asia-Pacific countries, which was reported by UNESCO (2007), collaboration through some forms of ICT can be an effective way in which HEI teachers can communicate with counterparts at the national level and strengthen co-operation.

For the society, integrating ICTs into teaching and learning brings the following benefits:

- Communities benefit from bridging the digital divide;
- Economic progress occurs from the better-educated workforce and from direct job creation in the ICT industry;
- Education is tailored to the needs and abilities of learners, and so drop-out rate reduces;
- Lifelong learning is permitted and promoted, resulting in education being more available to everyone, at all ages;
- "ICT helps provide solutions to many of the numerous barriers to the successful delivery of education in developing countries, including insufficient education budgets, inadequately funded teacher training, and a shortage of qualified teachers and appropriate learning materials" (International Institute for Communication and Development, 2010, p. 2).

ICTs THAT ARE POTENT FOR EFFECTIVE TEACHING AND LEARNING IN HEIs

1. Instant messaging (IM);
2. Presentation software;
3. Online community or Internet forum;
4. Online chat room
5. Learning Management System (LMS);
6. Learning Content Management System (LCMS);
7. Social networking Web site;
8. Social bookmarking Web site;
9. Web-blog, popularly called blog;
10. Twitter;
11. Wiki;

12. Mobile phone;
13. Digital camera;

Instant messaging (IM)

IM (commonly called *chatting*) "is a form of real-time, direct, text-based communication between two or more people using personal computers or other devices, such as mobile phones" (Ipsos MORI, 2008, p. 40). The user's text is conveyed over a network, such as the Internet. Yahoo Messenger® is one of the most used of IM applications. There are also America Online (AOL) and Windows Live™ Messenger. Several other free e-mail providers, like Google®, integrated IM facility into their e-mail services (for example, Google Hangout, formerly called Google Talk, which works with Google Mail—Gmail). One can log into one's e-mail account and chat with contacts right from there. Skype is another IM application. It transmits text, voice and video, making it possible for one to speak to and see others and be heard and seen in real time.

IM is being used increasingly by students of HEIs for casual and love conversations and sharing pictures and videos. It has become such an integral part of students' lives that many universities are working to move it beyond the social sphere into teaching and learning (African Leadership in ICT Program, 2011).

Through IM, teachers can meet with their students for interactive sessions. Teacher-students and students-students seminars and conferences can be held using IM. One outstanding benefit is that students who travel out of campus for reasonable cause and will miss such seminars when held in physical classroom are given opportunity to participate. Again, a student while on holiday or ordinarily away from campus can chat online with a lecturer to gain more insight into a topic or what was not well understood in the classroom lecture. Undergraduate and graduate students of online universities are on-hand witnesses to the use of IM by students in interacting with tutors and academic advisors.

Presentation software

Presentation is a method of using a computer to prepare and deliver information or knowledge in an outline form, on electronic boards or slates called slides, in a fashion intended to attract and sustain the attention of the user or audience and to make for easy comprehension and assimilation. Computer programs used for presentation are called presentation software. The most popular of these, in the commercial or proprietary category, is Microsoft Office PowerPoint. A very good free and open source variety, which is fast winning universal appeal, is OpenOffice.org Impress. They are usually used for creating presentations for meetings, conferences and the Internet. Their use for classroom work is recently becoming an obsession in countries that have discovered their positive impact on learning. For example, Microsoft Office PowerPoint presentation of lectures is seen as a normal methodology in Russell Group universities in the UK (UNESCO, 2007). Figure 1 is the first slide of a sample presentation for teaching a topic in English Grammar. Figure 2 is one of the slides of another teaching presentation.

With well created presentations, teachers in HEIs will draw and sustain the attention of very large classes throughout lecture periods. Basic equipment needed for a presentation are: (1) a desktop or laptop personal computer (PC) for creating and hosting the presentation and (2) a multimedia projector and a projection screen (or a plain white wall) for projecting the presentation. It is also helpful to have compact disks read-only-memory (CD-ROMs), flash disks or memory cards for copying and distributing the presentation (See Figure 2). The presentation can be

created to self-run, partially or completely. With the partial self-running option, the teacher prepares slides as visual aids. When the presentation is ready, it can be copied into CD-ROMs or flash disks or memory cards. It is important to ensure that the PC has at least one CD-rewritable drive or universal serial bus (USB) port or memory card slot to support copying. A PC that has all of these is better. Students can then be organized into groups in the classroom. Each group will sit before a PC with one of the CD-ROMs or flash disks or memory cards to watch the slideshow while the teacher physically narrates from his/her own corner. Microphones and loud speakers will be needed if the class is very large. As reported by International Institute for Communication and Development (2010, p. 3), a Zambian teacher says (of Microsoft PowerPoint): "Using ICT applications such as PowerPoint helps us enhance our visual presentations. With computers and the internet, my students learn more easily about their subjects."

***Figure 1**: Topic and Author slide of a presentation for teaching a topic in English Grammar*

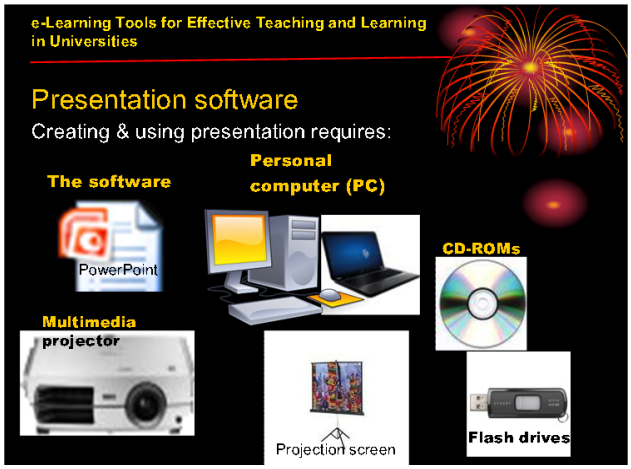

***Figure 2**: A slide illustrating the apparatus required for creating, showing and distributing a presentation. It may be one of two or more slides for explaining the sub-topic 'Presentation Software'.*

With completely self-running presentation, the teacher speaks into the computer to record the lecture he/she intends to clarify with the slides. The coming into view—of the slides, when the presentation is being shown (known as *playing slideshow*)—is carefully timed to harmonize with the speaking (called *narration*). With this option, students can alone engage in fully beneficial work in the classroom in the exact lecture period as if the lecturer is there with them, while the lecturer is in a meeting or in a conference in another country. Students can ask their questions right there (if their PC is online) or later through e-mail or mobile phone call/SMS (Short Message Service, popularly called Text). Both partial and completely self-running slideshows allow collaboration inside the classroom, and students can copy the presentation for private study and revision. The presentation can also be uploaded to the institution's Learning Management System (LMS), the class' online community and the teacher's Web site for the students to access. Online community and LMS are discussed below.

More interestingly, Microsoft Corporation has introduced Multiple Mouse Mischief (3Ms). This is auxiliary software (called a *plug-in)* that can be installed into PowerPoint. 3Ms helps teachers to easily make their presentations participatory. Using 3Ms, many mice are connected to a PC. Students individually or in small groups use a mouse to select answers to multiple-choice questions, to draw and paint illustrations, to write and to circle things on the screen.

Online community or Internet forum

Online community or Internet forum services allow people to form online groups and collectively create and maintain their own Web sites, usually hosted free-of-charge on the service providers' Internet domains. The famous online encyclopaedia, *Wikipedia*, describes it as "a virtual community that exists online and whose members enable its existence through taking part in membership ritual" (http://en.wikipedia.org/wiki/Online_community. Paragraph 1). Applications that are used to create online communities are legion. They include Google Groups, Google Sites and Yahoo Groups. Many ready-made Web site designs (called *templates*) are provided by these applications to suit various group purposes, including education. Users only need to select the template that relates to their group's nature and replace the contents with theirs, following simple steps provided.

Google Sites (Figure 3) will be of particular interest to HEI teachers and students. It has a classroom template. People whose institution's e-mail portal is on Google Mail (Gmail) platform, like the University of Nigeria, or whose private e-mail is [at]gmail.com, are already advantaged, because one must create a Gmail account to use Google Sites. Log into Gmail; click on Google Sites tab; click on Create Site; choose the 'Classroom site' template; change the name of the site to that of your class or group. Gradually change all other information on the discussion board, announcements board and other features.

Start uploading, as attachments, your word-processed lecture notes and other relevant articles/books you downloaded from Web sites. Also list Web sites that can be visited. Then invite all the students in the class or group and give them co-owner right, so that they can participate in discussions, take assignment/term paper topics and upload their completed work and other relevant documents. Co-owner right also enables students to ask questions, answer questions, read and post announcements and do other tasks. With this, teachers and students can have rich classroom experience online. A classroom extended to Google Sites is just for the class that owns it, since no outsider enters it or even sees what is in it except by invitation.

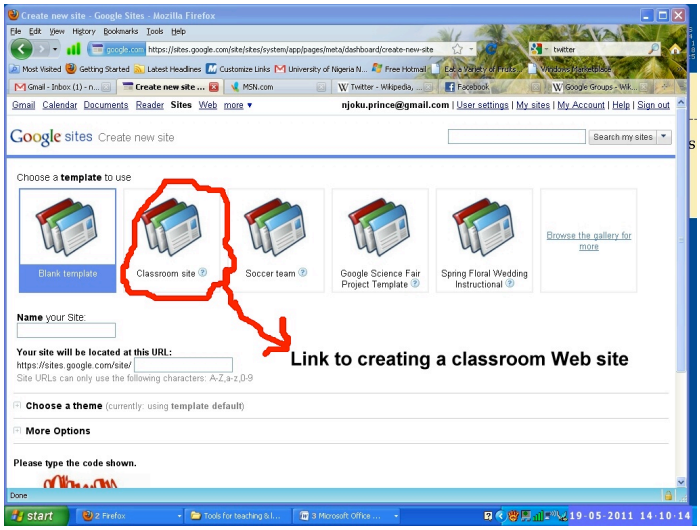

***Figure 3**: Google Sites home page as seen on Mozilla Firefox browser. Of special interest should be the 'Classroom site" button (circled and labelled by this author).*

Internet forum, according to www.unescobkk.org/index.php?id=5323, can be used by educators and students to form networks with other students and teachers in the same university and in others and with subject experts. The tool can also be used for online professional development and to enable students to improve their reading and writing skills.

Online chat room

An online chat room is a type of online or virtual community. It allows people to communicate to one another at the same time. Because the room is on the Internet, the people must connect to the Internet before they can enter it. Questions can be asked and answered immediately, no matter the locations of the questioners and the respondents. Discussants in a chat room must have chosen usernames and passwords with which they logged in. This means that an online chat room can be created and restricted to selected people, and this character makes it a very useful tool with which HEI teachers and students can draw maximum gain. Communication in a chat room is usually by typing and sending text, but—as Phelps (2010) and Roos (2010) also observed—it is as if people are discussing in real life. Figure 4 below illuminates this.

