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Critical success factors for ICT usage in learning

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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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International Journal of Education and Development using Information and Communication Technology (IJEDICT), 2014, Vol. 10, Issue 1, pp. 2-3

Editorial: Critical success factors for ICT usage in learning

Stewart Marshall
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Welcome to Volume 10 Issue 1 of the *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*. This issue brings articles from or about Denmark, Ghana, Kenya, Qatar, South Africa, Sri Lanka, and Tanzania.

The adoption of e-learning systems is becoming popular in higher learning institutions across the world including African universities. The author Lwoga examines "Critical success factors for adoption of web-based learning management systems in Tanzania". The results of the study showed that quality-related factors (instructor and system) were a key predictor of perceived usefulness and user satisfaction, and that information quality was found to significantly affect perceived usefulness. Further, perceived usefulness was a key determinant of user satisfaction, which in turn predicted continual usage intention of students within the e-learning system under the analysis.

The article by Smith and Hardman reports on a study of "The impact of computer and mathematics software usage on performance of school leavers in the Western Cape Province of South Africa: A comparative analysis". The findings indicated that there was no significant difference between the final Senior Certificate mathematics results of the schools with the computers and those without; no significant change in the results after the Khanya labs were installed; no significant change in the percentage of pupils that passed Senior Certificate Mathematics; and no significant change in Higher Grade Maths enrolment rates. This finding points to the need for caution in the implementation of ICT's into schools as a potential panacea for mathematical failure in our context.

In the article "Prevalence of online reading among high school students in Qatar: Evidence from the Programme for International Student Assessment 2009", Cheema reports on the results of a study using a nationally representative sample of 8,089 students. The results suggest small but significant differences in mean prevalence of online reading between boys and girls. Prevalence of online reading was found to be strongly associated with both entertainment- and schoolwork-related use of computers at home but weakly associated with computer use at school.

Liyanagunawardena, Adams, Rassool and Williams explore the implementation of online learning in distance educational delivery at a university in Sri Lanka in their article "Blended learning in distance education: Sri Lankan perspective". The lack of access to computers and the Internet, the lack of infrastructure, low levels of computer literacy, the lack of local language content, and the lack of formal student support services at the University were found to be major barriers to implementing compulsory online activities at the University.

In their article "Promoting proper education for sustainability: An exploratory study of ICT enhanced Problem Based Learning in a developing country", Roy, Kihoza, Suhonen, Vesisenaho and Tukiainen describe a pedagogical framework, Children as Agents of Social Change (CASC), as a possible vehicle to facilitate appropriate education about social issues. They analyse the first implementation of the CASC framework carried out at schools in Tanzania.

Results suggest that the participants were enlightened as to a variety of active problem solving possibilities and that they ranked the CASC methodology as an effective approach to sustainability.

The article "Determining distance education students' readiness for mobile learning at University of Ghana using the Theory of Planned Behavior", by Tagoe and Abakah, seeks to explain how students' beliefs influence students' intention to adopt m-learning. Factor analysis showed strong loadings of factors such as intentions and perceived behavioral control confirming that the TPB explained the students' m-learning readiness very well. The results provide valuable information on ways to implement m-learning programs incorporating the voice and needs of students.

The article "ICT-based, cross-cultural communication: A methodological perspective" by Larsen, Bruselius-Jensen, Danielsen, Nyamai, Otiende and Aagaard-Hanse discusses how cross-cultural communication based on information and communication technologies (ICT) may be used in participatory health promotion as well as in education in general. The analysis draws on experiences from a health education research project with grade 6 pupils in Nairobi (Kenya) and Copenhagen (Denmark) addressing the topic of physical activity in everyday life. The educational rationale for using cross-cultural communication is that meeting the unfamiliar (different children, cultures, schools and contexts) leads to curiosity and reflection about one's own situation; and subsequently that reflexivity builds action competence.

As always, the emphasis in IJEDICT is on providing a space for researchers, practitioners and theoreticians to jointly explore ideas using an eclectic mix of research methods and disciplines. The journal now has several sister publications (all free to read and subscribe):

- *ICT For Education and Development Blog* - http://stewart-marshall.com/ict4ed/
- *IJEDICT Weekly News* – an online newspaper published every Thursday http://paper.li/f-1325685118
- *ICT for Education and Development* - a daily, magazine style curation http://www.scoop.it/t/ict-for-education-and-development
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Critical success factors for adoption of web-based learning management systems in Tanzania

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ABSTRACT

This paper examines factors that predict students' continual usage intention of web-based learning content management systems in Tanzania, with a specific focus at Muhimbili University of Health and Allied Science (MUHAS). This study sent a questionnaire surveys to 408 first year undergraduate students, with a rate of return of 66.7This study adapted the information system success (ISS) model, and it used structural equation modelling (SEM) for data analysis. The results show that quality-related factors (instructor and system) were a key predictor of perceived usefulness and user satisfaction, and that information quality was found to significantly affect perceived usefulness. Further, perceived usefulness was a key determinant of user satisfaction, which in turn predicted continual usage intention of students within the e-learning system under the analysis. The researcher's paper is among the few exploratory studies that examines constructs of IS success model in the e-learning systems in sub-Saharan Africa, and Tanzania in particular, and presents e-learning success factors that should be of value to higher learning institutions management, e-learning systems designers and providers, and instructors when planning and implementing e-learning projects in the region and beyond.

Keywords*: Web-based learning management system, e-learning systems, IS success model, Tanzania, Africa.*

INTRODUCTION

The rapid developments of information and communication technologies specifically Internet technologies have created new opportunities for education. E-learning holds immense potential to enable higher institutions of learning to enhance teaching and learning experiences, improve access to educational resources and programmes, expand educational opportunities via distance-learning, and reduce the costs of education in the long-term. E-learning is an "innovative approach to education delivery via electronic forms of information that enhances the learner's knowledge, skills, or other performance" (Siritongthaworn and Krairit, 2006:138). E-learning has various benefits, such as personalized learning, increased access to information, effective means to standardize and deliver content, on-demand content availability, interactivity, self-pacing and building confidence (Bhuasiri et al., 2012). It consequently provides flexible, convenient and diverse learning environments to meet the disparate needs of learners (Bhrommalee, 2012). The e-learning approach can open the knowledge pipelines which instil a culture of inquisitiveness and enquiry in students and graduates that is critical for life-long learning. As compared to conventional learning styles, e-learning can offer a time-effective approaches and potentially reduce costs for classrooms and facilities, training, travel, printed materials, and labour (Bhuasiri et al., 2012).

The adoption of e-learning systems is becoming popular in higher learning institutions across the world including African universities. As a key higher education institution that develops human resources for health in Tanzania, Muhimbili University of Health and Allied Sciences (MUHAS)

revised its curricular to introduce innovative teaching and assessment methods, and improved its ICT infrastructure to enhance its teaching and learning activities since 2000s. MUHAS developed its ICT infrastructure and services by carrying out the following: established the optic fiber Local Area Network (LAN), increased access to greater numbers of computers, developed an online library catalogue, digital repository, and student academic record system, and subscribed to over 40 academic databases. The university has also introduced the learning management system (LMS) which is based on Moodle open source software. Despite the investments and applications of ICTs at the university, this institution has made little gains with the acceptance and usage of e-learning systems for teaching and learning activities. Previous studies demonstrate that the introduction of e-learning technologies is often a difficult process and students and instructors will not always use it as predicted (Venter et al., 2012).

Some of the factors that affect the acceptance and usage of e-learning technologies in most institution in developing countries include the technological infrastructure, high cost of technology, instructional efforts, graduate competencies, technology satisfaction (Venter et al., 2012), management support, methodology, resource accessibility and availability, culture of education and learning styles, intellectual investment, design of assistive tools, and global business (Ndume et al., 2008). As demands for higher education and e-learning continue to expand in Africa, it is important to determine factors that influence the perceptions of students and faculty when using a specific e-learning technology. The success of an e-learning system relies on both its early adoption (acceptance) and its sustained usage (Tai et al., 2012). It is therefore important to understand the relevant factors that predict student's intention to continue using the e-learning system.

Various e-learning studies have been conducted in Africa, including the discussion of implementation or description of novel systems and their dissemination (Matti et al., 2010; Nagunwa and Lwoga, 2013; Rhema and Miliszewska, 2010), acceptance and adoption of e-learning (Adeyinka and Mutula, 2010; Eke, 2011; Farahat, 2012; Tagoe, 2012; Venter et al., 2012; Wambui and Black, 2008), ICT readiness and acceptance (Gombachika, 2013), and descriptive usage of learning management systems and other learning technologies (Czerniewicz and Brown, 2009; Lwoga, 2012; Nihuka and Voogt, 2012; Unwin et al., 2010). Nevertheless, few studies have evaluated e-learning systems to understand factors that determine continual usage intentions of e-learning systems among students in the African context, and Tanzania in particular. Furthermore, research shows that, "weight of the impact of these factors may differ for different user types and e-learning technology types" (Pušnik et al., 2011). It is imperative to understand the attitudes and continual usage intentions of e-learning systems among students in order to synchronize the university's strategic goals with the educational objectives of students, justify the ICT investments and optimize the use of technology. The user adoption and use of an information system such as e-learning is an important factor that predicts achievement or failure of the system (Farahat, 2012).

Therefore, this study sought to establish the determinants of students' continual usage intention of the web-based learning management system and to investigate how these determinants can shape the students' intention to use online learning at MUHAS. The Information Systems Success (ISS) model (Delone and Mclean, 2003, 2004) has received great attention in IS literature and provides a theoretical basis for investigating student's attitudes and continual usage intention of web-based learning management system in this study.

CONCEPTUAL MODEL AND RESEARCH HYPOTHESES DEVELOPMENT

Information system models and theories are commonly used in many studies that investigate determinants of the acceptance and usage of e-learning technologies. This study used

Information Systems (IS) success model of Delone and McLean (1992), and its extended model (Delone and Mclean, 2003, 2004) to better explain the acceptance and usage of e-learning system at MUHAS. The first version of the Delone and McLean's (1992) model has six major dimensions of IS success: system quality, information quality, use, user satisfaction, individual impacts, and organizational impacts. Delone & McLean (2002, 2003) further extended the model to include service quality as the third quality factor and intention to use and net benefits as new dimensions. The factor related to intention to use was added as an alternative measure of ''use because an attitude is worthwhile to measure in some context" (Delone and Mclean, 2004).

Several studies on e-learning acceptance have made attempts to modify and/or re-specify the Delone and McLean (2003; 2004) model. For example, Adeyinka and Mutula (2010) re-specified the IS model to evaluate the effectiveness of WEBCT systems in educational setting at the University of Botswana. The study concluded that content quality, system quality, support service quality, teaching and learning quality, self-regulated learning, intention to use/use, user satisfaction and net benefits were important factors for evaluating the success of WebCT content management systems. Based on the expectancy disconfirmation theory (EDT) and IS success model, Roca et al (2006) proposed a decomposed technology acceptance model in the context of an e-learning service. The study found that users' continuing intention to use e-learning system was determined by satisfaction, which in turn is jointly determined by perceived usefulness, information quality, confirmation, service quality, system quality, perceived ease of use and cognitive absorption.

The recent works of Cheng (2012) used IS success model and Technology Acceptance Model (TAM) (Davis, 1989) to investigate the acceptance and continual usage intention of e-learning system in eight high-tech companies in Taiwan. The study found that information quality, service quality, system quality, and instructor quality influenced employees' perception about their beliefs (i.e. perceived usefulness, perceived ease of use, and perceived enjoyment), and this situation can further enhance employees' usage intention of the e-learning system (Cheng, 2012). Chen (2010) moreover examined the relationship between e-learning systems use and overall job outcomes based on the IS model in Taiwan. The study established that quality factors (information and system) had significant relationship with perceived usefulness, and that system quality has a significantly positive association with user satisfaction. Further, both perceived usefulness and user satisfaction influenced system use, and the overall job outcome.

Seddon (1997) re-specified IS success model of Delone and Mclean (1992), and proposed the relationship between the process and variance models in the original IS success model. Seddon (1997) replaced the IS use factor with four new variables: expectations, consequences, perceived usefulness, and net benefits to society. Seddon (1997) proposed that higher level of expectations about the net benefits of future IS use, (henceforth expectations) will lead to higher levels of IS use. The system use construct was placed outside a revised model of system success because it was deemed as a characteristic of user behavior more than a measure of system success. The construct of perceived usefulness reflects users' perceived value of information system, and it indicates the possibility of other constructs to improve the use of the system through perceived usefulness and user satisfaction (Seddon, 1997). Other scholars moreover argue that the measures of actual use (both observed and self-reported) need respondents to have some experience with the technology (Pynoo et al., 2011; Šumak et al., 2011). Hence, other measures of technology acceptance, such as perceived usefulness and intention to use may be used in the planning or initial stages of implementing technologies (Pynoo et al., 2011; Šumak et al., 2011).

Other information systems studies (Floropoulos et al., 2010; Landrum and Prybutok, 2004) moreover re-specified the IS success model (Delone and Mclean, 2004; Seddon, 1997), into five constructs: information quality, system quality, perceived usefulness, and user satisfaction. The models proposed that quality factors (i.e. information, system and service), influence both

perceived usefulness and user satisfaction (Floropoulos et al., 2010; Landrum and Prybutok, 2004).

This study adopted the Delone and McLean's (2004) extended model, and the re-specified IS success models developed by various scholars (Chen, 2010; Cheng, 2012; Floropoulos et al., 2010; Landrum and Prybutok, 2004; Seddon, 1997) to examine the success of e-learning systems in the Tanzanian's higher education context. In this study, success measures (e.g., instructor quality) were added to the Delone and Mclean model (2004) to suit the educational context of the study. Instructor quality (that is, instructor attitude towards e-learners) has been proven over the years that it has a significant relationship with the perceived usefulness of the e-learning system (Cheng, 2012; Lee et al., 2009). Since the e-learning system has just been introduced at MUHAS, the actual use of e-learning systems in this study shall be predicted by perceived usefulness, user satisfaction and continual usage intentions as suggested in the literature (Seddon, 1997; Šumak et al., 2011). Therefore, this study proposes that perceived quality as operationalized by the four dimensions of information quality, system quality, service quality, instructor quality have significant association with perceived usefulness and user satisfaction, which in turn have a positive relationship with continual usage intention of web-based learning management system as shown in Figure 1.

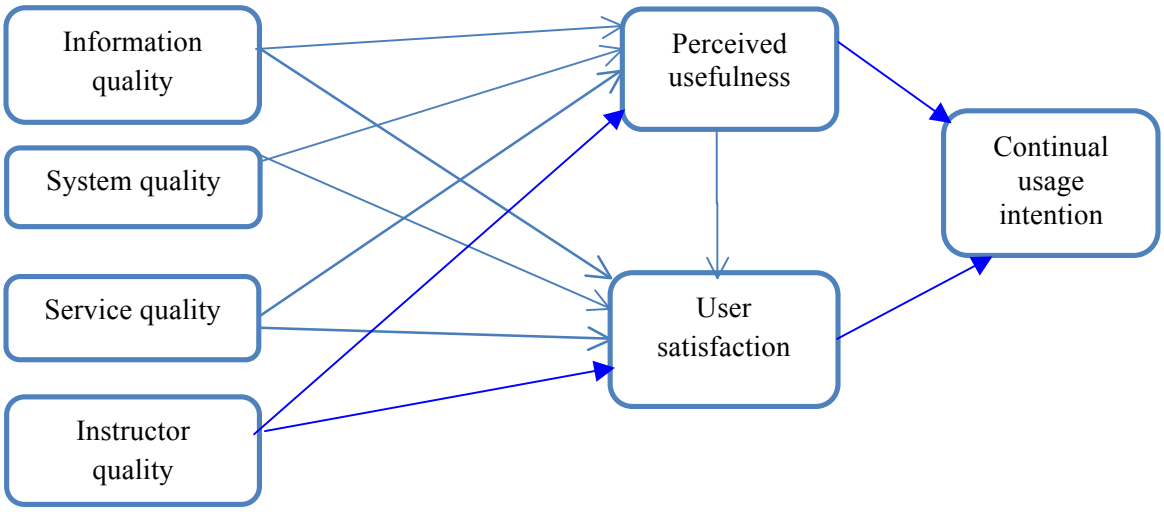


Figure 1: *Research model for the study*

Information quality (InfoQual)

Information quality in this study referred to the quality of course content delivered through the course management system. Course content quality is the, "judgment by (the students) of the degree to which course content management systems are provided with valuable content, concerning the defined needs of the students" (Adeyinka and Mutula, 2010). Measures of information quality includes personalization, completeness, easy to understand, security, timeliness, availability, relevance, and format of course contents delivered through the e-learning systems. Previous studies have shown that information quality has significant positive impacts on perceived usefulness of e-learning systems (Chen, 2010; Cheng, 2012). Besides, research demonstrates that information quality has significant positive effects on user satisfaction of e-learning systems (Ramayaha and Leeb, 2012; Roca et al., 2006; Wang and Chiu, 2011). Thus,

the quality of course contents may be important reason for students to perceive the usefulness of e-learning systems and to have higher levels of satisfaction with using e-learning systems. Hence, the study posed the following hypotheses:

H1: Information quality has a significant positive relationship with perceived usefulness of e-learning systems

H2: Information quality has a significant positive relationship with user satisfaction of e-learning systems

System quality (SysQual)

In the context of this study, the system quality measures the desired characteristics of the e-learning system. The metrics for system quality include responsiveness, usability, availability, reliability, and adaptability (Delone and Mclean, 2004). Prior studies show that system quality is a significant predictor of perceived usefulness of e-learning system (Chen, 2010; Cheng, 2012). Consequently, system quality was a significant determinant of user satisfaction of e-learning system in various studies (Chen, 2010; Ramayaha and Leeb, 2012; Roca et al., 2006). Thus, the more that students believe the web-based learning management systems will be reliable, available, and easy to use, the more they will use it. Hence, the study posed the following hypotheses:

H3: System quality has a significant positive relationship with perceived usefulness of e-learning systems

H4: System quality has a significant positive relationship with user satisfaction of e-learning systems

Service quality (ServQual)

Service quality refers to the overall support provided by the service provider, such as the ICT department, or specific unit in an organization, or outsourced services (Delone and Mclean, 2004). In this study, service quality refers to the support delivered by ICT technical staff. Measures for service quality include responsiveness, effectiveness and availability of technical support personnel (Delone and Mclean, 2004). Cheng (2012) found service quality as a useful determinant of perceived usefulness in e-learning systems usage. Consequently, various scholars showed that service quality significantly predicted user satisfaction of e-learning systems (Ramayaha and Leeb, 2012; Roca et al., 2006; Wang and Chiu, 2011). Hence, the study proposed the following hypotheses:

H5: Service quality has a significant positive relationship with perceived usefulness

H6: Service quality has a significant positive relationship with user satisfaction of e-learning systems

Instructor quality (InstQual)

Instructors are important people for shaping learners' behaviour in the e-learning course, and thus their attitude may affect learners behaviour (Cheng, 2012). Metrics of instructors quality include instructor's response timeliness, teaching style, and explanation/help towards learners through the e-learning system (Cheng, 2012). Prior studies found that instructor attitude towards e-learners had a significant positive relationship with perceived usefulness of the e-learning system (Cheng, 2012; Lee et al., 2009). Hence, the study proposed the following hypotheses:

H7: Instructor quality has a significant positive relationship with perceived usefulness of e-learning systems
H8: Instructor quality has a significant positive relationship with user satisfaction of e-learning systems

Perceived usefulness (PU)

Perceived usefulness is a "a perceptual indicator of the degree to which the stakeholder believes that using a particular system has enhanced his or her job performance, or his or her group's or organization performance" (Seddon, 1997). In this study, perceived usefulness relates to the degree to which the students believe that using the e-learning system shall improve their learning performances. Several scholars have acknowledged the strength of the perceived usefulness factor in determining the continual usage intention in technology acceptance studies (Pušnik et al., 2011; Venkatesh et al., 2003), and e-learning systems studies (Cheng, 2012; Lee et al., 2009; Lee, 2010; Lin and Wang, 2012; Venter et al., 2012). Besides, prior studies show that perceived usefulness has significant impacts on user satisfaction of e-learning system (Chen, 2010; Lin and Wang, 2012; Roca et al., 2006; Seddon, 1997). Learners can more readily accept an e-learning system once they believe that it will help them achieve their academic goals. Hence, the study proposed the following hypotheses:

H9: Perceived usefulness has a significant positive relationship with user satisfaction of e-learning systems

H10: Perceived usefulness has a significant positive relationship with continual usage intention of e-learning systems

User satisfaction (US)

This construct is a perception of satisfaction a user has with a system in relation to what the user expected upon first use of the system (Seddon, 1997). Measures of satisfaction include adequacy, effectiveness, relevance, dependability and usefulness (Urbach and Müller, 2012). Various studies have established that user satisfaction has a significant positive relationship with continual usage intention of e-learning systems (Chen, 2010; Cho et al., 2009; Lee, 2010; Lin and Wang, 2012; Roca et al., 2006; Wang and Chiu, 2011). Thus, the study proposed the following hypotheses:

H11: User satisfaction has a significant positive relationship with continual usage intention of e-learning systems

METHODOLOGY

This is an exploratory study which was conducted at MUHAS. The questionnaires were physically distributed to all first year undergraduate students (n=408) during the end of the second semester of 2012/2013. The rate of response was 66.7%. The study developed survey questions based on existing, tested and verified instruments to ensure content validity. The first part of the questionnaire consisted of questions about the student's demographic characteristics and usage experience of internet and e-learning. The second part contained questions about factors affecting adoption of e-learning based on the research model (see Figure 1). The study adapted measures of information quality from various scholars (Cheng, 2012; Lin and Wang, 2012), and included the following items: timeliness, availability, relevance, and format of course contents delivered through the e-learning systems. Six items selected from Cheng (2012) were used to

measure system quality, which included functionality, interactivity, system responsiveness, usability and usefulness. Service quality was measured through the responsiveness, effectiveness and availability of technical support personnel items which were adapted from various studies (Balaban et al., 2013; Cheng, 2012). Metrics of instructors' quality included instructor's response, timeliness, teaching style, and explanation/help towards learners through the e-learning system, which were adapted from Cheng (2012). Three items measuring user satisfaction were adapted from Lin and Wang (2012), which were adequacy, effectiveness and usefulness. Four items selected from various scholars (Cheng, 2012; Davis, 1989) were used to measure perceived usefulness, which included the following: using the e-learning system to increase productivity and control over learning, and enhancing effectiveness.

A five-point Likert scale, ranging from ''1 = strongly disagree'' to ''5 = strongly agree'', was used for all the items in the survey questionnaire, except for self-reported use that ranged from ''never (1)" to ''extremely frequent (7)". Each construct measured between three to six items. The study used the structural equation modelling (SEM) for data analysis by using AMOS version 21.0. The study conducted Confirmatory Factor Analysis (CFA) to determine the reliability and validity of the measurement model; and the structural model was used to analyse the hypothesized relationships formulated in the conceptual framework (Hair et al 2010).

RESULTS

Table 1 describes the demographic characteristics of study participants. Three quarters of study participants (79.8%, n=217) had used the e-learning system, but most were passive users and only a few (23.1%, n=51) were actively contributing to discussions and engaging with fellow students and lecturers. Over half of the respondents (65.6%, n=145) acknowledged that they had moderate experience with using e-learning systems. Slightly less than half of respondents (40.8%, n=111) had used the e-learning systems from slightly frequent to extremely frequent.

***Table 1**: Demographic characteristics of respondents*

		Frequencies	**Percentages**
Gender	Female	112	41.2
	Male	160	58.8
Age	18 - 21 years	110	40.4
	22 – 26 years	111	40.8
	27 – 31 years	26	9.6
	32 years and above	25	9.2
Degree programs	Doctor of Medicine	139	51.1
	Bachelor of Nursing	56	20.6
	Bachelor of Pharmacy	31	11.4
	Doctor of Dentistry	21	7.7
	Bachelor of Medical Laboratory Sciences	17	6.2
	Bachelor of Science Radiation Therapy Technology	8	2.9
Years of experience with internet	Less than one year	105	39.0
	1-2 years	45	16.7
	2-3 years	25	9.3
	3-4 years	27	10.0

		Frequencies	Percentages
	5 or more years	67	24.9
E-learning usage	Yes	217	79.8
	No	55	20.2
E-learning experience	Low experience	57	25.8
	Moderate experience	145	65.6
	High experience	19	8.6
Participation in online discussions	Yes	51	23.1
	No	170	76.9
Frequency of using e-learning	Almost never	55	20.2
	Extremely infrequent	43	15.8
	Quite infrequent	33	12.1
	Slightly infrequent	30	11.0
	Slightly frequent	71	26.1
	Quite frequent	32	11.8
	Extremely frequent	8	2.9

Measurement model

The study conducted the first-order confirmatory factor analysis (CFA) to test the measurement model and to ensure the validity of the study findings. The study used several common indices to evaluate overall goodness-of-fit between the research model and the data: normed v2, root mean square error of approximation (RMSEA), comparative fit index (CFI), the incremental fit index (IFI), the non-normalized fit index (NNFI), and the adjusted goodness-of-fit index (AGFI). The ratio of the chi-squared value to the degrees of freedom X^2/df for measurement model was 1.637 (X^2 = 460.124 with df 281), which is smaller than 3 as recommended by Hair et al. (2010), and it indicated a good fit for the measurement model. Other remaining indices also exceed their respective acceptable values as recommended by the literature (Hair et al., 2010) (see Table 2). Thus, the measurement model fits the sample data well.

***Table 2**: Fit indices for measurement and structural models*

Fit measures	Recommended values	Measurement model	Structural model
X^2 /df	≤ 3.00	1.637	1.658
AGFI	≥0.80	0.825	0.824
CFI	≥0.90	0.955	0.953
IFI	≥0.90	0.956	0.954
RMSEA	≤ 0.08	0.054	0.055
NNFI (TLI)	≥0.90	0.944	0.942

The study examined reliability and validity of the survey items by using convergent validity and discriminant validity criteria. Convergent validity of the measurement scales determined the

extent to which items on a scale are theoretically related. The study assessed the convergent validity by using four indices: reliability of respective question item, factor loadings from CFA, composite reliability (CR), and average variance extracted (AVE). The reliability of survey question item was ascertained by calculating Cronbach's alpha to measure internal consistency of the multi-item scales used in this study. Table 4 shows that the Cronbach's alpha value of all variables were greater than the acceptable value 0.7 (Cronbach, 1951), thus all variables were reliable and they had high internal consistency.

Moreover, convergent validity was evaluated by examining the factor loadings from the confirmatory factor analysis (see Table 3). Literature recommends that all factor loadings should be significant and greater than 0.50 (Hair et al., 2010). The standardized factor loading for all 27 items were significant ($p<0.01$) and they had value greater that 0.6 on the respective constructs. Thus, all factors in the measurement model had adequate convergent validity.

Table 3: *Result of confirmatory factor analysis for measurement model*

	Internal reliability Cronbach alpha	**Factor loadings**
Information quality (InfoQual)	0.862	
1. The chosen e-Learning tool provides important and helpful knowledge and information for my study.		0.777
2. Overall knowledge or information provided by the chosen e-Learning tool is satisfactory		0.793
3. This e-learning tool makes it easy for me to share ideas with my group mates		0.643
4. The knowledge or information provided from the e-learning system (Moodle) is available at a time suitable for its use		0.761
5. The information provided by the e-learning system appears readable, clear and well formatted		0.751
System quality (SysQual)	0.874	
6. The e-learning system can give the means for taking tests and turning in assignments.		0.697
7. The e-learning system enables interactive communication between the instructor and learners		0.664
8. The response time of the e-learning system is consistent.		0.778
9. The response time of the e-learning system is reasonable		0.813
10. The layout of the e-learning system is user-friendly		0.721
11. The layout of the e-learning system is in good structure.		0.724
Service quality(ServQual)	0.791	
12. A specific person (or group) is available for assistance with system difficulties		0.781
13. ICT staff respond promptly		0.911
14. Overall, support services of the e-learning system are satisfactory		0.765
Instructor quality (InstQual)	0.860	
15. The instructor promptly responds to learners' questions via the e-learning system.		0.847
16. The instructor communicates well with learners via the e-		0.908

	Internal reliability Cronbach alpha	**Factor loadings**
learning system		
17. Overall, the instructor's attitude is conducive to learners' learning via the e-learning system.		0.758
Perceived usefulness (PU)	0.913	
18. Using E-learning would increase my productivity in my course work		0.853
19. Using the e-learning system gives me greater control over learning		0.867
20. Using E-learning would enhance my effectiveness in learning.		0.858
21. By using the functions of the e-learning system I can concentrate more on my other studies		0.831
User Satisfaction (US)	0.839	
22. I am satisfied with the effectiveness of e-learning system		0.819
23. I am satisfied with the performance of e-learning		0.781
24. In general, using the e-Learning tool would give me a sense of satisfaction		0.880
Continual usage intention (CUI)	0.905	
25. I intend to continue using the e-learning system for knowledge construction and sharing		0.970
26. I intend to continue using the e-learning system for my coursework frequently		0.804
27. I intend to continue using e-learning system for my coursework more in the next semester		0.917

The results of the convergent validity using CFA are further shown in Table 4. The values of CR and AVE for all constructs were greater than the minimum acceptable values of 0.7 and 0.5 (Hair et al., 2010). Thus, the research model can be considered to have acceptable convergent validity.

