Understanding Technologies for E-Assessment:
A Systematic Review Approach

Osang Francis Bukie
PhD, National Open University of Nigeria and Research Scholar, International Center for Information Technology & Development,
Baton Rouge, USA
fosang@noun.edu.ng, bukie3osang@yahoo.com

ABSTRACT

The use of electronic assessment technology in institutions of higher learning is gaining rapid acceptance globally. This is not unconnected to the increasing global demands on higher education and the availability of several e-assessment platforms. Unfortunately, the slow rate of adoption of such technologies especially in the sub-Saharan Africa despites their benefits are of great concern to researcher. In addition to the focus on some of the existing technologies studied in this paper, a systematic review of 41 e-assessment related papers were analyzed. The findings revealed that while 80.5% of the papers focused on usage of one form of e-assessment technology or the other, only 2.4% of the papers reviewed investigated the fit of e-assessment tool (moodle and light wave). Therefore, there is an imbalance in research that explores users' views on the fit of the several e-assessment tools being used by the various institutions and how these varying fit affect usage and performance using appropriate theoretical framework. The research does not only expand the body of knowledge in the e-learning domain, it contributes towards the provision of a foundation for the assessment of e-assessment technologies.

Keywords: *Information systems, IS usage, performance, satisfaction, computer self-efficacy, e-assessment.*

1. INTRODUCTION

There is a plethora of terminologies associated with the use of information and communications technology (ICT) in the management of the assessment process in higher education. Some of them include e-examination, e-testing, web-based assessment, computer-based assessment, online assessment, computer-aided assessment and e-assessment etc.

From the initial focus on certification testing for the IT industry, e-assessment has grown into a widely accepted delivery model serving virtually every market that was once dominated by pen-on paper testing. According to [48], nearly one million tests per month are delivered in high-stakes, technology-enabled testing centers all over the world. Educational institutions are not left out in the adoption of such smart innovative technology in the delivery and sanitization of the evaluation process.

Electronic assessment has been designed in various forms. These include electronic report, electronic portfolio, blogs and forums, electronic examination etc. Electronic examination is arguably the oldest form of e-assessment. It is administered either within the local area network through the client server architecture or online via the internet.

In electronic report, students' reports are assigned and submitted online through the virtual learning environment. Lecturers download, marks, grades and returns the report to the student in an entirely 'paperless' system.

In the e-portfolio platform, the evidence of one's learning journey over time is demonstrated. This technology has been emerging in the educational sector since the birth of the personal computers and now on the Internet in a variety of formats. There are a variety of tools that can be used to develop e-portfolios, both for individuals and institutions [6]. They can be implemented with desktop tools (i.e., Microsoft Office, Adobe Acrobat) or online tools: Web 2.0 tools, which are mostly free, Open Source tools, or commercial tools that are created as both e-portfolios and assessment management systems.

A blog on the other hand is an online journal that encourages communication of ideas through the entries of individuals usually displayed in reverse-chronological order. It is seen as a website where people publish short items on a continuing basis. Discussion forums are a relatively new development within education. Whilst they have been used by students in a social setting for considerably longer, their use in the learning process is still in its infancy.

2. TECHNOLOGIES FOR E-ASSESSMENT

Basically, there are two broad types of tools used for the purposes of e-assessment. While some institutions in the world make use of learning management systems as tools for delivering teaching, learning and assessment in their institutions, others use large-scale computer based e-assessment technologies designed solely for assessment purposes.

2.1 Virtual Learning Environment (VLE)

In VLEs tertiary institutions assessment is bound firmly into course structures. This is because assessment is scheduled as part of a course and is undertaken by the students enrolled in a course. Hence there exist a link between assessment support and the existing structures of learning management system [18].

Similarly, [8] describes a virtual Learning Environment as a "software tool, which brings together in an integrated environment, a range of resources that enable learners and staff to interact online and includes content delivery and tracking." VLEs usually provide tools for developing online assessment tests. The assessment module of an e-learning platform must allow teachers at least four basic actions: (i) to develop different types of tests, such as true/false, multiple choice, fill-in the blank, matching, ordering, etc., (ii) to set dates and times when students must take the virtual tests, (iii) the system must be able to randomize the questions and answers to be included in the test, and (iv) instructors can override the automated scoring and determine how to communicate test results to students.