[13/10/11 15:02:01] **JOHN MATOGO** : *did you guys get my email.*
[13/10/11 15:02:52] **JOHN MATOGO** : *I only have 5 mins so that I do not interfere with Shirley's session.*
[13/10/11 15:03:18] **JOHN MATOGO** : *so what FOSS licensing models are you familiar with?*
[13/10/11 15:03:23] **Gaius C. Ebere** : *I got ur mail John*
[13/10/11 15:06:29] **Omar Cissé** : *Thank you John*
[13/10/11 15:07:30] **JOHN MATOGO** : *I put some links in module 1 so please spend sometime in checking those out..*
[13/10/11 15:08:15] **Gaius C. Ebere** : *@John, Ok, but I think that will be later*
[13/10/11 15:09:37] **William Shu** : *Hi everybody*
[13/10/11 15:09:40] **JOHN MATOGO** : *ok. guys in respect of Shirley Module 1 session is over.*
[13/10/11 15:09:44] **Olaniyi Moluga** : *John are u talking of the link in your mail or the document folder*
[13/10/11 15:10:02] **Gaius C. Ebere** : *Welcome Shu*
[13/10/11 15:10:08] **JOHN MATOGO** : *we will continue after the session later.*
[13/10/11 15:10:14] **William Shu** : *i had hiccups. hopee I can submit my answer to John's email*
[13/10/11 15:10:29] **JOHN MATOGO** : *Shirley please take over.*
[13/10/11 15:10:39] **Frederick Yeboah** : *@John you can continue till we get Shirley back. Thank you*
[13/10/11 15:10:43] **CHRIS PRINCE UDOCHUKWU NJOKU** : *John, Bukola, Gaius, Fred, Ola, omar, you're here already. I'm sorry I'm late*
[13/10/11 15:10:58] **CHRIS PRINCE UDOCHUKWU NJOKU** : *Welcome William*
[13/10/11 15:11:02] **JOHN MATOGO** : *@ Njoku welcome*
[13/10/11 15:11:14] **Frederick Yeboah** : *no problem Chris*
[13/10/11 15:11:17] **Gaius C. Ebere** : *Welcome Chris*
[13/10/11 15:12:01] **CHRIS PRINCE UDOCHUKWU NJOKU** : *About FOSS licencing models?*
[13/10/11 15:12:46] **CHRIS PRINCE UDOCHUKWU NJOKU** : *I think we talked about GPL*
[13/10/11 15:15:37] **JOHN MATOGO** : *what is hindering uptake of FOSS in your opinion?*
[13/10/11 15:15:49] **William Shu** : *Since GPL is already discussed, I guess we are looking at FOSS usage now!?*
[13/10/11 15:16:17] **JOHN MATOGO** : *yes..*
[13/10/11 15:16:23] **CHRIS PRINCE UDOCHUKWU NJOKU** : *Mentality.*
[13/10/11 15:16:37] **Gaius C. Ebere** : *@John, skepticism. the mentality that "if it is free, then it is not original"*
[13/10/11 15:17:10] **William Shu** : *Yeah, I think Chris has hit on the critical point: mentality.*
[13/10/11 15:17:24] **CHRIS PRINCE UDOCHUKWU NJOKU** : *Many people think that the free means no cost. So they seem to take it to be inferior*
[13/10/11 15:18:38] **Frederick Yeboah** : *The biggest issues is the provision of technical support for companies using FOSS.*
[13/10/11 15:18:54] **Frederick Yeboah** : *Welcome shirley*
[13/10/11 15:19:18] **Gaius C. Ebere** : *Shirley, you can shoot now*
[13/10/11 15:19:29] **CHRIS PRINCE UDOCHUKWU NJOKU** : *Absence of tech support, yes.*
[13/10/11 15:19:30] **Shirley Baffoe** : *@john kindly notify me when your discussion ends so. I can take over*
[13/10/11 15:20:08] **JOHN MATOGO** : *shirley please take over...thanks for the opportunity*
[13/10/11 15:20:22] **Shirley Baffoe** : *Ok*
[13/10/11 15:21:17] **Shirley Baffoe** : *I hope you've all been able to download the assignment*

Figure 4*: A section of copy of a class discussion, in an online chat room, on some topics of an advanced course in Free & Open Source Software organized by FOSSFA and GIZ's ict@innovation in 2011 (http://www.ict-innovation.fossfa.net). John Matogo and Shirley Baffoe were moderators or facilitators (teachers). Observe the time in front of a name. That's the time the person's text entered the room's message window; it was automatically attached.*

Most chat rooms have three parts (Figure 5):
(1) an input box or field (where a user types in text),
(2) a message window (on which contributions appear when sent),
(3) a participants list (showing names, and sometimes photographs, of persons in the room).

Internet Relay Chat (IRC), MSN, Yahoo, Google Mail, Facebook, and some other Web sites provide chat room. HEI teachers and students can use these universally free chat rooms to give and take quality education.

Figure 5*: A snapshot of Yahoo Chat room (Phelps, 2010, p. 1). Label A is the input box (You can see "Chat" at the beginning of the field); B is the message window; C is the users' list; D is "Send" button.*

Learning Management System (LMS)

LMS (or CMS – Course Management System) is an online education delivery system that improves upon the traditional classroom environment, offering teachers and learners an effective e-learning environment. Most software used in this system has intuitive user interface and robust features that make it easy-to-use and profitable. They can have classrooms, a main office, school announcements board, grade books for recording and computing marks, quizzes and tests facility, whiteboards, a teachers' lounge, messaging systems like chat room and forum, easy-to-use tools for creating lesson plans and courses, and much more. LMS can be hosted on an intranet and used to enhance the physical class experience of students. On the other hand, it can be hosted on the Internet for 100% distance learning. It can also be used to create a blended environment that combines both distance and physical class learning, or to offer customized courses to either exceptional or below-average students. Moodle® software is an example of LMS. LMS has been recognized by Free Technology Academy (2011, p. 10) as "an essential part of the IT infrastructures for online learning in organizations nowadays."

Moodle® is a LMS an institution or a teacher can use without paying for a licence. It supports learning in a classroom by accepting upload of lecture notes, video files, audio files and other course materials into it. It supports discussion through its facilities for chatting and forums. Students can also ask questions, not only to the lecturer, but also to others, and can take quizzes and examinations online. For each course in Moodle®, students can submit their assignments to their lecturers and share them with others. 'You can view your grades and any feedback from your teacher by clicking on "Grades" from the "Administration" block on your main course page.'(North Carolina State University, 2011, p. 6). Moodle® supports seventy-two languages. Teachers and students can conveniently use Moodle® to add much gain to their teaching and learning. In University of Nigeria (in West Africa), this author's workplace, a Moodle® e-learning platform exists. Ipsos MORI (2008) reported that in many UK universities, some forms of ICT, including LMS, seemed to be a central part of the university experience, impossible to avoid, and on the whole, students welcomed it.

Learning Content Management System (LCMS)

A LCMS is nearly the same as LMS (Table 1). On their difference, McIntosh (2006, p. 4) wrote: "The focus of the LCMS is the management of course content rather than learner activity." LCMS can create, store and deliver personalized content in the form of learning objects (LOs). Free Technology Academy (2011) described a LO as a self-contained unit of instructional material having three components, *viz*: a performance goal, the learning content and evaluation. A LCMS stores LOs in a central learning object repository (LOR). LOR enables instructional designers to search, to retrieve and to assemble contents into personalized courses. With LCMS, a HEI teacher can:

- gather contents from different sources and easily and quickly create new learning content;
- manage and edit e-Learning content;
- produce dynamic page appearance;
- schedule courses and define learning path;
- administer students effectively;
- make communication possible through e-mail, chatting and forum.

Moodle® is also a good LCMS.

Other LMSs and LCMSs, which can be found on http://www.edutools.com and http://www.trimeritus.com/LMSvendors/CELMS, include the following with free licences:

1. OLAT (developed in University of Zurich, Switzerland) – LCMS
2. LON-CAPA (developed in Michigan State University) – LCMS
3. KEWL (from University of Western Cape) – LCMS
4. COSE (by Cambridge Software Publishing) – LMS
5. Claroline (by Claroline Development Community) – LMS
6. ATutor (developed in University of Toronto, ATRC) – LCMS
7. LRN (called dotLRN, from LRN Consortium;) – LMS
8. Sakai – LMS (a strong player in the industry)
9. Docebo – LCMS
10. Dokeos – LCMS (from Belgium, in 34 languages)
11. Bazaar (incorporates Web Conferencing, Internet Relay Chat, etc.)
12. CourseWork (a LMS first developed and used by Stanford University in 2003 and later made available to others)
13. Pearson OpenClass (a LMS from Pearson Education);

and the following whose licences must be purchased:

14. WebCT (Blackboard Learning System) developed by Murray Goldberg in University of British Columbia, but now owned by Blackboard Incorporated.
15. ANGEL (developed in Indiana University-Purdue University Indianapolis)
16. Global Teach® (developed by ELearning India, Uttar Pradesh)
17. Virtual U (developed in Simon Fraser University)

18. ElearningForce JoomlaLMS (by Elearningforce, Inc.) is a LMS and LCMS adapted from Joomla, an open source Web site content management system.
19. eZ LMS (from University of North Dakota Aerospace Network)

Figure 6, which was made from information in *EduTools* (http://www.edutech.ch/lms/inst-platforms.php), shows the most commonly used LMSs and LCMSs in Switzerland by spring of 2005. WebCT took the first position. OLAT came second, because it was developed in the country and many Swiss universities have adopted it as an indigenous LMS. Moodle® came fourth, and Lotus Learning Space was at the bottom behind Claroline. Some LMSs that had fewer users than Lotus Learning Space had were not shown in the chart.