The study assessed the discriminant validity to determine the extent to which the items measure a construct. According to Fornell and Larker, the square root of the AVE from the construct should be greater than the correlation shared between the construct and other constructs in the model (Fornell and Larcker, 1981). Table 4 shows that the AVE of each construct is greater than the squared correlation for each pair of constructs, indicating that each construct is distinct. In summary, the measurement model demonstrated adequate reliability, convergent validity, and discriminant validity.

Table 4: *Composite Reliability (CR), Average Variance Extracted (AVE) and Discriminant Validity of constructs*

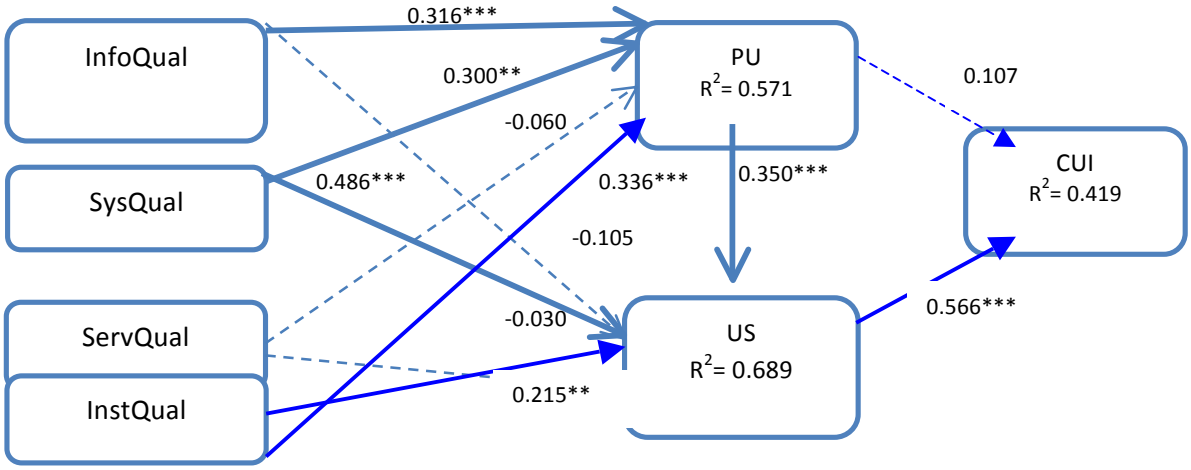
	CR	**AVE**	**US**	**InfoQual**	**ServQual**	**SysQual**	**InstQual**	**PU**	**CUI**
US	0.867	0.685	0.828						
InfoQual	0.863	0.558	0.486	0.747					
ServQual	0.861	0.675	0.483	0.590	0.822				
SysQual	0.875	0.539	0.714	0.643	0.658	0.735			
InstQual	0.877	0.705	0.629	0.435	0.476	0.570	0.840		
PU	0.914	0.727	0.707	0.619	0.483	0.651	0.617	0.852	

CUI	0.927	0.809	0.595	0.369	0.328	0.597	0.400	0.502	0.900

Structural model

The overall fit measures for the structural model included the following: X^2 /df = 1.658 (X^2 = 472.412 with df 285), AGFI = 0.824, CFI = 0.953, IFI = 0.954, TLI = 0.942, and RMSEA = 0.055. These fit indices of the structural model were greater than the recommended values as shown in Table 3, which indicate that the model fits the data well.

Hypothesis testing
The results from the structural equation modelling show that all of the hypothesized relationships were supported, except the four relationships. Figure 2 shows the standardized path coefficients, their significance for the structural model, and the coefficients of determinant (R2) for each endogenous construct.



Note: p* <0.05, p**<0.01, p***<0.001

***Figure 2**: Hypotheses testing results: standardized path coefficients and significance*

The results show that information quality had significant positive effects on perceived usefulness, but it had insignificant effects on user satisfaction, hence H1 was supported (b=0.316), but H2 was rejected. System quality was positively related to perceived usefulness and user satisfaction, hence both H3 and H4 were both supported (b= 0.300 and 0.486 respectively). Service quality had insignificant relationship with perceived usefulness and user satisfaction, hence H5 and H6 were rejected. Instructor quality was positively related to perceived usefulness and user satisfaction, hence both H7 and H8 were supported (b= 0.336 and 0.215 respectively). Moreover, perceived usefulness had significant positive relationship with user satisfaction, but it had insignificant effects on continual usage intention, hence H9 was supported (b=0.350), but H10 was rejected. Lastly, user satisfaction had significant effects on continual usage intention, hence H11 was supported (b=0.566). The model accounted for 57.1% of the variance explained in perceived usefulness, 68.9% of the variance in user satisfaction, and 41.9% of the variance in continual usage intention.

Table 5 shows the direct, indirect and total effects of information quality, system quality, service quality and instructor quality on perceived usefulness, user satisfaction and continual usage

intention. The results show that user satisfaction had higher impacts on continual usage intention than the other determinants within the model. Among the four quality-related constructs, system quality had the strongest total effect on continual usage intention.

Table 5: *The direct, indirect and total effect of variables depicted*

	Direct effects			**Indirect effects**			**Total effects**		
	PU	**US**	**CUI**	**PU**	**US**	**CUI**	**PU**	**US**	**CUI**
InfoQual	0.316	-0.105			0.111	0.037	0.351	0.006	0.042
SysQual	0.300	0.486			0.105	0.366	0.380	0.703	0.473
ServQual	-0.060	-0.030			-0.021	-0.035	-0.057	-0.046	-0.034
InstQual	0.336	0.215			0.118	0.224	0.376	0.349	0.255
PU		0.350	0.107			0.198		0.329	0.311
US			0.566						0.614

DISCUSSION OF STUDY FINDINGS

This study adapts the IS success model (Delone and Mclean, 2003, 2004), and the re-specified IS success models developed by various scholars (Chen, 2010; Cheng, 2012; Floropoulos et al., 2010; Landrum and Prybutok, 2004; Seddon, 1997) to examine the significant factors for acceptance of web-based learning management systems at MUHAS in Tanzania. The model developed, combined seven variables: information quality, system quality, service quality, instructor quality, perceived usefulness, user satisfaction and continual usage intention.

The empirical results show that system quality was a significant positive determinant of perceived usefulness and user satisfaction, derived when using the e-learning system. System quality further exhibited stronger effects on the intention to use e-learning systems more than other quality factors. Good system characteristics such as guaranteed response time, interactivity, user interface and better design functionalities are important factors in enhancing utilization and satisfaction of e-learning systems. Students usually perceive that e-learning systems are useful, and they are satisfied with using a system that provides easy and user-friendly operations, a finding that corresponds to the works of Chen (2010), and Cheng (2012).

Instructor quality was a significant predictor of both perceived usefulness and user satisfaction. The higher the instructor quality, the higher the overall usefulness and satisfaction of using e-learning systems, as perceived by the learners. These results are consistent with earlier research (Cheng, 2012; Lee, 2010). Instructor quality, such as ability to respond to students' queries and good communication to learners can increase productivity and effectiveness of student's learning processes, and consequently the overall satisfaction of e-learning system as perceived by learners.

Information quality was a significant determinant of perceived usefulness, but had no relationship with the user satisfaction. On one hand, this finding shows that if students perceive the e-learning system has accurate, updated, reliable, readable and well formatted course contents, they will find the online courses more useful for their learning processes. These results support previous research (Chen, 2010; Cheng, 2012). On the other hand, the insignificant influence of information quality on user satisfaction may be because the e-learning system had just been introduced at the University. Thus, most students were not familiar with the system, and it could be possible that they were not able to decide on the relevance of course content on the e-learning system.

Service quality had insignificant association with perceived usefulness and user satisfaction. This finding could be due to the fact that most study participants had moderate experience (65.6%, n=145) and thus service quality was not a significant factor in predicting their perceived usefulness and satisfaction. However, other studies have shown that technical guidance and support play a key role in enhancing learners' e-learning acceptance (Cheng, 2012; Ramayaha and Leeb, 2012; Roca et al., 2006; Wang and Chiu, 2011). It is important to improve ICT support services in Tanzanian institutions to enhance students' intentions to to continue using the e-learning systems. According to Wang and Chiu (2011), "learning is an interactive process between instructors and learners, not the interaction between information systems and users". Technical support for ICT is essential for enhancing service quality that can aid students to use the e-learning system, leading to increased user satisfaction with the system.

Perceived usefulness moreover had significant association with user satisfaction, but had no effects on continual usage intention of the e-learning system. Indications are that perceived benefits such as increased productivity, effectiveness, and greater control over learning can thereby increase user satisfaction with the e-learning system. The positive association between perceived usefulness and user satisfaction was consistent with earlier studies (Chen, 2010; Floropoulos et al., 2010; Lin and Wang, 2012; Roca et al., 2006; Seddon, 1997). The perceived usefulness of e-learning systems is an important extrinsic motivator for user satisfaction of e-learning system. Perceived usefulness however was insignificant in enhancing continual usage intention of e-learning systems, which may lead one to question whether students are aware of the potential benefits of e-learning system.

User satisfaction was directly and significantly associated with user intention to continue using e-learning systems, a finding that corresponds to earlier studies (Chen, 2010; Cho et al., 2009; Lee, 2010; Lin and Wang, 2012; Roca et al., 2006; Wang and Chiu, 2011). Indications are that students intend to continue using e-learning system based on their perception of using the system more than their experiences and perceived usefulness of the system.

CONCLUSIONS

This study used IS success model (Delone and Mclean, 2003, 2004), and the re-specified IS success models developed by various scholars (Chen, 2010; Cheng, 2012; Floropoulos et al., 2010; Landrum and Prybutok, 2004; Seddon, 1997) to examine the significant factors for acceptance of web-based learning management systems at MUHAS in Tanzania. The model developed, combined seven variables: information quality, system quality, service quality, instructor quality, perceived usefulness, user satisfaction and continual usage intention. The results show that quality factors (instructor and system) were a predictor of perceived usefulness and user satisfaction, and that information quality was found to significantly affect perceived usefulness. Further, perceived usefulness was a key determinant of user satisfaction, which in turn predicted continual usage intention of the e-learning systems. Understanding the nature of these factors may help universities in sub-Saharan Africa and Tanzania in particular to promote the use of e-learning systems and services for teaching and learning processes. It is thus important for e-learning system designers and providers, and course instructors to consider all these factors for effective acceptance and usage of e-learning systems and services.

IMPLICATION FOR PRACTICE

The study provides managerial insights to university management and e-learning managers on how to motivate students to continue using e-learning systems in higher learning institutions. The

implications of this study are in five folds. Firstly, the study found that system quality was a significant predictor of perceived usefulness and user satisfaction. The study suggests that system designers should develop e-learning systems with better functionalities, interactivity, user interface and guaranteed response that reflect user requirements to enhance student's acceptance and usage of the system. System designers should also conduct regular user needs survey to update e-learning system features according to user's disparate needs. Course instructors should also take the advantage of multimedia functions that exist at the e-learning systems to motivate students to use the e-learning systems.

Secondly, the findings indicated that the instructor's attitude towards e-learners had significant association with the perceived usefulness and user satisfaction. This study first suggests that instructors should give sufficient, appropriate and timely feedback to students via the e-learning systems. Secondly, instructors should develop interactive online courses to motivate students to make greater use of e-learning systems. Thirdly, the ICT directorates or e-learning unit at the universities should conduct regular continuing professional development programmes or workshops to build the capacity of course instructors on design and delivery of online courses. These workshops should be supplemented with online faculty development tutorials to improve expertise in the design and delivery of e-learning courses.

Thirdly, service quality had insignificant association with perceived usefulness and user satisfaction. However, other studies have shown that service quality play a key role in enhancing learners' e-learning acceptance (Cheng, 2012; Ramayaha and Leeb, 2012; Roca et al., 2006; Wang and Chiu, 2011). This study suggests that e-learning units or ICT directorates should play a key role in providing technical ICT support in terms of help desks, and training to students to facilitate learners' e-learning acceptance. They should also make sure that the e-learning system has adequate online help services and tutorials to enhance usage of e-learning systems among students.

Fourthly, information quality had significant relationship with perceived usefulness. This finding suggests that course instructors, designers and e-learning managers should motivate students to use e-learning systems by developing learner-centered programmes, which are relevant, regularly updated, and well formatted.

Lastly, perceived usefulness had positive impact on user satisfaction, which in turn had significant association with students' continual usage intentions of e-learning system. The e-learning system designers should therefore develop e-learning systems that deliver benefits and pleasures to learners without complicating the learning process (Cheng, 2012). However, findings showed that perceived usefulness had insignificant relationship with continual usage intention. This study suggests that e-learning managers and providers, and instructors need to educate students on the benefits of e-learning system to enhance acceptance of e-learning systems. In summary, it is important for e-learning system designers and providers to improve all quality factors (information quality, system quality, service quality and instructor quality) to make the learning process more useful, and increase students' satisfaction, which may lead to continued intention to use the e-learning systems.

LIMITATIONS AND FURTHER RESEARCH

This study has several limitations. First, the study surveyed only first year undergraduate students because they were the first batch of students to use the e-learning system at MUHAS. Second, the study did not measure net benefits, as proposed by both Delone and McLean (2004) and Seddon (1997). Thus, future studies should examine the impact of this success factor. Third, the study focused on a web-based learning management system adopted by a specific university,

and thus the study findings cannot be generalized to other universities using different e-learning systems. Further studies that assess various e-learning platforms, and which include students from different years of study and that cover multi-institutions would improve the generalizability of the study findings.

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The impact of computer and mathematics software usage on performance of school leavers in the Western Cape Province of South Africa: A comparative analysis

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ABSTRACT

In this study the impact of computer immersion on performance of school leavers Senior Certificate mathematics scores was investigated across 31 schools in the EMDC East education district of Cape Town, South Africa by comparing performance between two groups: a control and an experimental group. The experimental group (14 high schools) had access to computers since 2001 while the control schools received computers between 2006 and early 2007. That is, the experimental schools could be expected to be more immersed in computer technology than the control schools. Findings indicated that there was no significant difference between the final Senior Certificate mathematics results of the schools with the computers and those without; no significant change in the results after the Khanya labs were installed; no significant change in the percentage of pupils that passed Senior Certificate Mathematics; and no significant change in Higher Grade Maths enrolment rates. This finding points to the need for caution in the implementation of ICT's into schools as a potential panacea for mathematical failure in our context. Recommendations for further qualitative work to provide a more nuanced picture of computer usage should be made.

Keywords: *computer assisted learning; high school; impact study*

INTRODUCTION

The rationale for this research is twofold: on the one hand South Africa currently faces a crisis in mathematics education, which has seen it placed last[1] in the Third International Mathematics and Science Study (Howie 2001; Howie et al., 2000; Global competitiveness report 2013, Evan 2013). Despite improvements[2] in the Senior Certificate[3] results over the 19 year period since the first democratic elections, Chisholm (2004) indicates that the quality of primary education remains poor in South Africa, especially in under-resourced schools, where grade 6 students, for example, perform 3 years below grade level (Taylor, Muller and Vinjevold 2003). Recent research (Evans, 2013) indicates that South Africa is ranked second last in the world in terms of mathematics and science proficiency. In a bid to address this problem and build technological capacity in the country, especially in disadvantaged schools, the Western Cape Education Department (WCED) has committed itself to the integration of computer technology into schools under the Khanya project initiative. The introduction of computer software to improve mathematical performance is

[1] The international average score for 38 countries was 487 points; South Africa achieved a total of 275 points.

[2] The extent to which these results represent real gains has been a much debated issue in the local media, see for example Jonathan Jansen's 'Matric quick fixes miss the mark' published in the *Sunday Times* 4/1/2004 which sparked a flurry of commentary.

[3] This is a school leaving examination, colloquially referred to as the 'matric exam', which students write in their final year of schooling. Obtaining a matric endorsement enables students to proceed to university.

informed by a well-established relationship between learning outcomes and learning resources (Schollar 2001). The assumption underlying the implementation of computer-based technology, such as mathematics software, into schools in South Africa is that the technology will help to develop autonomous learners, who are both mathematically and technologically literate and, in doing so, will help to bridge the digital divide that continues to grow in South Africa (Department of Education 1996; 2000). While there are some studies (Howell and Lundall 1997, 2002; Organisation for Economic Co-operation and Development (OECD) 2003; Howie, Muller and Paterson 2005; Hardman 2008) that investigate the implementation of computers into schools in South Africa and while the South African Institute for Distance Education (SAIDE) (2004) research uses case study methodology, an extensive[4] review of the research in the field in South Africa has not revealed any comprehensive case studies that investigate the impact of computers on Senior Certificate results. What is disturbing is that international benchmarking, in the form of the Trends in International Mathematics and Science Study (TIMSS), shows that South African pupils are way below their peers internationally when it comes to Mathematics (and, indeed, Science).

A further indicator that all is not well in the sphere of Mathematical education in South Africa is the ongoing poor Matric[5] Mathematics enrolment and results. The first issue is the very low number of pupils that chose Mathematics as a subject in the Grade 10-12 band under the previous curriculum, where it was optional (all pupils in Grades 10-12 now have to take either Mathematics or Maths Literacy). For example, in 2007 only 61.5% of enrolled Matrics chose Mathematics as a subject (Department of Education 2009). The second issue is the number of pupils that *passed* Mathematics at Matric Level: in 2007 less than a third (32.5%) of all Matric pupils gained a pass in Mathematics at some level, with only 4.5% passing at Higher Grade level; the level accepted by universities as sufficient for study in the science or technology fields (Department of Education 2009).

Various attempts have been made by governmental and non-governmental departments and organisations to ameliorate this alarming situation. In particular, with reference to this article, the Western Cape Education Department (WCED) established the Khanya Project in April 2001 “to determine the contribution that technology could make towards addressing the increasing shortage of educator capacity in schools. With many skilled educators leaving the profession, fewer ones entering it, and AIDS already starting to take a significant toll amongst educators, it was necessary to explore alternatives. One of these alternatives is to use technology, already being used extensively in other disciplines, as an aid to augment teaching capacity” (van Wyk 2002 p.21).

The Khanya Business Plan, version 4.1 and dated 26 March 2002, described the “very ambitious goal” of the project to be: “By the start of the 2012 academic year, every educator in every school of the Western Cape will be empowered to use appropriate and available technology to deliver curriculum to each and every learner in the Western Cape.” (van Wyk 2002, p.10). The emphasis of the Khanya Project is “to use technology as a teaching aid, hence to improve curriculum delivery.” (van Wyk 2002, p.11).

In order to meet its goals, the Khanya Project has since its inception been rolling out technology (computers, computer laboratories, numeracy and literacy software, ICT teacher training and technical support) to some of the most disadvantaged schools around the Western Cape in a series of phases, termed ‘waves’. By 2007 there had been seven such waves. The mathematical

[4] This search focused on 1) published journal articles, 2) government reports and 3) NGO websites.

[5] Matric is the name given to set of school-leaving examinations written by Grade 12 pupils in South Africa.

software systems provided to the high schools in the Khanya Project are one of two South African-produced systems: MasterMaths (2007) or CAMI Maths (2009). Both are examples of what is termed Computer Assisted Instruction (CAI), defined as involving the use of computers and computer software to provide drill exercises and tutorials (Kirkpatrick and Cuban 1998). While current research in CAI focuses on authentic learning as opposed to mere drill and practice exercises and tutorials, the Khanya project's chosen software is best described as drill and practice and not as promoting authentic learning (Hardman, 2008).

It is against this background of poor Mathematics enrolment in the last three years of high school, disappointingly low Matric Mathematics pass rates, and the Khanya intervention as one means of ameliorating these issues that this research was undertaken in one education district of the Western Cape Province of South Africa, in order to see if the access to the Khanya computers has had any significant impact on Matric Mathematics results and Higher Grade enrolment. We hypothesised that computers would impact positively on student performance.

Research on a Link between Computer Usage and Academic Attainment - Computers and Mathematics Performance in Developed Nations

The impact of computers on academic (particularly mathematical) attainment is a much studied topic in the developed world, with numerous studies emanating from research in the United Kingdom – see Watson (1993); BECTA (2001); Higgins (2001); Harrison et al. (2002); Harrison, Lunzer, Tymms, Fitz-Gibbon and Restorick (2004) – and the United States – see Christmann, Badgett and Lucking (1997); and Tienken and Wilson (2007).

A recent landscape review of the impact of ICT in schools (Condie and Munro 2007) analysed over 350 varied literature sources published since 2000 that are related to the impact of ICT in UK schools. Their highly equivocal conclusion is the following: "the evidence of the impact of ICT on attainment is, as yet, inconsistent, although there are some indications that in some contexts, with some pupils, in some disciplines, attainment has been enhanced. There is not a sufficient body of evidence in any of these areas, however, to draw firm conclusions in terms of explanatory or contributory factors" (Condie and Munro 2007, p. 29).

All these studies were originated from relatively wealthy European or North American nations. This is unfortunate but unavoidable as it is only in those countries where computers have been used in schools for many years, and for which there are decades of research into ICT impact. It is questionable whether all the findings outlined will be transferable to impoverished schools in a city at the foot of Africa.

Research showing Positive Impact on Particular Strands of Mathematics

Amidst this ambivalence, a number of studies have shown ICT to have produced positive effects in various strands of Mathematics:

- Clements (2002) reported that the use of Logo helped pupils to develop higher levels of geometric thinking and to learn geometric concepts and skills; while Forsythe (2007) discovered that the use of dynamic geometry software (specifically, Geometer's Sketchpad) aided geometric understanding.
- Raghavan, Sartoris and Glaser (1997) showed that 6th grade pupils who were taught concepts of area and volume using a computer-based programme performed better overall than 8th grade pupils taught traditionally, especially on the more complex problems.

- Various studies have shown the positive effect of computer algebra software and tutoring programmes on algebra exam scores – see Koedinger et al. (1997), Shaw, Jean and Peck (1997), Stephens and Konvalina (1999) and Barrow et al. (2007).
- Cox and Nikolopoulou (1997) and Hennessy (2000) illustrated the benefits of the use of computers in developing data-handling skills, extrapolation and interpolation.

One topic-based piece of research that shows clearly that using computers produced worse results than more traditional teaching methods is that of Wong and Evans (2007). Their study, involving Year 5 pupils in Sydney, Australia, showed that pen and paper instruction (PPI) methods was better than a computer based computer software package (Back to Basics Maths Multiplication) in improving pupils' basic multiplication fact recall.

Research on Computers and Mathematics Performance in Developing Nations

When one reads literature reviews on ICT and attainment, like that of Cox et al. (2003) or Condie and Munro (2007), one is struck by the large body of research that has been done in developed countries, and the almost complete lack of (reported) research in developing nations, like South Africa. It has been shown that the level of effectiveness of computers in improving mathematical understanding is context-dependent (Noss and Pachler 1999) and thus this dearth of research into this topic in disadvantaged schools (but particularly *high* schools) around the world is a serious omission that the current paper attempts to address.

The only significant peer-reviewed exceptions to this general paucity are:

i. The Chilean national Enlaces (links) programme, as reported in Hinostroza et al. (2002) and Somekh (2007). This programme, which provided computers, educational software and the like to the vast majority of Chilean schools was shown to have a number of peripheral positive impacts, yet case studies of some of the schools in the *Enlaces* programme have not provided evidence of measurable gains on traditional national students' assessment tests.

ii. An Indian study on computer–assisted learning (CAL) by Banerjee et al. (2005) involving an investigation of 15 000 students. They studied a two year long CAL programme for over 15 000 children in Grades 2 to 4 in the city of Vadodara, and found that mid- and post-intervention test scores showed that the CAL programme had had a substantial, statistically significant positive effect on Mathematics achievements, increasing Mathematics scores by 0.35 standard deviations in the first year of the intervention and 0.47 in the second year. It was equally effective for all pupils, from the strongest to the weakest academically.

iii. A Turkish study on the use of dynamic geometry software, as reported by Isaksal and Askar (2005), reported no statistically significant impact of computer use. This study, involving 7th grade pupils from one school instructed in a variety of mathematical topics, showed that there was no mean significant difference between the scores of the Autograph- and traditionally taught groups.

iv. A South African study by Louw et al. (2008) into the effect of the use of MasterMaths[6] on Matric mathematics results in a sample of ten schools in the Western Cape province of South Africa; five experimental schools and five sample schools, found that that there "is only equivocal support for the effectiveness of the [Khanya] intervention" (Louw et al.

[6] MasterMaths is a Mathematics software programme that is used by many Khanya schools and which provides tutoring support

> 2008 p. 49), but that "the amount of time that learners spent [using MasterMaths] was significantly correlated with an improvement in mathematics performance" (Louw et al. 2008 p. 49). There "is a clear, but not conclusive indication that the Khanya intervention improves mathematics performance in Grade 12 learners" (Louw et al., 2008 p. 49).

It should be noted that only one of these studies, that of Louw et al. (2008), was completed in what in South African terms would be considered a high school.

As mentioned above, the quantitative aspect of my research will replicate much of the statistical work of Louw et al. (2008), though in different schools and with more recent data. What will be interesting to see is whether the impact of the computers on mathematical performance has increased or decreased a few years after Louw et al's study, bearing in mind that in some Khanya schools the 2007 matric students will have had access to computers and software for 5 years; their entire high school career.

CONCEPTUAL FRAMEWORK

This study draws conceptually on the work of Vygotsky (1978), most specifically on the notion that tools (in our instance computer software and hardware) impact on cognitive development.

Mediation

A fundamental premise of Vygotskian theory is that basic biological (or 'elementary') processes are transformed into higher cognitive functions through the use of culturally meaningful tools (such as language or, indeed a computer) during social interaction (Vygotsky 1978). That is, children are born with certain basic, biological processes, such as for example, perception and the potential for eidetic memory (Diaz, Neal and Amaya-Williams 1993). As the child develops within the social world, these elementary processes are transformed by the child's interaction with the social world. Higher cognitive functions develop first as interpsychological functions, with m/other initially guiding the child's activity, and later 'turn inward' becoming intrapsychological functions. Higher cognitive functions, then, have *social* origins. This conceptualisation of development famously overcomes the prior dualist[7] stance to development by positing that mind is social and is captured in Vygotsky's general genetic law:

> *Every function in the child's cultural development appears twice: first, on the social level, and later on the individual level; first, between people (interpsychological), and then inside the child (intrapsychological). This applies equally to voluntary attention, to logical memory, and to the formulation of concepts. All the higher functions originate as actual relations between human individuals.* Vygotsky 1978, p.57.

What emerges from this law is a clear understanding that the nature and the quality of *mediation* are crucial in the development of higher cognitive functioning and, relatedly, self-regulation. Computer software, then, can be seen to mediate a student's access to mathematics, which is the hypothesis informing this research.

[7] That is, that mind is either naturally 'given' or socially derived.

RESEARCH DESIGN AND METHODOLOGY

The Research Questions

The following questions were investigated in this study:

i. Are Matric Mathematics results in EMDC East high schools that have Khanya computers better than those at EMDC East high schools without Khanya computers?
ii. Have Matric Mathematics results in EMDC East high schools improved since the beginning of the Khanya intervention?
iii. Did the Khanya intervention result in a higher pass rate in Mathematics in EMDC East high schools?
iv. Did the Khanya intervention result in a higher percentage enrolment in Higher Grade mathematics in EMDC East high schools?

In order to establish the impact of technology on mathematical performance in sampled schools, the study undertook a quantitative analysis by comparing the Matric Mathematics results and enrolment of various schools in the EMDC East region; the latter chosen randomly from the four education districts in the greater Cape Town area. It is likely that the results of schools in this region are indicative and typical of all urban schools in the greater Cape Town area.

The data used were secondary in nature; data already collected and categorised and accessed via the WCED database and Khanya. The WCED data provided the Matric Mathematics results (by symbol) for each school in the EMDC East, divided into Higher Grade and Standard Grade results. The Khanya data included a list of all the EMDC East schools, the Khanya wave to which each belonged, and the installation dates of the Khanya computer laboratories and software

Sample

31 high schools in the EMDC East region of Cape Town formed the sample. The experimental group consisted of all 14 EMDC East high schools who had had computers since at least 2001. That is, this represents the entire population of schools with the Khanya intervention. The control group was all 17 EMDC East high schools in the Khanya project who had access to computer from at least 2006.All schools were chosen based on the assumption that computers are used for no less than 1 hour per week by the students for mathematics instruction and that the teachers have had at least on hour's training in the requisite programmes (van Wyk, 2002). However, the authors understand that access to computers does not necessarily ensure use and we read our findings with this in mind.