Some of the examples of VLEs in use in the higher education sector are listed in the table 1 below:

Table 1: Virtual Learning Environment (VLE)

LMS platform	Statistics
CLAROLINE http://www.claroline.org	The Caroline VLE was initiated in 2001 by The Catholic University of Louvain (Belgium). The software has been translated into 35 languages and is currently used by more than 2500 organizations from 117 countries. In Nigeria, it is being used by 7 organizations including University of Port Harcourt.
Dokeos http:www.dokeos.com	This e-learning software is currently used by almost 300 universities around the world and there are more than 250,000 active users of the platform at present. It is available in 34 languages.
ILIAS http://www.ilias.de	The ILIAS learning management system was developed between 1997 and 2000 at the University of Cologne. It is currently available in more than 20 languages. Users have the freedom to choose among different interfaces and styles. Toshiba TEC has been using ILAS for training employees across Europe since 2010
MOODLE http://moodle.org	Moodle was originally developed by Martin Dougiamas in Australia in 1999. Currently, it is the most used VLE throughout the world, with more than 2 million users. By October 2013, Moodle had a user-base of 73,750,202 users in 7,879,680 courses in more than 230 countries and in more than 70 languages. The United State of America currently top other countries with a total user base of 14471 registrations.
SAKAI http://sakaiproject.org	The earliest versions of Sakai were originally developed at the Michigan and Indiana Universities. At present, the Sakai Foundation is constituted by more than 100 international universities, colleges and commercial affiliates.
Web CT: BLACKBOARD www.blackboard.com	The Blackboard Learning System is a virtual learning environment and course management system developed by Blackboard Inc in 1997. It provides users with a platform for communication and sharing content including the assessment and grading of online assignment by Lecturer and students.

dotLRN http://dotlrn.org	Originally developed at MIT, the dotLRN platform is now used by nearly half a million users in more than eighteen countries worldwide. It uses widely adopted enterprise-class open-source software for supporting learning and research.
ATUTOR http://**atutor**.ca	A Tutor is an Open Source Web-based (LMS) used to develop and deliver online courses. A Tutor was first released in late 2002. Its text based accessibility features in the system enables a blind person to listen to the entire interface of the system with the help of a screen reader, and can access the system without needing a mouse. These features also allow A Tutor to adapt to a wide variety of technologies including cell phones, personal data assistants (PDAs), and text-based Web browsers etc.
TOPCLASS	Top Class is the name of WBT's Learning Management System (LMS). Instructors can create and design tests, quizzes, polls and surveys. Tests can be configured for randomization, maximum attempts, timed tests, negative marking and much more.
	Here, each course has a built-in database for exam questions. Instructors load the questions into the database then create exams and quizzes based on these questions. The exams and questions can be edited, deleted, and re-used anytime for a quick feature rich online examination system.

VLEs have evolved through the years giving rise to three different types of solutions: (i) commercial software, (ii) open source platforms, and (iii) internally developed platforms. Today, there are over 200 VLE being used today.

2.2 High Stake E-Assessment Tools

While VLEs comprises of both the teaching, learning and assessment modules, high stake e-assessment technologies are designed primarily for assessment purposes. The case for using dedicated platforms for end-of-semester examinations is most compelling for institutions with large numbers of students, especially when there is an established database of suitable questions. [14] stated that e-assessment differs from other learning technologies in that the stakes are much higher among staff and students particularly where it is used for examinations. High stake e-assessment shares similar issues with learning management system in terms of design, delivery and associated support needs [43].

Table 2 below present some popular high-stake e-assessment tools being used today.

Table 2: High stake E-assessment tools

E-Assessment Platform	Statistics
TAO	TAO is a dedicated large-scale computer based assessment (CBA) platform developed jointly by the Public Research Centre Henri Tudor (Centre for IT Innovation – CITI) and the University of Luxembourg (Educational Measurement and Applied Cognitive Science – EMACS). Platform consists in a series of interconnected modules dedicated to the management of subjects, groups, items, tests, planning and results in a peer-to-peer (P2P) network.
Course Builder for Dreamweaver from Macromedia Company	Course builder includes a number of questions types including drag-and-drop, single choice, multiple-choice, true-false, text-entry, and exploratory exercises. By setting an option, the user can track students' scores and send them directly to an AICC-compliant learning management system such us Lotus Learning Space, or save the information in a database (Horton and Horton, 2003).
Perception from Question mark	Scalable, flexible SaaS solution with available 24/7