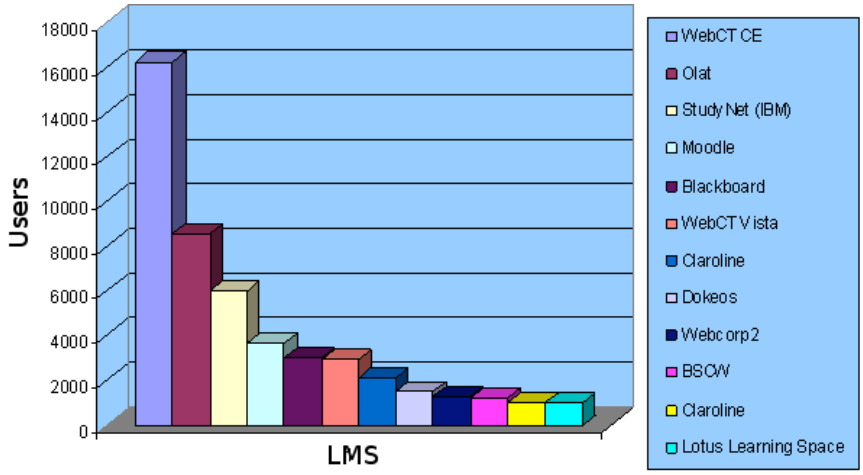

Figure 6: *A bar chart of use of LMSs in higher education institutions in Switzerland*

LMS and LCMS Authoring Tools

LMS and LCMS authoring tools are computer programmes used for creating contents for LMS and LCMS. They are of various types. Some are made specifically for the development of e-learning. Examples of e-learning-specific authoring tools are:

1. e-Learning XHTML Editor (eXe) which is a Web-based authoring tool formulated to help teachers in any educational institution to design, develop and publish web-based teaching and learning materials. A teacher does not have to be proficient in HTML (HyperText Markup Language) or XML (eXtensive Markup Language) in order to use eXe. This tool can export content as self-contained Web pages or as content packages that complies with specifications of SCORM (Sharable Content Object Reference Model) 1.2 or IMS (Instructional Management Systems).
2. OpenFuXML developed in the University of Hagen, Germany. It is a highly flexible XML-based tool that produces contents in several formats for various devices and extensively supports creation of mathematical and other scientific contents.
3. CourseLab
4. Hot Potatoes
5. Renpy
6. Wink

There are generic authoring tools. These are also used to build web contents. Generic authoring tools include:

1. HTML editors
2. Dreamweaver (CourseBuilder)
3. Authorware
4. Macromedia Flash.

Some LMSs have an authoring tool inside them, while for others you have to use an external authoring tool. Authoring tools that are designed particularly for e-learning traditionally come with facilities to build course structures, to facilitate questioning and testing and to export courses into LMS or LCMS in formats that conform to Aviation Industry Computer-based-training Committee (AICC) and SCORM standards. Tools to produce audio, video clips, graphics and animations in LMS or LCMS include Dynebolic, Audacity, Songbird, InfraRecorder, Gimp, Inkscape, Blender and Dia. Among browsers for showing content are Mozilla Firefox and Microsoft Internet Explorer.

Comparison of LMS and LCMS

Table 1*: What make LMS and LCMS similar and different, as adapted from Greenberg (2010) and http://www.e-learningsite.com/.*

Features		LMS	LCMS
1.	Facilities for enrolling in a course and for activity and learners administration online	Present	Present
2.	Online Payment facility	Present	Absent
3.	Imports learners	Yes	Yes
4.	Instructor-led registration of learners	Yes	Yes
5.	Schedules courses	Yes	Yes
6.	Defines curricula	Yes	No
7.	Defines learning path	Yes	Yes
8.	Plans reading materials	Yes	Yes
9.	Supports online courses	Yes	Yes
10.	Supports information on offline events	Yes	Yes
11.	Supports upload of digital resources	Yes	Yes
12.	e-mail facility	Present	Present
13.	Chat room	Present	Present
14.	Discussion Forums	Present	Present
15.	Supports Webinars (i.e. online seminars)	Yes	Yes
16.	Supports learners collaboration	Yes	Yes
17.	Allows assessments	Yes	Yes
18.	Analyzes results	Yes	Yes
19.	Creates and administers tests	Yes	Yes
20.	Tracks results	Yes	Yes
21.	Supports content creation	No	Yes
22.	Develops content navigation controls and user interface	No	Yes
22.	Creates templates	No	Yes
23.	Organizes reusable content	Yes	Yes

Criteria for selecting a LMS/LCMS

It is wise to evaluate several LMSs/LCMSs before deciding which one to deploy. In the evaluation process, it is necessary to have a criteria list that meets the need of the specific e-learning project. Questions that can be asked and honestly answered during evaluation of a LMS/LCMS include the following:

- Which server platforms are supported?
- Which e-learning standards does the LMS support?
- Which collaboration methods are supported?
- Are there functions incorporated for calendar and event notification?
- Does the system have publishing and document sharing functions?
- Can somebody who is not a programmer run the system?
- Does the system allow learner assessments?
- Are the reports meaningful for performance tracking?
- What are the costs of updating and maintaining the system?
- Can the system be scaled up and to what extent?

Social networking Web sites

Social networking Web sites, otherwise known as social media or Web 2.0, have been found to be useful to learning and teaching. As reported by UNESCO (2008a), Professor Ron Cooke, Chairman of UK Joint Information Systems Committee, said that the use of social networking sites which were driven by students could have real value over study periods when students were away from the campus as well as being able to discuss issues with other students of different universities on similar courses. In UK, Social networking sites are used regularly and, according to a survey (Joint Information Systems Committee 2008) 73%–84% of students informally discuss coursework using these sites. 75% of the students strongly agreed that such sites were useful in enhancing their learning. Minocha (2009) listed several benefits of social networking sites to UK university students and teachers.

A social networking site is a site or platform on the Internet that focuses on the building of social networks among people who share interests and/or activities. In the words of *Wikipedia* (http://en.wikipedia.org), "A social network service essentially consists of a representation of each user (often a profile), his/her social links, and a variety of additional services." Most social network services are web-based and provide means for users to interact over the Internet, such means as e-mail and IM. Although many social networking sites exist, the most popular of them is Facebook. According to a recent Australian study, Facebook was the fourth most visited Web site (Ng, 2010). On average, users spend 26.5 hours each week online, and a quarter of that time—6.5 hours—is dedicated to Facebook. Another study conducted by Grunwald Associates LLC and the United States (US) National School Boards Association (reported by UNESCO, 2008b) found pupils saying that one of their most common topics of conversation on the social networking scene was education. Almost 60% of the 1,277 primary and secondary school pupils who responded to the survey discussed education topics online, and over 50% of the them talked specifically about schoolwork. Indeed, both US district leaders and parents believed that social networking could play a positive role in students' lives. They recognized opportunities for using it

in education at a time when teachers, as a routine, assigned homework that required use of the Internet to complete.

Facebook can be used to ask questions and receive answers. Hard questions you have not been able to get answers to or topics you want more ideas/information on can be raised. According to http://www.facebook.com, in its note on "How Questions Work", Facebook's "Questions" feature "is designed so that anyone on Facebook can help you find the answer [to a question]." For example, when you ask a question and your friends answer or follow, their friends can see and answer it, too, and so on.

Friends of teachers and students in one HEI include teachers and students in other HEIs. Questioning through Facebook, therefore, results in advanced cross-fertilization and cross-breeding of reliable answers and can create an unfathomable pool of very useful knowledge. You can, however, narrow the respondents to be your class members only, where the question is specifically for them. Entire class or seminar group members can be given assignments in this way, and how far away they are from the giver is not a hindrance. You use "Privacy Settings" on "Account" menu to do this. More conveniently, a teacher or a students' group leader or any student can create a course discussion group within Facebook.

In UK universities, students talk about creating their own group on Facebook and inviting their lecturers to join. A female psychology student remarked thus:

> We have actually done group work through Facebook. We had a presentation to give and we were put in groups of six and we all had Facebook. Most of us lived off campus and it was easy to liaise and share notes through Facebook (Ipsos MORI, 2008, p. 22).

Of course, for any of the above uses of Facebook; teachers, all students and group members in the courses concerned must create accounts on Facebook and invite and accept one another as friends. They also need to have e-mail addresses. Facebook has IM (chatting) facility. The facility here can be used just as explained earlier under instant messaging (IM).

Social bookmarking Web sites

Social bookmarking is a method for Internet users to organize, store, manage and search for bookmarks of resources online. The bookmarks are merely referencing the resources; users do not share the resources themselves. Social bookmarking can be likened to compiling and using bibliographies, which many HEI teachers and students are conversant with. Descriptions may be added to the bookmarks, just like annotations added to a bibliography. These descriptions help users to understand the content of the resource without first needing to download it for themselves. Such descriptions may be free text comments, votes in favor of or against its quality, or tags (keywords) that collectively or collaboratively become *social tagging*, "the process by which many users add related terms (called metadata) in the form of keywords to shared content" (Golder & Huberman, 2006, p. 200).

In a social bookmarking system, users save links to web pages that they want to remember and/or share. These bookmarks are usually public, and can be saved privately or shared only with a group or groups. People allowed to view the bookmarks can usually view them chronologically, by tags, or via a search engine. Rethlefsen (2007) hinted that social bookmarking could be useful as a way to access a consolidated set of bookmarks from various computers, organize large numbers of bookmarks and share bookmarks with contacts. One good and popular social bookmarking site is the one known as "Delicious" (http://www.delicious.com).

Teachers and students can use Delicious to compile, store, share, search for and use lists of books, journals, papers/lectures, videos, speeches, pictures and other media on course-specific topics. HEI teachers can liaise with their institution's libraries so that the libraries can use social bookmarking to provide lists of Web sites relevant to courses. Through these collaborations, the difficulty in a teacher or a student getting sufficient number of materials for writing a lecture or paper will be removed. Also, there will be little difficulty in finding materials to read/use about a topic.

Web-blog

A Web-blog, usually shortened to blog, is "a frequently updated, personal website featuring diary-type commentary and links to articles or other websites" (Kaplan & Haenlein, 2011, p. 1). It is a term used to describe Web sites that maintain an ongoing chronicle of information. Given the personal perspectives presented on blogs, they often generate ongoing discourse and a strong sense of community. Blogs provide diverse, alternative sources of information for HEI subjects. African Leadership in ICT Program (2011, p. 65) observed: "They are a tool that can be used by academics and students for a wide range of educational purposes."

A teacher or a student can create a blog and use it to share and generate immense information and knowledge on various topics. Teachers should try to create blogs and periodically post brief articles on them in a style that motivates students to freely express, in the "Comments" section, their own opinions and findings without fear of being repudiated. Students should be encouraged to search for and read blogs relevant to their courses and comment on them. Comments by other readers, many of whom are experts in the disciplines, will certainly provide more insights and help students to assess their own comments. Creating and using a blog are known as blogging.

Twitter

In *Wikipedia* (http://en.wikipedia.org/), one finds twitter to mean a Web site which offers both social networking and micro-blogging services. A micro-blog is a form of blog that allows typically smaller contents (than a bog) such as short sentences, individual images or video links (Kaplan & Haenlein, 2011). Twitter has been used for a variety of purposes in many different industries and scenarios, with one example reported in the news titled "Could Tunisia Be the Next Twitter Revolution?" (http://andrewsullivan.theatlantic.com/the_daily_dish/2011/01/could-tunisia-be-the-next-twitter-revolution.html).

Twitter had been used to organize public protests, including the 2011 Egyptian protests, 2010–2011 Tunisian protests, 2009–2010 Iranian election protests, and 2009 Moldova civil unrest. It has also been used in emergencies and political campaigning. It can be successfully used to pressurize governments to take necessary actions towards holistic integration of ICT into higher education for effective teaching and learning. Twitter can be used in higher education, for collaboration and for sending urgent academic messages from teachers to students and from students to students. Below is a testimonial by a teacher who had used twitter.