Data Analysis and Interpretation

It is important to note that the logic behind the Khanya intervention, as stated by Louw et al. (2008), is this: "the principal cause of the low achievement levels in Mathematics was assumed to be the low capacity of teachers, and the ICTs would compensate for low-capacity teachers" (p. 43). Put another way, "the Khanya computers and software were expected to provide the coverage of the curriculum that poorly trained teachers were not able to provide" (Louw et al., 2008 p. 43). The Khanya project was, therefore, implemented in order to impact positively on students' mathematics results through the provision of computers and mathematics software.

Louw et al's (2008) study, based on results in the 2003 Grade 12 final examination, provide a qualified 'yes' as an answer to the question as to whether the Khanya intervention has actually succeeded in improving mathematics marks. The statistical analysis reported here, based on more recent data – the 2007 Matric results - represents an attempt to re-answer this question, and look at various new questions not answered by Louw et al. (2008), such as whether the

intervention resulted in an increase in Higher Grade (as opposed to Standard Grade) Mathematics enrolment.

THE TESTS

The Mean Student Score

Matric results are given as symbols, is converted to numerical data for statistical analysis. The points allocation used by the University of Cape Town (UCT) for Matrics who wrote before 2008 was selected as a suitable conversion table (see Table 1 below):

***Table 1**: UCT's admission rating system for the South African School Leaving Qualification*

ACADEMIC LEVEL	ADMISSION POINTS BY SYMBOL					
	A	**B**	**C**	**D**	**E**	**F**
Higher Grade	8	7	6	5	4	3
Standard Grade	6	5	4	3	2	1

In the Matric HG results received from Khanya and used for analysis no 'F grade' totals are indicated. Instead, all F grades are grouped under 'fail' (as an F is indeed a higher grade fail). However, this did not provide a problem with this analysis as this (minor) absence is consistent across all the data.

After using the above table to convert grades to points, an average score for each pupil was generated. The method used to generate this is quite simple: for each year and each wave we multiplied the number of A grades, B grades et cetera obtained by the pupils in each of the groups by the UCT points allocation. These were then summed and the total divided by the total number of students who wrote Matric Mathematics. We have termed this final statistic the 'mean student score' (MSS).

Test 1: Comparing the 2007 Matric Mathematics Results of an Experimental and Control Group

The first test involved comparing the 2007 Matric Mathematics results between two groups: an experimental group and a control group. The unit of analysis was individual schools, and the size of the study sample was 31 high schools. The experimental group consisted of all 14 EMDC East high schools in the Khanya Pilot, second and third waves[8] (and thus which received their Khanya labs from 2001 to 2003). Pupils at these schools would thus have had at least four years of access to the computer facilities, *assuming they were used*. The control group was all 17 EMDC East high schools in the Khanya sixth and seventh waves, which received their computer labs in the period between late 2005 and 2007. Pupils at these schools would thus have had little opportunity (on average around one year) to use the computer facilities.

[8] The different 'waves' mentioned refer to the different phases of implementation of the Khanya intervention, with the 'pilot wave' being the first group of schools that received the Khanya computers.

A t-test for independent samples was not able to be carried out as the Kolmogorov-Smirnov test for normality indicated that the data is not close to being normally distributed.

***Table 2**: Mean Student Score Ranks (Test 1)*

TEST RESULTS				
	Group	**N**	**Mean Rank**	**Sum of Ranks**
Mean Student Score	2 control	17	14.35	244.00
	3 experimental	14	18.00	252.00
	Total	31		

A non-parametric Mann-Whitney U test, which does not require the assumption of normality, was thus performed on the data instead. The test revealed no significant difference in the mean rank of the experimental group (mean rank = 18; n = 14) and the control group (mean rank = 14.35; n = 17), U = 91; z = -1.11; p = 0.266 (see Tables 2 above and 3 below).

***Table 3:** Mann-Whitney U test results: mean student score (Test 1)*

TEST RESULTS	
Mann-Whitney U	91.000
Wilcoxon W	244.000
Z	-1.111
Asymp. Sig. (2-tailed)	.266
Exact Sig. [2*(1-tailed Sig.)]	.279[a]
a. Not corrected for ties.	
b. Grouping Variable: Group	

The Mann-Whitney U test reported in table 3 revealed no significant difference in the mean rank of the experimental and the control group. The effect size statistic was also calculated as 0.2, which indicates a small to medium effect size using Cohen's (1988) criteria. In other words, a small to medium amount of the variance between the control and experimental groups' Mathematics results is explained by whether or not the students had access to computers.

On re-analysis of the schools within each of the groups, it became clear that the MSS of four schools were acting as outliers, with MSS vastly superior to the other schools in the sample. The two groups were thus re-defined by excluding these schools; one because it was a selective intake school and three others because they are ex-Model C schools[9] with far superior facilities, better qualified teachers and a wealthier pupil body. The exclusion of these four schools ensured a more effective comparative dimension between the experimental and control schools.

[9] Model C schools were, during the Apartheid years, schools for White pupils only and were thus better resourced than township schools.

With these re-defined groups, the Kolmogorov-Smirnov test for normality indicated that the data were normally distributed. Levene's Test for the Equality of Variances gave a significance value of 0.4129, and thus we could assume equal variances for the two groups.

Table 4: *Group Statistics (Test 1 – redefined groups)*

TEST RESULTS					
		N	**Mean**	**Std. Deviation**	**Std. Error Mean**
Mean Student Score	**e**	13	.9286	.48358	.13412
	c	14	.6106	.36505	.09756

A t-test for independent samples was performed with the re-defined groups to compare the mean student scores of the redefined control and experimental groups. This revealed that there is no significant difference between the results for the control schools (mean = 0.6106, std deviation = 0.365) and the experimental schools (mean = 0.9286; std deviation = 0.484); t(25) = 1.938, p = 0.064 (2-tailed) (see Tables 4 above and 5 below).

The effect size statistic eta squared was calculated as 0.131, which indicates a small effect size using Cohen's (1988) criteria. In other words, only a small amount of the variance between the re-defined control and experimental groups' Mathematics results is explained by whether or not the students had access to computers. This is an incredibly low mean as some learners wrote standard grade mathematics and obtained a failing grade, which scored 0 points.

Table 5: Independent Samples t-test results (Test 1 – redefined groups)

TEST RESULTS										
		Levene's Test for Equality of Variances		**t-test for Equality of Means**						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Mean Student Score	**Equal variances assumed**	.676	.419	1.938	25	.064	.31806	.16411	-.01993	.65605
	Equal variances not assumed			1.918	22.297	.068	.31806	.16585	-.02563	.66175

Test 2: Comparing Matric Mathematics Results Before and After the Khanya Intervention

The second test involved comparing the 2003 and 2007 Matric Mathematics results for Khanya schools in the fourth and fifth waves (a sample of 11 different schools). These 11 schools represent the *entire* population of schools which had long term exposure to computers. Schools in these two waves received their Khanya labs and software in the period from 2004 to mid 2005. Essentially this test enabled a comparison of results before and after the Khanya intervention, since in 2003 none of these schools had the Khanya facilities, and by 2007 they would have all had them for at least 2½ years.

***Table 6**: Paired Sample Statistics (Test 2)*

TEST RESULTS				
	Mean	**N**	**Std. Deviation**	**Std. Error Mean**
Mean Student Score (before Khanya)	.9549	11	.38195	.11516
Mean Student Score (after Khanya)	.8267	11	.48608	.14656

The Kolmogorov-Smirnov test for normality indicated that the data were normally distributed, thus a paired samples t-test was conducted to evaluate the impact of the Khanya intervention on the MSS. There is no statistically significant change in the MSS from before Khanya (mean = 0.955; std deviation = 0.382) to after Khanya (mean = 0.827; std deviation = 0.486), t(10) = 0.958, p = 0.361) (see Tables 6 above and 7 below).

***Table 7:** Paired Samples t-test results (Test 2)*

TEST RESULTS								
	Paired Differences					**t**	**df**	**Sig. (2-tailed)**
	Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**				
				Lower	**Upper**			
Mean Student Score (before Khanya) - Mean Student Score (after Khanya)	.12818	.44366	.13377	-.16987	.42624	.958	10	.361

The effect size statistic eta squared was calculated as 0.084, which indicates a very small effect size using Cohen's (1988) criteria. Thus, only a very small amount of the variance between the Mathematics results pre- and post- Khanya intervention is explained by whether or not the students had access to computers.

Further Tests: Impact on the Matric Mathematics Pass Rate and Higher Grade Enrolment

The above tests have indicated that the Khanya intervention has not brought about a significant improvement in the overall Matric Mathematics results. There are other questions that could then be asked, however, such as:

- Did the Khanya intervention at least ensure a greater pass rate at Matric Mathematics? If this were true due to the intervention, it would be an important finding, and would indicate that the computers have been a success at improving the grades of the lowest achievers.
- Did the Khanya intervention bring about a greater (percentage) enrolment in Higher Grade rather than Standard Grade Mathematics? Again, if this were true it would be most encouraging as it is indeed the stated desire of education authorities to have more pupils sit the exams at the former rather than the latter level, as Higher Grade Mathematics is one of the key requirements for entrance to critical university courses like engineering.

Both these questions were answered by using quantitative measures.

With regard to the first question above, for each school in the same sample group as for Test 2, the total number of passes at both Higher Grade and Standard Grade level, and the total number of Matric Mathematics candidates, was determined for both the years of 2003 and 2007. These figures were then used to calculate ~~a~~ percentage of pass for each school. This was the raw data on which a paired samples t-test was carried out to evaluate the impact of the Khanya intervention on the percentage of pupils passing Mathematics at Matric level (the Kolmogorov-Smirnoff test for normality showed that the data was indeed normally distributed).

***Table 8**: Paired Samples Statistics (Test 3)*

TEST RESULTS				
	Mean	**N**	**Std. Deviation**	**Std. Error Mean**
% passing (before Khanya)	40.91	11	16.32	4.92
% passing (after Khanya)	35.80	11	17.40	5.25

The results of this test showed that there was no statistically significant change in the pass percentage from before Khanya (mean = 40.9; std deviation = 16.3) to after Khanya (mean = 35.8; std deviation = 17.4), $t(10) = 0.878$, $p = 0.401$ (see Tables 8 and 9).

***Table 9**: Paired Samples t-test results (Test 3)*

TEST RESULTS								
	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
% passing (before Khanya) - % passing (after Khanya)	5.115	19.324	.5.826	-7.867	18.096	.878	10	.401

***Table 10**: Wilcoxon Signed Rank Test - Ranks (Test 4)*

TEST RESULTS				
		N	Mean Rank	Sum of Ranks
% on HG (after Khanya) - % on HG (before Khanya)	Negative Ranks	2[a]	2.50	5.00
	Positive Ranks	4[b]	4.00	16.00
	Ties	5[c]		
	Total	11		
a. % on HG (after Khanya) < % on HG (before Khanya)				
b. % on HG (after Khanya) > % on HG (before Khanya)				

Table 10 responds to the question of whether the Khanya intervention caused an increase in the number of Matric Higher Grade Mathematics candidates; for each school in the same sample group as for Test 2, the number of higher grade candidates and total candidates for both 2003 and 2007 was determined. This was then converted to a percentage; used as the raw data for the tests.

***Table 11**: Wilcoxon Signed Rank Test Results (Test 4)*

TEST RESULTS	
	% on HG (after Khanya) - % on HG (before Khanya)
Z	-1.153[a]
Asymp. Sig. (2-tailed)	.249
a. Based on negative ranks.	

The Kolmogorov-Smirnoff test for normality showed clearly that the data was not normally distributed, thus the non-parametric alternative to the paired sample t-test, the Wilcoxon Signed

Rank Test, was carried out. This test revealed no significant difference in the percentage of pupils enrolled in Higher Grade Mathematics after the Khanya intervention compared with before, with Z = -1.153 and p = 0.249 (see table 11). The median score of percentage HG enrolment did not change from pre-intervention to post-intervention, staying at 0% (see Table 12).

Table12: *Wilcoxon Signed Rank Test – Descriptive Statistics (Test 4)*

TEST RESULTS				
	N	**Percentiles**		
		25th	**50th (Median)**	**75th**
% on HG (before Khanya)	11	.0000	.0000	2.2500
% on HG (after Khanya)	11	.0000	.0000	8.9300

The effect size statistic was also calculated as 0.25, which indicates a small to medium effect size using Cohen's (1988) criteria. In other words, a small to medium amount of the variance between the percentage of pupils enrolled in Higher Grade Mathematics is explained by whether or not the students had access to computers

Interpretation of the Test Results

Results from these tests appear to indicate that the Khanya intervention has not brought about a significant improvement in the sample schools' Matric Mathematics results. In addition, calculations of effect score statistics showed that any variances in mean student scores were typically influenced in only a small way by the Khanya intervention.

In fact, if one looks at the mean student score of the schools in the sample used for the second test (pre- and post-intervention), one can see that after the Khanya intervention the MSS has actually *decreased* (from 0.955 to 0.827, a decrease of 13.4% – see Table 6. Similarly, the percentage of pupils passing Mathematics at Matric level has also decreased after the Khanya intervention, from 40.9% to 35.8%.

One needs to interpret these observations carefully, however, as it is not totally right to infer from this that the Khanya intervention has not had a cognitive impact. This is because, firstly, the statistical analyses showed that there was no statistically significant change in the pre- and post-intervention results in either direction, and secondly, the Khanya intervention, by which access to computers is enabled, is only one of the many factors that influence Matric Mathematics results, as is shown in the next section.

Other factors influencing Mathematics results

Taylor et al. (2003) have summarised the many factors which will influence pupil performance in South Africa. These include a number of factors – such as race, gender, socio-economic status and teacher-pupil ratios - which, whilst extremely significant in influencing Matric Mathematics results, would probably not be relevant at this instance as there would almost certainly be only a minimal change in these over the 4 year period (2003 to 2007) between the pre-Khanya results and post-Khanya results used in the above analysis.

However, the following influential factors might well have changed in the sample over the 4 year period, mainly due to the inevitable turnover of staff at schools:

- Teacher qualifications
- The teaching method utilised by the teachers
- Availability and variety of learning materials
- School ethos – particularly the presence of a joint vision between staff and pupils regarding the future of the school and the importance of a strong work ethic
- The level of effectiveness of the school management
- The level of discipline of pupils and teachers
- Community relations – whether or not the students, staff and parents are working together to facilitate good education

It might be that in a number of the schools in the EMDC East that were tested pre- and post-Khanya intervention there has been a decline in the quality of some or all of these measures listed above. If that were the case, it would certainly explain why the MSS has declined. Many of these variables are very difficult to measure (especially retrospectively) and, where they *are* quantifiable, access to such data will be extremely difficult due to their sensitive nature. This makes controlling (statistically) for these factors very difficult. In addition, the samples used in these tests are simply not large enough to attempt such highly complex models.

The consequence of this is that we have not attempted to work any of these factors into our current analyses. However, their influence is large and could provide excellent research opportunities for those interested in pursuing this line of investigation.

One other factor which was not mentioned by Taylor et al. (2003) but is obviously significant in the context of determining whether or not the use of computers has made a difference to Mathematics results, is the frequency of use of the mathematics software. Louw et al. (2008) performed correlational analyses on the relationship between improvement in Mathematics performance and the amount of time spent on the MasterMaths system, and found it to be positive, statistically significant and moderate in strength ($r = 0.37$; $n = 125$; $p < 0.001$). .

Unfortunately, as has been shown by the same Louw et al. (2008) study into the use of MasterMaths in Khanya schools, pupils spent very little time using the software provided. In three of the experimental schools used in the study for which log files of MasterMaths usage were available, over a six month period Matric pupils logged onto MasterMaths an average of only seven times, for an average total of little over 2½ hours (158 minutes). This raises the critical question as to how effective an intervention like Khanya can be if the advanced technology it provides is used so seldom. As Louw et al. (2008) state: “the statistics reported…are so low as to raise serious concerns about the implementation of the intervention” (p. 45).

DISCUSSION AND CONCLUSION

Our findings regarding the impact of computers on academic performance in Mathematics are uniform. Whether one is looking at a before- and after-scenario regarding the availability of computers, or a comparison between schools with and others without computers; in neither case do our findings shown a significant change in Matric Mathematics results. Similarly, no significant changes were shown in the percentage of passes, nor in the percentage of Higher Grade candidates, before and after the Khanya intervention. We began this paper posing the following questions:

i. Are Matric Mathematics results in EMDC East high schools that have Khanya computers better than those at EMDC East high schools without Khanya computers?

ii. Have Matric Mathematics results in EMDC East high schools improved since the beginning of the Khanya intervention?
iii. Did the Khanya intervention result in a higher pass rate in Mathematics in EMDC East high schools?
iv. Did the Khanya intervention result in a higher percentage enrolment in Higher Grade mathematics in EMDC East high schools?

Our findings reported above point to a negative response to all questions posed.

These findings contrast with the majority of previous studies which found a positive, beneficial relationship between the use of computers and Mathematics results – for example, the studies of Christmann et al. (1997), Waxman et al. (2002), Banerjee et al. (2005) and Harrison et al. (2004). Our findings were more in line with the minority group that did not find a positive impact on the same, such as Angrist and Lavy (2002), and Wong and Evans (2007). Some major meta-analyses of computers' impacts, such as those of Higgins (2001) and Tienken and Wilson (2007), agreed that whilst some studies have shown positive impacts other have shown otherwise.

It needs to be re-iterated, however, that this study does not attempt to isolate the numerous factors that impact on Mathematics attainment in Khanya schools; instead focussing on only one (the provision of computers and Mathematical software). The fact that providing the facilities has not, in this instance, brought about an improvement in Matric Mathematics results could merely indicate that this intervention is insufficient to make a difference in isolation. Put another way, the other factors that are impeding the improvement in Mathematics results may be too strong to be overcome by this initiative alone. If and when these other impediments are overcome sufficiently then it is possible that the Khanya computers may prove their ability to impact Mathematics results positively.

Further to this, this research did not include a quantitative analysis of the number of hours that the computers were utilised by each of the schools included in the various samples used in the tests. There were limited evidence that is available to answer this question - based on phone calls to around a dozen or so disadvantaged schools in the Cape Town area; the data on computer usage from a Khayelitsha case study school; and the work of Louw et al. (2008) in the same city - would seem to indicate that various factors have restricted the use of the Khanya computers in the mathematics class to, in most cases, seldom or never. Obviously, the mere presence of computers in these schools is not going to be enough to bring about an improvement in Mathematics grades; they need to be utilised for the purposes envisaged by the Khanya Project to ensure a positive impact.

As Banerjee et al's (2005) very encouraging study of a computer-assisted learning intervention in Vadodara, India, showed, the key is making use of the computers that are already in the schools but are not being used. "The programme found a way to make these computers pedagogically useful in the treatment schools, without placing additional demands on teachers' time. It is the utilisation in this specific way and not the possession of the computers that had an impact" (Banerjee et al., 2005 p. 6).

In conclusion, this research points to the fact that computers, alone, cannot impact on mathematical attainment; how they are used is critical to understand how they can potentially impact attainment. That is, further, qualitative work needs to be done to ascertain how or indeed whether, computers in South African schools are used as cognitive tools.

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Prevalence of online reading among high school students in Qatar: Evidence from the Programme for International Student Assessment 2009

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ABSTRACT

Recent research has suggested presence of a significant relationship between prevalence of online reading and reading literacy. In this study we examined the prevalence of online reading among 15-year old students in Qatar using a nationally representative sample of 8,089 students. Bivariate and multivariate analyses were conducted at the item and scale levels in order to understand the relationship of online reading activities with computer use for schoolwork and entertainment, and demographic differences such as gender, grade and socioeconomic status. Our results suggest small but significant differences in mean prevalence of online reading between boys and girls. Prevalence of online reading was found to be strongly associated with both entertainment- and schoolwork-related use of computers at home but weakly associated with computer use at school. Implications were discussed.

Keywords: *Online reading; Qatar; PISA; analysis of covariance; ICT; computer use*

INTRODUCTION AND THEORETICAL FRAMEWORK

Recent research has suggested existence of an explanatory relationship between prevalence of online reading and reading literacy (Gil-Flores, Torres-Gordillo, & Perera-Rodríguez, 2012; Hsieh & Dwyer, 2009; Lee & Wu, 2013; Moyer, 2011; Pfost, Dörfler, & Artelt, 2013; Silva, 2009) even though in many cases that relationship is not direct or potentially as strong as that for traditional (hardcopy) reading (Baron, 2013; Coiro, 2012; Robertson, 2006). Hsieh and Dwyer (2009) for example used the theory of self-regulated learning to explore the indirect effect of online reading on reading literacy within context of an intermediary role of meta-cognitive reading strategies. Using a sample of 169 undergraduate students they showed that online reading had a significant effect on learning objectives. A conceptually similar study by Lee and Wu (2013) based on PISA 2009 used nationally representative samples from 15 countries and showed that not all types of online reading activities contributed similarly to reading literacy. Specifically, they found that information seeking activities led to an improvement in reading literacy while social entertainment activities worsened it. This finding was also supported by Gil-Flores, Torres-Gordillo, and Perera-Rodríguez (2012) who focused on the Spanish sample from PISA 2009 and showed that information searching activities resulted in better digital reading performance as compared to online social activities. On the other hand, in contrast to the findings of Hsieh and Dwyer (2009) and Lee and Wu (2013), a German study by Pfost, Dörfler, and Artelt (2013) based on a sample of 1,226 secondary school students found evidence that supported existence of a negative relationship between online reading and reading achievement. The same study also suggested that traditional book reading remained a significant and positively correlated predictor of reading achievement. Regardless of whether the effect of online reading on reading literacy is direct or indirect, since the ultimate aim of most educational policies directed at the individual level is to improve literacy, from an empirical point of view it is important to examine significant determinants of such literacy. Thus, given this reasoning, prevalence of online reading as a potential predictor of reading literacy on its own merits an in-depth examination.

An obvious predictor of online reading among students is frequency of computer use. However, not all types of computer use involve online reading. For example, when a student uses a computer to play a single-player game, little or no online reading may be involved. On the other hand, activities such as reading online news, reading emails, or chatting online cannot be accomplished without involving some degree of online reading (Gil-Flores, Torres-Gordillo, & Perera-Rodríguez, 2012). Similarly, when online reading does take place not all of it may contribute to reading literacy. One may categorize online reading activities into two distinct groups: social entertainment activities such as interacting with social networking websites or chatting online that contribute little to reading literacy (Pfost, Dörfler, & Artelt, 2013), and information-seeking activities such as using an online dictionary or searching online information to learn about a particular topic, that contribute to such literacy (Lee & Wu, 2013).

It is also important to consider whether online reading activities occur at home or school because the nature of such activities may not be the same at the two locations. For example, when at school students may have limited opportunities to engage in activities such as chatting online, reading personal emails, or searching for information not directly related to schoolwork. An increasing body of recent literature suggests that students' use of computers at home has surpassed such use at school with students reporting frequent use of computers for online activities such as reading email or searching the internet for information (Ilömaki, 2011; Kent & Facer, 2004; Lahtinen, 2012; OECD, 2005; Slewyn, 1998). Computer use at home is not necessarily restricted to entertainment activities such as playing games, online chatting etc. but also relates to school-related activities such as completing homework, or using online chatting or email to communicate with teachers and classmates. This makes it important to distinguish between computer use at home for school-related work and that for entertainment. Past studies that have investigated student use of computers at home and school in context of demographic differences, and have reported significant effects for factors such as age, gender, grade, prior experience with computers, socioeconomic status etc., include Arch & Cummins (1989), Comber, Colley, Hargreaves, & Dorn (1997), Jackson, Ervin, Gardner, & Schmitt (2001), Kent & Facer (2004), Mitra et al. (2000), Miura (1987), Singh (2001), and Taipale (2012). In addition to their effect on computer use demographic differences between students may also play an important role in moderating the relationship between prevalence of online reading and reading literacy (Gil-Flores, Torres-Gordillo, & Perera-Rodríguez, 2012; Liu & Huang , 2007; Pfost, Dörfler, & Artelt, 2013).

In this study we examine the prevalence of online reading activities such as reading online news, searching online information to learn about a particular topic, reading emails etc. among students in context of demographic factors such as gender, grade, and socioeconomic status, and use of computers for entertainment and school-work. Given the potential explanatory link between online reading and reading literacy as suggested by previous research, such examination has the potential to add to our understanding of the determinants of prevalence of online reading which in turn can contribute to the improvement of reading literacy among students. For this purpose we use a nationally representative sample from the Qatari portion of Programme for International Student Assessment 2009. To our knowledge no other study has conducted this kind of analysis for countries of the Persian Gulf in general and for Qatar in particular. We believe that such country-specific analyses are appropriate and needed because given the often significant differences in social, political, and economic dimensions findings from one country are not readily generalizable to others, and because given the rapid advances in information and communication technology (ICT) over time, results of older studies tend to lose their relevance quickly. For instance, with respect to ICT what was relevant ten years ago in Italy may not be relevant today in China.

In the next section of this paper we provide a description of our method, followed by results of statistical analyses, and a discussion including conclusions, implications, study limitations, and suggestions for future research.

METHOD

Participants and Data Collection

The data for this study came from student portion of the Program for International Student Assessment (PISA) 2009 (OECD, 2012b). PISA is an international literacy assessment of 15-year old students that is supervised by OECD and administered in participating countries by their respective national educational authorities. In Qatar administration of PISA was overseen by the Supreme Education Council which is the official body responsible for management and control of all levels of education in this country.

Cases were selected in a two stage clustered stratified random sampling process where a random sample of schools in Qatar was selected in the first stage and a random sample of students was drawn from each selected school in the second stage. The resulting sample was nationally representative. The target population was all 15-year old students enrolled in public and private schools in Qatar in 2009. The ICT-related data were collected from students in the form of an ICT survey questionnaire that included questions about ICT availability at home and school, and students' use of and attitudes towards ICT (OECD, 2008; OECD, 2009; OECD, 2012a).

The sample for Qatar comprised of 9,078 students which shrunk to 8,089 after listwise deletion of cases with missing or invalid values. Of the 8,089 students 4,194 were girls (51.8%), 99 were in grade 7 (1.2%), 263 in grade 8 (3.3%), 1,062 in grade 9 (13.1%), 5,123 in grade 10 (63.3%), 1,506 in grade 11 (18.6%), and 35 in grade 12 (.4%). Since this is a sample of 15-year old students there was very little variability in age (M = 15.74, SD = 0.29).

Measures

The following measures and variables were used in the statistical analyses performed for this study.

Prevalence of online reading

This is our primary variable of interest in this study and is based on seven underlying items that measure the frequency of a student's computer use for online reading-related activities. This measure is based on seven underlying items which had a reliability of .85 in our sample. A sample item included, " How often are you involved in reading online news?" The response categories were 1 (don't know what it is), 2 (never or almost never), 3 (several times a month), 4 (several times a week), and 5 (several times a day). The inter-item correlations for this scale ranged between .32 and .68 (M = .46, SD = .08). Responses for the seven items were averaged into a single score for each student. Mean, standard deviation, and the percentage of responses for each category of the seven items is presented in Table 1. The response pattern shows that most students engage in reading activities at least several times a week. These activities include reading emails (65.7%), chatting online (68.7%), reading online news (51.9%), using an online dictionary or encyclopedia (49.1%), searching for information to learn about a particular topic (64.3%), taking part in online group discussion or forums (42.4%), and searching for particular information online (43.5%). The prevalence of online reading scale was standardized to have a

mean of 0 and standard deviation of 1 with standardized scores ranging between -2.94 and 1.65. The sample density function for prevalence of online reading is presented in Figure 1. The distribution is approximately normal which suggests appropriateness of this measure for procedures such as *t* tests and analysis of covariance (Tabachnick & Fidell, 2007).

In order to differentiate between entertainment and school use of computers we used three measures of computer use, computer use at home for entertainment, computer use at home for school-related tasks, and computer use at school.

Computer use at home for entertainment

This measure is based on eight questions that asked a student about the frequency of computer use for various entertainment activities at home. A sample item included, "How often do you use a computer to publish and maintain a personal website or blog?" The response choices were 1 (never or hardly ever), 2 (once or twice a month), 3 (once or twice a week), and 4 (almost every day). For our sample the reliability of this scale was .84 and the inter-item correlations ranged between .23 and .68 (*M* = .41, *SD* = .13). This scale was standardized to have a mean of 0 and standard deviation of 1 with standardized scores ranging between -2.83 and 2.43.