Company	Support: Question mark On Demand provides comprehensive assessment authoring, delivery and reporting. It offers and administer assessments using a Windows application, a database, and a local area network and a second version for Web applications which includes the same computer-based applications as well as a server component that allows the users to create, edit, offer, and administer tests from anywhere using a Web browser (Horton and Horton, 2003).
Hosted Test, from HostedTest.com	It allows users to create and edit questions, combine them into tests, and administer students using a Web browser. Question types include multiple-choice, one-choice, short-answer, and long-answer (Horton and Horton, 2003).
Maple ta from Maple soft Incorporated	Its Maple TA (MTA) is an online assessment system capable of handling most assessment tasks, but particularly designed for the assessment of mathematics, where it can call on the power of its Maple engine to probe deeper knowledge and understanding.
Remarks from University of New England & 3 other universities.	Only intended for assessor use to annotate WORD files of take-home assignments. Assessor marks from screen. Windows 32-bit and 64-bit platforms (Windows XP with Service Pack (SP) 2, Windows Server 2003 with SP1, Windows Vista, and Windows 7), and XP tablet version.
Exam pro plus developed by Cyber Space Ltd.	It is a customized e-assessment platform currently being used in NOUN to administer electronic examination to their students. It is a web application that runs IIS on a local area network or through the internet (optional). It uses the server-client architecture with the server being connected into an existing LAN. In the platform, there are four integrated but independent modules comprising the global admin, the Lecturers, the technical staff and the students' module.

3. SYSTEMATIC REVIEW OF E-ASSESSMENT TECHNOLOGIES

A systematic literature review is a process that seeks to aggregate empirical data using a formal protocol. It has been defined as ''a means of evaluating and interpreting all available research relevant to a particular research question of topic area or phenomenon of interest' [29]. Systematic review has long been used in the medical domain. The steps in conducting evidence based literature review have been clearly identified and studied in information systems [36] and software engineering [29].

3.1 Research Question

Does the existing literature in the e-assessment domain sufficiently explore the use of theoretical framework in the analysis of the number of teachers using modern technologies such as e-assessment and how such usage has resulted to better service delivery and increased task performance impacts especially in the developing countries in the world?

3.2 Rationale for the Use of Literature Review

The concept of electronic assessment has great implications for education. However, the slow rate of adoption of e-assessment technologies despite its relatively early introduction to the market and its central role in the educational sector is of great concern to information systems practitioners and researchers. Unfortunately, existing systematic reviews and other forms of review in the e-assessment domain have failed to focus on the key human related factors such as e-assessment fit, usage and satisfaction as they affect performance of the various e-assessment technologies. In the light of the slow rate of adoption of e-assessment especially in the developing countries of the world, and its adverse consequences on the future and sustenance of assessment in the educational sector, a systematic review has become necessary in order to identify the gap created or caused by limited understanding of such key human related factors as they affect job performance in work places.

A thorough understanding and conceptualization of these factors would in no small measure improve the global re-engineering, adoption and utilization of e-assessment technologies considering the increasing students' population and shortage of lecturers with the necessary ICT skills capable of handling e-assessment in the 21st century.

3.3 Objectives of the Review

The framework provides the essential first step in organizing the literature synthesis to determine if the published literature on e-assessment technology considers factors that influences usage and performance such as e-assessment technology fit, utilization, satisfaction and the resultant performance outcome in developed and developing countries.

In the literature synthesis, the framework focused on the scope, identification of the conceptual model used in the study, and to make explicit the relationship to the synthesizing question of the analysis.

The work will attempt to focus on teachers (both male and female of all ages) and the students in both developed and developing countries of the world who have been using one form e-assessment technology or the other. The work included the analysis of e-assessment tools used for high stake summative examinations only. Assessments in formative assessment mode were not analyzed.

4. METHODOLOGY

The methodology used was the systematic literature review approach. The literature that describes this area of investigation is not indexed in a single database. A strategy that involved searching across multiple databases using search terms was adopted. Most literatures were located in the following categories: Education (E), Information technology (T), and Behavior/Organization (B). Databases searched were: EBSCO compendium (2005-2014), Google scholar (2005-2014), African Journal of Information Systems (2005-2014). The 9 years time span was intended to provide focus on the more current literature.

4.1 Study Selection

Independent searches were made using the title, abstract and keywords for the phrases ('electronic (e)-assessment /examination' OR 'e-assessment technologies' OR 'e-assessment use). As not the entire database supported Boolean phrases in the same way, the search was adapted as required to obtain equivalent results. The formula below guided the searches $(E_1$ or $...E_i) + (T_1$ or $...T_j) + (B_1$ or $...B_k)$, where E, T, and B represent search terms in the categories of education, information technology and behavioral/ Organization, respectively.

The following criteria were used to select the studies:

- Study of educational outcomes.
- Study of electronic-assessment outcome.
- Sample description.

- Comparison being studied or objective of the study.
- Reporting of results.
- English-only studies (including countries outside Nigeria).