> In my experience, and in the short time that I have used it, Twitter has grown quickly to play a major part in the way that I interact with fellow colleagues and professionals from around the world. In my classroom and with the children I teach it has been an exciting tool to utilise and support learning…In my opinion there is great potential in the use of Twitter to support teaching and learning. It is

> unique in this role because it is all about conversation on a larger scale (Barrett, 2008, p. 1).

Short text messages displayed on a twitter user's profile page are called tweets. If one uses twitter without changing its settings, tweets will be seen by everybody who visits, but senders of tweets can change settings to keep them visible only to other twitter users that subscribe to their tweets; these subscribers are called followers (Stone, 2009). When a teacher sends tweets and students follow along with other followers, there is a pool of ideas that enhance learning. When a student sends tweets, the impact is similar. Additionally, the use of this technology is a skill in itself, which many students will find very useful after graduation. Twitter is used free-of-charge through the Twitter Web site (http://www.twitter.com/) on online PCs or on mobile phones that connect to the Internet. Using it on mobile phone attracts fee charged by the telecommunication service provider.

Wiki

Wiki is a Web site that allows its users to create and collaboratively edit web pages using a web browser. The major web browsers are Microsoft Internet Explorer®, Mozilla Firefox®, Apple Safari®, Google Chrome® and Opera®. The pages are interlinked; that is, one can move from one page to another and to another. Black *et al* (2007, p. 245) described wiki as "essentially a database for creating, browsing, and searching through information."

A wiki invites all users to edit any page or to create new pages within the wiki Web site. It strongly welcomes scholarly citations, which makes it an authoritative source of knowledge. A wiki can be said to be a flexible (always updated) online encyclopaedia. They are created using wiki software. "Wikis are already extensively used in many higher education programmes for educational purposes, and are one of the authoring tools being used to generate 'open' content" (Global e-Schools and Communities Initiative, 2011, p. 66). A very popular wiki is *Wikipedia* (http://en.wikipedia.org/). Academics can collaboratively create wikis around the courses they teach.

Mobile phone

A research conducted in 2010, as reported by UNESCO (2010a) in Bangkok, discovered that 62% of first-year students of Lingnan University in Hong Kong had mobile phones that could access the internet, and about 70% of them took photos with their phones at least once a week. "Students carry mobile phones everywhere they go and use them all the time," observed Kennedy (2010, p.2) who was working with language instructors in the university to develop a blended learning environment that incorporates the use of iPhones and iPad. Njoku (2013) similarly found that 100% of 2,019 undergraduate and postgraduate students surveyed in the University of Nigeria owned mobile phones that could connect to the Internet, and 64% of the phones could download and upload e-mail attachments. These findings in Lingnan University and the University of Nigeria are likely to represent the situation in many HEIs globally.

Prof. Kennedy submitted that mobile phone could make learning more individualized. He added that in their new courses, students would be asked to use the technology in mobile phones as an integral part of their language learning – taking photos, creating voice notes, recording interviews and presentations, and reflecting on the activities and what they have learned. The students would then present what they had done. "Such activities," he said, "will enable each student to contextualise their learning experiences, providing a unique highly personalised experience. Using these strategies, you get much better student engagement compared to what can happen

in a conventional classroom." Also, Tom Joseph, Director of 'Asia Pacific Education Programmes', Autodesk, rightly pointed out that besides enhancing learning, mobile phones had become the best channel to reach students (Ng, 2010). "In parts of Africa where traditional classroom education is inaccessible," wrote UNESCO (2010b, p. 1), "people have taken education into their own hands by utilizing mobile phones and laptops. This innovative way of acquiring information, known as eLearning, provides great potential to expand education."

HEI teachers should agree to Prof. Kennedy's suggestion that they should leverage the technologies and applications in mobile phones and take advantage of the skills students already have by building activities and resources around the phones which the students carry for twenty-four hours of the day and for seven days of the week. A peculiar feature of some HEI programs is that their students are in diverse departments scattered on campus. This demands timely communication towards getting all students to participate in all program activities, even in extreme emergency. Mobile phones meet this demand.

Digital camera

Digital cameras are cameras that shoot, store and export still or motion pictures to PC or the Internet in electronic form. They can be standalone or come as a feature of a mobile device, such as mobile phones and iPads. Many standalone cameras are pocket-sized, which makes them easy to carry and use anytime and anywhere. They can be used to take still photographs and videos that aid understanding and enhance learning. Students can be assigned to take such photographs and videos as relate to their course topics and write notes about them. This places students as collaborators with their teachers and, as Prof. Kennedy said, enables each student to contextualise their learning experiences.

LESSONS AND RECOMMENDATIONS

1. There is a difference between LMS and LCMS, though they appear to be the same. One, therefore, has to give thought to whether it is LMS or LCMS that will actually meet one's needs.
2. The Swiss experience shows that LMS and LCMS are being recognized as needed tools in higher education, and an institution adopted either LMS or LCMS and a particular brand of it according to the institution's peculiar requirements.
3. Students and teachers in many universities in the UK have proved that Facebook, online communities, instant messaging, LMS/LCMS and any other ICTs can be made to be indispensable in academic work at higher education level, going by the report from Joint Information Systems Committee (2008).
4. When students set up their own mechanisms for collaborative learning, they are more engaged than when tutors set up the mechanisms for them.
5. In Australia, a targeted ICT policy is in place to assist teachers to harness the new technology.
6. Stop, look closely and think about LMS/LCMS to choose. Nowadays, a lot of applications are labelled LCMS. It is also necessary not to forget costs for updates, training, support and maintenance when one is calculating the cost of a LMS to adopt.
7. Adopt free and open source software (FOSS). Why? FOSS provides:

(a) Low total cost of ownership (TCO). You are likely to pay only for training and maintenance by a consultant. The costs of buying a LMS, for example, are generally high. Open source-based LMS offers an interesting alternative to a commercial one.

(b) High flexibility and customizability. You can modify the software to your needs, because you are permitted to change the software by adding or removing features.

(c) Wide user communities. You can participate in the software's user forums, newsgroups, and discussion lists and gain from the experiences of others.

(d) Multi-platform capabilities. Many open source applications run on Windows, Linux and Mac operating systems and works well on older hardware. So you are not tied to using a particular application because you are running an operating system that accepts only that application, or you are not forced to change to another operating system or hardware, as is the case with most commercial software.

8. HEI teachers should hold appropriate belief about teaching and learning and be convinced about ICTs use. They should believe that learning must emphasize collaboration. Only when lecturers themselves are convinced about ICTs use, that they can make sacrifices to get things done in the present phase of institutional infrastructural poverty and personal economic distress. The sacrifices teachers can make include:

   (a) personal ownership but professional deployment of the ICT hardware and software they can afford

   (b) spending time, and however-small money, to plan, design, use, evaluate, adjust and reuse ICTs and to learn from people who have used or know how to use the tools

9. Like it happened in Latin America and Caribbean schools, as reported by Alvariño & Severín (2009), efforts should be made to train teachers and students of HEIs specifically in making educational use of ICTs, paying more attention to certifying teachers' ICT skills, because, as Sunkel & Trucco (2011) reported, basic ICT training had been found inadequate for effective application of ICT by teachers. Regarding training students, more benefits will come from delivering training which emphasizes attitudes towards information and acquiring information handling and presentation skills, rather than the way technology itself is used.

10. ICTs acquisition projects should be planned and executed. Probable projects include sensitizing teachers and students on education uses of ICTs; setting up e-learning portal; establishing computer laboratories; giving subsidies to lecturers and students for the purchase of personal computers; putting computers, multimedia projectors and interactive whiteboards in classrooms.

11. Some technologies will be easier to introduce into the teaching environment than others. Students ought to be encouraged to use those forms of ICT that they currently use in a social situation—such as social networking sites—for their academic work. It is a good experiment to introduce newer forms—such as wikis, which are perceived to be little used in education (although in reality they tend to be in use to a certain extent). Deploying newer and earlier forms of ICTs will require different approaches from teachers and course designers. HEIs will need to support their staff to deliver this. HEIs need to be aware of the way students already use social networking sites, so as to help students to use the networks they already have in place. They also have to know that some students at present do not use social networking sites at all.

12. ICTs should be integrated into the entire higher education through a tripartite investment strategy. Researches (Light & Martin, 2007; Organization for Economic Co-operation and Development, 2009) indicate that ICT-enabled learning is most effective in a 1:1 e-learning environment where:

a) ICT tools and connectivity are deeply integrated into classrooms and used across the curriculum;

b) Teachers are skilled and comfortable using digital resources to enhance teaching and learning.

The same researches also have evidences that to achieve integration and skill, governments and university authorities must invest in professional development and curriculum resources as well as in PCs and networks. These three investment areas reinforce themselves, according to Intel World Ahead (2009). The author of this paper additionally believes strongly that private-sector companies (including ICTs makers) and international development organizations have a part in this partnership, especially in developing countries. HEIs should reach out to this third party to invest as their corporate responsibility and aid provision, respectively. ICT makers' contribution must move away from giving PCs to university staff and students at prices above market rates for payment in installments, towards offering them at production cost, if donation is not feasible.

13. We may not delay educational use of ICTs until everybody accepts it. When reluctant teachers, students and HEIs, even when they are majority, see others benefiting from the technology, they will want to join. Thus appetite will be raised.

CONCLUSION

Effort has been made here to sensitize readers on the need for HEIs to produce graduates with skills our twenty-first century demands and the role of ICTs in this task. What ICTs actually are, the benefits of integrating ICTs into higher education, what thirteen computer-based ICTs are and how they have been and can be used in higher education, have also been covered. The necessity to deploy new ICTs in HEIs should by now no longer be in doubt, if anybody had doubt earlier. HEIs in developed countries have demonstrated this. In UK, PowerPoint presentations of lectures, WebCT (a LMS) for filing of lecture notes, e-mailing tutors (which is usually available all the time and for some), the submission of coursework and assignments online and discussions of course topics through Facebook are all seen as normal. In Switzerland, the use of LMS/LMCS in higher education institutions is common. Lessons abound for us from these and other spatial experiences and have been outlined alongside valuable recommendations to make things happen in HEIs worldwide. For example, the use of social networking sites, which are driven by students, can have real value over study periods when students are away from the campus as well as being able to discuss issues with other students in different institutions on similar courses.

The next step is to vigorously begin action. Action can, however, not be fruitfully begun if we neglect one assertion UNESCO made:

> The right conditions [both on individual, institutional and government levels] need to be in place…before the educational benefits of ICT can be fully harnessed (Jonassen, 2002, p. 10).

The findings of the research commissioned by Joint Information Systems Committee (JISC) (2008) show that a great opportunity exists for HEIs to enhance their existing ICT provision and for students and lecturers to increase their knowledge and understanding of how these technology channels can help them in their academic work.