Table 1: *Descriptive Statistics and Response Category Percentages for Online Reading Activities*

Scale/Item	*M*	*SD*	Don't know what it is	Never or almost never	Several times a month	Several times a week	Several times a day
How often are you involved in the following reading activities?*	3.56	1.19	5.8	16.1	23.1	26.2	28.9
1. Reading emails	3.78	1.25	7.5	9.8	17.0	28.1	37.6
2. Chat online (e.g. MSN)	3.94	1.27	5.2	13.6	12.5	19.7	49.0
3. Reading online news	3.50	1.19	4.6	18.9	24.6	26.2	25.7
4. Using an online dictionary or encyclopaedia (e.g. Wikipedia)	3.40	1.19	7.3	15.5	28.1	28.3	20.8
5. Searching online information to learn about a particular topic	3.78	1.05	3.7	7.0	25.1	36.2	28.1
6. Taking part in online group discussions or forums	3.23	1.27	6.5	29.5	21.5	19.4	23.0
7. Searching for practical information online (e.g. schedules, events, tips, recipes)	3.32	1.14	5.7	18.1	32.7	25.3	18.2

Note. *n* = 8,089. Percentages for some items may not sum to 100 due to rounding. All figures based on unstandardized scale and items.
*This row contains mean percentages for the seven items.

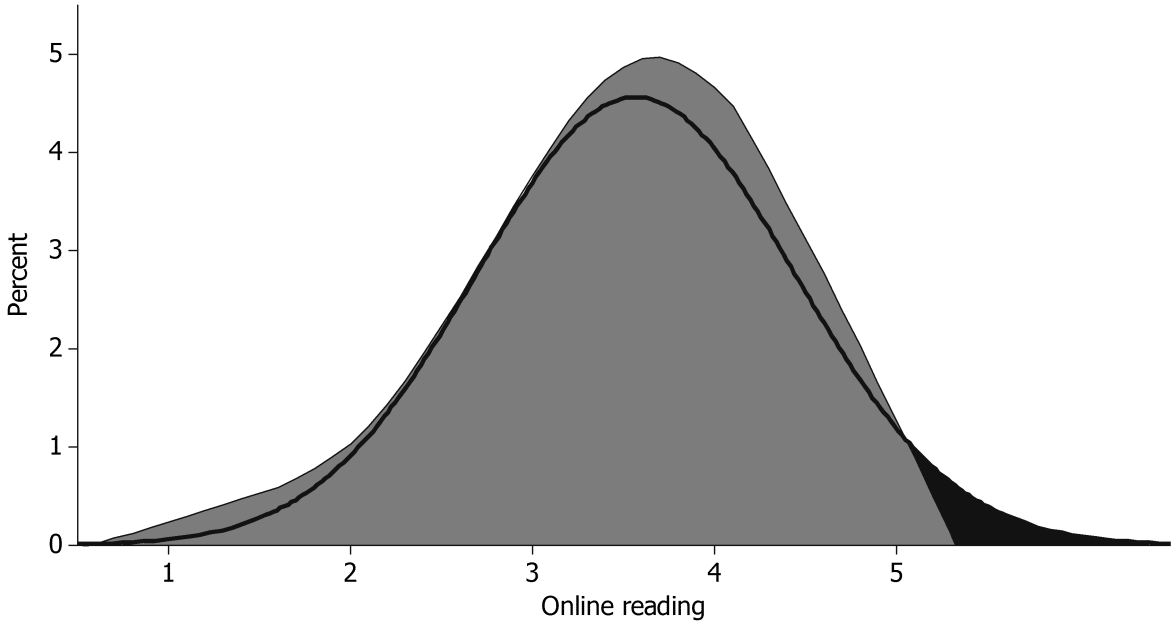

Figure 1: *Sample density function of online reading (light fill) superimposed on the normal density curve (dark fill).*

Computer use at home for school-related tasks

This measure is based on five questions that asked a student about the frequency of computer use for school-related work at home. A sample item included, "How often do you use email for communication with teachers and submission of homework or other schoolwork?" The response choices were 1 (never or
hardly ever), 2 (once or twice a month), 3 (once or twice a week), and 4 (almost every day). For our sample the reliability of this scale was .79 and the inter-item correlations ranged between .27 and .56 (*M* = .43, *SD* = .11). This scale was standardized to have a mean of 0 and standard deviation of 1 with standardized scores ranging between -2.30 and 2.53.

Computer use at school

This measure is based on nine questions that asked a student about the frequency of computer use for school-related work at school. A sample item included, "How often do you use a computer for doing individual homework on a school computer?" The response choices were 1 (never or hardly ever), 2 (once or twice a month), 3 (once or twice a week), and 4 (almost every day). For our sample the reliability of this scale was .91 and the inter-item correlations ranged between .42 and .67 (*M* = .52, *SD* = .06). This scale was standardized to have a mean of 0 and standard deviation of 1 with standardized scores ranging between -1.34 and 3.19.

Demographic controls

We used grade, gender, and socioeconomic status (SES) to control for demographic differences among students. Grade had six levels (grades 7 through 12) and gender had two categories, male and female. Although grade is not a variable of direct interest in this study we have included

it as a control variable as it is reasonable to expect greater proficiency and frequency of computer use at higher grade levels as compared to lower levels. PISA reports socioeconomic status as an index based on several sub-scales such as parental education, parental occupation, cultural possessions, family wealth, and home education resources. The Cronbach's Alpha for this index in our sample was .56 (OECD, 2012a). After standardization socioeconomic status ranged between -4.24 and 2.62 in our sample (M = 1, SD = 0). In addition to these three demographic variables we considered using age as an additional control. However, the effect was age was universally insignificant in all of our analyses. This is not surprising considering the fact that PISA is a survey of 15-year old students which results in very small variation in this variable in our sample. For this reason we decided to exclude age from the set of demographic control variables.

Analytical Method

We investigated the prevalence of online reading at both bivariate and multivariate levels. In our bivariate analysis we examined the relationship of online reading individually with the computer use measures and demographic control variables. For gender we conducted independent samples t tests in order to evaluate the difference in online reading between boys and girls. For socioeconomic status and the three measures of computer use we looked at their pairwise correlations with prevalence of online reading. For multivariate treatment we used grade and gender as factors, and socioeconomic status and the three measures of computer use as covariates in an analysis of covariance model with prevalence of online reading as the dependent variable. R^2 for this model was computed as a measure of goodness of fit and effect size.

For all statistical analyses we evaluated the validity of model assumptions and used normalized sampling weights. Cohen's (1992) recommended guidelines were used for interpretation of effect sizes, all tests of significance were evaluated at the 5% level of significance, and residuals from estimated models were analyzed for any sign of problems that could interfere with generalizability of our statistical results. All analyses were conducted with SPSS 20.0.

RESULTS

Bivariate Results

In order to test the relationship between prevalence of online reading and gender, we performed independent samples t tests on prevalence of online reading with gender as the independent variable (see Table 2). Scale-level results indicated a significant overall difference in prevalence of online reading between boys and girls (ΔM = .07, t = 3.29, p = .001) with boys outperforming girls. Item-level results showed a similar (but not identical) general trend with boys' reporting significantly higher mean prevalence of online reading as compared to girls in activities such as reading emails (ΔM = .10, t = 3.54, p < .001), chatting online (ΔM = .11, t = 3.85, p < .001), using an online dictionary or encyclopaedia (ΔM = .11, t = 4.16, p < .001), searching online information to learn about a particular topic (ΔM = .16, t = 6.84, p < .001), and searching for practical information online (ΔM = .16, t = 6.33, p < .001). The only activity for which girls' surpassed boys was in taking part in online group discussions or forums (ΔM = .16, t = 5.81, p < .001). There was no significant mean difference between boys and girls in reading online news (ΔM = .03, t = 0.94, p = .349). Cohen's d was calculated for each t test as a measure of effect size. Their interpretation is based on guidelines suggested by Cohen (1992).

Table 2: *Results of Independent Samples t Tests for Mean Differences in Online Reading* Activities between Boys and Girls

Scale/Item	*t*	*p*	Δ*M* (Boys - Girls)	95% *CI*	|*d*|*	Effect size interpretation†
How often are you involved in the following reading activities? ‡	3.29	.001	0.07	(.03, .12)	.07	Small
1. Reading emails	3.54	< .001	0.10	(.04, .12)	.08	Small
2. Chat online (e.g. MSN)	3.85	< .001	0.11	(.04, .13)	.09	Small
3. Reading online news	-0.94	.349	-0.03	(-.06, .02)	.02	-
4. Using an online dictionary or encyclopaedia (e.g. Wikipedia)	4.16	< .001	0.11	(.05, .14)	.09	Small
5. Searching online information to learn about a particular topic	6.84	< .001	0.16	(.11, .20)	.15	Small
6. Taking part in online group discussions or forums	-5.81	< .001	-0.16	(-.17, -.09)	.13	Small
7. Searching for practical information online (e.g. schedules, events, tips, recipes)	6.33	< .001	0.16	(.10, .18)	.14	Small

Note. n = 8,089, df = 8,087. All figures based on standardized scale and items.
*Cohen's d based on pooled standard deviation.
†Interpretation based on Cohen (1992). Insignificant mean differences not interpreted.
‡This row contains scale statistics.

In order to investigate the relationship between prevalence of online reading, socioeconomic status, and the three computer use measures we examined the pairwise correlation matrix of these variables (see Table 3). The pattern of correlations suggested statistically significant weak to moderate correlations among the four predictors ranging from .07 between computer use at school and SES, to .50 between computer use at home for entertainment and computer use at home for school-related tasks. Prevalence of online reading had a moderate association with SES, r = .29, p < .001, computer use at home for entertainment, r = .56, p < .001, and computer use at home for school-related tasks, r = .42, p < .001, and a weak association with computer use at school, r = .11, p < .001.

Multivariate Results

The analysis of covariance results for prevalence of online reading as a function of gender, grade, SES, and the three computer use variables and their interactions are presented in Table 4. These results suggest that holding all else constant, there is a significant mean difference in prevalence of online reading between boys and girls (F = 78.5, p < .001), and among the six grade levels (F = 19.6, p < .001). In addition, socioeconomic status and all three computer use variables individually have a significant effect on prevalence of online reading (SES: F = 142.07, p < .001; computer use at home for entertainment: F = 1825.75, p < .001; computer use at home for school-related tasks: F = 355.36, p < .001; computer use at school: F = 12.08, p < .001). More

specifically, the effect of computer use at home for school-related tasks on prevalence of online reading depends on computer use at home for entertainment (F = 45.21, p < .001) but not on computer use at school (F ~ 0, p = .989), and the effect of computer use at school on prevalence of online reading depends on computer use at home for entertainment (F = 16.26, p < .001). The adjusted R^2 for this model was .39 suggesting that approximately two-fifths of the variation in prevalence of online reading can be explained by the predictors included in the model. Using Cohen's (1992) guidelines this translates into the multiple correlation index of population effect size, f^2 = .63 which is considered large.

DISCUSSION AND CONCLUSIONS

In this study we examined the prevalence of online reading among 15-year old students in Qatar using a nationally representative sample of 8,089 students. Bivariate and multivariate analyses were conducted at the item and scale levels in order to understand the relationship of online reading activities with computer use for schoolwork and entertainment, and demographic differences such as gender, grade and socioeconomic status. Our results suggest small but significant mean differences in prevalence of online reading between boys and girls in line with prior studies such as Jackson et al. (2001), and Lee and Wu (2013). Online reading was found to be strongly associated with both entertainment- and schoolwork-related use of computers at home but weakly associated with computer use at school supporting the findings of previous studies such as Gil-Flores et al. (2012) and Lee and Wu (2013). Our multivariate model was able to explain approximately 39% of the total variation in prevalence of online reading. The similarity of general results from our bivariate and multivariate analyses lends support to the robust nature of our findings.

The results from our statistical analyses have a number of implications for researchers and practitioners. First, in general boys tend to participate more than girls in various types of online reading activities ranging from reading emails and chatting to searching for practical information online. Although the mean differences between boys and girls are small they are significant and tend to be in the same direction. The only case where girls' participation exceeded that of boys was for taking part in online group discussions or forums and the only case where the difference was not significant was for reading online news. The obvious implication here is that there is scope to improve the diversity of online reading activities among girls. What is not so obvious is that if girls are not spending as much time as boys on online reading activities then towards what end is that extra time diverted. Given the suggestion in recent literature (e.g. Cheema, in press; Guarino & Tanner, 2012) that in Qatar girls tend to outperform boys in areas of literacy such as reading, science, and, to some extent, mathematics, one could make a case that perhaps girls are spending more time on activities that are more directly related to academic achievement (such as reading textbooks or other assigned readings, completing homework etc.) as compared to spending more time on online reading activities. This notion gains support when we consider that boys tend to spend significantly more time on online reading activities as compared to girls even after partialling out the effect of other computer-related uses such as computer use at home for entertainment, computer use at home for school-related tasks, and computer use at school, as suggested by our multivariate results.

Table 3: *Means, Standard Deviations, and Correlations for Online Reading, Socioeconomic Status, and Various Types of Computer use*

			*r**				
	M	*SD*	1	2	3	4	5
1. Online reading	0	1	-				
2. Socioeconomic status	0	1	.29	-			
3. Computer use at home for entertainment	0	1	.56	.26	-		
4. Computer use at home for school-related tasks	0	1	.42	.20	.50	-	
5. Computer use at school	0	1	.11	.07	.22	.45	-

Note. n = 8,089.
*All correlations significant, $p < .001$.

Table 4: *ANCOVA Results for Prevalence of Online Reading*

Source of Variance	*SS*	*df*	*MS*	*F*	*p*	η_p^2
Main effects:						
Grade	60.21	5	12.04	19.6	< .001	0.01
Gender	48.23	1	48.23	78.5	< .001	0.01
Socioeconomic status	87.29	1	87.29	142.07	< .001	0.02
Computer use at home for entertainment (X_1)	1121.73	1	1121.73	1825.75	< .001	0.18
Computer use at home for school-related tasks (X_2)	218.33	1	218.33	355.36	< .001	0.04
Computer use at school (X_3)	7.42	1	7.42	12.08	< .001	~0
Interactions:						
X_1 x X_2	27.77	1	27.77	45.21	< .001	0.01
X_1 x X_3	9.99	1	9.99	16.26	< .001	~0
X_2 x X_3	~0	1	~0	~0	0.989	~0
Error	5043.54	8209	0.61			
Total	8251.37	8222				

Note. n = 8,089. Adjusted R^2 = .388.

Second, some of the strongest correlations for prevalence of online reading were observed with computer use at home for entertainment and with computer use at home for school-related tasks, while a very weak correlation was observed between prevalence of online reading and computer use at school. This suggests that for students most of their online reading takes place at home and not at school. This observation is in line with prior research and makes intuitive sense because while at school there is a limited opportunity to participate in most popular online activities among students such as reading emails or chatting online. What is more interesting is that the partial effect of computer use at home for entertainment on prevalence of online reading was more than four times the similar effect of computer use at home for school-related tasks. This means that most online reading activities take place in context of non-school-related computer

use. This is an important implication for school administrators and teachers interested in improving the diversity and prevalence of online reading activities among students and points towards a need to incorporate online reading elements in both school-related tasks completed at school and those assigned as homework.

Finally, results from our multivariate analyses suggest the presence of some significant interaction effects. More specifically, the effect on prevalence of online reading was moderated by computer use at home for entertainment for both computer use at school and computer use at home for school-related tasks. These two interaction effects are presented in Figures 2 and 3 based on parameter estimates corresponding to our analysis of covariance model while holding all variables not included in the plots at their average levels. Figure 2 shows the effect of computer use at home for school-related tasks on prevalence of online reading at three different levels of computer use for entertainment, at one standard deviation below the mean (low), at the mean (medium), and at one standard deviation above the mean (high). At all three levels of computer use for entertainment, there is a positive relationship between prevalence of online reading and computer use at home for school-related tasks. However, the three regression lines are not parallel. As the level of computer use for entertainment increases the slope of the regression line decreases indicating that the effect of computer use at home for school-related tasks on prevalence of online reading weakens. This makes intuitive sense because, with all else held constant, as students spend more time on entertainment there is lesser time available for homework.

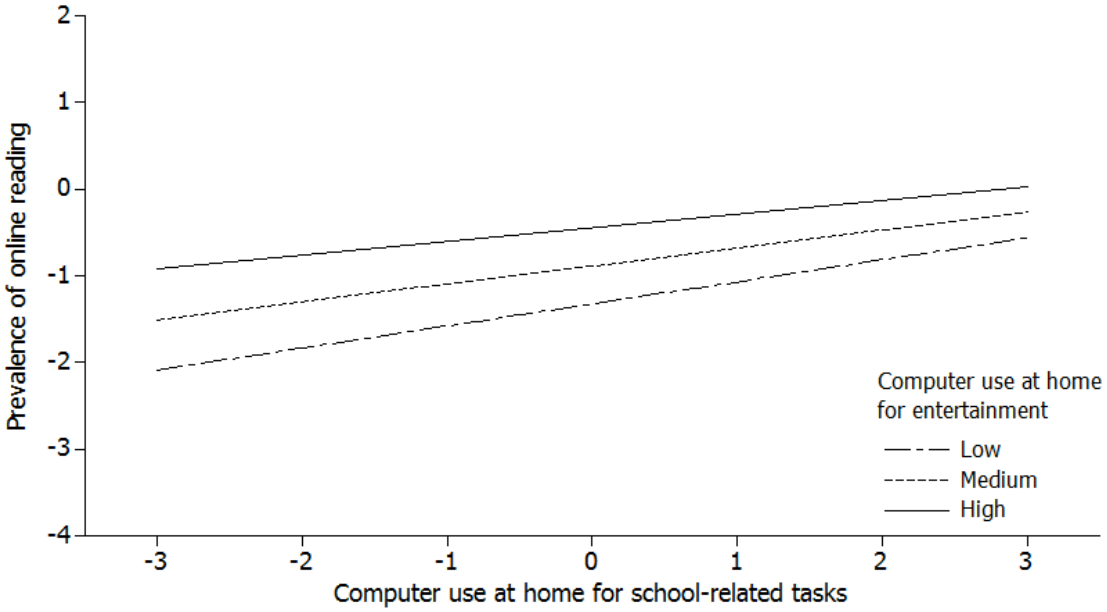

Figure 2: *The moderating effect of computer use at home for entertainment on the relationship between computer use at home for school-related tasks and prevalence of online reading.*

Figure 3 shows the effect of computer use at school on prevalence of online reading at three different levels of computer use for entertainment (Low, *M* - 1*SD*; Medium, *M*; High, *M* + 1*SD*) while holding all other variables constant at their average levels. The plot suggests that for

students whose computer use for entertainment is low there is no relationship between computer use at school and prevalence of online reading, while this relationship is positive for students whose computer use for entertainment is moderate and slightly negative for students whose computer use for entertainment is high. This is a remarkable result that is basically suggesting that a moderate amount of computer use at home for entertainment is actually a good thing that can have a beneficial moderating effect on the relationship between computer use at school and prevalence of online reading. One possible explanation for this observed phenomenon could be that students who spend too much time with computers for entertainment purposes (such as playing computer games) may find non-entertainment tasks less exciting and boring while on the other hand students who spend too little time with computers outside of school-work may not have well-developed computer skills necessary to realize their full potential, with either case resulting in a weak effect of computer use at school on prevalence of online reading. The overall implication here is that there are positive spillover effects of computer use at home for entertainment on prevalence of online reading but only when such computer use is moderate.

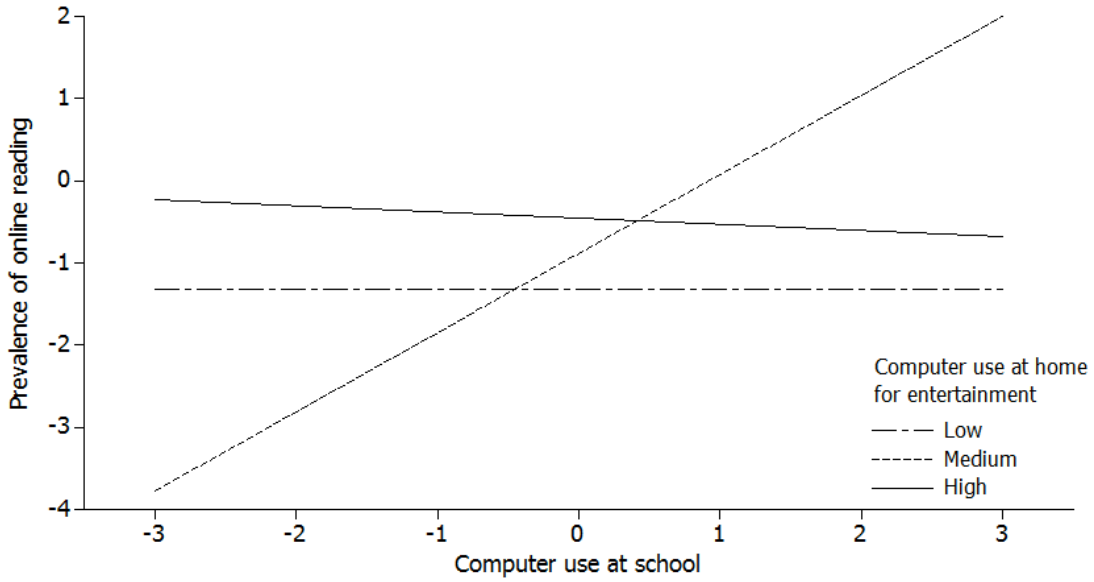

Figure 3: *The moderating effect of computer use at home for entertainment on the relationship between computer use at school and prevalence of online reading.*

Based on the discussion presented in this section our general conclusion is that computer use, whether at home or school and whether for entertainment- or school-related tasks, is a significant predictor of online reading even after accounting for demographic differences among students such as gender, grade, and socioeconomic status. Additionally, these various types of computer use moderate each other's effect on prevalence of online reading. Given the potential explanatory link between online reading and reading literacy as suggested by previous research, the findings reported in this study add to our understanding of the determinants of prevalence of online reading which in turn can contribute to the improvement of reading literacy among high school students.

It should be noted that the findings presented in this study generalize only to the population of 15-year old students in Qatar. Although this represents a good approximation to the high school student population in this country the results may not be applicable to other countries given the

often significant differences in social, political, and economic dimensions. We encourage those interested in this line of research to replicate our study with samples from other countries, age groups, and grade levels in order to gain a better understanding of the variation in prevalence of online reading. Our findings also suggest that any comprehensive theoretical or empirical model of online reading habits should not only include a mechanism to differentiate between school and home use of computers but also whether such use is for entertainment or school-relates tasks.

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Blended learning in distance education: Sri Lankan perspective

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ABSTRACT

The purpose of this paper is to explore the implementation of online learning in distance educational delivery at Yellow Fields University (pseudonymous) in Sri Lanka. The implementation of online distance education at the University included the use of blended learning. The policy initiative to introduce online components to distance education in Sri Lanka was guided by the expectation of cost reduction and the implementation was financed under the Distance Education Modernization Project.

This paper presents one case study of a larger multiple-case-study research project that employed an ethnographic research approach in investigating the impact of ICT on distance education in Sri Lanka. Documents, questionnaires and qualitative interviews were used for data collection. The lack of access to computers and the Internet, the lack of infrastructure, low levels of computer literacy, the lack of local language content, and the lack of formal student support services at the University were found to be major barriers to implementing compulsory online activities at the University.

Keywords: *Distance education, Blended learning, Developing country.*

INTRODUCTION

Globalization, though a contested concept, is a major force behind the contemporary social transformations. Within an increasingly competitive global economy driven by technological innovation, contemporary economies rely heavily on knowledge-based production; today, "knowledge has become 'the central factor of production'" (Drucker, 1969, p. 248) in many developed economies with an increasing reliance on intangible capital (David & Foray, 2003). Due to the rapid rate of knowledge production in the contemporary knowledge-based economies, the rate of knowledge depreciation is also high (David & Foray, 2003; Davis & Botkin, 1994). This has placed a great importance on lifelong learning. Furthermore, the global economy demands new skills from workers; thus, whether literacy rate — the traditional indicator of education and the standard of living in a country — is an adequate measure of educational level is questionable. In fact, Dordick and Wang (1993) argue that

> *In the information age, literacy is not sufficient to ensure a high-quality work force; higher education is needed. A useful measure is the percentage of students attending tertiary school in their age groups.* (p.111)

In wealthy countries, tertiary education enrolment rates rose from 2.2% in the 1960s to 59% in 2002, catering to the new skills demanded by the global economy. However, developing countries

have only had a microscopic increase in tertiary education enrolments — from 1.3% to 4% (UNESCO, 2005). Apart from this, the deteriorating conditions in the global economy for generic workers engaged in routine and/or low skills jobs (Klein, 2002) and the privileged position of educated and skilled 'knowledge workers' in the contemporary global knowledge economy (Beck, 2000; Castells, 2000) also increases aspirations of higher education.

Dordick and Wang's position is important in reviewing the case of Sri Lanka, where the literacy rate (currently over 91%) is higher than the South Asian average, but higher education enrolment rates are low. Data from household surveys show that there is a disproportionately low access to higher education in Sri Lanka. For example, in 2000, when 53% of Indians were illiterate, there were 5.7% with above secondary level education; on the other hand, in Sri Lanka, where only 14% were illiterate, just 3% had attained above secondary level education (Riboud, Savchenko, & Tan, 2007).

HIGHER EDUCATION IN SRI LANKA

Sri Lanka is often cited as a statistical outlier in the South Asian region for its remarkable record on literacy rates and the achievement of universal primary education (Jayaweera & Gunawardena, 2007; Riboud, Savchenko, & Tan, 2007). The 'Free Education Policy' of Sri Lanka allows every child to access primary and secondary education in state schools free of charge. Not only are there no enrolment fees or tuition fees, but also the text-books and uniforms are provided free of charge. However, at the tertiary level, there are very few places (around 22,000 entrants a year – catering for just 3% of the school leaving-age cohort) for higher education in state universities with no tuition or enrolment fees. The General Certificate of Advanced Level examination (equivalent to the UK's A-levels or the final-year exams of high schools in the US) is used for university entrance evaluations and there is heavy competition to access these limited places in the state university system.
The government has acknowledged that:

> *Successfully meeting Sri Lanka's economic challenges will require an educational system that better meets the needs of the country. The present system leaves far too great a share of our human resources under-developed* (Government of Sri Lanka, 2002, p. 11).

Increasing capacity in the traditional higher education system has been frequently attempted since the 1980s, but has failed miserably. Although many private institutions provide good quality programs — some even offering UK, Australian and US university degrees — the high fees charged in these programs have hindered the participation of many potential students. A large scale survey (of academically qualified students for university entry) (Nanayakkara & Wijesuriya, 2007) about options for higher education provision in Sri Lanka revealed that the majority of students who failed to secure a place in the state university system chose distance education provided by state universities to pursue higher education. This survey also revealed that 80% of qualified students (without a place in the state university system) did not pursue higher education due to financial difficulties. Therefore, providing affordable higher education opportunities for all is an important policy initiative for Sri Lanka.

Distance Higher Education

The Open University of Sri Lanka and external degree (distance education) programmes offered by some of the state universities are the forms of distance education offered by the state university system and, unlike the conventional state university undergraduate programmes, these levy a fee on students. Assuming distance education to have a per capita student cost significantly less than that of campus-based studies (as many do), the Sri Lankan government,

too, have turned to the option of distance education to attempt to expand higher education in Sri Lanka. By analysing the unit cost (considering both direct and indirect costs) of various degree programmes offered by 44 faculties in Sri Lankan state universities and comparing them across universities, Chandrasiri (2003) concluded that the Open University of Sri Lanka produced both arts and science graduates at the lowest cost. Further, Loxley, Ho et al. (2003) state that, on average, the unit cost of the Open University of Sri Lanka is only 20% of the conventional university system. Therefore, one might be able to justify the Sri Lankan government's decision to expand the higher education system using distance education.

However, distance education programmes conducted by state universities (except the Open University) are heavily criticized for their quality (Kaye, 2002). Some universities are accused of merely providing the outline syllabus plus summative assessment for students registered for external degree programmes (Kaye, 2002). In his report on external degrees in Sri Lanka, Kaye (2002) showed that the authorities believed that 'new technologies' (CD-ROMs, the Web) could be used to deliver course materials to students, rectifying this issue.

BLENDED LEARNING IN HIGHER EDUCATION

Many (including Sri Lankan education officials) believe blended learning "combines the best of both worlds" (Graham, 2006, p. 8). There are many conceptions of blended learning that complicate the understanding of what blended learning comprises. Some scholars such as Masie (2006) define blended learning so broadly that "[a]ll learning is blended learning!" (p. 22). Graham's (2006) definition: "[b]lended learning systems combine face-to-face instruction with computer-mediated instruction" (p. 5), which presents blended learning as a mixture of traditional face-to-face learning and distributed learning systems placing emphasis on the use of computer technologies, is adopted as the working definition for this article.