The title and abstracts of the search results were assessed for relevance. Studies that mentioned the use of electronic assessment in large scale were selected to determine if technology was used to assist the assessment process. Studies that mentioned the use of software to support e-assessment were selected to determine the views of the users regarding the software. To be included in this review, the software must have been designed specifically for the purpose of supporting e-assessment activities. This excluded a number of studies that discussed the use of virtual learning environments since the use of VLEs encompasses not just the assessment modules alone but also the teaching and learning interaction processes. Also studies relating to the use of portfolios, blocs and peer assessment were not included in this study as emphasis was placed on high stake large scale e-examination studies that require much preparation and experiences from Lecturers in higher institutions.

The initial cross-database search produced 187 articles. The number was reduced to 163 after duplicates were identified and removed. After the initial review of abstract, 97 papers were identified to be included based on the criteria for inclusion. 41 papers finally met eligibility criteria for final inclusion after downloading the full articles and reading through their abstracts as well as the findings of some of them as the case may be.

5. RESULTS

This section deals with the extent to which the studies reviewed below sufficiently or insufficiently addressed issues associated with e-assessment technology use and performance. Table 3 below shows a year-by-year analysis of literature on e-assessment usage and performance from 2005 till 2014 for the 41 articles included in this review.

Table 3: Years of publication of papers reviewed

TABLE I. YEAR	TABLE II. FREQUENCY	TABLE III. PERCENTAGE
TABLE IV. 2005	TABLE V. 1	TABLE VI. 2.4%
TABLE VII. 2006	TABLE VIII. 1	TABLE IX. 2.4%
TABLE X. 2007	TABLE XI. 5	TABLE XII. 12.2%
TABLE XIII. 2008	TABLE XIV. 8	TABLE XV. 19.5%
TABLE XVI. 2009	TABLE XVII. 2	TABLE XVIII. 4.9%
TABLE XIX. 2010	TABLE XX. 6	TABLE XXI. 14.6%
TABLE XXII. 2011	TABLE XXIII. 5	TABLE XXIV. 12.2%
TABLE XXV. 2012	TABLE XXVI. 8	TABLE XXVII. 19.5%
TABLE XXVIII. 2013	TABLE XXIX. 3	TABLE XXX. 7.3%
TABLE XXXI. 2014	TABLE XXXII. 2	TABLE XXXIII. 4.9%

While 2012 and 2013 had 19.5% and 7.3% respectively, 2014 had 4.9% of the papers reviewed as the most current as at the first quarter of 2014 as at the time of this research.

From the papers reviewed, 80.5% of the papers focused on usage of one form of assessment or another. On the other hand, 19.5% (8) of the other papers did not explicitly investigate e-assessment or ICT use. It is also clear that only 2.4% of the papers reviewed [18] investigated the fit or appropriateness of e-assessment tool (moodle and light wave). There is therefore an imbalance in research that explores users' views on the appropriateness or fit of the several e-assessment tools being used by various institutions.

Three of the articles representing 7.3% of the papers mentioned or referred to a theory. These theories included: The grounded theory [37], computer self-efficacy model [46], and ITDEM model of action research by [33].

A summary of the unit of analysis, purpose, theory used, key factors identified as well as the main findings of the past studies are attached in table 4 below.

Table 4: Summary of papers reviewed and their findings

S/N	Author	Unit of analysis	Theory used	Factors identified	Findings
1	Isom, Jamie 2012	Teachers, administrator	-	-	- Lecturers were positive about assessment - Stars positive for student learning and teachers were more involved. - The transition was more positive for admin than teachers.
2	Cole, M.S 2013	Students	-	Age, no of test, socio economic status, sample size	- Majority of students performed and preferred paper based exams.
3	Jackson, T. 2011	Students, tutors, managers, external examiners & quality officers	-	-	- Sees e-assessment positive innovation. - Training to tutors and students to appreciate the reliability and acceptability of e-assessment technologies.
4	Newhouse, C.P 2011	Students	-	-	- It is feasible to implement any of these for high stake exams purpose. - Both were implemented without much technical difficulties.
5	Eva-Heinrich, J.M. 2012	Academics	-	Fit of moodle and light wave	Moodle and light wave possesses the fit for assignment management and marking as well as support for teaching and learning.
6	Adegbija, et al. 2013	Students	-	Use and sex	All students did not prefer e-assessment Females consider e-exam stressful Need for more computer literacy
7	Osang, F. 2012	Academic staff	-	ease of use, computer literacy use	81.9% of lecturers are computer literate 63% of lecturers found maple to platform challenging. E-exam preferred to pen and paper.
8	Jamil etal 2012	Lecturers	-	Gender, dept, designation, qualification, experience, literacy	Positive towards computer based exam Female, highly ranked, less experienced, more positive towards computer based exam.
9	Ayo, C.K 2007	Students	-	Computer literacy, ease of use and reliability	81.3% of students seeking admission are computer based literate It is reliable New technologies comes with added complexities
10	Smith, A. & Peck, B. (2010)	Nursing students	-	Use	Assessment should inculcate contemporary technologies for all inclusive participation `
11	Whitelock,	Tutors	-	Positive reaction,	- Open mentor tools provide additional features like