The future

Personal computers are, sadly, still out of the reach of many students in most households, especially in developing nations. The ubiquity, acceptability and accessibility of mobile phones today give them the quality to be the central technology for tomorrow's higher education. Software developers and phone makers should partner to ensure that the world has its most affordable phones able to open virtual campuses and upload and download files from them. A time is expected when digital books, hybrid mobile computers and touch-screen writing tablets will be in the hands of every undergraduate and lecturer alongside, if not to replace, the text book, chalk and chalkboard. Since computer applications are increasingly moving away from being those of standalone desktop and laptop computers to those of cloud servers, cloud computing will make information cheaper and more available if the ubiquitous connectivity that many movements are working towards is provided, and this has great positive implications for use of ICTs in HEIs.

This author agrees completely with the science and technology education specialist in the World Bank, Hawkins (2010**),** who observed that the ordered physical classroom of desks might quickly become a relic of the industrial age as schools around the world are re-thinking the most appropriate learning environments to foster collaborative, cross-disciplinary, student-centred learning. Also, we should not be heading into the future with the idea of the traditional one-hour lecture period. Lecturers should begin to think of being virtual teachers or mentors as opportunities for peer-to-peer and self-paced, deeper learning increase. Investigations in order to expatiate on or disprove these future possibilities are needed.

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Reviewing and constructing categories for educational technology professionals

David Woo
University of Hong Kong, Pokfulam, Hong Kong

ABSTRACT

This literature review highlights the tension between cohesiveness and incoherence in operationalizing categories of educational technology professionals. Literature on learning technologists, educational technologists, e-learning technologists, information and communications technology coordinators and information technology coordinators was analyzed through a multilevel model of comparative education to address to what degree these educational technology professionals are similar units of analysis. Cohesiveness and incoherence within and between these categories by geographical and organizational levels, non-locational demographic groups and aspects of education and society was teased out. A degree of cohesiveness in operationalizing educational technology professionals was illustrated when the categories were framed as technologists and technology coordinators. However, ambiguity and incoherence were demonstrated particularly when attempting to locate an educational technology professional at a precise intersection of geographical and organizational levels, non-locational demographic groups and aspects of education and society. Researchers and practitioners can operationalize new categories of educational technology professionals by addressing ambiguity and incoherence within these educational technology professional categories. The review raises methodological implications and the need to establish valid constructs. It also raises the question of whether such categorization is necessary and worthwhile in an age of technological and professional change.

Keywords: *higher education, educational technology, technologists, comparative education, technology coordinators*

INTRODUCTION

As schools and other educational institutions develop using information and communication technology (ICT), educational technology professionals may play vital roles in the process of teaching and learning through technology. Their increasing presence in the research literature reflects their proliferation in practice. There may be a great opportunity to learn corporately about these professionals through the literature.

However, categories of educational technology professionals present several methodological challenges, particularly in establishing validity. Like the word technology, technologist is an assumption-laden term. The paradox of literature on educational technology professionals is that the terms used to describe educational technology professional roles are used casually without clear definitions or agreement on appropriate usage. As educational technology roles emerge in practice and as practitioners and researchers try to make sense of these roles by developing categories and assumptions for them, validity for each category must be established. Spillane and Healey (2010, p. 255) state succinctly that, “Fancy statistical methods, or even random assignment, cannot compensate for loose constructs”. If researchers, practitioners and readership do not agree on what a technologist is, they will read and write with many different assumptions about technologists and arrive at many different conclusions. A lack of clarity about the terms used to describe educational technology professionals does not advance reliable, collective knowledge about educational technology professionals.

This article is a literature review on educational technology professionals. The purpose of this review is to identify and compare how educational technology professionals have been operationalized in research and practice. The identification and comparison are a means to address to what degree categories of educational technology professionals are valid concepts, and to what degree they are comparable units of analysis. Prevalent categories of educational technology professionals were identified based on the root words to describe these professionals in the literature and this review presents limits to these categories. The first section is an examination of the technologist category. The second is an examination of the technology coordinator category. The possibility of operationalizing other educational technology professional categories was also examined based on gaps in the literature. The final section draws attention to methodological implications, opportunities to improve rigor and validity in category construction, and the question of whether such educational technology professional categorization is necessary and worthwhile in an age of technological and professional change.

This article features comparisons within and between selected categories of educational technology professionals. Comparing requires category descriptors, or levels. Although it is possible to create a unique framework for comparing technologists, the Bray and Thomas (1995) multilevel model of comparative education has been a useful foundation in the wider domains of education studies for academics and practitioners to make thoughtful comparisons (Bray, Adamson and Mason 2014). It presents a range of levels within domains with which cohesiveness and incoherence within and between categories of educational technology professionals can be explored. It can also be used for comparison between educational technology professional categories and other educational roles.

The framework's domains are geographic and organizational levels, non-demographic groups, and aspects of education and society. The analysis for each educational technology professional category addressed several levels for each of the three domains. The analytical framework is not exhaustive and leaves room for articulating new units (Manzon 2007). For instance, this review presupposed the creation of levels for comparison within the domains of non-locational demographic groups and aspects of education and society. Educational technology professionals were identified within the non-locational demographic groups domain by their membership groups, that is, to which groups educational technology professionals belong, either by self-identification or by others' identifying them; and by their associated groups, or other groups, with whom educational technology professionals work but to which membership is not claimed. Educational technology professionals were identified within the aspects of education and society domain by their professional knowledge, skills and practices; and by job titles and more generally, nomenclature associated with the educational technology professionals.

To question whether educational technology professional categories should be treated as equivalents or sub- or super-categories to each other and to question whether each category is used coherently in the literature required some reasonable generalization of educational technology professional nomenclature. In other words, this review requires operationalizing units. The units of technologists and technology coordinators were created from the root words of the terms used in the literature. The technologist literature review encompasses literature on learning technologists (LTs), educational technologists (ETs) and e-learning technologists (ELTs) since their root is technologist. Technologist is the reference term for all three groups. The technology coordinator literature review encompasses literature on ICT coordinators and information technology (IT) coordinators. The term technology coordinators refers to these two groups in this review.

TECHNOLOGISTS

Geographic/organizational levels

Regions and countries

Technologist categories may be constructed from the geographical location of technologists. Much research on LTs (Oliver 2002; Lisewski & Joyce 2003; Seale 2004; Ellaway et al. 2006; Davis & Fill 2007), ETs (Shurville, Browne & Whitaker 2008) and ELTs (Soyoz 2010) has been geographically located in the United Kingdom (UK). Shurville, Browne and Whitaker (2008) added that ETs can be geographically located in Australia. Mostert and Quinn (2009) reflected on the ET experience in South Africa. Oliver (2002) said that LTs can be found in North America and are referred to as instructional technologists.

Organizations and organizational units.

Similarly, technologist categories may be constructed from the types of organizations and organizational units to which these technologists belong. Almost all reviewed research on technologists has placed these roles within higher education institutions (HEIs), including universities and the British Council. Within HEIs, LTs have been assigned to subject-specific faculties (Davis & Fill 2007) and finer assignments such as to an e-learning unit of a learning technology section within a subject-specific faculty in a university (Ellaway et al. 2006). Ellaway et al. (2006) added that LTs can be responsible towards units, sections, colleges, universities and other organizational units within HEIs. Other authors have provided few clues as to where a technologist fits within an HEI's organizational units. LTs have been characterized as working within vague boundaries with no formal authority. And Seale (2004) suggested that LTs are a part of a community that includes disability officers, academics, researchers, and staff developers.

An exception to technologists' organizational locality came from Davidson's (2003) placing of ETs in school districts in the United States. A school district had 7 ETs who served 17 schools. Nonetheless, Davidson noted that these ETs, like other technologists, often operated with vague organizational boundaries, as demonstrated in the ETs working across multiple physical spaces in schools and rarely being anchored in a fixed location such as at an office or at a desk. Nonetheless, a strong consensus in the literature for locating technologists in HEIs may legitimize a distinct technologist category.

Non-locational demographic groups

Membership groups

Technologist categories may be constructed from who these technologists are, and are not, in terms of professional identity and personal demographic membership. The literature has offered varying and sometimes contradicting non-locational inclusion and exclusion criteria for technologists. For instance, Oliver (2002) provided the most specific non-locational demographic information to describe LTs in UK HEIs. Based on existing research, Oliver (2002) said that they were likely to be young, under-forty, and paid with external funding; and they were peripatetic, that is, they worked in many different places for short periods of time. Conversely, Shurville, Browne and Whitaker (2008) said that ETs had disparate and undocumented backgrounds and qualifications but did not specify what disparate means. As regards exclusion criteria, Oliver (2002) said that academics and established professionals with learning technology responsibility, and learning support, non-academic professionals including technicians and librarians were not LTs. Ellaway et al. (2006) concurred by stating that LTs were not academics. Mostert and Quinn (2009) said that ETs were neither academics nor academic development staff. Davidson (2003)

added that while combining aspects of these roles, ETs were not teachers, IT teachers, technicians or curriculum specialists. In contrast, Soyoz (2010) suggested that ELTs were the least exclusive technologist category. Soyoz (2010) claimed that an ICT coordinator ancillary role with a primary English teaching role comprised an ELT. Academic managers and website coordinators could also be ELTs. He added that teachers in schools and staff in corporate learning departments were ELTs.

Associated groups

Technologist categories may also be constructed from the types of groups with whom these technologists work. However, in the same way that researchers and practitioners have reluctantly located technologist membership within the bureaucracy of HEIs, they have tended to avoid operationalizing quantities and qualities of discrete stakeholder and organizational bodies that interact with technologists. Davis and Fill (2007) noted that the LTs in their study worked with ten academics in a subject-specific faculty. As Davidson (2003) located her ETs in schools, the ETs worked primarily with teachers but not parents or students. Each ET role was supported by an administrative technologist position. Other authors claimed that within HEIs, technologists work with academics (Lisewski & Joyce 2003), with either academics and academic development staff in curriculum development teams or project managers and various designers, developers and programmers in courseware development teams (Mostert & Quinn 2009), and academics and administrative staff in an e-learning unit of a learning technology section of a subject-specific university faculty while answering enquiries from external staff, students, academics and administrative staff (Ellaway et al. 2006). Technologists may also refer to others as clients and customers. Oliver (2002) said that central to the LT role was collaborating with different groups. However, Seale (2004) and Shurville, Browne and Whitaker (2008) said that LTs and ETs respectively did not work with organizations outside their HEIs, although this should be encouraged.

The importance of strong professional relationships for the learning technologist's success has been featured in the technologist literature (Oliver 2002; Lisewski & Joyce 2003; Davis & Fill 2007). Strong relationships have stemmed from collaboration and community, both of which have been central features of the learning technologist's successful working (Oliver 2002; Lisewski & Joyce 2003; Ellaway et al. 2006). However, Oliver (2002) qualified these elements by stating that they, like deep organizational learning, were difficult to come by. This is not least because technologists could associate with so many stakeholders that this naturally frayed loyalties. Bates (2004) and Bates and Sangra (2011) provided the lone voice for lone rangers, HEI technologists whose scope of technology integration in teaching and learning has been at the individual level, largely in isolation.