Graham, Allen and Ure (2005) identified three main reasons for introducing blended learning: improved pedagogy, increased access and flexibility, and increased cost-effectiveness. They argued that blended learning is able to increase active learning strategies, shift the style of learning to be more student-centred, and facilitate peer learning. This improved pedagogy of blended learning can be applied to both on-campus as well as off-campus or distance programmes. Jagannathan (2006) shows that, in developing countries, some blended learning courses have improved quality of learning experience for learners. Blended learning programmes allow students to undertake part of their learning activities online, reducing the time they are required to attend face-to-face lectures. This can help learners in rural areas, with mobility problems, with family commitments and/or who are employed, thus increasing accessibility of the programme. The flexibility offered by blended learning is very attractive for employed learners who desire to upgrade their knowledge. In a recent study, Raturi, Hogan and Thaman (2011) showed that mid-career educational professionals who were keen on professional development preferred courses offered through eLearning because they did not impinge upon their work times. However, in order to make the best use of the accessibility and flexibility offered by blended learning, the learner needs to possess Internet connectivity and digital skills, which in some instances are taken for granted by learners, teachers and policy-makers. The main reasons that Graham, Allen and Ure (2005) presented for introducing blended learning are indeed the reasons why the Sri Lankan educational authorities have introduced it to the Sri Lankan distance higher education: to maintain or even improve quality in a cost-effective manner while providing greater access.

Blended Learning in Sri Lankan Distance Higher Education

Blended learning is used in both on-campus and distance education in Sri Lanka. The Distance Education Modernization Project (DEMP), aided by the Asian Development Bank — which commenced in 2003 — significantly increased the resources for modern technology use, especially online education, in distance education in Sri Lanka. Through the development of distance education technologies, especially online education, the project aimed to increase access to post-secondary education in Sri Lanka while improving the quality and relevance of learning by introducing both blended learning programmes and fully-online programmes.

Before DEMP introduced online technologies, distance education was traditionally a print-based system with very few face-to-face seminars or tutorials. Online components were introduced to distance education in Sri Lanka either as fully-online or blended-online programs and the learners were able to access these courses through an island-wide network of 26 access centre facilities, which were also established under the project. There are other access centre facilities in Sri Lanka, such as "Nanasala" centres (www.nanasala.lk), established under the e-Sri Lanka government initiative, and access centres established by non-governmental organizations such as Sarvodaya (www.sarvodaya.org). These centres play a vital role in providing access to the online components of programmes to distance learners because computer and Internet penetration rates in the country are low. For example, only 11.4% of households owned computers in 2009 (Department of Census and Statistics Sri Lanka, 2009). Learners can also use Internet-cafes to access these programmes, if they lack access to computers and the Internet. Considering the low levels of access to physical resources, such as computers and the Internet, along with the low computer literacy — only 20.3% among 5-69 year olds (Department of Census and Statistics Sri Lanka, 2009) — prevailing in the country in 2009, the serious concern is whether the online component of distance education is sufficiently accessible to a broad range of the target learners.

The discussion so far showed the need for higher education in order to be competitive in the global knowledge economy. Thus far, Sri Lanka has not been able to expand its higher education system using traditional approaches. The government has invested in information and communications technologies (ICTs), hoping to increase higher educational access through distance education. At the time of conducting this research (at the end of DEMP), there was no research undertaken to understand the impact of introducing online learning to distance education in the Yellow Fields University.

RESEARCH DESIGN

This paper presents some of the findings of a larger study that examined the impact of ICTs in Sri Lankan distance education using a multiple-case-study method employed in an ethnographic research approach (Liyanagunawardena, 2012). Data was collected from December 2009 to March 2011 using multiple methods: qualitative interviews, questionnaires and documentary evidence. The project explored policy, implementation and the user perspective in using ICTs for distance education in Sri Lanka and the case study of Yellow Fields University is discussed here.

Context

Yellow Fields University is a higher education provider in Sri Lanka with many years of experience in distance education. Distance education at the University uses a variety of media and delivery methods; some examples include printed materials, face-to-face sessions (tutorials or lab classes), digital resources, and audio and video-tapes. DEMP substantially increased the levels of resources at the University and financed the upgrading of some print-based courses to electronic media. Even before the project — as early as 2003 — the University used online learning technologies, but they were largely individual efforts. Today the University uses

Moodle™ as its Learning Management System (LMS) and standard templates for courses are in place.

Students registered in Yellow Fields University programmes that have a Moodle™ presence (because not all programmes do) are able to view weekly lesson plans and access any resources uploaded through the LMS. Digital submission of assignments is supported in some programmes, while others rely on traditional hard copy submissions. Online discussion forums and chat sessions are highly encouraged; for example, one Faculty (with 43 courses on Moodle™ at the time of writing) has introduced a "virtual office hour" where the course lecturer is guaranteed to be online for clarifications through chat. Interaction is considered important at Yellow Fields University, mirroring results from various studies; for example, Owtson, Garrison and Cook (2006) have found student satisfaction to be highly dependent on the level of interaction they have with instructors and other students in blended courses. Some Yellow Fields University programmes use online quizzes as an assessment tool, while Wikis are used for group projects.

All students registered with the University are automatically registered with the National Online Distance Education Service (NODES) established under DEMP. This gives them the right to use the access centres, though, as discussed later, this has proved of limited utility for many.
Yellow Fields University has implemented three types of online courses:

- Supplementary-Online
- Blended-Online
- Online-plus

Very few postgraduate programmes (only three until early 2010) at the University were Online-plus (more than 20% of the activities are compulsory online activities). The majority of courses use ICTs to supplement traditional delivery (where the printed materials are sent to the students and they have occasional face-to-face tutorials) and there are some courses that use a blended approach. A Blended-Online course organizes around 20% of its activities (comprising of compulsory and non-compulsory activities) online as opposed to a Supplementary-Online course, where less than 5% of the activities are non-compulsory online activities. This formula for online activities in Supplementary-Online courses allows students who are unable to access the online component of a course to still engage in the programme. This is important due to the current conditions in Sri Lanka, where a large majority of the households do not own computers.

Data Collection

For the Yellow Fields University case study, permission from the University officials was received and then the research was advertised through official channels to recruit participants. Students and lecturers of the University programmes with some online components were invited to participate in the research. Data collected from the University consisted of 96 usable questionnaires, 13 individual interviews and one group interview involving 16 individuals (Students 10, Lecturers 5, and Administration 1). Another six individual interviews were conducted separately with a purposively-selected set of Sri Lankan educational authorities to understand the thinking behind the initiative to introduce ICTs for distance education.

Printed questionnaires were distributed on four occasions, once in a regional centre and in other three instances at the main campus to students who were registered in a programme that had an online component and volunteered to participate in the study. Out of the 109 questionnaires distributed 92 were received with 84.4% response rate. Email questionnaires were sent to 26 students who provided their contact details, but only 6 responses were received, achieving only a 23% response rate. Jamtsho, Rinchen et al (2010) reported a study where a web-based questionnaire was used in Sri Lanka hoping to attract 500 responses, in fact had only received 20 responses. This shows that there are issues with online questionnaires used in this context, and in fact a survey created for data collection using Bristol Online Survey tool was abandoned due to

the fears of not attracting sufficient responses for a meaningful analysis because it took a long time to load.

Both English and Sinhala (the native language spoken by the majority of Sri Lankans) languages were used to collect data and the questionnaires were prepared in both languages. These questionnaires were used to collect data from students. Questions in the questionnaire were organized into five sections: programme details; the use of ICT in the programme and student views; the use of ICTs for learning; and opportunities for using ICTs and demographic details. At the end of the fourth section, space was provided for comments. This space was used by several students to describe issues they faced when using ICTs. It was also observed that in some instances even though respondents preferred to answer the questionnaire in English medium, this space for comments was written in Sinhala. This shows the importance of using participants' mother tongue in data collection, because even though the respondent selected to respond to an English medium questionnaire, when expressing his/her thoughts freely s/he must have found that his/her knowledge of the language was restrictive. As the respondent in this instance knew that the researcher was able to comprehend Sinhala comments, s/he has used the language s/he is most comfortable with. If that had not been the case, it is suspected that the respondent would have skipped the open-ended question completely.

Each interviewee was given the option to select his/her preferred language for the interview. All interviews were audio recorded and later transcribed. Where clarifications were required, an interviewee was contacted either by email or telephone. Sinhala transcriptions were translated to English and were verified to be satisfactory. (Some of the interview extracts presented here have been translated from Sinhala to English). SPSS 13.0 and MSExcel 2007 software packages were used to analyse and present quantitative data. Qualitative data were first analysed to identify recurring themes and coding was done accordingly using Nvivo 8.

RESULTS AND DISCUSSION

Participant Demographics

Due to incomplete data, only 96 questionnaires were used for the analysis. This consisted of 46% responses from females. 73% of respondents were in the 20-25 years age group. Geographically 54% of the respondents were from the Western Province (the Capital Colombo and surrounding area) and the next highest representation was from the Southern Province (30%).

Rationale for Blended Learning

Interviews conducted with educational authorities revealed that they believed introducing an online component to distance education would reduce the cost to students as well as to institutions while increasing access. For example, some of the views presented were:

> "The government wants to give prominent[sic] to distance education as a low cost answer to our existing problem."

> "Online and distance education mode will be utilized for more programmes and we are experimenting with it [...] Distance education based components, modules are implemented to allow more students to follow and also to cut cost. [..] Students can learn from their own places."

Authorities also believed that by introducing online components, students would acquire the necessary skills of using computers and the Internet that are valued in today's labour market.

Implementation

The approach to implementing online learning at the Yellow Fields University took into account the facilities available to distance students and the difficulties faced by students who do not have their own computers — thus, most of its online activities are non-compulsory. However, it was also seen that because the online components were non-compulsory, some students did not even attempt to use those resources.

Facilitating Change

DEMP conducted a series of workshops for lecturers who intended to introduce blended learning to their courses. Given the available templates (which the interviewed lecturers found easy to use) and proper training, lecturers were willing to experiment with online learning.

However, lecturers who implemented online activities were disappointed with the level of student participation. This was similar to the findings in the Tantrigoda (2010) study. Some lecturers who participated in the study revealed that they wanted to make the online component compulsory for the next cohort of students. They hoped that compulsory online activities would provide motivation for students to participate because these online activities carry marks. Nevertheless, some felt that making the online component of a programme compulsory would discriminate against students from rural areas who do not have facilities to access the Internet.

Students (particularly those employed) who possessed home computers and Internet connectivity felt that having the option to upload an assignment instead of coming to the University to handover a hardcopy would greatly benefit them as it would save time, money and effort. However, students felt that the online activities should be non-compulsory, providing the option to continue the traditional way. For example, a student who never accessed his programme's online component said that he never felt the need to post a question because he would be meeting his lecturers at the University.

Resistance to Change

There were a group of students who strongly opposed the initiative to introduce online components to distance education at the Yellow Fields University. These students did not own computers but were competent users who used the University computer facilities. They feared that the use of online facilities would constraint the poor — the category they identified themselves a part of — from accessing education. A 23-year-old male student said,

> We fear that online and ICTs would render distance education inaccessible to us – people who are not very well to do – and take away our right for education. That is why we think that online method and the use of ICT are not suitable for this context.

Two male students from the group interview had the following to say:

> Student 1: Not everybody can afford to have Internet access from home nor everyone can use the Internet. Then there will be a problem for people who are financially less stable. Children of ordinary families will face difficulty in pursuing a degree. At present if we consider <University Name>, anyone can afford to enter because we can afford the fees that they charge. [identifying information blanked out to preserve anonymity].
>
> Student 2: This online thing is already in the system, but not much, only about 10%. If this online thing becomes more important in this setup, it is going to create a negative impact on a student's economy because it is difficult to afford the initial capital required for that in the Sri Lankan setup. An ordinary family would find it difficult to afford. The easiest option is the already existing system. [...] If per capita income could be increased to a level

> where everyone can afford it and then trying out this method would suit our society better. If this is brought in now, it is not going to succeed. And it is going to create a problem too; in fact, this is not going to be a small one: it will be one which we will never be able to solve.

These students had limited access to resources and they were concerned that any change in the current system would increase course fees, making the programmes unaffordable to them. They also tried to justify why introducing online education would not be beneficial. One participant argued that a student following an online course would only have a "limited range of knowledge" because he/she is "not sharing his knowledge." Conversely, students in this group conversation identified online learning to be a medium for "knowledge sharing," especially with students at foreign universities. The conflict of ideas presented seemed to demonstrate the internal conflict and desperation to justify rejecting the use of ICTs for educational delivery at the University.

Issues

Resource Limitation

Resource Limitation was the main issue that manifested in different forms, such as access to computers and the Internet and financial resources. There were seven student interview participants (out of 10) who owned computers while 68% of the questionnaire respondents owned computers. Considering the much lower level of computer ownership generally in the country, this is a significant figure. The respondents from Colombo (the Sri Lankan capital) were much more likely to own computers than their counterparts from elsewhere. This was not surprising, because in Sri Lanka the ownership of computers is largely among urban dwellers. For example, in 2009 when the country's computer ownership was just 11.4%, computer ownership in the Western province (Colombo and the surrounding area) stood at 19% (Department of Census and Statistics Sri Lanka, 2009). This is also in accordance with the general Sri Lankan income distribution pattern, where Colombo dwellers earn significantly more than those in the other parts of the island (Department of Census and Statistics Sri Lanka, 2011).

Only five student interview participants out of the seven who owned computers had Internet connectivity. Other participants used the University computer lab facilities to access the Internet. One interview participant who did not have access to the Internet from her home computer travelled to a regional centre (this was not an access centre established under DEMP, but a regional centre of the University) via two bus rides consuming at least 45 minutes each way, to access the Internet. As can be seen in Table 1, half of the questionnaire respondents accessed the Internet from the educational institute and only 45% had home Internet connectivity. Library or public access points and Internet-cafes were also used by a sizable proportion of respondents.

Table 1 *Access to the Internet from*

	%
Educational Institute	50
Home	45
Library or public access point	29
Internet cafe	26
Friend/relative's place	21
Work	11

Liyanagunawardena (2008) described how Sri Lankan university students who owned computers but did not possess Internet connectivity overcame that barrier by downloading course materials and saving recommended Web resources page by page to be accessed from home, while students who did not own computers downloaded and printed them. As printing is expensive, these students had to choose only the most important sections of content to be printed. Alternatively, as one interview participant argued, one could convert the content into a short-note for printing, requiring a trade-off between time spent on a non-personal computer (which might cost money or have an overall time limit) and the cost of printing.

According to Bates' (2005) ACTIONS Framework — where he discussed the importance of Accessibility, Cost, Teaching and learning, Interactivity and user friendliness, Organizational issues, Novelty and Speed in relation to adopting technology for open and distance learning — the accessibility of technology is a major factor in selecting a technology for educational delivery, especially in distance education. Both the national figures on computer and Internet penetration and student ownership of resources raise serious concerns about the accessibility of the online component of the blended learning programmes to Yellow Fields University students.

Despite having the option to use access centres established under DEMP, none of the interview participants used these facilities (at the time of interviewing) due to reasons such as the travel distance to a centre, excessive administrative procedures, their Internet access policy and opening hours. Expressing their dissatisfaction with the service offered by these centres, one student mentioned that he was not allowed to use his pen drive (USB flash drive) at one of the centres; another said that he was asked to bring a letter from the Vice Chancellor of his University in order to be given access to a set of headphones to listen to a video lecture. Yellow Fields University, as well as these centres, restricted access to some Internet sites such as YouTube™, due to bandwidth issues. Because some students did not have computers at home, they had no other means of gaining access to these blocked resources.

Infrastructure

Even when students could afford to pay for Internet connectivity and had home computers, there were instances when their area was not serviced by an Internet Service Provider. A student from Hambantota (a rural district from Southern Sri Lanka) mentioned that his village was neither serviced by landline telephone service nor Mobile Broadband service. He had to travel at least 60km to reach the nearest access centre to access the Internet and, as it was a rural area, the public transport was neither reliable nor dependable. The lack of digital infrastructure as well as road infrastructure and reliable public transport in rural areas were other barriers for students to participate in online learning.

Many students complained that the Internet connection was too slow. Some of the views they expressed in questionnaires are presented below:

> "The speed of the connection is not satisfactory. It is slow"; "Sometimes it gets very slow and the pages don't load. So cannot get the contents"; "It takes a considerable amount of time to log on to the Internet and download programs thus I suggest to give programs in a CD."

Corroborating students' statements, a lecturer expressed this view:

> "[T]he network here within the campus at least for the last five-six months has been exclusively [incredibly] slow. It is very difficult to go online, not to mention about chats. So that kind of limitations are there. Specially during the week days, the network connection is not good at all."

In 1993, Nielsen established that 10 seconds is the maximum time that a user can keep attention focused until a response is received from a computer. But a study on browser loading times of Web pages conducted in 12 Asian countries including Sri Lanka reported loading times that were four times slower than generally is accepted (Baggaley & Batpurev, 2007). This showed that using online learning in this context is likely to be a frustrating experience for learners.

Lack of Student Support for Online Learning

Yellow Fields University has yet to establish a proper student support service that helps students to resolve problems they encounter in online learning. There is no uniform way of introducing the LMS to students and it is considered a responsibility of the lecturer if he/she is using Moodle™. Some lecturers used lab classes to introduce the LMS while others used overhead projected screens to show how to use it, especially when student numbers were large. There were lecturers who did not use either of these methods and depended on the textual letter posted to students by the University giving instructions on how to log in to the system. Students using a LMS for the first time encountered many problems when they tried to log in to the system. For example, one interviewee mentioned how she was unable to interpret the letter sent by the University giving instructions to log in to the system and had to get help from three other students to successfully log into the system for the first time. Many students faced similar problems. This corresponds with the findings by Tantrigoda (2010) who reported that 85% of students have not used the LMS because they were not familiar or confident with the Moodle™ environment.

Language and Digital Literacy

School education in Sri Lanka is conducted in local languages (Sinhala and Tamil) and recently the option to study in English language medium was also introduced. However, higher education in many disciplines is only accessible in English. Transition from a local language school education to English in higher education is a difficult step for students, especially those from rural areas. The Yellow Fields University's two-year foundation programme (for students not academically qualified in Advanced Level Examination) and the first year of degree programmes are conducted in all three language media (Sinhala, Tamil and English) to allow students who are used to the conventional system of study and have studied the school curriculum in local languages to have a smooth transition to English medium distance education. From the second year (of a degree programme) onward, all students study in English. Currently in the Moodle™ environment, resources for first year programmes are only available in English. Researchers from several Sri Lankan universities are involved in translating software, including Moodle™, to local languages. However, the lack of general content in local languages on the Internet is a problem for a majority of the people in Sri Lanka who are competent in local languages only.

Questionnaire data revealed that 83% of respondents were able to create and manage files and folders on their own while only 60% were comfortable in using a search engine on their own. Nine percent of respondents had never used a search engine; 5% had never sent an email with an attachment. The computer skills of respondents showed a significant relationship with their ownership of computers in 3 out of the 4 tasks listed in the questionnaire. Task 1 – "creating folders and managing files" did not show any significant relationship with the ownership of computers. In fact, it is a basic task that any novice computer user would learn at the very beginning. On the other hand, the ability to accomplish Task 2, 3 and 4 – "using word processor software to create a document," "sending an email with an attachment" and "using a search engine to find degree programmes offered by the National Online Distance Education Service" showed a positive relationship to the ownership of computers showing that the ownership of computer does help students to gain these valuable skills. The time that a student can use an

access centre facility is usually limited to allow fair access to resources by all students. Thus, students with limited or no other access to computers may not get sufficient time to develop the skills to do effective Web searches and develop strategies to filter results. However, these results and interpretation are indicative and should be treated cautiously as the sample was not drawn at random.

One respondent mentioned in her questionnaire that she did not know how to use a computer that was available to her. This respondent was a 25 year old female teacher from Badulla, possibly teaching in a school with computer facilities, but lacking skills to make use of the available physical resources. This appears to confirm Warschauer's (2003) argument that the minimally invasive learning was not successful unless special educational aid was available to gain digital skills. There could be other students who do not possess computer literacy and these students are likely to be marginalized when online learning is introduced unless they are provided with help to gain necessary skills.

THE BIG PICTURE

It appears that the government of Sri Lanka has invested in online technologies as a means of educational delivery to enhance the quality of programmes and increase access to programmes. However, the computer literacy and English language proficiency of the people, and the level of access to computers and the Internet — along with the supporting infrastructure — severely restrict access for a majority of people. Liyanagunawardena, et al. (2011) showed that 63% of students in a fully-online (no face-to-face component) undergraduate degree programme in Sri Lanka were from households earning more than the national median household income, suggesting that the use of online technology largely served already privileged groups. This could be a reason why 'not so well to do' students in the Yellow Fields University feared the initiative to introduce online components to their learning.

Even though universities, access centres and Internet-cafes provide access to students, there are a variety of problems that students encounter in these places. The lack of reliable public transport services, especially in the evening and weekends, is a problem for many who have to travel to access centres. Some policies practiced by institutions — such as blocking access to sites used by students, not allowing the use of removable storage devices and excessive procedures — make them unpopular among students (Liyanagunawardena, et al, 2013a; 2013b). Download speed (Williams, et al, 2012) and the reliability of connections are also common issues that frustrate learners. Charges for Internet access at Internet-cafes in Sri Lanka vary widely according to location. For example, an Internet-cafe in Kandy charges Rs.3/= (USD 0.02) per minute (that is Rs.180/= or USD 1.36 per hour) and a cafe in Unawatuna charges Rs.10/= (USD 0.08) per minute (that is Rs.600/= or USD 4.54 per hour) (World Embassy Information, n.d.), while access centres established under DEMP charge Rs.50/= (USD 0.38) per hour of Internet access to visitors other than registered students. This shows that students in rural areas are disadvantaged because they have to pay much higher prices for an hour of Internet access at an Internet-cafe while on average also having a lower income, making the comparative cost even more disproportionate. Andersson (2008) has also reported of similar problems faced by Sri Lankan students.

CONCLUSION

The contemporary work world favours knowledge workers with a higher education. The government of Sri Lanka is relying on distance education and educational technology to increase higher educational opportunities and improve the quality of offerings to enhance human

resources to gear towards a knowledge economy. Yellow Fields University has cautiously adapted online learning to its programmes using a blended approach. The lack of infrastructure and access facilities to students, the low level of computer literacy, lack of English language proficiency and the inadequacy of student support services suggest that, at the moment, the conditions are far from perfect to introduce compulsory online activities.

The lack of infrastructure is a major barrier in introducing online components to study programmes. Access centres, which were established to overcome this barrier, were inflexible on too many axes (Liyanagunawardena, et al, 2013a; 2013b) to provide substantial access across the geographic regions. Even though there are issues, such as logistics, that need many resources and/or much effort to overcome, there are others such as access centre opening times, policy on Internet access and policy on the use of hardware (e.g. removable storage, headphones) that can be addressed with relative ease to provide more student-friendly access centre facilities. Making it mandatory to provide an introductory session to the LMS to all students taking part in programmes with an online component is a relatively easy way to help students at the Yellow Fields University to start experimenting with the LMS. The university could then implement a helpline (both email and telephone) that provides help to users experiencing technical issues. In the long term, the government needs to carefully formulate a strategy to provide affordable connectivity to all geographic areas and promote digital literacy and meaningful localized content for Sri Lankans while also providing facilities for international language learning. Unless Sri Lanka addresses these issues effectively through policy, it compromises its ability to harness the full potential of online educational technologies to provide educational opportunities for the majority of Sri Lankans who are left out of traditional higher education system.

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Promoting proper education for sustainability: An exploratory study of ICT enhanced Problem Based Learning in a developing country

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ABSTRACT

One of the goals of education is to create responsible citizens who can adequately understand the problems faced by their societies and who can then act to help solve them. Such behaviour can be fostered through proper education that facilitates expert knowledge about social issues, nurtures the ability to think critically and learns the skills needed to pro-actively search for possible solutions. Through this study we aimed to develop an Information and Communication Technologies (ICT) supported pedagogical framework, *Children as Agents of Social Change* (CASC), as a possible vehicle to facilitate appropriate education about social issues. This article analyses the first implementation of the CASC framework carried out at schools in Tanzania. Forest fires in Tanzania are often caused by human activity and education about this pressing problem needs to be provisioned on a large scale. However, due to a lack of teachers and teacher expertise, this is not the reality. With help of the local community, we created a locally contextualised video supported by a Problem Based Learning (PBL) solution to connect local forest experts with school students. These students then creatively conducted PBL activities in order to help solve local environmental and conservation problems. Data was collected through pre- and post-tests of control-experimental groups and teacher interviews. Results suggest that the participants were enlightened as to a variety of active problem solving possibilities and that they ranked the CASC methodology as an effective approach to sustainability.

Keywords*: ICT for development, ICT supported pedagogical model, social issues, social awareness, Problem based learning, CASC*

1. INTRODUCTION

The key purpose of education is to prepare young people to meet the various challenges of life. The role of education as a vehicle for social transformation has been endorsed by philosophers such as Jiddu Krishnamurti and John Dewey. Psychologists, e.g. Gardner, refer to school as “the institution designed to change minds” (Dewey 1997; Krishnamurti 2002; Gardner 2006). Proper

education, which fosters understanding about one's society and its problems, can encourage personal transformation which, in-turn, can contribute towards a balanced and healthy social structure.

When education fails to provide opportunities for learners to connect abstract knowledge with their actual world; it only promotes inert learning. Learning which is aimed only at achieving academic results promotes narrow and individualistic activities and corresponding world views among the students. Without enabling personal transformation [through education], social reformations are susceptible to corruption (McWhittney & Markos 2003). Educational anthropologist, Ruth Benedict, argued that education is transformative as it can begin to resolve cultural issues by surveying "*the major wastages in our culture"* (Nash 1974).

School is an important cultural construct and therefore it is only sensible to promote proper education about social issues through schools (Schooling the world 2010). Mannheim strongly advocated that schools should cease to concentrate on "purely scholastic traditions" and that they should rather aim to "embody and impart humanisation qualities" among young people as schools are "uniquely qualified" to prepare pupils for life (Lawton 1975). Providing proper education regarding social issues at school level can help to make future citizens more responsible.

The United Nations Educational, Scientific and Cultural Organisation (UNESCO) holds forth that learning about issues of social importance is an important educational objective (UNESCO 2007; UN DESA 2005). School level initiatives such as *Design for Change* (DfC), which started out as a local initiative but has grown to global proportions within a few years with several thousand schools participating in its competitions (Design for Change 2012), bears evidence to the fact that school children feel connected to those problems that originate in their local contexts. Social problems can be used to create an opportunity for students to take responsibility for their transformation and to create a social change, even if it is a small one.

Proper education about social issues facilitates expert knowledge about social issues, nurtures the ability to think critically and supports learners in the development of skills needed to find solutions. Despite strong theoretical support, proper education about social issues does not readily take place in schools, especially not in developing countries. Educational administrators' inability to provide such proper education meaningfully is founded on two pragmatic problems: (1.) The severe lack of available teachers in developing countries (Olson et al. 2011; Tooley 2009) and (2.) most teachers are engrossed with meeting academic goals and they often lack the time, interest, support, capability or hands-on experience to facilitate the handling of actual issues of social importance (Tooley 2009).

When faced with their own limitations, humans often try to solve their problems through techniques and technology. Modern technologies e.g. *Information and Communication Technologies* (ICT) are often seen as a promising solution to overcome deficiencies in educational systems (Kozma 2005). However, ICT projects have continued to underperform in developing countries (Day & Greenwood, 2009). ICTs are not even explored as a viable option by many because of the high costs combined with unsure returns on investment. Many ICT based solutions have been noted to contain linguistic codes, cultural assumptions, social images and Western/European notions that underpin the choice of what constitutes desirable knowledge (Selinger 2009; Cox 2012). These underpins are untrue foundations, leading to ineffective solutions. Oliver argues that adopting a *social account of technology* would lead to better-integrated solutions, for instance, in the field of educational technology (Oliver 2012).

Our study is exploratory in nature and aims to create a pedagogical framework named *Children as Agents of Social Change* (CASC). CASC combines ICTs with a problem-based learning approach in order to promote awareness, critical thinking and skills to deal with the issue among

middle and high school children (Roy et al. 2013). Through CASC, our aim is to provide learner-centric, culturally sensitive, locally contextualised and cost effective interventions. CASC is based on the principles of the CASC Framework (pedagogical aspect) and CASC Media Artifact guidelines (ICT aspect) which were formulated by the first author while working in India with school children for a period of nearly two years. These guidelines were further refined through numerous discussions with several teachers as well as students in various schools in India. Discussions in Finland with various educational as well as technology experts have also contributed towards the enhancement and fine tuning of this model. The core principles of CASC and their implementation guidelines were finalised by the first author and this particular study was lead by the second author, who is a native of Tanzania (TZ).