	Denise and Watt, Stuart (2007)			negative reaction, questions, answers	simple visual displays of the use of feedback - Open source tools are easier to adapt and use
12	McCann (2010)	Faculty member	-	Voluntariness, advantages, compatibility, trial ability, visibility.	Voluntariness and compatibility was identified as significant.
13	Adewale, et al. (2007)	Learners	-		Learners have positive perception on e-exam
14	Goldhaber, O. A (2012)	Students	Colorado growth model & value-added models	Class size, teacher qualification, student background	Highest inter temporal correlations with lagged scores, student background and classroom characteristics
15	Chung, R. R. (2008)	Teachers	Schon's concept	Attitude, support, experience, usefulness	Performance assessment is useful in preparing new teachers that leads to learner centered, assessment driven teaching
16	Liu, S-H (2011)	Teachers	-	Use	- Confirms conflict b/w teacher beliefs and teaching activities - External requests and student test scores were key in constructivist teachers.
17	Orlando 2014	Teachers	Grounded theory	Policy changes, cultural beliefs, use, political beliefs	- Cultural, political beliefs and institutions policies affect technology practices and use
18	Buabeng-Andoh C. 2012	Teachers	-	Use, age, experience	- Positive correlation between ICT use and teachers competence. - Teacher's perception use of ICT was positive but not significant. - Inverse correlation between ICT use, age and teaching experience
19	Teo, T. 2008		-	Affect(liking) perceived usefulness, perceived control and behavioral intention to use	No gender or age difference regarding attitude Significant difference for attitude by the subject area of studies Association between years of experience and level of confidence and attitude.
20	Teo, T. Hwee, J. 2010		Computer self efficacy model	Computer self efficacy, basic computer skills, media related skills, web related skills.	- Study validated a 3 fact or scale for measuring teachers self efficacy construct, had High BCS, fairly high WBS and low MRS with regards to self efficacy
21	Oates, G. 2010	Lecturer	-	Technology use curricular congruency equity and affordance	- Aspects of assessment in maths need attention.
22	Jamil, etal 2012	Teachers	-	Gender, depts., designation, qualification, teaching experience, certifications, and exam experience	- Positive attitude for female, highly ranked, highly qualified less experienced with computer qualification, with CB experiences are more positive towards CB exam.
23	Fluck A. 2009	Teachers	-	Practice	- Keyboard as a distraction - Low level skill used it.
24	Lingard, M. 2005	Lecturers	-	Purpose, time, pedagogy	- Time is needed to understand it's operation - Experience is key to use.

				experience	
25	Chigona A. & Chigona, W. 2010	Lecturers	-	Use, insufficient training, technical support.	- Factors mentioned impede ict use in Kenya
26	McDowell etal 2008	Lecturers	ITDEM model of action research	Identification, thinking, doing, evaluation and modification	- One tool cannot fit all - Action research can be used to engage lecturers in investigating assessment practices.
27	Ang'ondi E.K. 2013	Teachers	-	Attitude, belief and ict use	- Teachers confirmed that learning of ict add more burden to teachers - They belief, they are not competent enough to handle ICT task without support
28	Sato, M 2008	Teachers	-	-	- Improvement in practice attributed to standards and assessment task.
29	Christian, B. 2014	Pre-service Teachers	-	-	y engaging in assessment task, pre-service teachers became more value literate ere was a shift in perception of the role teachers play in developing the values of literacy for students
30	Aojula, H. et al 2006	Prospective students	-	CBA use	% of students agreed that integrated is useful in helping them to learn A should be applied to other courses
31	Coulby et al 2011	Medical student	-	Experience, attitude to learning	- Students found completing of assessment using PDA straight forward
32	Jordan 2011	Students	-	Use	- Evaluation leads to improvement in student performance
33	Sanna A. et al 2012	Student	-	Use, robustness, trustworthiness	- Assessment is objective and efficiently implemented
34	Doukas 2007	Students	-	Usefulness, use	- E-exam was preferred by students - It makes exam processes easier
35	Bauer et al 2008		-	Use, Support	- E-exams benefits are enormous - Objectivity in marking is critical
36	Palak D & Walls R.T 2009	Teachers & Students	-	Use, student-centered beliefs, teacher centered beliefs, attitudes, confidence, technical support, mgt support,	achers attitudes towards technology are the most significant predictor for teacher /student use. achers positive attitudes towards technology do not have the same influence on student technology use.
37	Hermans et al 2008	Teacher	-	Constructivist beliefs, traditional beliefs, use, experience, attitude, sex and age	- Teachers belief is significant in explaining teachers adoption of technology - Experience, attitude, gender, constructivist belief showed positive effect aditional belief showed negative effect on technology adoption
38	Bee et al 2008	Teachers in Malasia	-	Attitude towards use, Use, ICT competency, lack of time, technical support, age	- They showed positive attitude towards technology - Elderly teachers were eager to adopt ICT - Experience users and on the job learners indicated high training & support needs.
39	Ilomaki 2008	Teachers & Students	-	Use, competence, school community, learning environment, teaching practice	- Students are motivated users of new technology. Most teachers still find it difficult using ICT - Male students show better skills in technical issues than female students. - Current technologies used in schools are boring and does not provide competence
40	Peralta, H. 2007	Teacher	-	Ict use, individual factors, Teachers	- Level of confidence varies from country to country depending on availability