Aspects of education and society

Professional knowledge, skills and practices

As HEIs have become increasingly aware of how technology impacts curriculum, they have thought about new ways by which they can support technology integration in curriculum. One of these ways has been the employing of technologists. And technologists can be categorized not only by where they work and with whom they work, but also by the knowledge, skills and practices needed for their work.

Ellaway et al. (2006) described LTs as pedagogical support for teaching with information technology (IT). Oliver (2002), Lisewski and Joyce (2003) and Davis and Fill (2007) argued that LTs were sources of pedagogical expertise and that this was important for their success in activities, primarily collaborating with people on curriculum development. Shurville, Browne and

Whitaker (2008, p. 919) added that their ETs must understand "pedagogically sound methodologies." Mostert and Quinn (2009, p. 81) similarly recommended ETs, "identify areas of teaching, learning, assessment and evaluation that might benefit from the use of ICTs and in assisting lecturers to use ICTs in pedagogically sound ways." ETs' specific collaboration practices could include technology integration planning for individual lessons and for an overall curriculum, and co-teaching with teachers in classrooms and computer labs (Davidson 2003). Nonetheless, Davidson (2003) found her ET provided primarily technical support and not pedagogical support in a school. Hartley et al. (2010) delivered the broadest scope for the LT and ET by stating that any professional working in advance learning technology could be considered an LT or ET. Technologists could be considered a cohesive category insofar as technologists need to exercise pedagogical and technological knowledge.

Technologists have operated in diverse technological and pedagogical domains. This has reflected the diverse technologies, organizations and people found in HEIs. Bates's (2000) technologists specialized in distance learning. The LTs in Lisewski and Joyce's (2003) study worked on e-moderating online courses on Blackboard learning management system (LMS). Seale's (2004) LTs exercised accessibility practices for producing electronic materials for disability students. Ellaway et al. (2006) said their LTs developed three bespoke virtual learning environments: one for undergraduate medical students; another for undergraduate veterinary medicine students; and another for postgraduate students; besides, they developed a number of teaching, administration and support applications. Davis and Fill's (2007) LTs worked on blended learning with a specific toolkit. And Shurville, Browne and Whitaker (2008) and Mostert and Quinn (2009) said their ETs also worked on blended flexible learning. Soyoz's (2010) ELTs developed interactive white board teacher training courses or coordinated websites.

As regards generic competence domains, Hartley et al. (2010) developed competency-based curriculum themes for the teaching and learning of advanced technology at the tertiary and vocational education levels. They listed several competence domains that students and teachers in educational technology might need for the next decade: knowledge; process; application; personal and social; and innovative and creative. This was a rare attempt to standardize the competencies that LTs and ETs should possess and by which they should be assessed. However, even the authors admitted the possible difficulties of assessing certain competence domains, particularly the innovative and creative, and the personal and social competence domains. Davidson (2003) found that although ETs did consider themselves to be a discrete body with an overall skill set and attributes, those skills and attributes were not clearly defined. This ambiguity in generic competence domains is prevalent in the literature.

Although technologists may work within specific technological pedagogical domains, like the people with whom technologists work, the technologists' practices within these specific technological pedagogical domains have remained exceptionally vague and diverse in the literature. Oliver (2002) stated that LTs' specific practices by and large remained undocumented. He described the LT role as transdisciplinary, pointing out academic activities, and administrative, management or support activities. Ellaway et al. (2006) supported this argument by stating that LTs brought incongruent roles, expectations and norms of practice to the category. They alluded to LTs as designers, developers and providers; and described them in terms of apologist, evangelist and advocate; and they said that bringing income to their section was important. In Davis and Fill (2007), the LT role was that of a facilitator. Davidson (2003) identified five sub-identities for ETs in schools: technician; classroom teacher; specialist; administrator; and district curriculum specialist. Davidson (2003) claimed that ETs were translators who rendered different systems intelligible to users. Shurville, Browne and Whitaker (2008) added that ETs were local champions and project managers, and could be recognized as techie. Mostert and Quinn (2009) noted the shift ET practice from an instructional designer to a curriculum designer. The literature demonstrates how technologists' job scope can be broad and eclectic.

Nomenclature

The diversity in organizational units, working partners, skills, knowledge and practices correlates with a variety of job titles for technologists. Oliver (2002) said LTs were bestowed a variety of job titles by both practitioners and researchers. Ellaway et al. (2006) added that differences in job titles and practices created tension for LTs in organizations. Davidson (2003) and Shurville, Browne and Whitaker (2008) acknowledged a plethora of ET job descriptions and titles, whether in schools or in HEIs, and Shurville, Browne and Whitaker (2008) added that since many ET job titles were not recognized, this lack of legitimacy led to uncertainty in an ET's career path. Only Soyoz (2010) provided specific job titles for ELTs, and this might be a result of his different construction for the ELT category. For instance, he said that Global Products Manager was a job title of an ELT.

Technologist nomenclature in the literature also demonstrates diversity. Many authors (Oliver 2002; Lisewski & Joyce 2003; Seale 2004; Ellaway et al. 2006; Davis and Fill 2007; Hartley et al. 2010) wrote about learning technologists and to a great extent operationalized this category of educational technology professionals. Other authors (Davidson 2003; Shurville, Browne & Whitaker 2008; Mostert & Quinn 2009) operationalized the term educational technologist, and Soyoz (2010) the e-learning technologist. Oliver (2002) added that LTs were called instructional technologists in North America.

Origins

The origins of these educational technology professionals are diverse. Oliver (2002) characterized LTs as new professionals, and Lisewski & Joyce (2003) added that the LT was a neophyte, youthful profession. In contrast, Shurville, Browne and Whitaker (2008) said that the educational technologist (ET) role has existed since the 1970s. Davidson (2003) contradicted this by saying the earliest reference to an ET was in 2000 and that the role evolved within a larger system from multiple antecedents including computer subject teacher, district technology consultant position and a traditional IT coordinator. Authors have not reached a consensus on how technologist roles emerged.

TECHNOLOGY COORDINATORS

Geographic/organizational levels

Regions and countries

The literature has placed the technology coordinator role in many nations (Banyard, Underwood & Twiner 2006; Davis 2008; Rodríguez-Miranda, Pozuelos-Estrada & Leon-Jariego 2014), and in states such as Hong Kong (Law 2000; Wong 2008; Woodhead 2009; Harbutt 2011). However, this does not mean that ICT coordinators have been equally distributed across geographic levels. For instance, according to the Second Information Technology in Education Study (SITES) 2006, in the self-governing entities of Denmark, Hong Kong and Singapore, other IT staff for supporting IT were available at a higher rate than other self-governing entities. Unlike technologists, they could exist in sufficient geographic levels for quantitative study (Devolder et al. 2010) and large-scale international comparative study (Law et al. 2008; Microsoft Partners in Learning 2011).

Organizations and organizational units

The literature has placed the technology coordinator role within primary (Wong 2008; Devolder et al. 2010; Rodríguez-Miranda, Pozuelos-Estrada & Leon-Jariego 2014) and secondary (McGarr & McDonagh 2013) schools. While ICT coordinators have existed in schools in nations and states, the school contexts have varied considerably as ICT coordinators have been found in mainstream, public school contexts in districts, regions and nations as well as in non-mainstream school studies in states. An argument to explain this uneven distribution across geography and organizations can be found in the aspects of education and society section for other categories in this review. Furthermore, the literature has not definitively placed ICT coordinators within organizational units in schools. Rodríguez-Miranda, Pozuelos-Estrada and Leon-Jariego (2014) located technology coordinators in school and classroom settings in their study but did not specify these settings and whether or not there were other settings for technology coordinators. An explanation for this is offered in the membership groups within Non-locational demographic groups section.

The technology coordinator role has been covered more extensively than the technologist role in the literature, at different geographic and organizational levels. This supports the role's prevalence in education and its categorical legitimacy within primary and secondary schools. Although the geographic and organizational levels may vary greatly, this also suggests a strong degree of consensus that an ICT coordinator can be located broadly in terms of geography and organization.

Non-locational demographic groups

Membership groups

Few claims about ICT coordinator personal demographics are made in the literature. This may reflect the pluralism of the people who occupy the post. For instance, Rodríguez-Miranda, Pozuelos-Estrada and Leon-Jariego (2014) mentioned that 75% of their ICT coordinator survey respondents were men, but this may not indicate anything beyond the Spanish mainstream primary school context. Data on the number of technology coordinators in schools around the world may not exist. As regards professional identity, the literature has identified ICT coordinators as primarily teachers in schools, and sometimes administrators such as principals (Davis 2008). Spillane and Healey (2010) have said

These positions…were also classroom teachers. Having formally designated leadership position while also working as a classroom teacher very likely constrains the time and effort leaders devote to supporting their colleagues. Moreover, we suspect that for most of these individuals their own classroom teaching may take priority over their (ancillary) leadership and management responsibilities. (p. 263)

Similarly, the ICT coordinator in Harbutt's (2011) study was a teacher who, as compensation for taking the post, had a token two hours removed from the teaching timetable. Rodríguez-Miranda, Pozuelos-Estrada and Leon-Jariego's (2014) ICT coordinators likewise were relieved of 20% of their teaching load for ICT coordinator responsibility. In sum, the ICT coordinator role was not full-time but ancillary and part-time. All of this may explain why ICT coordinators may not belong to specific organizational units in schools, because the people occupying these posts are teachers and other roles assigned to organizational units.

Associated groups

More generalizations have been made about ICT coordinators in relation to other school stakeholder groups. The ICT coordinators have had a narrower sphere of influence and scope of school stakeholders than LTs. ICT coordinators worked with teachers and technicians (Law 2000;

Law et al. 2008; Wong 2008). In Hong Kong schools they could work in ICT teams (Law 2000), the members of which were primarily teachers. They might receive varying degrees of support from these groups (Harbutt 2011). The literature has made few claims about ICT coordinator interactions with other stakeholders such as students and parents. Harbutt (2011) said that the ICT coordinator in his study provided ICT training and support for teachers but not for parents.

Aspects of education and society

Professional knowledge, skills and practices

The consensus in the literature is that ICT coordinators support technical aspects of teaching through technology, for instance, by troubleshooting technology (Davis, 2008; Wong 2008; Devolder et al. 2010; McGarr & McDonagh 2013) and answering technical questions (Rodríguez-Miranda, Pozuelos-Estrada & Leon-Jariego 2014). This can be irrespective of curriculum, whether English national curriculum or International Baccalaureate (Harbutt 2011), or technology-infused, school-based curriculum (Woodhead 2009). This work can often be burdensome (Davis 2008; McGarr & McDonagh 2013) not least because technical support consumes the most time, and is the most urgent and immediate from teahcers, but has such a low priority for ICT coordinators (Rodríguez-Miranda, Pozuelos-Estrada & Leon-Jariego 2014).