In the current study, we analyse the first CASC implementation conducted in Tanzania for which we designed a video supported PBL intervention for environment conservation education. The video-based CASC media artifact implemented for the experiment aimed to highlight and educate pupils about the dangers of forest fires in Tanzania. The research questions of this study are:

1) Does ICT, combined with contemporary educational practices like problem-based learning, succeed in connecting local working-level experts to provide expert knowledge to middle and high school pupils in developing countries such as TZ?

2) Does ICT, combined with contemporary educational practices like problem-based learning, support the provision of proper education among middle and high school children in developing countries such as TZ?

3) Does this intervention, based on the CASC framework, attain its objectives of being a learner-centric, culturally sensitive, locally contextualized and cost effective educational solution?

In order to answer the above questions, we conducted an experiment in the Morogoro region of Tanzania. We used video to connect local environmental officers to secondary school students who, in turn, absorbed the expert information, discussed the local social problem in groups and carried out projects in order to find a solution to the identified social problem.

Section 2 discusses the CASC Framework in two parts: principles of the framework and guidelines for the development of the CASC media artifact. Section 3 imparts details related to Research Design and Methodology. Section 4 discusses CASC implementation in Tanzania and in Section 5 we examine the results of the intervention. Section 6 closes with a discussion, concluding remarks and acknowledgements.

2. CHILDREN AS AGENTS OF SOCIAL CHANGE - CASC FRAMEWORK

2.1 Principles of the pedagogical CASC Framework

2.1.1. Acknowledging and focusing on an authentic social issue

Social problems exist as a background to any educational domain. Proper learning about the social problems in one's society is vital to the overall advancement of the society. The success attained with social issues education (such as the Design for Change initiative) has proved that children do indeed connect to authentic social issues and try their best to effect change (DfC 2012). Education relating to such topics is vitally important as it helps to prepare students for real life where they do come into contact with these issues as well as the social and behavioural patterns that create and/or maintain these problems. Often school curriculums are so focused on

academic skills that they tend to ignore social issues, the very critical area in which pupils need guidance. This important gap can be bridged.

2.1.2. Using technology through CASC media artifact

In CASC, technology is used to overcome limitations such as the inadequate expertise of teachers when faced with addressing social problems. CASC uses ICTs to engage local working-level experts in the problem-domain by connecting them to schools and enabling them to discuss key issues involved in the understanding of the social problem. These experts know the problem area/s well; however, most often than not, they are not connected to the schools.

2.1.3. Use of contemporary constructivist pedagogy to enhance learning

Pedagogical practices based on constructivist contemporary pedagogy such as *Problem based learning* (PBL) have been found effective in engaging students in the learning process. PBL is an effective instructional method in conveying a variety of content areas in schools in urban, suburban and rural communities. In PBL the students solve a real-life problem, typically in groups of 3-4 students. It is effective among elementary, middle and high school student populations as well as low-income student groups (Hung et al. 2008). In the PBL approach, learners acquire the problem solving skills as well as the content and contextual knowledge that revolves around the problem (Hung 2006). PBL can equip students with skills in critical thinking, collaboration, communication and problem solving (Chung & Chow 2004; Hung et al. 2008). In CASC, students are asked to find their own solutions to solve a relevant social problem via projects conducted in groups.

2.1.4. Asking learners to share their solution

CASC asks students to present their work to their peers and this strategy urges the learners to carefully revise so that they improve their own learning efforts. When students prepare their lessons, as teachers, they have to familiarise themselves with their presentation topic in detail so that they will be able to answer questions and allay the doubts of their fellow students. This re-learning for teaching leads to a better understanding of some topical aspects and hence, the social issue.

2.2 CASC media artifact guidelines

An important component of the CASC framework is the *CASC Media artifact*, which is supported by meaningful pedagogical practices. Here we describe the core design principles and guidelines of the CASC media artifact.

2.2.1. Locally contextualized video-based media

The term 'educational video', in this study, is defined to include all media with moving pictures and sound used for educational purposes. Videos have been used in classrooms since the early days of filmstrips. The current trend is the prolific use of digital video to support student learning in various subjects (Mitra et al. 2010; Fill & Ottevill 2006). According to Choi and Johnson, video is a suitable educational media solution to support the learning of complex skills because it can expose learners to problems and events that cannot be easily demonstrated and understood verbally (Choi and Johnson 2007). Video can be used to gain students' attention, create anticipation among students and increase memorized content, among other potential outcomes (Fill & Ottewill 2006).

Situated cognition is a broad framework that “emphasises the importance of focusing on everyday cognition [and] authentic tasks” and *anchored instruction* is an instructional approach to implement situated cognition. “When people learn new information in the context of meaningful activities, they are more likely to perceive the new information as a tool rather than as an arbitrary set of procedures or facts” (CTGV 1990). The *anchored instruction* methodology (used by CTGV) uses a fictitious story to anchor the instructions. We posit that when the children see visuals from their everyday reality in particular contextual perspectives, they can understand such perspectives much better and sometimes they can also validate the authenticity of the issue from personal experiences.

2.2.2. Use of local human resources and knowledge

Easterly has suggested that the working-level experts in specific problem domains are a good resource as they understand social issues at a localized and in depth level (Easterly 2006). Many times these experts, who work hands-on within communities to resolve the social issues, have valuable knowledge about how to effectively deal with these social issues; but this knowledge may not be the common knowledge of the community.

Quality education must be meaningful to the learner. Vygotsky stressed that the concept of *community* plays a central role in the process of "making meaning". He also discussed the concept of *More Knowledgeable Others in Education* (Vygotsky 1978). While teachers may lack deeper knowledge about a relevant social issue, within the community there are experts who may be well-versed in the problem domain. CASC proposes the use of ICT based CASC media artifacts to connect this expert knowledge to the community via schools.

2.2.3. Use of local language

UNESCO has noticed in its study on languages that people afford special importance to their own language and that using the native language of participants fosters true participant inclusion which in turn achieves lasting results (UNESCO 2012). Studies have reinforced that children understand a problem more readily when the issue is discussed in their native language (Malone 2008; SEAMEO 2009; SEAMEO 2010). Several ICT based solutions make unrealistic assumptions about the learners’ cognitive abilities to understand a non-native language. CASC emphasises the use of native language for instruction.

2.2.4. Cultural sensitivity

Vyogotsky advocated that culture affects individual development and that learning culture is the prime determinant in an individual’s development (Vyogotsky 1978). ICT based educational technology solutions, in which content and method fails to authentically connect to the real cultural and social contexts of the learner, can raise the learner’s *cognitive load* and limit the learning ability. To limit the cognitive load, learning materials should be designed and presented with content that the learners can easily relate to (Mayer 2001; Vesisenaho & Sutinen 2010).

2.2.5. World view sensitivity

World view is the fundamental cognitive orientation of an individual or society encompassing the entirety of the individual or society's knowledge and point-of-view, including natural philosophy; fundamental, existential and normative postulates; or themes, values, emotions and ethics (Palmer 1996). An attempt to understand the world view of the learners is an essential step towards designing effective solutions.

2.2.6. ICT infrastructure sensitivity

ICT infrastructures in different schools within the same urban or rural regions can vary greatly and a one size fits all approach is not viable. Depending on the ICT infra-structure available at the schools, various combinations of ICT devices can be used to connect the experts to the school students. Thus, the design needs to take into consideration the available technological facilities and resources.

3. METHOD

3.1 Research design

CASC's approach, along with its technical artifacts, slots into the domain of Design research's close cousin, Development Research (DR), also called research with a developmental goal. In design research, the focus is on extending the boundaries of human and organisational capabilities by creating new and innovative artifacts (Hevner et al. 2004, Peffers et al. 2007). According to Reeves, the DR process is based on iterative analysis, design, development, implementation and formative evaluation phases (Reeves 2000). Critical reflection leads to the refinement of problems, solutions and research methods during a DR process. This entails searching for practical and innovative solutions to real-world problems while also developing generic design principles. Innovative ICT artifacts and products are created and investigated to determine how and why they work (de Villiers 2005b). Development research is problem-oriented, constantly searching for new and innovative solutions, while also seeking findings that are transferable, practical and socially responsible (de Villiers 2005a).

As mentioned earlier, many ICT based solutions harbour euro-centric notions regarding knowledge, language, culture, social reality and world views which render them useless to the developing world (Selinger 2009; Cox 2012). Through this implementation of CASC based intervention, we have tried to derive certain generic principles in designing ICT based educational solutions meant to bolster social issue awareness whilst bridging the gaps that render such solutions inefficient.

3.2 Research methodology

This study took place in the Morogoro region, along the slopes of the Uluguru Mountains, in Tanzania. In this study we first designed a video supported PBL intervention for environment conservation education, specifically targeting the issue of forest fires in Tanzania. We created a video using CASC Media Artifact Guidelines discussed in Section 2.2. A description of the media creation process is provided in Section 4.3.

Two villages and four secondary schools were selected for this study: two schools each for the control and experimental groups. Morogoro and Kingo Secondary schools (comprising of 97 participants) were used as a **control group,** while Kayenzi and Kauzeni Secondary schools (comprising of 79 participants) were used as an **experimental group.** All four schools are public schools. Tables 1 and 2 describe the distribution of the population in terms of age and gender.

***Table 1**: Sample population based on age group*

	Age (10-16)	**Age (16-21)**	**Total**
Experimental Group	18	61	79
Control Group	44	53	97
Total	62	114	176

***Table 2**: Sample population based on Gender-distribution*

	Male	**Female**
Experimental Group	40	39
Control Group	44	53
Total	84	92

The two groups were similar in several ways e.g. the medium of education in all four schools was English while the students' native language was Swahili. The two control group schools were situated about 1-5 km away from the city centre whilst the two experimental group schools were located 5-8 km from the city centre. The average age of participants in each school was about 16 years old. Study material and books were not readily available in any of the schools and most students shared books in groups e.g. 1 book to be shared amongst 4 students. There was also a general lack of books for self-study, even in the libraries. One school in each group (Kayenzi Secondary School and Morogoro Secondary School) had a sufficient number of teachers while the other two schools were understaffed. Only the students belonging to the experimental groups were exposed to intervention that consisted of watching videos, group discussion, PBL and solution presentations by the groups. Students in both groups were asked to complete pre- and post-test questionnaires. These questionnaires, along with the analysis of students' projects and interviews conducted with the teachers from the experimental group schools, have been used as primary data sources. A mixed-method approach has been used to analyse these data sources. More details about data analysis are provided in Section 5, while in Section 4 we explain how the CASC Media artifact was implemented in the study.

4. CASC BASED IMPLEMENTATION IN TANZANIA

4.1 Local social issue: Forest fires in Tanzania

Forest fires are a serious social problem in Tanzania (Philemon 2011). Hunters, farmers, livestock keepers, charcoal makers and timber sawyers are responsible for most of the forest fires in Tanzania (Kilahama, Sawr, & Burgess 2009). Many farming communities use fire as a farm preparation method as it is cheap, simple and sometimes the only option available (Kibuga & Samweli 2010). The Controller Auditor General in TZ has stated that TZ is losing an average of 420,000 hectares of forests annually through uncontrolled fires and rampant tree felling (Philemon, 2011). The effects of the forest fire problem are severe as, apart from the loss of resources, forest fires also result in a major increase in forest fragmentation and the destruction of the landscape (Martínez et al 2009).

It is agreeable that for the sake of all humanity "sustainability needs to become part of people's thinking, their way of life and their value system" (Wals 2010). This requires learning processes

that transcend traditional ways of transferring knowledge. It is essential to involve and arouse the interest of the younger generation if one wishes to find a sustainable solution to the forest fire problems (Doggart 2009). There has been a lack of sufficient educational structures and programmes to address the forest fire problem in local communities (Kilahama et al. 2009).

Such educational programmes do not generally take place in Tanzanian schools where the instruction is still mainly teacher-centric and lecture-based. The general teacher-student ratio is calculated as 1:46 by the government (United Republic of Tanzania 2011) and 1:66 in some regions by an NGO (Oxfam International 2012). The high teacher-student ratio combined with a lack of time, interest, capability, support or hands-on experiences of the teachers are the major obstacles to properly educating students about forest fires.

4.2 Background work

The main reasons for choosing this particular area for our study included the availability of forest reserves, the historical existence of a forest fire regime, the availability of suitable forest fire experts and the proximity of forests to the schools/actual world of the children. Our first step was to meet the village officials after which our four target schools were identified (Kihoza 2011). The head teachers of these schools were consulted and their thoughts and opinions regarding the study were noted. Secondly, we set out to explore the educational traditions and ICT infrastructure in the schools. During the school visits it became apparent that the most common educational approach was text-book based and teacher-centric and that the students had no prior experience of PBL. Thus, before the students in the experimental group started to work with the problem-solving process, they were shown a video explaining the PBL process.

4.3 Process of CASC artifact creation

After the social issue and the forest regions were identified, *local working level experts* were identified with the help of village chairpersons. These experts work as local forest officials and knew the local forests well. These experts share the same *culture and world view* as the targeted learners. Digitally recorded interviews with Forest Experts were conducted in *the local forests*, in *Swahili.* These interviews covered topics such as the causes of forest fires, the role humans play in forest fires as well as possible solutions. These videos were edited to create a short educational documentary about forest fires. In addition to the CASC media based video; two other useful videos were downloaded from the internet and also used for this intervention. The first external video showed an example of a forest fire in another context, while the second video was a short introduction to the project based learning process. Project based learning and problem based learning are very closely-linked approaches as they are both based on constructivist pedagogical principles.

Table 3*: Details of the video used for the intervention*

Video	Duration	Language in Audio
Video 1: CASC Educational Documentary about Forest Fires	26:59	Swahili
Video 2: Raging Forest Fire in California	4:11	English
Video 3: Project based learning Explained (BIE, 2010)	3:50	English

4.4 Intervention process

An initial survey of the schools revealed that the experimental schools had no ICT infrastructure like projectors and computers. The availability of electricity could not be guaranteed and so equipment and a power-generator adequate to support a laptop, LCD projector and sound systems were transported to the experimental group schools.

The first step in the study was for the students to watch the three videos: a local CASC media artifact, the forest fire video from another context and a video explaining the PBL process. In Figure 1, the students in the experimental group are watching the local CASC artifact video.

Figure 1*: Students watching CASC video*

After the students had watched the videos, they were divided into self-organised groups of 9-11 students. All groups were balanced based on gender and class level uniformly. Groups discussed the issue and were asked to come up with ideas on how they could work together to address the forest fire problem (as seen in Figure 2). After 30 minutes of discussion, student groups identified eight projects (Table 4) which were to be completed one week hence in addition to their regular studies. The teachers were informed of the project topics so that they could offer support if necessary.

***Figure 2**: Students discussing the issue of forest fires*

***Table 4**: Details of the eight projects planned by the eight groups*

School	Project Title (Size of the group)	Venue	Task Accomplishment Plan
Kauzeni Secondary School	Reducing dependence on forest products as a source of energy in the community (9)	Indoor	Preparation of project report and oral presentation
	Demonstrating the effects of unplanned forest harvesting (10)	Indoor	Preparation of project report and oral presentation
	Planting trees (9)	Indoor and Outdoor	- Planting trees - Preparation of project report and oral presentation (posters)
	Community education on the effects of forest fires and illegal forest harvesting (11)	Indoor and Outdoor	- Visiting nearby community - Preparation of project report and oral presentation
Kayenzi Secondary School	Community awareness on the importance of forests (10)	Indoor and Outdoor	-Visiting nearby community - Preparation of project report and oral presentation
	Side effects of forest fires (11)	Indoor	Preparation of project report and oral presentation
	Protecting planted and natural trees (10)	Indoor	Preparation of project report and oral presentation
	Organized felling and planting of trees (9)	Indoor	Preparation of project report and oral presentation (posters)

After the groups had identified their topic, they were given one week to work on their projects (Kihoza 2011). Up to this point, researchers had been involved with the students but from this point onwards the teachers were provided with a list of project titles and it was suggested that they provide the students with guidance, if and when required. The groups had to complete the projects in addition to their regular classes. The research team did not contact the groups during this week. The groups produced a theoretical document and showed, in practice, that the knowledge regarding environmental conservation had been well understood.

Figure 3: *Student presenting and explaining her group's project*

Figure 4: *Student presenting and explaining his group's project*

In the final stage of the PBL process the students were asked to present their projects. The aim was to describe the problem from a chosen viewpoint, summarise their understanding of the problem and discuss their solutions. Some of the presentations were conducted inside the

classroom while others were conducted outside. Each presentation was followed by a question and answer session during which the presenters answered questions about the projects.

Two different sets of post-test questionnaires were administered that included questions in Swahili. The questions concerned with environmental conservation and forest fires were the same for the control and the experimental group. In addition, the experimental group was asked to answer questions related to the effectiveness of the video supported PBL approach. After the post-tests, teachers in the experimental group schools were asked to share their reflections on the whole intervention procedure.

5. RESULTS

Mixed-method data analysis based on pre- and post-test questionnaires from experimental and control groups, analysis of the learners' projects in the experimental group and post-intervention interviews of two experimental group teachers' were used as data sources in the following sections.

5.1 Pre-test questionnaire

The pre-test questionnaire showed that prior knowledge regarding forest fires and environmental education of the experimental and control groups were on a similar level as shown in Figure 5. In addition, their prior knowledge and experiences regarding environmental conservation were on a similar level. Both the groups, for instance, had already studied this topic in different courses in their school. The majority of students in both the groups strongly agreed that issues like environmental conservation are not only the responsibility of government officials or parents, but that they also have a responsibility towards the environment. Based on this data, we can safely conclude that students aspired to change the circumstances around them.

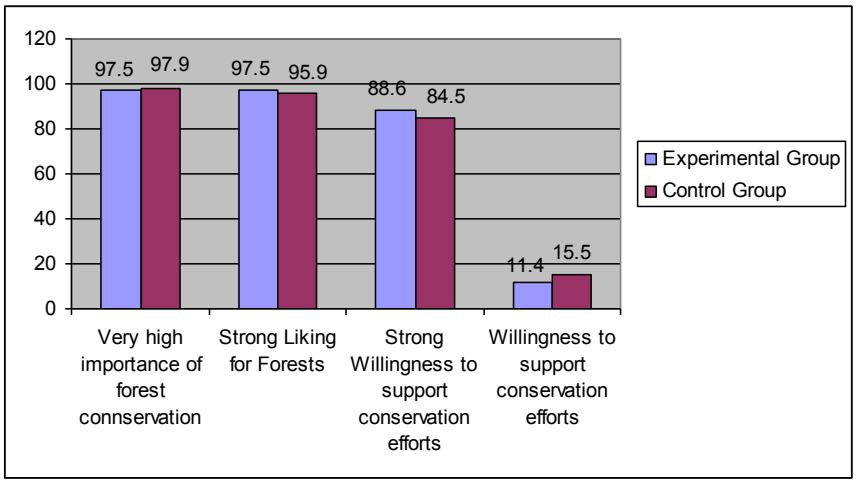

Figure 5: *Students' interest in Environmental Conservation*

5.2 Post-test questionnaires

In the post-test, the students were asked to identify at least two things which they would like to do in the future to help address the problem of forest fires and their devastating effects. The experimental group expressed interests in more diverse activities compared to the control group. The majority of students in the control group mentioned community education as their prime activity of interest (81.4%) as shown in Figure 6. This shows that the intervention process awakened the participants' interest to many more possibilities.

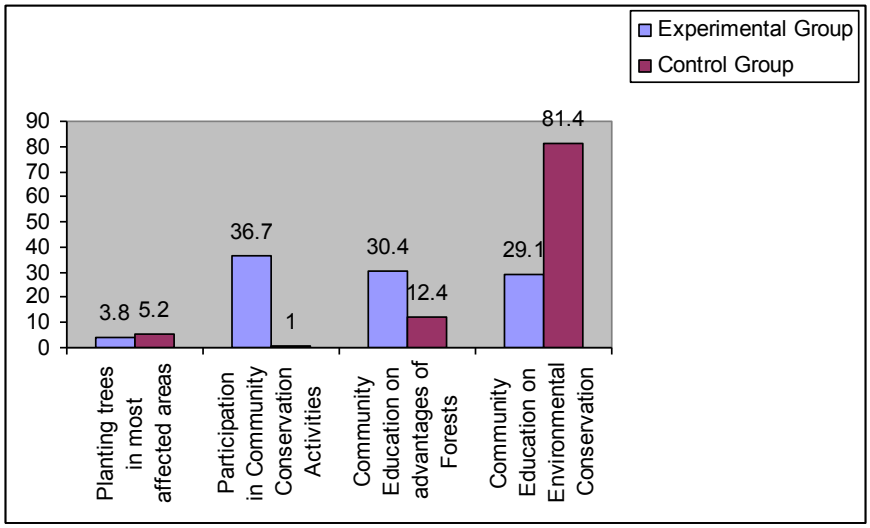

Figure 6: *Future interest projections of students*

The students in the experimental group were asked to share their opinions regarding the effectiveness of the PBL and video approach (Table 5). Altogether 79 students answered this question, and 88.6% of the respondents agreed that, in their opinion, the video supported PBL approach was an effective way of providing environment conservation education.

Table 5: *Effectiveness of the intervention (N=79)*

	Agree (%)	**Disagree (%)**
Kayenzi Secondary School	82.5	17.5
Kauzeni Secondary School	94.8	5.2
Kauzeni and Kayenzi Combined	88.6	11.4

We also asked the experimental group to identify the most important thing which they had learned from the video. Responses to the questionnaire revealed that students in the experimental group (70.5% in total) mostly learned about general forest conservation. Other aspects such as the advantages of forest conservation (10.3%), disadvantages of forest burning (5.1%), both disadvantages of forest burning and advantages of forest conservation (7.7%), planting trees

(1.3%), the use of advanced technology in fighting forest fires (3.8%) and good agricultural practices that support forest conservation (1.3%) were mentioned less frequently.

We also asked the participants to evaluate and then indicate whether they had gained extra knowledge from the videos. A total of 84.8 % of the students agreed that they had gained new and valuable knowledge from the videos as seen in Table 6.

Table 6: *Extra knowledge gained from watching the videos (N=79)*

	Gained extra knowledge (%)	**Gained little knowledge (%)**	**Gained no extra knowledge (%)**
Kayenzi Secondary School	90	10	0
Kauzeni Secondary School	79.4	17.9	2.7
Kauzeni and Kayenzi	84.8	13.9	1.3

5.3 Content of the projects

In Table 7 we expand Table 4 by showing the achievements of the eight projects carried out by the experimental group.

Table 7*: Identified results of the projects*

School	**Project Title**	**Achievements made by the group**
Kauzeni Secondary School	Reducing dependence on forest products as a source of energy/fuel in the community.	Suggested various low energy consumption cookers and other low cost sources of energy were presented.
	Demonstrating the effects of unplanned forest harvesting.	Recommended and explained the concept of regular tree planting and Community Empowerment.
	Tree-planting.	*Planted 30 trees* during the one week project. They also explained the importance of trees in our lives sufficiently.
	Community education on the effects of forest fires and illegal forest harvesting.	*Cleared a bush to separate a forest area and farm area*. Sufficiently explained the effects of forest fires on living things and its impact on climate change.
Kayenzi Secondary School	Community awareness about the importance of forests.	Spoke to youths who may cause forest fires when they hunt in the forest.
	Side effects of forest fires.	Explained the side effects of forest fires and how to avoid it sufficiently.
	Protecting planted and natural trees.	Presented the idea of making roads to separate the forest and farm areas clearly.
	Organized felling and planting of trees.	Explained the harvesting and planting of trees in an organised way sufficiently. Also explained why we should not harvest natural trees randomly.

The projects identified and focused on the four main areas of *prevention*, *avoidance*, *detection* of the worst affected areas and *aiding* recovery by planting trees. The students identified: *education* though community visits, *discussions* with relevant groups of people and *direct participation* as concrete methods which can be used to help solve the problem of forest fires.

5.4 Teachers' reflections on the experience

The reflections of the teachers in the experimental groups varied greatly. Teachers from the first experimental group commented that:

> *"Through this [CASC implementation's design i.e. use of video, group discussion, project-based-learning and presentation], I have realised that the forestry topic taught in the second year has been well understood within a short time compared to the time we use in classroom. Secondly, school has gained [appreciation for students] by seeing students voluntarily planting trees with no teacher's instructions. I wish we can have projects like this frequently so we can learn and face more challenges for improving our environmental conservation efforts."*

The teacher in the second experimental school stated:

> *"[CASC intervention] has reminded us that students have been missing a big part of education when they learn without study tours and project based activities. We are planning to integrate forest tours so that they can learn and see the effects of forest burning and illegal trees cutting."*

6. DISCUSSION AND LIMITATIONS OF THE STUDY

Sustainably is an important life-skill and lack of expertise among teachers is a chief obstacle in the quest to provide proper education about sustainability. Not all teachers in developing countries like Tanzania are qualified or capable to suitably teach pupils about forest fires. We wanted to see whether technology could be used to overcome these constraints. It is important to note that for this intervention the teachers did not receive any separate or extra training. The visible contrast in Figure 6 clearly illustrates that the intervention successfully introduced the students to new possibilities i.e. they were empowered to connect the subject matter which they had learnt to the real world in which they live.

The content of the intervention was easily understandable for the learners; and by incorporating respect for the learners' choice of projects and their creativity in the design of the intervention, we were successful - to a large extent - in conveying expert knowledge to the learners. Though some groups chose to research the problem, two groups chose pragmatic projects: one team cleared a bush to help separate a forest area from farmland and another team planted 30 trees. Students discussed forest fires with other people who may likely cause them. The intervention empowered students by giving them an opportunity to effect small, yet positive changes, to their immediate milieu.

Forest officials need community support and they were pleased to discover a way in which they could connect with the community at large. Working-level experts had a deeper understanding of the problem of forest fires and, through the CASC media artifact they could augment the lack of teachers' in-depth knowledge about this pressing social issue. Empirical data proves that this intervention was successful in connecting working-level experts to the schools with whom they would have otherwise had no, or limited, contact.

It was clear from the teachers' comments that they also gained valuable new knowledge about aspects of constructive pedagogy because of the CASC intervention. All the student participants ranked the CASC artifact as an effective solution to addressing environmental education. This created a win-win situation for all the stakeholders.

6.1 Limitations of the study

Children often need some support in the form of a teacher/s and a neutrally positive adult presence also exerts a positive influence on them. Influenced by our technological bias, we did not perform any detailed investigation as to the level of the teachers' involvement in the projects completed by the students and teacher's prior familiarity with PBL approach. Although children were free to ask any questions related to the videos, video remains a dynamic media and the pupils had no control over the pace of the video which was a technological limitation in this study. Despite the schools in both groups sharing key characteristics with 'normal' schools across Tanzania, the sample size was limited and the sample was not precisely random.

7. CONCLUSIONS

Vyogotsky advocated the idea that culture is the prime determinant of individual development (Vyogotsky 1978) and from this point of view, educational technology solutions developed by culturally-alien technicians who do not understand the local contexts, world view and culture of the targeted learners may be technically deterministic. Many ICT based educational interventions have been based on Western notions that underpin the choice as to what constitutes desirable knowledge (Selinger 2009).

Hidden behind these surface-level facts are two larger issues. Many developing nations seek or are given assistance in the form of aid to promote better education. Effective aid in education can become an investment in the firm foundation and long-term development of a country. However, aid is often expensive and comes at a high cost. Some of the global educational aid is spent on the development of ICT based educational solutions by foreign experts. These practices may however not be very effective, especially in the domain of social issues. Oxfam has noted that "as much as 70 per cent of aid for education globally is spent on technical assistance, much of it to highly paid Western consultants" (Oxfam 2006). Such aid can put nations in vicious circles of international debt. We wanted to negate the identified incorrect ways of doing such a project. The aim of this implementation of CASC was to ascertain whether such projects could be done at a very local level, by local people and at much smaller costs compared to other ineffective aid-funded projects. In addition, CASC does not wish to dilute the quality of the learning experience.

The second pertinent issue is that technology is being pushed onto the educational domain. Brummelhuis and Kuiper define *technology push* as a learning process "driven by capabilities of technology without any specific need from the perspective of the teacher, the learner or the learning content" (Brummelhuis and Kuiper 2008). We agree with Selinger that "ICT is a powerful tool that, when it is implemented appropriately, can catalyse and accelerate educational reform and development" (Selinger 2009). However, this observation must also be balanced by the fact that *technology push* in developing countries can create serious inequities within the system. It forces educational systems to use their very limited resources to procure and maintain technology whilst ignoring basic priorities like the availability of schools, educational infrastructure and well-researched teacher training programmes. Lack of clarity in a decision maker's mind about what is of primary importance and what is secondary, can be exploited by technology pushers looking to acquire more gains in terms of power and/or resources.