				training, education factors	- Training is key - Only Greek teachers relate training to self-interest others belief in formal training
41	Ertmer, P.A 2010	Teacher	-	Knowledge, self-efficacy, pedagogical beliefs, culture	-Teachers mindset is yet to accept that teaching is not effective without appropriate use of ICT resources to facilitate student learning

6. DISCUSSION OF FINDINGS

Information technology systems are gradually changing the face of education in the 21st century. The capabilities of ICT cannot be fully utilized if much attention is not focused on how humans interact with the systems and how these interactions results to the achievement of the set goals and objectives of the organization. That means that technologists must not only concentrate on building functional systems, they must also build systems that are compatible with the end-users, and that satisfies the needs of population. Such technologies must not only be seen to fit the task, it must also be used. Technologies with poor TTF would results to either systems underutilization or abandonment. According to [49], in order for technology to positively impact on performance, it must not only be utilized but also fit the needs of the user.

It is also important to note that only 2.4% of the papers reviewed [18] investigated the appropriateness of e-assessment tool (moodle and light wave). There is therefore an imbalance in research that explores users' views on the appropriateness or fit of the several e-assessment tools being used by various institutions. This implies that the impact of technology on given task cannot be satisfactorily explained without considering factors associated with the level of complexity or suitability for tasks they are designed to be implemented.

From our analysis of the papers reviewed, only three of the articles representing 7.3% of the papers on e-assessment technology mentioned a theory. The importance of organizing and presenting knowledge using appropriate theoretical frameworks cannot be over emphasized.

None of the papers combined the measurement of performance using both the precursors of utilization, technology fit, satisfaction or performance.

7. CONCLUSION

From the analysis, there is much to be learned regarding e-assessment technology implementation in educational institutions. While most studies have focused on the technicalities involved in the deployment of e-assessment, very few studies in this domain actually focused on understanding the behavioral and human factors that influences the adoption and sustenance of e-assessment technologies in the educational sector.

Complete evaluation of the factors predicting e-assessment usage and performance involves the inclusion of precursors of utilization, fit and satisfaction constructs,

none of the studies in our study included all these factors in their studies. The seeming incomplete understanding of these factors as well as their relationship may be responsible for the mobile portability tendencies of many institutions and the high rates of systems underutilization and failures.

It is believed that this work is one of the first to start looking at the various aspects of the e-assessment technology with a view to encouraging its adoption owing to the benefits associated by its usage in the evaluation processes in higher institutions.

Different tasks in ICT have various levels of difficulties. It is high time these specific tasks are studied rather than discussing ICTs generally as if their operations are the same. This will to a large extent further endear information systems to the various users.

Further research is needed therefore aimed at providing and analyzing the precursors of e-assessment usage, fit, satisfaction and performance using appropriate theoretical framework. This to a large extent will guide institutions of higher learning towards not only investing in latest technologies, but in e-assessment technologies that best fit and satisfy the needs of their users.

The earlier version of this work was presented at the 2014 ICT4Africa conference held in Cameroon.

REFERENCES

[1] Adegbija M.V., George, A. O. & Bola, O.O. (2013). Investigating Students' Views on E-Assessment: A Case Study of University of Ilorin, Ilorin, Nigeria. Global Media Journal: Pakistan Edition; Spring2013, Vol. 6 Issue 1, p107

[2] Adewale, O.A., Ajadi, T.O. & Inegbedion, J.O. (2011). Perception of Learners on Electronic Examination in Open and Distance Learning Institutions: A Case Study of National Open University of Nigeria. US-China Education Review A 5 639-644.

[3] Ang'ondi, E.K. (2013). Teachers Attitudes and Perceptions on the Use of ICT in Teaching and Learning as Observed by ICT Champions. X World Conference on Computers in Education July 2-5; Toruń, Poland.