Research methodology in large-scale studies provides further insight into ICT coordinators as technical support staff. What ICT coordinators were asked in SITES 2006 and in the SITES M-1 case studies, in contrast to what others were asked in those studies, presuppose what this educational technology professional role in schools entails. For instance, in SITES 2006, the ICT coordinators filled out a technical questionnaire. They were asked about the maintenance of ICT infrastructure such as computers. They were also asked about the availability of technical support for teachers when using ICT. Similarly, to explore the school ICT infrastructure in which a good practice takes place, the SITES M-1 researchers toured the school with either the principal or one of the ICT members. On the other hand, in both studies a school principal would be consulted on ICT developments in the school, the school's ICT implementation plan and the major obstacles in implementing this plan. Each school principal was also asked about the availability of pedagogical support for teachers when using ICT. All of this evidences the disassociation of pedagogical support and educational technology leadership from the ICT coordinator. Presumably the principal knew more about the availability of pedagogical support for teaching through technology in the school. The ICT coordinator presumably knew more about the technical support for teachers using ICT in the school. Wong's (2008) study also demonstrated this curious reliance on school principals to understand ICT coordinators as teachers and head teachers in Hong Kong, and head teachers in the UK were surveyed about the ICT coordinator role in schools.

When ICT coordinators have provided pedagogical support, this support has lacked depth and sustainability. The ICT coordinator in Harbutt's (2011) study developed voluntary workshops for teachers and had the authority to no more than encourage teachers to use software in a vague way without tangible outcomes and practices. In Woodhead's (2009) case, an instrumental teacher, not the official ICT coordinator, was instrumental in the leadership, policies and relationships to change pedagogical support for teaching through technology in a new curriculum. In the SITES 2006 study, the ICT coordinator was identified as a frequent, informal method by which to deliver ICT knowledge and skills, but it was unclear if this was pedagogical support, technical support or both. Wong (2008, p. 9) observed, "It is uncertain, for example, whether ICT coordinators are meant to perform operational or pedagogical functions, or both." Nonetheless, ICT coordinators ideally would provide pedagogical support (Rodríguez-Miranda, Pozuelos-Estrada & Leon-Jariego 2014). Only in the UK context has there been strong evidence that ICT coordinators are "pedagogical leaders, with few if any technical support duties" (Wong 2008, p. 9).

Nomenclature

The practice of categorizing technology coordinators has been more prevalent than categorizing technologists. This has reduced ambiguity to a degree because the names for technology coordinators in the literature are less diverse. The names generally are IT coordinator and ICT coordinator. Governments may legitimize such terms in their policies for technology in schools.

OTHER CATEGORIES

Clarifying ambiguity and incoherence in educational technology professional categories across geographic and organizational levels, non-locational demographic groups and aspects of education and society presents the opportunity for operationalizing other categories of educational technology professionals. Locating educational technology professionals at other intersections of these domains does the same. Constructing other educational technology professional categories may take the form of developing sub-categories of technologists and technology coordinators; or developing alternatives to existing categories of educational technology professionals. These other categories fill gaps in the literature. This section explores possible alternatives and sub-categories by first summarizing technologists and technology coordinators across geographic and organizational levels, non-locational demographic groups and aspects of education and society in Table 1.

Table 1: *A summary of technologists and technology coordinators*

		Technologists	Technology Coordinators
Geographic/ organizational levels	Regions and countries	UK, Australia, South Africa and North America	Many nations and states
	Organizations and organizational units	HEIs and units, sections and colleges within HEIs	Individual primary and secondary, mainstream and non-mainstream schools
Non-locational demographic groups	Membership groups	Full-time, not academics, librarians, lone rangers, technicians or teachers	Part-time, teachers and administrators
	Associated groups	Academics, administrators, academic development staff, students, communities	Teachers, technicians, ICT teams
Aspects of education and society	Professional knowledge, skills and practices	Diverse and emergent skills and knowledge; trans-disciplinary pedagogical support practices; technical, administrative and academic practices	Technical support practices and generally not pedagogical support or technological pedagogical leadership
	Nomenclature	LTs, ETs, ELTs and instructional technologists; diverse job titles	ICT coordinators and IT coordinators; unknown job titles

ET: educational technologist; ELT: e-learning technologist; HEI: higher education institution; ICT: information and communications technology; IT: information technology; LT: learning technologist; UK: United Kingdom;

Geographic/organizational levels

Other educational technology professional categories and sub-categories may be operationalized at undervalued, finer or broader geographical and organizational levels. The educational technology professional categories reviewed in this paper were found in individual schools and HEIs, and within HEIs, various departments and faculties. They were found in certain nations, states and systems. A nation, state or organization could operationalize its own categories of educational technology professionals. Additionally, categories of educational technology professionals could exist for categories of HEIs, or other educational institutions. These include informal or casual educational organizations and non-mainstream or private schools, such as tutorial schools. For example, Apel (2009) and Friesen (2010) set out to operationalize and categorize technology leaders within the geographic/organizational level of private international schools, that is, a category of non-mainstream schools. Friesen (2010, p. 10) observed, "Neither international private school teachers nor IT workers have received extensive attention in academic literature." Educational technology professionals were also found within groups of schools, namely technologists in a United States education system school district in Germany (Davidson 2003). Furthermore, since schools can be increasingly stratified by classes, grade levels, content areas and curricula, educational technology professionals could be assigned to one or more of those organizational units. This would mirror the type of technologist stratification found in HEIs.

Non-locational demographic groups

Other educational technology professional categories and sub-categories may be operationalized at non-locational demographic groups. Associated and membership groups can be clarified greatly. For instance, Friesen (2010) identified IT workers as,

A new occupational group enters the traditionally mono-professional realm of the teacher…The literature is ambiguous regarding the designation of these employees. Although 'IT worker' dominates, 'IT staff' is also common. Compounds with 'ICT' are rare. 'Technician' does not adequately discriminate functions" (p. 1)

The proposition that educational technology professionals work within or belong to communities of practice should be accompanied by a clear definition of these communities. Similarly, educational technology researchers have often sampled educational technology leaders in schools without clarifying their roles. For instance, Apel (2009) defined technology leaders as the primary technology decision-makers in these schools, and these technology decisions might encompass technical, pedagogical, administrative and other considerations. In the same way, The Microsoft Partners in Learning (2011, p. 14) international study on innovative teaching practice ambiguously defined its sample as several thousand students, "teachers of students," and "school leaders". Therefore, the term technology leader remains ambiguous and broad. It could include traditional school roles, such as principal, and emergent, unconventional categories of educational technology professionals. Other educational technology categories may exist in practice but have not been disseminated, even within an institution where the professionals are found. For instance, Bates (2004) and Bates and Sangra (2011) have been great proponents of a "lone ranger" educational technology category comprising professionals who work largely in isolation in HEIs. The distinctiveness of the lone ranger category comes from the absence of non-locational demographic groups. Other operationalized educational technology categories may also be undervalued because, like the technology coordinators, the role has been primarily part-time and ancillary to another role, or there has been insufficient supply of these professionals.

Aspects of education and society

Other categories of educational technology professionals may emerge, and existing categories may change as aspects of education and society emerge and change. The more a school integrates IT into their curriculum the more they may need different types of support, including technical, administrative, managerial and pedagogical support, at individual and organizational levels. In describing IT workers in a private international school in Singapore, Friesen (2010, p. 143) broaches this possibility of "low-level technical staff…tasked with comparatively straightforward repair jobs, while upper-level workers engage in more complex tasks that require a greater degree of professional judgment. These higher-level IT workers are managers of school-wide resources." To increase support levels for school staff, schools may design more full-time roles to replace ancillary, part-time. Ultimately, educational technology professional roles can only evolve insofar as the school's policies, curricula and pedagogies can change to support role evolution in the environment. Introducing and sustaining technological pedagogical change in a school demands reflexivity at several levels. ICT coordinators may be unevenly distributed across geographic and organizational levels because many organizations in many nations do not have environments to scale or to sustain this role.

Davidson (2003) examined the relationship between roles and school reforms. In an environment of continuous reform, Davidson argued that even the technologist role was evolving rapidly. It came from traditional roles, such as computer subject-teacher, technology coordinator and district technology consultant position. She suggested that the ET role was evolving to include more responsibility and to become more integrated with colleagues' roles. Davis (2008) supported this by constructing a possible bridge between the IT coordinator and other possible educational technology roles. Davis argued that at one stage, presumably an immature one, neither a change manager nor an IT coordinator was needed in a school. However, at another stage when IT use among teachers became localized, an IT coordinator was needed, alongside change management. McGarr and McDonagh (2013) supported the evolution of roles when they said that the ICT coordinator role might be changing because schools might require greater pedagogical support. They envisioned ICT coordinators becoming more influential in school leadership and policy-making and moving away from the technician and trouble-shooter roles. A teacher in Harbutt's (2011) report also supported the evolution of the ICT coordinator role to achieve the school's technological ambitions:

...It's difficult for the IT coordinator to be full-time in the classroom and do his IT stuff. We need to look at things as a school. We need to prepare and train our teachers. We've got the tech but do we know how to use it effectively? Maybe we should put a halt to spending money on machines and spend more on releasing the IT coordinator from his teaching duties. (p. 22)

If education environments and school roles are changing rapidly, educational technology professional pluralism may be great. For instance, Apel (2009) introduced nine discrete categories for educational technology professionals in international schools. He furthermore demonstrated the ambiguity and pluralism of educational technology professionals in international schools by introducing twenty job titles of technology leaders in his study. New categories can emerge from such pluralism, particularly as standardization is applied to the profession. Formal curriculum is being developed for training technologists and other professionals working in advanced learning technology (Hartley et al. 2010) and this curriculum can reify categories of educational technology professionals.

DISCUSSION AND CONCLUSION

A comparison of categories of educational technology professionals by geographic and organizational levels, non-locational demographic groups and aspects of education and society

demonstrates incoherence and cohesiveness within and between categories. The review is a demonstration that categories can be delineated in several ways and that within categories diversity can still be prevalent. In sum, the categories are cohesive insofar as the literature can reach consensus for certain geographic and organizational levels, non-locational demographic groups and aspects of education and society where these professionals are present. In other words, the categories present a roadmap for present and future categorization. For instance, many researchers and practitioners place technologists in HEIs and technology coordinators in schools. However, a limitation of educational technology professional categories is that these categories cannot be easily compared or located at precise intersections of geographic and organizational levels, non-locational demographic groups and aspects of education and society, in accord with the Bray and Thomas (1995) analytical framework. Other analytical frameworks may employ different kinds of levels and highlight other similarities and differences within and between categories. Nonetheless, incoherence or great variety may present opportunities for clarification by the creation of sub-categories or alternatives.