In developing countries, appropriate educational technology solutions using technology along with pedagogy should be preferred; not only for their cost effectiveness but also for the quality learning which they promote. By combining contemporary pedagogical practices like PBL along with ICTs, CASC promotes a deeper learning experience among learners as well as self-reliance within the communities. Its approach encourages social responsibility amongst children by giving them a chance to act as problem-solvers rather than passive bystanders.

Students 'acted' in response to the problem via their projects hence, CASC also advances a participatory world-view. Learner's actions, in form of their group work, upset the rooted dynamics of indifference which are socially patterned into them through enculturation and socialization. This new attitude makes the youth a strong resource for their communities. Due to the technical advantage of scalability, the same CASC media artifacts can be used in multiple schools without any expensive redundant efforts and without disturbing the experts' regular work which may very well be outside the educational domain.

Through this approach, local experts shared their knowledge about an authentic social problem and this knowledge was used in a learner-centric way which makes CASC intervention a meaningful learning experience for students. Based on the evidence, we claim that interventions based on CASC framework principles can create ICT based solutions that are learner-centric, culturally sensitive, locally contextualised and cost effective. Artifacts based on CASC principles can be created by an individual, organisation or community. This framework highly limits the need for huge budgets, for foreign experts or heavy technical expertise.

Use of CASC will not uproot a social problem right away but this approach is useful and important in raising a generation of learners who will have learnt important life-skills to help them resolve social issue and would therefore make a positive contribution towards their respective societies. The CASC framework can be used to make quality education about social issues widely available to larger student populations through educational systems in developing countries. The CASC framework is suitable for agencies like UNESCO that seek to promote understanding about important social issues through their Decade of Education programmes. This approach can be useful to individuals, schools or Non-Governmental Organisations to better prepare youngsters to meet the challenges of life beyond the boundaries of the school walls and hence make education a truly meaningful experience.

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Determining distance education students' readiness for mobile learning at University of Ghana using the Theory of Planned Behavior

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ABSTRACT

The use of mobile technologies in the classroom is transforming teaching and learning in higher institutions. This study investigated University of Ghana Distance Education students' perceptions toward mobile learning. The paper using the Theory of Planned Behavior (TPB) explained how students' beliefs influenced students' intention to adopt m-learning. Findings from the study showed that most of the students had mobile phones, and used them for conversation and texting. Young students were more likely to have smart phones that their older colleagues. Factor analysis was further conducted which showed strong loadings of factors such as intentions and perceived behavioral control confirming that the TPB explained the students' m-learning readiness very well. Thus, attitude, subjective norm and behavioral control influenced students' intention to adopt m-learning. The results provide valuable information on ways to implement m-learning programs incorporating the voice and needs of students.

Keywords: *m-learning; m-readiness; higher education; m-learning adoption; technology*

INTRODUCTION

Distance education globally has witnessed significant transformation because of the Internet. Today one can talk about the shift from e-learning (learning supported by digital "electronic" tools and media) towards m-learning (e-learning using mobile devises and wireless transmission) (Keegan, 2002; Sharma and Kitchens, 2004). Globally, the penetration of mobile phone and devices have transformed teaching and learning in several universities in both developed and developing countries. Mobile-cellular penetration rates stand at 96% globally; 128% in developed countries; and 89% in developing countries (International Telecommunication Union, 2013). As observed by Jacob and Isaac (2008) "wherever one looks, the evidence of mobile penetration is irrefutable: cell phones, PDAs, MP3 players, potable game devices, handhelds, tablets and laptops."

In spite of country differences in mobile phone penetration, there is an inexorable evidence in Africa and elsewhere of a high rate of use of mobile phones by young people in our universities (Brown, 2008; Koszalka and Ntloedibe-Kuswani, 2010; Porter et al. 2012; Makoe, 2012). This high rate of adoption of mobile phones by young people has far-reaching implications for the transformation of teaching and learning and the way distance education programs could be offered by universities in Ghana. That is why effort by the University of Ghana to launch the University of Ghana Integrated Digital Mobile Learning Platform for Distance Education (IDMP) ought to be seen as a worthwhile gesture. This m-learning program will provide distance education students with an internet enabled mobile tablet device pre-loaded course materials and other applications (University of Ghana, 2012).

As the University of Ghana plans to introduce m-learning into its Distance Education program, some writers have argued that m-readiness surveys should precede the adoption of m-learning by students (Abas, 2009; Mahat, Ayub and Wong, 2012). Determining the m-readiness of students allows university administrators to listen to the voices of students (Abas, 2009; Mahat,

Ayub and Wong, 2012) and to incorporate voices of students in the planning and implementation of m-learning to ensure the acceptance and use of the mobile technology by the students. Although some studies have been done on m-learning in Ghana, most of the studies lack strong theories to explain students' m-readiness (Annan, Ofori-Dwumfuo and Falch, 2012; Asabere, 2012; Asabere, Enguah and Mends-Brew, 2012). Furthermore these studies do not focus on m-readiness of students in Distance Education programs. What this study attempts to do is to use the Theory of Planned Behavior (TPB) to examine factors that university Distance Education students consider as important in the adoption of m-learning and also explain the relationship among these factors. The relevance of TBP is based on the fact that students' readiness to use m-learning would be based on intention which would influence their behavior. But TBP does not only establish the intention-behavior relationship, it also explains how other factors such as attitudes, subjective norm and perceived behavior control are mediated by intention. Ajzen (2011, cited in Kautonen, Gelderen & Fink, 2013, p. 2) defines intention as "a person's readiness to perform a given behavior." The TBP postulates that intention devoid of unforeseen circumstances that limit individual control, helps predict future behavior (Carmack and lewis-Moss, 2009).

DISTANCE EDUCATION AND MOBILE TECHNOLOGIES

Distance education has always grown on the wings of technology. Several scholars have traced the evolution of the impact of technologies on distance education since its inception (Garrison, 1985; Taylor, 1995; Taylor & Swannell, 2001; Schultze, 2011). The first generation described as the era of correspondence courses was driven by the print technology. The second era was characterized by limited media courses (postal mailing, strengthened with audiotape and television broadcast). The third phase was driven by the personal computer and based on multimedia applications such as print, audio and video-conferencing which offer synchronous communication (Garrison, 1985; Taylor, 1995; Taylor & Swannell, 2001; Anderson and Dron, 2011; Schultze, 2011). The fourth phase traced to the influence of the Internet is based on the use of world-wide web (www) to provide both synchronous and asynchronous delivery (e-learning) and recently m-learning (Taylor, 1995; Taylor and Swannell, 2001; Anderson and Dron, 2011). The growth of m-learning in teaching and learning credence to the statement by Keegan (2002, p. 8) that 'Mobile learning is a harbinger of the future of learning' and that the "future is wireless" Keegan (2005 cited in Zawacki-Richter, Brown and Delport, 2008). Stockwell (2008, p. 254) has noted that "many see mobile learning as the next generation of learning, one that is to be readily embraced by the learners using technologies that most already possess."

MOBILE LEARNING

The definition of m-learning has come in different shades and forms since its evolution (Kukulska-Hulme, 2009). These definitions have ranged from *technology oriented to e-learning oriented and to location oriented* and *learner-centered* (Winters, 2006; Fotouhi-Ghazvini, et al. 2010; Cheung, 2012) where mobile learning is defined in the context of the use of handheld electronic devices such as a PDA, mobile phone, iPod, PC Tablets, etc., for educational activities in and outside the classroom to critical areas such as context (learning) and social connectedness (Kukulska-Hulme, Sharples, Milrad, Arnedillo-Sanchez, and Vavoula, 2009). One often cited definition of mobile learning in this context is the one offered by O'Mailley, et al (2003, p.6) as: "Any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies." This learning could occur in context and culture and also "everywhere at every time without permanent physical connection to cable networks. This can be achieved by the use of mobile and portable devices…" Georgiev, Georgieva and Smrikarov (2004, p. 2).

Pouezevara (2012) has argued that what separates m-learning from e-learning in the learner-centric perspective is the spontaneity of learning and the way learning becomes context-specific through the interaction between the learner, device, and the environment. A similar view has been expressed by Kukulska-Hulme et al. (2009) that mobile technologies lend themselves to personalized, situated, authentic and informal learning. Naismith et al. (2005) have identified various types of learning that emerge through the use of mobile technologies. These are: behaviorist learning, constructivist learning, collaborative learning, situated learning and informal learning.

Behavioral learning is described by Naismith et al. (2005) as one that is facilitated through reinforcement of an association between a particular stimulus and a response. In the case of m-learning, problems (stimulus) are presented to students who find solutions (response) to the problems. Feedback from the system provides reinforcement. Constructivist learning occurs when students construct new ideas or concepts with mobile devices based on their current and past knowledge (Naismith et al. 2005). Situated learning posits that learning can occur in authentic context (Naismith et al. 2005). A situated learning environment provides students the opportunity to interact appropriately with their environment, using mobile technologies by accessing information about the environment and gathering information from it (Jeng, et al. 2010). Collaborative learning emphasizes activities that promote learning through social interaction. Through conversations and peer support through peer group learning, students are able to share ideas and new knowledge and also create new collaborative learning groups. Informal learning is learning that occurs outside the formal curriculum. Students learn from varied sources outside the formal institutions and these learning sources are incorporated into the classroom situation (Niasmith et al., 2005).

As mobile learning technologies become ubiquitous in the classroom, more attention is being focused on the learning experiences that occur between students, teachers and the devices. As argued by Kukulska-Hulme et al (2009), these learning experiences transcend spatial, temporal and/or conceptual borders and involve interactions with fixed and mobile technologies. Naismith et al. (2005) explicate that as learning moves more and more outside of the classroom and into the learner's setting, both real and virtual, learning will become more situated, personal, collaborative and lifelong.

For distance education, Kukulska-Hulme (2007) has noted three critical reasons why m-learning is very important. These are: (a) improving access, (b) exploring the potential for changes in teaching and learning, and (c) aligning with wider institutional or business aims. For distance education students, they need to be able to perform tasks such as studying the course material, making notes, writing assignments, accessing a forum, sending and receiving e-mail, and communication with tutors (Kukulska-Hulme, 2007). Using mobile technologies in distance education could offer more flexibility to students (Ally, 2005). Indeed, Ally (2005) has explained that introducing m-learning into distance education programs may require organizational change and meticulous planning: converting existing course modules and new ones developed; putting in place a telecommunication infrastructure; training of staff and faculty; and provision of mobile devices to students.

The provision of mobile devices and which of the devices could be described as portable has become a point of discussion. Caudill (2007) points to hardware advances as one of the two key components to the emergence of m-learning, the other being networking. Caudill (2007) further explicate that to be described as a mobile technology, that hardware must be easy to carry around and people can easily accessed the hardware on a regular basis. Some of the devices which fall within this categorization are mobile phones, PDAs, and MP3 players. The second component contributing to the emergence and success of m-learning mentioned by Caudill is wireless networking. While some of the devices could operate in a non-networked, offline

environment, several of these devices depend on access to the Internet to trade information and access up-to-date information (Caudill, 2007). Although some writers do not categorize laptop and notebook computers as mobile devices (Traxler, 2007; Caudill, 2007), recently, there has been some consensus on which devices could pass as mobile technologies. These devices include laptop/PC tablets, smartphones, MP3 players, iPods, USB drive, e-book reader, and even wearable devices (Sharples, Taylor, Vavoula, 2007; Trifonova, Georieva and Ronchetti 2006; Corbell and Valdes-Corbell, 2007; Peters, 2007; Zawacki-Richter, Brown and Delport, 2008; Cavus, 2010).

THEORETICAL FRAMEWORK

Few researchers have studied students' m-learning in higher education (Lu and Viehland, 2008; Liu, Li and Carlsson, 2010; Park, Nam and Cha, 2012; Cheon, Lee, Crooks and Song, 2012). Apart from the paucity of research, very few researchers have used the Theory of Planned Behaviour in explaining students' m-readiness in universities (Cheon, Lee, Crooks and Song, 2012) in Ghana. The theory planned behavior (TPB) is an extension of the theory of reasoned action (TRA) made "necessary by the original model's limitations in dealing with behaviors over which people have incomplete volitional control" (Ajzen, 1991, p. 181).

According to Bamberg, Ajzen and Schmidt (2003), the theory of planned behavior is guided by three considerations: beliefs about likely consequences of the behavior (behavioral beliefs), beliefs about the normative expectations of others (normative beliefs), and beliefs about the presence of factors that may further or hinder performance of the behavior (control beliefs). They further posit that behavioural beliefs create a favorable or unfavorable attitude toward the behavior. Indeed, Armitage and Conner (2001, p. 474) have observed that "the more favorable the attitude towards the behavior, the stronger should be the individual's intention to perform it." Normative beliefs result in perceived social pressure or subjective norm.

Subjective norm is about individual's perceived expectation that significant others want them to perform a behavior in question (Haggar and Chatzisarantis, 2005). If students perceive that other students endorse (or disapprove of) the use of mobile devices, they are more or less likely to intend to use them (Conner and Armitage, 1998; Armitage and Conner, 2001). The study measured normative beliefs as students' perception toward the extent to which significant other and students were in favor of using m-learning in their courses (Cheon et al. 2012, p. 1057). Although Cheon et al. (2012) used two referent groups, that is, peer students and instructors; we dropped the instructor group in this study. So we proposed that normative beliefs of peer students as the antecedent of subjective norm and as a single item measure (Conner and Amitage, 1998; Amitage and Conner, 2001).

Control beliefs which give rise to perceived behavioral control has to do with the perceived ease or difficulty with behavior (Ajzen, 2012). Ajzen (1991) has argued that the resources and opportunities available to students are critical in dictating the likelihood of use of mobile devices. Ajzen (1991) further argued that perceived behavioral control is akin to Bandura's (1977 cited Ajzen, 1991) concept of perceived self-efficacy which is "concerned with judgments with how well one can execute courses of action required to deal with prospective situation" (cited in Ajzen, 1991, p. 184). Indeed, the significance of self-efficacy in the study is that, a person's behavior is influenced by his/her confidence in his/her ability to do something.

Hagger and Chatzisarantis (2005) have noted that recent studies have shown that it is possible to differentiate two subcomponents of perceived behavioral control: the extent that an individual has access to the means to exert control over the target behavior, termed perceived controllability (Ajzen, 2002); and an individual's situation-specific self-confidence for engaging in the behavior,

labelled self-efficacy (Armitage and Conner, 2001). Hagger and Chatzisarantis (2005) have explained that it is critical that measures of controllability focus on statements of subjective control an individual may have over the target behavior, while self-efficacy should focus on statements that refer to the perceived abilities and capacities of the actor toward participating in the target behavior. In relation to m-learning, this study adopts the position of Cheon et al. (2012) by measuring perceived behavioral control using the two constructs: self-efficacy and learner autonomy. According to Choen et al. (2012, p. 1057) "self-efficacy refers to the judgment of general ability to perform a behavior, while learner autonomy is the extent to which students are responsible and have control over the process of learning with mobile devices."

Ajzen (1991) has explained that apart from attitudes, subjective norms and perceived behavioral control, a central factor in the theory of planned behavior is the individual's intentions to perform a given behavior. Ajzen (2012, p. 19) has argued that "fundamental to the theory of planned behavior is the idea that behavior is guided by intentions." Ajzen (1991) further posit that "intentions are indications of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behavior." In combination, attitude toward the behavior, subjective norm, and perception of behavioral control leads to the formation of a behavioral intention (Davis, Ajzen, Saunders and Williams, 2002; Bamberg, Ajzen and Schmidt, 2003; Ajzen, 2012).

As a general rule "the more favorable the attitude and subjective norm, and the greater the perceived control, the stronger should be the person's intention to perform the behavior in question" (Davis et al. 2002, p. 811). When we apply the theory of planned behavior to students' m-learning readiness, the theory suggests that intentions to adopt m-learning together with attitudes, subjective norms and perceived behavioral control, predict the likelihood that students will be more willing to use m-learning in their studies (Davis et al. 2002). In this study since the students have not started using the mobile devices, their intentions to use the devices should they be introduced becomes a strong determinant in the study.

The model proposed in this study includes the use of TAM's perceived ease of use and perceived useful which directly affect attitude toward use (Cheon et al. 2012). That is, students' perceived ease of use m-learning would positively influence their attitude towards m-learning, while students' perceived usefulness of m-learning would positively influence their attitude toward m-learning. Indeed, it has been established that attitude and perceived use predict individual's behavior intention to use a technology (Lee, 2006). In this study, the perceived ease of use of m-learning is defined as "the degree to which students believe that using m-learning will be free of effort" (Davis, 1989). The perceived usefulness of m-learning is defined as "the degree to which the user believes that using m-learning would enhance his/her learning performance" (Davis, 1989).

METHODS

The population comprised all students of the University of Ghana Distance Education program. The University of Ghana Distance Education program has a student population of 9,311, comprising 2,167 Level 100 students; 2,017 Level 200 students; 2,697 Level 300 students; and 2,430 Level 400 students. From the total population of 9,311 students and based on academic levels, a sample of 400 students were selected based on Krejcie & Morgan's (1970) method of determination of sample size, and using the stratified sampling method.

The questionnaire method was the main data collection tool. We utilized an amended version of Cheon et al (2012) questionnaire to investigate students' mobile learning readiness. In all, there were forty-five questions. The first section covered questions on the demographic characteristics

of students. The rest of the questions focused on: ownership and features of mobile phones; perceived ease of use (PEU) (three items); perceived usefulness (PU) (three items); attitudes (ATT) (two items); student readiness (three items); subjective norm (three items); perceived self-efficacy (three items); learning autonomy (three items); behavioral control (three items); and intention (five items). The study dropped questions on instructor's readiness because the use of m-learning has not started at the University. A five-point Likert scale was used to measure the responses on the interview schedule. The responses ranged from: *I strongly agree* – (1) to *I strongly disagree* – (5). The data collection was done in August when students were on the University of Ghana campus to write their semester examination.

DATA ANALYSIS

The data was analyzed using the SPSS version 16. Frequencies were computed for demographic characteristics, ownership of mobile phones and features on the mobile phones. Further analysis was conducted using factor analysis. The Kaiser-Meyer-Oklin (KMO) test for sampling adequacy and the Barlett Test of Sphericity were conducted. The KMO measure of 0.957 suggests that sample is adequate for carrying out a factor analysis. The Bartlett's test of sphericity was found to be significant, suggesting that the strength of the relationship among the variables is strong (χ^2 = 6556.0, *df* = 190, $p < 0.000$) showing evidence of adequate number of significant correlations among items to justify the conduct of factor analysis (Lu and Viehland, 2008). Table 1 shows the test of reliability results for the various constructs. The Cronbach alpha (α) values are deemed as acceptable based on the common threshold values recommended by accepted literature (Nunnally & Berstein, 1994).

Table 1: *Test of Reliability Results*

Constructs	No. of Item	Cronbach Alpha
Perceived Ease of Use (PEU)	3	0.785
Perceived Usefulness (PU)	3	0.885
Attitude (ATT)	2	0.805
Student Readiness (SR)	3	0.808
Subjective Norm (SN)	3	0.887
Self-efficacy (SE)	3	0.891
Learner Autonomy (LA)	3	0.897
Behaviour Control (BC)	3	0.910
Intention (INT)	5	0.895

FINDINGS

The demographic characteristics showed that the majority of students (79%) could be described as young students, 17% as middle-aged students, and 4.0% as older students. About 50.3% of participants in the study were males, while 49.7% forty-nine percent were females. As expected of a distance education program, about forty-two (42%) of students were workers, while fifty-eight (58%) of the students were not employed. The data revealed that 98.7% of students had mobile phones. Of those with mobile phones, the types of mobile phones are shown in Table 2. Over 50% of students owned more sophisticated phones.

Table 2: *Types of mobile phones owned by students*

Type of mobile phone	Frequency (f)	Percentage (%)
Classic cell phone (telephone only	78	20.7
Classic cell with digital camera and/or MP3 player	92	24.5
Smartphone with email and internet capability (e.g. Blackberry etc)	116	30.9
3G phone (e.g. Apple iPhone, Android etc)	90	23.9
	366	**100.0**

Table 3 shows that young students were more likely to own smart phones and 3 G phones than the more matured students.

Table 3: *Cross-tabulation of Type of mobile phones owned by Age*

	Classic cell	Cell/camera	Smart phone	3G phone
	F %	F %	F %	F %
Young students	64 (21.5)	61 (20.5)	94 (31.6)	78 (26.3)
Middle-aged students	8 (12.5)	28 (43.8)	18 (28.1)	10 (15.6)
Older students	6 (40.0)	3 (20.0)	4 (26.7)	2 (13.3)

$\chi^2 = 20.16$, $df = 6$, $p < .005$.

The study found that about 60% of students had laptops. Only a few of the students had iPod (8%), e-book reader (9.6%) and Tablet PCs (11.1%). Among the few students owning Tablet PCs, Level 100 and Level 200 students had a slightly higher percentage than their colleagues in Levels 300 and Level 400 (Table 4).

Table 4: *Cross-tabulation of level of students and ownership of Table PCs*

	Do you have a Tablet PC?	
Levels	**Yes**	**No**
	F %	**F %**
Level 100	17 (12.9)	115 (87.1)
Level 200	11 (14.3)	66 (85.7)
Level 300	9 (9.6)	85 (90.4)
Level 400	4 (6.0)	63 (94.0)

On the services and features which students often used on their mobile phones (Table 5), texting was the most frequent activity followed by listening to music, chatting and accessing social networking sites (Facebook, Twitter, YouTube etc.).

Table 5: *Services and features used often by students on their mobile phones to support their learning*

	Several times a day	Once a day	Few times a week	Few times a month	None
	F %	F %	F %	F %	F %
Sending and receiving e-mails	100 (27.6)	22 (5.9)	87 (23.5)	78 (21.1)	83 (22.4)
Sending and receiving text messaging	238 (63.8)	20 (5.4)	92 (24.7)	15 (4.0)	8 (2.1)
Chatting	198 (53.4)	15 (4.0)	37 (10.0)	21 (5.7)	100 (23.7)
Playing games	100 (27.0)	29 (7.8)	72 (19.4)	82 (22.1)	88 (23.7)
Listening to music	206 (55.2)	25 (6.7)	70 (18.8)	35 (9.4)	37 (9.9)
Accessing social network sites	197 (52.7)	28 (7.5)	57 (15.2)	28 (7.5)	64 (17.1)
Watching videos	94 (25.3)	33 (8.9)	100 (27.0)	55 (14.8)	89 (24.0)
Taking pictures	159 (42.9)	24 (6.5)	94 (25.3)	52 (14.0)	42 (11.3)

When asked to indicate which particular features of the mobile phones students had used to support learning in their distance education programs (Table 6), using the cell phone to make calls was very popular among students. Students also used the internet browser either on their phones or on their laptop computers to download learning materials. Text messaging was also used by students in their DE program. A few of the students use digital cameras to copy timetables and weekly activities posted on notice boards. Audio messaging such as Skype and use of Games were the least used by students in their DE programs.

Table 6: *Features used by Students in their DE program to support their learning*

	Once	Few times	Several times	Rarely
	F %	F %	F %	F %
Telephone	39 (10.5)	57 (15.4)	214 (57.7)	61 (16.4)
Digital camera	24 (6.5)	102 (27.6)	62 (16.8)	181 (49.1)
Emails	28 (7.4)	117 (31.5)	91 (24.5)	135 (36.4)
Internet browser	29 (7.8)	73 (19.7)	195 (52.6)	74 (19.9)
Text messaging	30 (8.1)	100 (27.0)	149 (40.2)	92 (24.8)
Audio messaging (e.g. Skype etc.)	18 (4.9)	55 (14.9)	33 (8.9)	264 (71.4)
Games	22 (6.0)	64 (17.4)	48 (13.0)	234 (63.6)

The majority of students said they would adopt m-learning if implemented next year (Table 7).

Table 7: *Planning to adopt m-learning next year*

	Frequency	Percent
Agree	275	73.1
Uncertain	53	14.1
Disagree	48	12.8
	376	**100.0**

Factor Analysis

A factor analysis was conducted to determine if the questions on m-learning readiness of students as adapted for this study could be grouped together. The reliance on the scree test led to the extraction of three components (Hayton, Allen & Scapello, 2004). The total percentage of variance for the cumulative value of the three factors was 66.6%. The principal axis factoring was used with the oblique rotation method using the default delta (0) (Costello & Osborne, 2005) because of its advantages over the orthogonal rotation approach (Matsunaga, 2010).

The pattern factor matrix generated showed salient loadings (Table 8). Factor loadings greater than [0.40] was relied upon which led to the extract of three factors. Factors items comprising Behavioral Control (BC), Intention (INT), Self-efficacy (SE), and Learning Autonomy (LA) loaded strongly on Factor 1, whereas, Social Norm (SN) and Student Readiness (SR) though loading on Factor 1, were not as strong as BC and INT. Items on Attitude (ATT) and Perceived usefulness (PU) loaded strongly on Factor 2. Items on Perceived Ease of Use (PEOU) loaded on Factor 3.

Students' perception of benefits and challenges on the adoption of M-Learning

In the questionnaire, students were asked to indicate the benefits or the potential uses and the challenges of mobile learning devices in teaching and learning. Some of the benefits mentioned by students were that adopting m-learning would help students them have easy access to course work and will also make learning easy. Students also noted that since the device to use would be easy to walk around with, it would enhance interaction and discussion more among students. According to one student "*Since I like to access my phone a lot at any time of the day, I would be moved to read whatever course materials installed on the device*." For another student "*It will solve the problem of delay of modules if the Acrobat Reader (pdf) files could be easily accessed online*."

With the challenges, the major issues students identified were, cost of the devices and the difficulties in getting money to buy some of the items to support learning. Other challenges mentioned were the irregular supply of power, intermittent network failures, security and privacy. Loss of mobile device means loss of course material and this can create problems for students. There was also the fear that "*Students who are not having smart phones would be left behind*." According to a student "*It will hamper my ability to use mobile technology in distance education because I come from a very remote area and have no access to the internet, it would be useful if the modules and the face-to-face tutorials are maintained because internet usage is not available throughout the country*." According to another student "*It might be difficult for some old folks who are not ready to adjust to technological changes*."

Table 8: *Pattern Matrix of M-learning Readiness Items*

	Factor		
	1	2	3
I have a sufficient extent of self-confidence to make decision to adopt m-learning	.917		
I intend to adopt a mobile device for university courses	.906		
I have a sufficient extent of control to make decision to adopt m-learning	.872		
I plan to participate in m-learning if introduced next year	.854		
I predict I would use a mobile device for my courses	.843		
I would have more opportunities to create knowledge in my coursework with a mobile device	.822		
I am confident about using a mobile device for my courses	.817		
I plan to use a mobile device if a course has mobile learning functions	.796		
I would be able to actively access coursework material with a mobile device	.795		
I would be comfortable to use a mobile device in my courses	.785		
I would be able to control the pace of learning in my classes with a mobile device	.757		
I think other students in my classes would be willing to adapt a mobile device for learning	.745		
I have a sufficient extent of knowledge to use m-learning	.739		
Most people who are important to me would be in favor of using a mobile device for university courses	.662		
I think the students would be in favor of utilizing m-learning in their course work	.623		
Most people who are important to think it would be easy to use mobile device for university courses	.510		
Using m-learning in my coursework is a wise idea		.855	
I believe that mobile devices would be useful for my learning		.827	
Using m-learning in my coursework would be a pleasant experience		.777	
I believe that using mobile devices would allow me get my work done more quickly		.724	
I believe that using mobile devices would improve my ability to learn		.523	
I believe that mobile devices would be easy to operate			.797
I believe that mobile devices would be easy to use			.718
I believe it would be easy to access course material with my mobile device			.549

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

DISCUSSION

The adoption of m-learning in higher education has been found to enhance teaching and learning. The purpose of this study was to identify factors that may aid the adoption of m-learning among students, as well as the relationship among these factors. The study found that there was high penetration of mobile phones among the students. The study found that although over 50% of students owned more sophisticated mobile phones across groups and ages, young students compared to their more mature colleagues had more sophisticated mobile phones. In addition, the distribution of ownership of Tablet PCs was concentrated among students at Level 100 and Level 200, also confirming the use of mobile devices among the youth (Koszalka and Ntloedibe-Kuswani, 2010; Porter et al. 2012; Mohammad, Mamat and Isa, 2012; Makoe, 2012). Another significant finding is that about 60% of students have laptop computers.