[4] Aojula, H., Barber1 J., Cullen R., & Andrews J (2006) Computer-based, online summative assessment in undergraduate pharmacy teaching:

The Manchester experience. Pharmacy Education, 6(4): 229–236.

[5]   Ayo, C. K. Akinyemi, I .O. Adebiyi, A. A. & Ekong, U. O. (2007). The prospects of e-examination implementation in Nigeria'. Turkish Online Journal of Distance Education. 8 (4): 125-134.

[6]   Barrett, H. C. (2007). Researching Electronic Portfolios and Learner Engagement. Journal of Adolescent & Adult Literacy, 50(6), 436-449.

[7]   Bauer, Y., Degenhardt, L., Gilch, H., Kleimann, B., & Wannemacher, K. (2008). Online Exams as Part   of the IT-supported Examination Process Chain. Baueronline eunis.dk/papers/p81.

[8]   Becta. (2006). Becta's View: E-assessment and e-portfolios. Coventry: Becta ICT Research.

[9]   Bee Theng, Lau and Chia Hua, Sim. (2008). Exploring the extent of ICT adoption among Secondary   school teachers In Malaysia. International Journal of Computing and ICT Research Vol 2. No. 2, pp.19-36. http://www.ijcir.org/volume2-number2/article 3.pdf.

[10] Buabeng-Andoh, C., (2012). An Exploration of Teachers' Skills, Perceptions and Practices of ICT in Teaching and Learning in the Ghanaian Second-Cycle Schools. Contemporary Educational Technology, 3(1), 36-49.

[11] Christian, Beverly J. (2014) "Using Assessment Tasks to Develop a Greater Sense of Values Literacy in Pre-Service Teachers". Education Papers and Journal Articles. Paper 46. http://research.avondale.edu.au/edu_papers/46.

[12] Chung, R.R. (2008). Beyond Assessment: Performance assessment in teacher education. Teacher Education Quarterly. Winter 2008.

[13] Cole, M.S (2013). Students' Performance and Preference on Computer-based Tests VS Paper-based Test: A case study. Msc Thesis/Dissertation State University of New York at Fredona.

[14] Conole, G., & Warburton, B. (2005). A Review of Computer Assisted Assessment. ALT-J, Research in Learning Technology, 13(1), 17-31.

[15] Coulby C., Hennessey S., Davies N., and Fuller R. (2011). The use of mobile technology for work-based assessment: the student experience British Journal of   Educational Technology Vol. 42, No. 2, 251–265.

[16] Doukas N. And Andreatos A. (2007). Advancing electronic assessment. International Journal of computers, communications and control. Vol II, no.1. pp. 56-65.

[17] Ertmer P. A. (2010). Teacher Technology Change: How Knowledge, Confidence, Beliefs, and Culture Intersect. Journal of Research on Technology in Education, Vol.42 No.3.

[18] Eva-Heinrich, J.M and Granshaw B. (2012). Pathways for improving support for the electronic management and marking of assignments. Australasian Journal of Educational technology. Vol. 28 No. 2, 279-294.

[19] Fluck, A., Pullen, D., & Harper, C. (2009). Case study of a computer based examination system. Australasian Journal of Educational Technology, 25(4), 509-523.

[20] Georgiadou, E., Triantafillou, E and Economides A.A. (2006). Evaluation parameters for computer-adaptive testing. British Journal of Educational Technology Vol. 37 No. 2. 261 – 278 doi:10.1111/j.1467-8535.2005.00525.x.

[21] Goldhaber, D., Gabele, B. & Walch, J. (2012). Does the Model Matter? Exploring the Relationship   Between Different Achievement-based Teacher Assessments. CEDR Working Paper 2012-6. University of Washington, Seattle, WA.

[22] Hermans, R., Tondeur, J. Braak, J. and Valcke, M. G. (2008). The impact of primary school teachers' educational beliefs on the classroom use of computers. Computers & Education 51, 1499–1509.

[23] Ilomäki, L (2008). The effects of ICT on school: teachers' and students' perspectives. PhD dissertation, Department of Teacher Education, University of Turku, Finland. www.doria.fi/bitstream/handle/10024/42311/B314.pdf?sequence=3

[24] Isom, Jamie S., (2012). "Perceptions of Nebraska Teachers Regarding the Transition from STARS to NeSA and its Perceived Influence on the Implementation of a Balanced Assessment System" Educational Administration: PhD dissertations, and Student Research. Paper 85. http://digitalcommons.unl.edu/cehsedaddiss/85.

[25] Jackson, T. (2011). Stakeholders' perception of the utilization of electronic assessment in an HE environment. A Thesis submitted for the Degree of M.Phil by Research in the University of Hull.