The tension between cohesiveness and incoherence in operationalizing categories of educational technology professionals requires more exploration. Reviewing categories and constructing categories for educational technology professionals are significant ways to advance research into these professionals. This also raises the question of whether such technologist categorization is necessary and worthwhile in an age of technological and professional change. While there are calls for standardization and codification for technologists (Ellaway et al. 2006; Shurville, Browne & Whitaker 2008), and while adding classifications to multilevel models of comparative education have been an important way to create more definitive units of analysis (Manzon 2007), less-codified or dogmatic approaches by researchers and practitioners to understanding educational technology professionals may also be appropriate. Educational technology professionals can be left an "ill-defined population" (Oliver 2002, p. 251) with scant cohesion or recognizable professional identity (Lisewski & Joyce 2003; Ellaway et al. 2006). At present, the battle to operationalize educational categories and professional identities for these educational technology professionals is waged in the imaginations of researchers and practitioners.

On the one hand, since the literature is emergent, all of it is necessary and constructive for educational technology professionals. As technologies continue to change education systems, educational technology professionals will be needed in increasing numbers to support these changing systems. The professional ranks will grow, as the need to research these professionals in several ways. For instance, how specific educational technology professional roles are designed, how they evolve over time to support changing teaching and learning practices, and how different levels of schooling and areas of the world mediate these emerging roles. The degree of technology integration in an educational institution and the types of educational technology professionals that the institution can support and sustain can also be explored. Furthermore, a limitation of this literature review on educational technology professionals is the dearth of large-scale, comparative international studies that feature these professionals. For instance, the large-scale, international comparative education study SITES (Law et al. 2008; Law, Lee & Chan 2010) provides incidental information on these professionals because they comprise part of the sample. Similarly, there have been few (Devolder et al. 2010) national (Rodríguez-Miranda, Pozuelos-Estrada & Leon-Jariego 2014), regional or trans-organizational studies (Apel 2009) to focus primarily on educational technology professionals. In general, educational technology professionals' presence in the literature is undervalued.

On the other hand, the literature may only be as useful as it is reliable in several ways. Some research methodologies may be less appropriate than others for researching these professionals, and this, for instance, may contribute to the dearth of large-scale, comparative international studies that feature these professionals. The lack of validity can become problematic in large-scale, survey studies of educational technology professionals. In accord with Apel's (2009) study,

to survey educational technology professionals from different contexts, to ask them to self-identify their roles according to categories developed by a researcher, and then for the researcher to generalize based on this dubious self-identification without additional validation may distort findings. Inappropriate comparison points also arise when Apel (2009) attempted to compare educational technology professionals in the United States of America (USA) with educational technology professionals in international schools around the world. Although he suggests a high degree of convergence between international schools and between schools in the USA, the context of each international school may differ greatly from the contexts of the other international schools, let alone the context of schools in the United States. A similar problem exists for Wong's (2008) study of ICT coordinators in Hong Kong and in the UK primary school contexts because how ICT coordinators are defined and identified not only in individual school contexts but also in national contexts may be different. To try to group together schools of the same category but different circumstances, and schools of different categories and circumstances but of the same country is dubious at best. Equally dubious is Davidson's (2003) assertion that the ET role is growing in United States schools without offering any quantitative evidence outside a case within one school district. If educational technology professional roles are highly contextualized, broad and ambiguous, qualitative research methods may be a more appropriate, but less statistically generalizable research approach to substantiate to what degree a sample falls within certain categories. There are many geographical and organizational units in which to study and to compare educational technology professionals, including in mainstream schools and in private schools in a nation. The more researchers and practitioners can agree on how to reduce the high degree of these professionals' contextualization for statistical generalization, the more large-scale studies and comparisons can and should be made. Researchers and practitioners have the opportunity to make more agreeable analytical and statistical generalizations from more rigorous research into these professionals.

The limited literature also points to the difficulty in synthesizing literature on these professionals. Discovering literature on educational technology professionals, even developing the appropriate terms by which to search for these professionals, presents challenges. The categories of educational technology professionals in this review do not represent the totality of educational technology roles in practice and likewise, the literature reviewed in this article do not represent the totality of the literature. Their selection, however, is to present a range of research and practice from which categories of educational technology professionals can be operationalized, and to highlight the challenges to operationalizing.

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EmergingEdTech's 2013 Free Education Technology Resources eBook (Book Review)

Reynald Maravilla Cacho
Philippine Normal University, Philippines

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This 2013 digital booklet edited and, in part, written by Kelly Walsh of the College of Westchester in White Plain, New York presents a compilation of 15 chapters, mostly contributed and/or originally published as blog posts by teachers, education bloggers (via guest posting) and technology enthusiasts on EmergingEDTech.com. This free eBook provides an overview and access links to many incredibly free and nonfree applications and resources on the internet for teachers and students to use inside and outside the classroom for teaching, management and productivity purposes.

Such an eBook can be stored in any computer, or mobile device that can read pdf files. Its 15 chapters deal with: (1) blogs and blogging resources; (2) cloud apps; (3) collaboration & brainstorming tools; (4) educational games and gamification; (5) educational videos, lectures, podcasts, and more; (6) flipped classroom resources; (7) iPads in education; (8) online interactive white boards; (9) massive open online courses; (10) picture and image editing application; (11) presentation and screencasting; (12) popular social networking applications and social learning; (13) teaching with cell phones & smartphones; (14) surveys and polls; (15) other topics and resources.

The material opens with an overview on creating a blog for educational purposes. This is followed by the introduction of Cloud apps noting that the *Internet is the Ultimate Cloud*. Approaches to making lesson plans accessible through Google Drive, Edmodo, and Dropbox to name a few are also provided. For making it more exciting, this eBook also shares useful tools for collaboration and brainstorming such as Bubble.us, Mindmeister.com and Mindmapper. This is, of course, by no means exhaustive. Interestingly, one can find sections promoting internet enabled game apps and free resources for iPads and other device that could lead to cognitive, social, and emotional learning for basic and higher education students. To respond to the multimodalities of learners, educational videos, lectures, podcasts, and trending *Flipped* classroom resources whether coming from Teachem.com or TED Ed Website, are briefly noted. As one would expect from its American context, the use of iPads in education is explicitly endorsed. A substantial number of pages feature the whys and hows of using iPod/iPad apps and resources for education, providing a wide array of useful links.

Several useful online interactive white boards are indicated in this eBook. The editor recommends free or with-fee tools that could meet users' requirements. Responding to the growing popularity of Massive Open Online Courses (MOOCs) there are informative infographics and useful links. Apart from the educational resources, 5 free picture and imaging tools are suggested. In addition

a variety of presentation and screencasting tools for enhancing PowerPoint slides are highlighted from Glogster, Prezi to Voki. This eBook also promotes popular social networking and social learning apps; a wide collection of app combined with brief information and links is up for grabs for teachers interested in trying out the potentialities of Instagram, Twitter, and Facebook in class. With mobile devices almost becoming ubiquitous, teaching with cell phones and smartphones will be a common scenario. Ways to embrace cell phones/smartphones in the classroom for iPhones apps or Androids are sketched through web or article links showcasing their use and other resources on how to get the most of them in school. Similarly, brief insights on the online tools for surveys and polls are offered. The last chapter features a wide variety of free miscellaneous resources focusing on computer literacy tools, search for grant links, and the potential usefulness of Second Life that according to the editor did not warrant a full chapter. Finally, a fitting conclusion for this eBook wraps up with a link listing unrestricted productivity tools for educators and general applications intended for everyone.

Given the ever-changing Web, one might have wished that the version reviewed had noted that Kathy Schrock's "iPads in the Classroom" (linked on p. 42) offers many tutorials, lists of apps and related materials.. Defunct links were found on pages 61 (5 Skills You Need to Succeed…); 64 (The Widening World of Massive Open Course); 65 (What's A MOOC); 83 (On Popular Networking Applications…); and page 102 (Understanding Text Message Shortcuts) . One hopes web-documents are regularly updated so that these sorts of problem can be addressed. Regular searches or an exploration of the Internet Archive might track down what is currently mis-located.

As far as choosing academic content is concerned, one might frown upon the citing of references directly from Wikipedia on page 60. It would have been more appropriate if the primary references about MOOCs were checked and adopted rather than simply linking it to Wikipedia entry. Useful websites that are not sustained come and go. Vuvox and the OneTrueMedia presentation tools suggested in Chapter 11 are no longer available. They might have been active in 2013 but are currently out of reach. As to providing other alternatives, it would have been useful if information were provided about another free presentation and screencasting tool, *Camtasia,* rather than providing just a link to an article at the end. Moreover, Google Drive with its online form tool (which is free) could also have been suggested in Chapter 14 rather than just presenting Doodle and Survey Monkey. Since this eBook builds on the American context, iPad/iPhone suggested apps and resources dominate over Android tools and research, cases cited as examples, and links belong mainly to the American educational setting. Nonetheless, much of what it offers may cut across cultures and boundaries.

There is much to be grateful for in this eBook. Other than that it comes for free, its pdf format provides a table of contents that is hyperlinked to the various chapters for easy navigation, the language in general is conversational and engaging, not to mention the appropriate iconic images which represent certain apps and tools are adopted. The author did a great job of compiling and editing most visited articles or sites featuring ICTs for education and personal use. Although it explicitly promotes EmergingEdTech.com, other relevant and accessible links to trusted sources are also suggested. I, for one, found interesting tools and resources that I have not known before such as the links for alternative interactive whiteboard and social learning sites, to name a few. If one is tired of reading such a considerable text, this pdf eBook can also be converted into audio text, or one could let Adobe Read-Out-Loud functionality do its thing

A strong point of this text is that it provides useful links to insightful articles, research, PowerPoint templates or instructional videos. Although most of the case studies cited are in an American context -- particularly on the benefits of gamification in education and social engagement to limiting attrition -- one European study noted (a report shared by Simon Thomas on the use of iPads in Longfield Academy in Kent, England, on page 43) argues for the value of the iPad as an educational tool. This eBook will also be useful for educators and, of course, researchers looking

for related literature. Every tool is a learning experience. It is a good thing that the author himself tried and tested most of the apps promoted in this eBook. His personalized inputs added flavor to the tools' acceptability and compatibility whether to try out the resources suggested or just apply what is applicable to one's needs and setting.

Information and Communication Technology for learning is almost everywhere and is evolving fast. This 2013 eBook provides a quick and handy guide for both beginning teachers looking for ICTs for teaching-learning processes, and experienced ones wanting to try free or non-free alternatives. Nevertheless, an updated edition is desirable to correct some inaccessible links and kinks, or a full eBook version that provides more substantial chapter contents devoid of minor inconsistencies and formatted in a modular style. Apart from the minor criticisms presented, this booklet offers materials that are beneficial for basic to higher education teachers and students alike. Overall, the major advantage of having this text on hand is that it suggests tools and resources for personal, instructional, academic and productivity purposes, and, most of all, it is free.

Original article at: http://ijedict.dec.uwi.edu/viewarticle.php?id=1982