Since Tablet PCs will be the main device to be used for m-learning at the University of Ghana, the study found that though a small population of students owned Tablet PCs, the few who owned them were distributed across the various levels, but showing a greater ownership among the young students. Most students used their mobile phones for communication (texting, chatting, and emails). Apart from making telephones and texting other students about tutorial periods and assignments, using the internet browser to download additional material and digital cameras to copy timetables, the use of games and Skype are the least used mobile devices to support teaching and learning.

The strong loading of behavioral control and intention to adopt m-learning from the factor analysis provide valuable insight into students' preparedness to receive m-learning. This finding is consistent with that of Cheon et al (2012) where they found that college students' behavioral control was a key determinant in their intention to adopt m-learning. The expressions of high levels of controllability and self-confidence in the decision to adopt the use of mobile learning devices should provide administrators the justification to introduce m-learning to accomplish educational goals. As stated by Shih and Mills (2007 cited in Cheon at el. 2012), mobile activities such as texting, making calls, internet browsing and taking pictures are familiar to students.

The findings of the study support the importance of the theory of planned behavior control in determining students' m-learning readiness and the need for more attention to be paid to control beliefs such as perceived self-efficacy and learning autonomy. Furthermore, the strong showing of attitudinal beliefs (perceived usefulness and perceived ease of use) also show that students who feel that m-learning is easy to use would adopt the device. This is because of the high penetration of mobile phone ownership among students (98.7%). One of the results of the study is the lower loading of the normative beliefs. This finding is consistent with that of Cheon et al. (2012) and that of Shuie (2007). Indeed, the theoretical implication is that whilst perceived behavioral control tend to influence intention to adopt m-learning, the same cannot be said about the normative beliefs.

CONCLUSION

The study aimed at determining students' m-learning readiness based on the theory of planned behavior. The study examined students' m-learning readiness as they prepare for the roll-out of the University's m-learning program for distance students. The results showed that the majority of students owned mobile phones. Younger students had sophisticated mobile phones than older students. Students used these for several activities. They copied time-tables with their phones and used it to social network. The female students used their phones to take pictures more than the male students. About 73.1% of students had the intention to adopt m-learning in teaching and learning in their distance education program. Although the majority of students did not own Tablet

PCs, the use of sophisticated phones is a strong indication of the acceptance of use of mobile technology among students. This is a positive influence in the adoption of m-learning devices at University of Ghana. The use of the TPB reveals the importance of attitude, subjective norm and behavioral control in understanding students' perceptions toward the adoption of m-learning. It is crucial for implementers of m-learning programs to understand what makes students accept the use or rejection of mobile devices and how to improve user acceptance of these devices. This study reveals that perceived behavior control with its dimensions, perceived self-efficacy and learning autonomy have strong influence on intention to adopt m-learning. This should help administrators of the distance education program develop plans for the implementation of m-learning.

Finally, implementers of the University of Ghana Distance Education m-learning program should ensure that they address some of the challenges of students. These include the cost of the devices, so that it will be easily accessed by students. Also, the new devices should be within the comfort level of students so that both young and more mature students will be able to use confidently. Because students are the end-users of the devices they need to be involved in the implementation process in order to guarantee their commitment and success of the program. These findings of the study should help in the design of more inclusive and user-accepted m-learning systems at the University of Ghana.

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ICT-based, cross-cultural communication: A methodological perspective

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ABSTRACT

The article discusses how cross-cultural communication based on information and communication technologies (ICT) may be used in participatory health promotion as well as in education in general. The analysis draws on experiences from a health education research project with grade 6 pupils in Nairobi (Kenya) and Copenhagen (Denmark) addressing the topic of physical activity in everyday life.

The article outlines a sequence of educational events (the Cross-Cultural Communication (3C) model) comprising exchange of letters, recording and exchange of films[1] and Skype communication sessions interchanging with reflection sessions in the classes. The educational rationale for using cross-cultural communication is that meeting the unfamiliar (different children, cultures, schools and contexts) leads to curiosity and reflection about one's own situation; and subsequently that reflexivity builds action competence. In the present case study, the 3C model was used as a means of health promotion, but the approach may be used in relation to almost any topic. The 3C model is discussed in relation to theories of co-learning, knowledge guiding and sharing and participation. The article discusses methodological potentials and challenges.

Keywords: *Co-learning, cross-cultural communication, health promotion, ICT, participation, self-reflection, social learning.*

> *"When sitting only in computers using electronic things, when sitting down and not doing anything that can make you active, I would advise you to even make them active and they will be able to prevent the lifestyle diseases. ... I would like them to stop being lazy to know how to work to wash the house, to wash the utensils, to clean the house and do the house chores. I would like to advise them because most of them waste a lot of time at computers and phones. I'm afraid that if they continue like that it may spoil them. [Kenyan pupil reflecting on his new insights into Danish pupils' lives. 16th March 2012]*

[1] Film in this article means short film shot by non-professionals with a handheld camera.

1. INTRODUCTION

On a global level teachers are aware of the potential of introducing children to other cultures than their own. Pupils have pen pals in other schools, to start with within their own country, but as they grow older, also with children in other countries – either within Europe (http://www.etwinning.net/en/pub/index.htm) or around the world (http://www.theglobalexperience.org). There are a number of experiences with using Information and Communication Technology (ITC) to facilitate these meetings. Two ICT-related communication platforms, KIDLINK and iEARN, have been running for many years. The KIDLINK was established by professional educators in Norway in 1990 (Burleigh & Patti, 2011). The iEARN, established in 1988, is a non-profit organization in contact with more than 30,000 schools from more than 130 countries (http://www.iearn.org.). Both projects help students and teachers to make friends around the world and build up a global network, enhance learning and improve writing and reading skills – especially in English.

1.1 Cross-cultural, ICT-based education and learning in European schools

In a European context, cross-cultural dialogue in health promotion is a relatively novel approach. The Young Minds projects 1 and 2 demonstrated web-based, cross-cultural dialogues to be a strong tool when working to reduce alcohol consumption among young people in European countries, and improve the pupils' well-being and the school environment (Simovska & Jensen, 2003; Jensen et al, 2005). Some of the recommendations in Young Minds 2 were that ICT could be used in concrete and effective collaborative learning environments and that the "interplay between cross-cultural collaboration, taking action and participating in online learning environments contributes to students' increased sense of self-determination and control over their activities" (Jensen et al, 2005, p.127). The Young Minds projects concluded that international cooperation increased the commitment among pupils and teachers and encouraged them to view their environmental and health problems and conditions in a broader perspective. In addition, the pupils' English skills were improved (Jensen et al, 2005, p. 106). The experiences with cross-cultural collaboration from Young Minds continued in the Shape Up project (Simovska & Jensen, 2003; Simovska et al, 2006). The rationale was that health problems were both local and global. Furthermore, it was a motivating factor to integrate an international dimension in schoolwork addressing health issues.

1.2 ICT-based education and learning in Africa

In the African context, experiences with integrating ICT in action-oriented and cross-cultural communication projects have been developed later than in high-income countries. A review on cross-cultural communication documented the integration of ICT in educational and learning processes in Africa (Ocholla, 2003), and others have demonstrated the presence of a 'digital divide' including barriers in low-income countries' weak infrastructure, lack of skills, lack of relevant software and limited access to the Internet (UNDP 2001; UN 2003; Aduwa-Ogiegbaen & Iyamu, 2005). Recently another cross-cultural communication project has integrated mobile technologies as awareness and communication tools (Botha et al, 2009). Today countries like Kenya have a fairly well functioning ICT-structure and the technical challenges in cities like Nairobi are limited (http://www.un.org/africarenewal/Africa-Renewal-May-2013).

Based on the work mentioned above, the present article describes the further development of an ICT-integrated, Cross-Cultural Communication (3C) model for learning practice. This has been developed on the basis of a study linking grade 6 primary school pupils in Nairobi and

Copenhagen. The focus of the study was everyday movement as an element in health promoting school teaching.

2. METHODOLOGY

2.1 Theoretical perspectives

The argument for cross-cultural education models builds on a conceptualization of learning as a dynamic social process. Social learning is a key component in several central theoretical approaches to learning. Daw (2005) argues for the concept of co-learning between teachers and pupils in a classroom setting. With reference to Vygotsky, he asserts that children's participation in the dialogue and the communicative process is essential for their understanding, i.e. socialization and learning are integrated. On that basis it can be argued that sharing of knowledge is essential for cross-cultural communication projects.

Rogoff (1990) further developed Vygotsky's (1978) approach to guiding and sharing knowledge: "Children enter the world embedded in an interpersonal system involving their caregivers and others who are already involved with societal institutions and technologies. Through guided participation with others, children come to understand and participate in the skilled activities of their culture" (Rogoff, 1990, p.191). Rogoff states that through shared problem solving or communication (guided participation), the learner is involved beyond the individual level: "it is an appropriation of the shared activity by each individual that reflects the individual's understanding of and involvement in the activity" (Rogoff, 1990, p.195).

The social learning theories contend that knowledge and learning are related to interaction between pupils, and further that understanding and reflections come out of shared problem solving and communication. Co-learning can be described as: "… a process of interactive and experiential dialogue and collaborative interaction in a particular field with specific objectives" (Law, 2011, p.4). The characteristics of a classroom environment with a co-learning approach are: 1) shared power among co-learners, 2) social and individual learning, 3) collective and individual meaning-making and identity exploration, 4) "community of practice" with situated learning and 5) real world engagement and action (Law, 2011, p.5).

The main principle of co-learning related to cross-cultural communication is that pupils do not only acquire knowledge *about* pupils from another culture, but attain knowledge and understanding *with* pupils by sharing, exploring and reflecting in an equitable participatory process. Facilitating and guiding learning with the perspective described by Law (2011) indicates a genuine participatory approach. Hart (2008) and Simovska (2009) both analyze the way children's participation frequently is either non-participatory (first steps of the participation ladder from Hart, 2008) or only symbolic (Simovska, 2009). This pilot study aimed to use the cross-cultural dialogue as the motivating factor for health promotion and learning based on a synthesis of the theories described above.

2.2. Design

The pilot study was conducted from October 2011 till June 2012. Two primary schools in Copenhagen, Denmark and one in Nairobi, Kenya participated. The main theme for the activities was movement and physical activity. Data on the educational processes were generated using: 1) films as a way to display non-formal physical activities like playing, walking and cleaning (apart from formal activities like Physical Education in schools); 2) participant observation especially on

what kind of physical activities pupils do in and outside schools; 3) semi-structured interviews with teachers and headmasters on the learning processes; and 4) group interviews with the pupils with the purpose of reflecting on the relation between bodily activities and health issues.

The pupils were informed verbally and in writing about the study. In addition, parents and teachers received letters explaining details about the project including aim, educational methods and steps. Informed consent was obtained from parents as well as children.

The pilot study is part of the 'Children Across Cultures Tackling Unhealthy Settings' (CACTUS) programme which is driven by Steno Health Promotion Center, Kenyatta University and Roskilde University. Parallel to the present study on cross-cultural communication, other related studies are being conducted on pupils' perceptions of food and movements with the long-term view to prevent diabetes and other non-communicable diseases[2]

3. THE CROSS-CULTURAL COMMUNICATION (3C) MODEL - STEP BY STEP

Based on the experiences of the project, an educational ICT-based, Cross-Cultural Communication (3C) model has been developed. It comprises 14 steps (see Table 1).

Table 1: *The 14 steps and key learning points of the Cross-Cultural Communication (3C) model.*

Steps	Content	Main points and comments
Step 1	**Selection of schools**	• Important to find right match based on explicit criteria • Dedication and sound pedagogic environment are crucial • Access to the Internet • Basic ICT skills among the teachers
Step 2	**Introducing the model to the schools**	• All relevant stakeholders (management, teachers, parents) should be involved • Purpose and methods should be explained thoroughly • Transparency related to learning (co-learning) • Activities to be coordinated with school year and terms

[2] The CACTUS programme focuses on risk factors for diabetes and other non-communicable diseases. An estimated 366 million people live with diabetes worldwide of which 80% live in low- and middle income countries (IDF, 2011). Overweight, obesity and sedentary lifestyles are increasing on a global scale leading to rises in cardiovascular and other lifestyle-related diseases (IDF, 2009). Educating children is an entry point to reduce the increase in obesity prevalence rates, and schools have been pointed to as a setting for health promotion (WHO, 2005, Currie et al, 2012).

Steps	Content	Main points and comments
Step 3	**Introducing the model to the classes**	• Activities to be harmonized with teaching plans (curricular or extracurricular activities) • Assessment of language skills • Learning outcomes should be explicit
Step 4	**Writing and exchanging letters**	• Matching pupils to each other in friendship classes • Talks about 'ethics' • Logistics of exchanging the letters
Step 5	**Reflection one in the classes**	• Class-based discussion of main learning points, similarities and differences
Step 6	**Ensuring ICT equipment and skills are available**	• Extent of ICT literacy among teachers and pupils • Knowledge culture related to integrating ICT in teaching and learning
Step 7	**Planning the films**	• Pupils selecting themes for filming (facilitated by teachers) • Pupils planning the films (facilitated by teachers)
Step 8	**Filming the scenes**	• Pupils conducting the actual filming (if necessary assisted by 'experts')
Step 9	**Editing and exchanging films**	• Editing is time consuming and requires know how and specialized software • Should ideally be done by the pupils (if necessary assisted by 'experts') • Logistics of exchanging the films
Step 10	**Reflection two in the classes**	• Class-based discussion of main learning points, similarities and differences
Step 11	**Preparing the Skype sessions**	• Based on content of letters and films, what important questions and themes should be discussed? • Agreement on way to present the questions and answers
Step 12	**Skype sessions in the classroom**	• The two classes agreeing on the choreography of Skype sessions • Check all the technology before kick off • Allow for time (whole sessions) for pupils to get acquainted before selected educational themes can be dealt with

Steps	Content	Main points and comments
Step 13	**Reflection three in classes**	• Class-based discussion of main learning points, similarities and differences (co-learning) • Deciding on next step in relation to friendship class
Step 14	**Reflection at school level**	• Sharing experiences and lessons learned among all teachers, parents and management teams • Next steps • How can the experiences be integrated into the visions, missions and structure of the future school plans?

3.1 STEP 1-3: Selecting schools and introducing the methodology to schools and classes

The schools in Nairobi and Copenhagen were sampled seeking representation from both higher, middle and lower socio-economic parts of town. The school in Nairobi was selected on the basis of its conducive learning environment, the cordial relations between pupils and teachers and its access to the Internet. Though all schools were urban, their catchment areas were more or less extended causing pupils to use different means of transport to school (walking, cycling or being driven by car). Approximately 104 Kenyan and 41 Danish grade 6 pupils took part in the various phases of the project.

The selection process in Nairobi took about two weeks. First the class teachers were contacted by the headmistress, and subsequently the researchers introduced the study principles and procedures in more detail to the class teachers. Finally, the pupils were introduced to the project.

3.2 STEPS 4-5: Writing and exchanging letters and reflection in classes

In order to prepare the pupils for communicating online, introduction letters were exchanged between the two countries. In one hour's time, every Kenyan pupil wrote 2–3 pages about themselves, their families, where they lived and their free time hobbies. In Copenhagen, the process of writing letters was slightly different. In the first school the class teacher took it upon himself to produce the letters with the class as part of his English teaching. In the second school, the researchers joined the class together with the teacher and supported the writing process. The Danish letters were generally shorter than those from Kenya and contained information about families, hobbies, idols and material possessions. Most of them contained a photo.

The letters from Nairobi were distributed among the pupils in Copenhagen and vice versa. Because of the high numbers of pupils per class in Nairobi as compared to Copenhagen, the Danish pupils had 2-3 Kenyan pen pals each. After having received and read the letters from their friends in the friendship classes, it was possible for the teachers to use the letters as a means of teaching and reflection. Letters are personal statements on personal issues, family, local society and also reflections on personal feelings about the importance of communication and in general become friends. The pedagogical outcomes were to develop writing skills and competences in expression of thoughts and ideas (Intercultural competences). The work with the letters took about two month altogether. However, it may be feasible to complete this phase within a much shorter time span, if the logistic is clear from the beginning.

3.3 STEP 6: Ensuring that ICT equipment and skills are available

The research group decided to base the cross-cultural communication on an online platform. After a period of investigating different options, the Skype platform was chosen because it is free and relatively easy to access and use. This was deemed to be crucial for the sustainability of the approach in low- and middle-income countries.

In Nairobi, only few of the teachers were experienced in the use of computers and they were not used to integrating ICT in their teaching. The Kenyan school had no Internet access and only one computer was working. In that sense the Kenyan school was IT illiterate and the process had to start from scratch. The school offered the project to refurbish a room dedicated to the project only. The project contacted an ICT engineer who established internet access via a broadband connection, and provided the school with one stationary computer, projector and all necessary equipment for a Skype session.

In Copenhagen, both teachers and pupils were computer literate and both schools used ICT in their teaching. Furthermore, both Danish schools had all the basic equipment installed in the classrooms.

3.4 STEP 7-10: Making, editing and exchanging films; and reflection in classes

As a next step films were produced about being physically active in everyday life. The purpose was to introduce the discussion themes by showing the films before the Skype dialogues. First, the films should introduce the broad subject of being physically active in everyday life as the subject of the communication. Second, reflections on the films were meant to form the basis of the questions for the Skype session; making it easier for pupils who did not know each other to communicate. Finally, the subjects of the films were largely influenced by the pupils' choices in order to encourage participation.

In Kenya, the themes for the films were debated in the class. Five groups were formed in which ideas for short films about physical activity in everyday life were discussed. The following themes were chosen in discussions between the pupils, the teachers and the research team: 1) "being active by working" (e.g. cleaning the classroom), 2) "being active at home and on the way to and from school and during housekeeping", 3) "being active in physical exercise lessons in schools", 4) "being active in the classroom", 5) "being active during school breaks". In Nairobi, the researchers went together with some of the Kenyan pupils to their homes on a Saturday and made the Kenyan film about their housework and families. Later, scenes from the school focused on break time activities and cleaning the classroom. A handheld compact Canon LEGRIA FS307 camera was used.

In Copenhagen, after having read the letters, the pupils, class teachers and researchers discussed and chose four themes for the films. The themes were meant to describe the physical activities and places of the pupils' everyday lives, such as "the club and the stone", "the street and city life", "the skater park" and "football". There were 4-6 pupils in each group. They prepared the film in detail as to what lines and actions and places to film within the school neighbourhood. The filming in Copenhagen took place over the course of two half school days. The researchers operated the cameras and the pupils directed and acted their stories. In one of the schools, the pupils requested that a soundtrack of their favourite songs should be added to the activities in the film.

The films from both Copenhagen and Nairobi were edited by the researchers into short films of approximately 3-5 minutes in accordance with the pupils' scripts. This was done in Copenhagen using the software, Windows Movie Maker®.

During the observations and in the following interviews it was documented that all the Kenyan pupils watched and were excited to see the Danish short films. They were surprised to see how Danish pupils were allowed to walk around in the streets looking into the shops. They found the skating park presented in a film to be very attractive. Furthermore, they were surprised to see the Danish pupils playing football in the rain. Generally the free behaviour of the Danish pupils and their access to city spaces were surprising for the Kenyan pupils. This differs from the Kenyan pupils who live a somewhat more restricted life, due to long school hours and less save city environments.

The Danish pupils really liked the Kenyan pupils' display of songs and dance and their play during school breaks. They were also somewhat shaken by the way the Kenyan pupils would spend hours of hard labour to clean their class room twice a week using small hand brooms and buckets of water. More generally, they were surprised to learn that the lives of the Kenyan pupils did not differ radically from their own; their clothes were neat and clean, they had modern technologies and they looked happy and healthy. The Danish pupils reflected that this picture contrasts the image displayed in the Danish media of African children being hungry and miserable. The Kenyan pupils were surprised that their daily life activities and cleaning in classes was of interest to their Danish friends.

The film production steps were time consuming and the exchange (sending the videos to each other) caused problems. It was not easy to send the films via the Internet, and the drop box application was not functioning in Kenya. Consequently, the films were hand-carried on CD-ROMs to the Kenyan school. Some more sustainable way of handling this was subsequently discussed among the researchers.

3.5 STEPS 11-13: Preparing and conducting the Skype communication and reflection in classes

After editing the films, the researchers visited the Danish schools once again to show the final result. The films from Nairobi were shown afterwards. Inspired by the films the pupils formulated two questions for their Kenyan and Danish friends respectively. Preferably the questions should relate to the theme everyday physical activities and places.

The Danish films were shown to the Kenyan pupils just before the Skype session, so they did not have much time to reflect on them, though some comments were made.

In Nairobi, there were a number of technical problems. During the first Skype session, the low quality of the microphone made it very hard for the Danish pupils to hear and understand the Kenyans. One of the Skype sessions also involved a failure of the electricity supply, a problem which was solved by using a generator that was fortunately nearby.
In Copenhagen, the contact via Skype to Nairobi was easily established. The Danish and Kenyan pupils were divided into groups and asked each other two questions in turn. The opposite group replied after each question. In Nairobi two spokesmen were chosen, who stood in front of the webcam and replied to the questions asked. In Copenhagen, the pupils who were most confident in the English language usually spoke.

There was some difference between the two sessions in Copenhagen. The lessons learned from the first session informed and improved the second one in term of organising and steering the conversations and improving the sound. During the second Skype session, the dialogue and questions had a special style, the sound was better and the Danish pupils talked as one big group. We conclude that only one Skype session is not enough if the pupils should get the full benefit of the communication process. Pupils from the two countries first need to become accustomed to each other and find a way to communicate clearly on a media like Skype.

3.6 STEP 14: Concluding reflections at school level

After the last Skype session pupils and teachers were interviewed to evaluate the process, and in Kenya a meeting took place with all teachers and the school management. The meeting summarized the lessons learned and strengths and weaknesses of the pilot project. It was also discussed how the interventions could have long term effects – even in subjects that were not included in the pilot. The involvement of teachers, the very comprehensive curriculum and frequent testing of the pupils were discussed as barriers to the new ideas. All the teachers stated that they liked the project and asked for further involvement with more classes and more 3C activities with Danish classes.

In Denmark all pupils from the two classes were divided into two groups in order to discuss the process. The two class teachers made comments about their involvement as well. Pupils from the Danish classes were very excited about the Skype meetings. They all wanted it to last even longer because it was fun and not too 'school-like'.

4. CROSS-CUTTING THEMES – ANALYSIS AND DISCUSSION

4.1 Potentials

The project was conducted in order to gain experiences with cross-cultural communication as a learning approach using and integrating ICT in health promotion. The educational rationale of cross-cultural communication is mainly that sharing and dialogue – co-learning - expand the understanding of one's own situation and the socio-spatial context. The recent technological advances in ICT have increased the possibilities for cross-cultural communication. The study findings showed that the cross-cultural communication process, using letters, film and the Skype sessions, was exciting and a great motivation factor for participatory learning.

According to Jensen (2004), pupils will be more engaged and motivated if they feel responsible and are involved in a participatory way. Even though the Kenyan pupils were not involved according to the top category of Hart's (2008) ladder of participation, the level of participation was high compared to the normal teaching situation in the Kenyan classes. Despite the fact that Kenyan schools generally are more disciplinary and teacher-driven in their educational approach, the study showed that both Danish and Kenyan pupils experienced the participation in the steps of the 3C model as more engaging and closer to real life learning than traditional class room learning. This is in line with Law (2011) who recommends "real life engagement and action" and Glasser (2007) who argues for co-learning based on non-hierarchical relationships, collaboration, trust, full participation, and shared exploration. Simovska (2009) states that it is possible to establish genuine and real participation if pupils are taken seriously. The 3C model has proven to be motivational and an initiator of participatory reflections. The study observations and interviews showed that the project made a great impression and created enthusiasm and fun among the pupils. It is therefore essential that pupils should be actively involved in the communication and exploring process. Not only the pupils but also the teachers were engaged in sharing knowledge,

experiences and comments across the borders. With guided participation mediated by the researchers and the teachers, the communication had an impact on the pupils in both Nairobi and Copenhagen. The pupils and the teachers developed ownership the project as it progressed. They exchanged comments about their lifestyle and local contexts and the pupils became more and more informed about each other's culture. The concept of 'guided participation' refers to Rogoff's research (1990) and involves both the formal and informal ways in which teachers, researchers and pupils were interacting as well as the social settings that shaped the pupils physical activities.

The reflection sessions are conducted in steps 5, 10, 13 and 14 of the 3C model (Table 1). The co-learning approach leads to learning about oneself and one's place in the world by sharing with others and then again looking at oneself in a new perspective (Law 2011). This might lead to new insights and provide new opportunities. In the present study self-reflection was applied to issues of health promotion and physical activities, but it may be used in relation to almost any other theme such as human rights or environmental sustainability.

Generally, the study resulted in various degrees of participation and learning from the real life experiences – increasing as the project progressed. From an educational point of view the learning outcomes of the pilot study were development of knowledge, skills and competences. The pupils gained more knowledge about each other's countries and the daily life of their friendship classes. During the process and following the various steps in the 3C model, especially the Danish pupils acquired and enhanced their language skills by speaking and writing in English. Displaying one's own communication skills and courage to stand in front of all the others was also a learning experience. This is in line with Jensen's (2004) argument that action-oriented experiences are important and will be further developed if the experiences are rooted in a real life setting.

4.2 Challenges

Research in Kenya has shown that integrating ICT into educational institutions is not easy due to absence of educational software, lack of internet access and the teachers' computer illiteracy (Wims & Lawler, 2007). Due to lack of ICT equipment and expertise at the Kenyan school, it proved necessary to have a consultant facilitating the project in Kenya (Step 6 in the 3C model). The stability and supply of the electricity in a country like Kenya has to be taken into account as well. Even though both Danish schools had previous experiences with different kinds of cross-cultural communication, this way of cross-cultural communication was new to both the Danish and the Kenyan teachers.

Another challenge was the different curricula, educational plans and teaching approaches in the two countries. While the Danish curriculum has some space to integrate external projects during school hours, the Kenyan curriculum is very condensed and examination-oriented. As a consequence, educational plans are strictly adhered to. Hence, it is hard for the Kenyan teachers to work with the 3C model during the school hours. Curriculum development work has to be planned in advance and it has to be in line with other curricular demands (Step 3 in the 3C model). However, during the intervention the Kenyan headmistress and class teachers were very flexible and they became increasingly involved and interested. Nevertheless, the project would not have been possible, if the research team were not facilitating the process. A suggestion is to have this kind of activity as an extra-curricular activity for the Kenyan pupils and then have the Skype session during the afternoon for the Danish pupils as well. The time difference between the two countries is 1-2 hours depending on summer time (daylight saving time), so it should be feasible for the schools to plan.

The time limit of the project also appeared to be a challenge. The pupils needed more time to communicate to get accustomed to each other and make friends. Thus, more than one Skype session is needed (Step 12 in the 3C model).

Ensuring ownership already starts in step 2 of the 3C model, where the schools should obtain a clear understanding and acceptance of the aims of the project. The level of mental ownership is also related to participation. More participation leads to stronger feeling of ownership (Breiting, 2008, p. 173).

It was mainly the participating class teachers who had ownership to the project, because the project was introduced as a class-related project rather than as a whole school project. However, in future rounds this can easily be adapted. During the process, and especially at the end, it became increasingly clear, that the sustainability aspect needs to be more integrated from the onset of the project, meaning that all teachers in the school should be informed and involved as much as possible – as mentioned in Step 14 of the 3C model.

The present study, during which the 3C model was developed, was based on an amount of resources that is not feasible under real life circumstances. Subsequently, time and economy could be a barrier to up-scaling the model in its present form.

Negative side effects should also be considered. More specifically it should be considered how children from low- and middle-income countries react to being exposed to relatively prosperous conditions in high-income countries (Step 4 about ethics in the 3C model). Furthermore, the films produced during Step 8 often included scenes from the children's private homes. This raises the issue of privacy. However, the experiences from the project indicate that pupils were not that concerned about sharing private issues. On the contrary, the Kenyan pupils purposively and proudly chose to show their homes with their friends in Denmark.

5. CONCLUSION

This article has described an ICT-based, Cross-Cultural Communication (3C) model developed from a pilot research project involving Kenyan and Danish primary schools. A detailed manual, the 3C model, was provided (Table 1) and potentials and challenges were explored along with general theoretical considerations and practical educational points. The 3C model is based on a theoretical foundation combining notions of social learning, co-learning and participation. The educational rationale for using cross-cultural communication is that meeting the unfamiliar leads to curiosity and reflection about one's own situation and subsequently increased action competence. It is the hope that others will feel inspired to use the method and develop it further.

Further research is needed on the ways in which the model may be improved and adapted to various settings and countries with disparate availability of time, skills, traditions and financial resources and learning targets in relation to health promotion in particular and education in general.

From a practical perspective, teachers are provided with an innovative educational tool. The 3C model may be used not only in health education but in other subject as well. It is important to emphasize that the procedure described here is by no means fixed and may be modified and adapted to local circumstances.

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