[26] Jamil J., Tariq R.H., Shami P.A (2012). Computer-Based Vs Paper-Based Examinations: Perceptions

of University Teachers. TOJET: The Turkish Online Journal of Educational Technology, Vol.11 Issue 4.

[27]   Jordan S., (2011) Using interactive computer-based assessment to support beginning distance learners of science Open Learning Vol. 26, No. 2, 147–164.

[28]   Karadeniz, S. (2009). Computer-based Tests: the impact of test design and problem of equivalency, Computers in Human Behavior, 23, 32–51.

[29]   Kitchenham, B. (2004). Procedures for performing systematic reviews, Technical report. TR/SE0401, Leele   University. http://www.scientificcommons.org/42461878.

[30]   Lingard M. (2005). Introducing Computer-assisted Assessment: considerations for the new practitioner. Investigations in university teaching and learning Vol. 2 (2)   ISSN 1740-5106.

[31]   Liu, S-H. (2011). Factors related to pedagogical beliefs of teachers and technology integration. Computers & Education 56 (2011) 1012–1022.

[32]   McCann, A. L., (2010). Factors affecting the adoption of an e-assessment system. Assessment & Evaluation in Higher Education. Vol. 35, No.7, 799–818

[33]   McDowell, L., Smailes, J., Sambell K., Sambell, A. and Wakelin, D. (2008). Innovations in Education and Teaching International Vol. 45, No. 2, 143–153.

[34]   Newhouse, C.P. (2011). Using IT to assess IT: Towards greater authenticity in summative performance assessment. Computers and Education 56 (2), 388-402.

[35]   Oates G. (2010). Integrated Technology in Undergraduate Mathematics: Issues of Assessment. The Electronic Journal of Mathematics and Technology, Volume 4, No., 2, ISSN 1933-2823.

[36]   Okoli, C. (2011) A Guide to Conducting a Theory-Driven Systematic Review, John Molson School of Business, Concordia University.

[37]   Orlando, J. (2014). Veteran teachers and technology: change fatigue and knowledge insecurity   influence practice. Teachers and Teaching, (ahead-of-print), 1-13.

[38]   Osang F., (2012). Electronic Examination in Nigeria, Academic Staff Perspective—Case Study: National Open University of Nigeria (NOUN)," International Journal of Information and Education Technology vol. 2, no. 4, pp. 304-307.

[39]   Palak, D., & Walls, R. T. (2009). Teachers' Beliefs and Technology Practices: A Mixed-methods Approach. Journal of Research on Technology in Education, 41(4).

[40]   Peralta, Helena & Costa, Fernando Albuquerque (2007). Teachers' Competence and Confidence regarding the Use of ICT. Sísifo. Educational Sciences Journal, 03,   pp. 75‑84.

[41]   Sanna A., Lamberti F., Paravati, G., Demartini C. (2012) "Automatic assessment of 3D modeling Exams," IEEE Transactions on Learning Technologies, 5(1), pp. 2-10.

[42]   Sato, M., Chung, R. R., and Darling-Hammond, L. (2008). Improving Teachers' Assessment Practices through Professional Development: The Case of National Board Certification. American Educational Research Journal, 45(3), 669-700.

[43]   Seale J. (2002) Using CAA to Support Student Learning, LTSN, http://www.ltsn.ac.uk /application.asp?app=resources.asp&process=full_ record&section=ge neric&id=38.

[44]   Smith, A., Peck, B. (2010). The teacher as the 'digital perpetrator': Implementing web 2.0 technology activity as assessment practice for higher education Innovation or Imposition? Procedia Social and Behavioral Sciences 2 (2010) 4800–4804.

[45]   Teo T. (2008). Pre-service teachers' attitudes towards computer use: A Singapore survey. Australasian Journal of Educational Technology, 2008, 24(4), 413-424.

[46]   Teo T., and Koh, L (2010). Assessing the dimensionality of computer self-efficacy among pre-service teachers in Singapore: a structural equation modeling approach. International Journal of Education and Development using Information and Communication Technology, (IJEDICT), 2010, Vol. 6, Issue 3, pp. 7-18.

[47]   Tomson Prometric (2005). The Benefits and Best Practices of Computer-based Testing, Tomson Prometric, Thomson Prometric Best Practices.pdf.

[48] Whitelock, Denise and Watt, Stuart (2007). E-assessment: how can we support tutors with their marking of electronically submitted assignments? Ad-Lib, Journal for Continuing Liberal Adult Education (32) pp. 7–8.

[49] Goodhue, D., & Thompson, R. (1995). Task technology fit and individual performance. MIS Quarterly, 19 (2), 213-236.