E-Assessment: an E-Business Enabler in Higher Education

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Abstract **- In the context of higher education, e-business can be viewed as the series of interconnected processes initiated with student application for entry and completed upon graduation. While e-learning is an integral component of this process, the assessment component remains primarily manual. This leads to an educational paradox whereby students are encouraged to e-learn, on one hand, while they are imposed in old-fashioned assessment practices, on the other. It also establishes a business paradox whereby universities strive to maximize their financial incomes through research funding but still do not exploit ICTs to minimize their costs in the pillar of assessment. As ICT skills span the requirements of university students horizontally and across departments, developing an e-Assessment System for ICT skills could address both paradoxes. This paper presents an e-Assessment system implemented within a nursing university department setting with 79 participants in Cyprus. Findings of a quasi-experimental design that validated the system's effectiveness indicate that performance of students who used the system were significantly different than those students who followed a traditional learning process.**

Keywords **- E-Assessment, Higher Education, ICT Skills, Nursing, Performance-Based Assessment**

I. INTRODUCTION

Commonly held beliefs that students have either been "born digital" [1] or being "digital natives" [2] may lead universities to decide not to offer any computer literacy courses. Universities also consider the new generation of students as computer literate who do not have to learn computer skills ICT but simply live it and experience it [3].

As referenced by Murray et al. "Most universities do not require a computer literacy course in the core curriculum" [4, 5]. Critical information technology competencies are often taken for granted, to the detriment of students who lack basic computer and Internet skills. While this may be due to the fact that curriculum of secondary education has nowadays been enriched with computer literacy courses which were previously taught at university level [6, 7] presents a list of US based universities which include a computer literacy course in their requirements.

Overall, the gap that usually exists between the expectations or requirements of universities as to the level of computer skills of their freshman students, on one hand, and their reported computer self-efficacy levels, on the

other, enlarges the misconception that university students can perform well in college without a course on computer literacy. It reported that students self-assessed ICT skills are usually unjustifiably overrated compared to their objective performance results [8]. After all, ICT skills must "be assessed, not assumed" in order to objectively be considered as valid [9].

II. E-ASSESSMENT

A. Definition of E-Assessment

Based on their activity and final deliverable, e-assessment is distinguished as follows [9, 10]:

1. Computer-based assessment (CBA) refers to assessments delivered and marked completely by computer without any human intervention. A typical example is a test with multiple choice or true/false type of questions delivered via a computer at the end of which the computer gives a score (and perhaps other information) to the test taker and the test designer.

2. Computer-assisted assessment (CAA) refers to assessment practices that depend and rely partly on computers and partly on human intervention. Typical examples include the use of online discussion forums for peer-assessment, audience response systems in group work, preparation and submission of assignment work electronically, e-portfolios submitted for assessment.

B. Drivers of E-Assessment

The factors that make e-assessment possible and successful and consider the financial gains as a major driver for its adoption and implementation are addressed by [11].

Taking a purely financial and cost effective view, e-assessment contributes to the increased registration and retention of students and creates opportunities for the introduction of new courses, new forms and methods of delivery programs and degrees based on flexible, open and distance learning thus opening new horizons for an institution's financial upgrading.

Consequently, in terms of administrative drivers that lead to its adoption is the pivotal role it can play in forming strategies to cope with large number of students and university candidates in contrast with the limited space available to accommodate large cohorts for in-class assessment. A study found that the demand for portable qualifications linked to the job market and the cost-effectiveness as important financial drivers for adopting e-assessments [12]. Universities need to consider the potential for access to large student markets via online education and distance education programmes.

C. Barriers to E-Assessment

At the academic level, the limited time of academic staff, lack or inadequacy of training on e-assessment platforms, methodologies and techniques to develop e-assessment items, organizational structures and cultures that prevent academic innovative e-champions to diffuse their new assessment approach are identified as the major barriers to the development and adoption of institution-wide e-assessment policy [11].

III. ICT SKILLS & THE BUSINESS CASE OF E-ASSESSMENT

Although taken for granted by many academics, the students' ICT skills play a pivotal role to the students' development in their early academic life. To this end, the paradox becomes even more intriguing when it comes to the assessment of students' ICT skills whereby students are using web based platforms to learn and enhance such skills that are subsequently assessed by collecting the students' work and ma-assessed. Such a process leads to the break of the e-business chain in the educational context, thus requiring manual and human intervention to be completed and unmatched high costs for its successful execution and completion. In such scenarios, CBA proves essential and effective.

However, the business case of CBA in relation to ICT skills assessment is questioned, as the process needs to address a number of technical and business issues. From the

technical point view, the inherent complexity of integrating software applications commonly used by students within the underlying CBA system needs to be resolved. From a business perspective, the system needs to appear as integral component of the university's unified learning management system (LMS); thus exploiting existing resources without the need to invest in the acquisition of additional systems.

IV. E-ASSESSMENT SYSTEMS IN HIGHER EDUCATION

University academic publishers often enhance their portfolio of services by offering a variety of assessment systems. Integrated within LMSs these systems include objective test banks and simulators that grade tasks performed in a flash-based imitation of an MS Office environment. Task evaluation is performed by comparing the recorded user-generated mouse/keyboard events with a set of possible correct mouse/keyboard combinations.

Such systems could be used in a "credit-by-exam" process by university administrators whereby university students could be exempted from the computer literacy course if they passed a test prior to registration [13].

The benefits being brought to educational establishments across the United States by ICT skills learning environments, such as MyITLab, are highlighted to include the decrease in drop/failure/withdrawal rates from 50 to less than 20 per cent and the increase of the mean scores among students to the level of 80 per cent [14].

Results of a survey undertaken among instructors and student users of their ICT skills management system also confirm the reduction of instructors' workloads with auto-graded assignments and exams. Considerable reduction of turnaround time for grading projects and the ease of cheating identification are reported by instructors; while anytime and anywhere access, step-by step instructions, and the ability to learn at their own pace are indicated by university students as the most important benefits gained [15].

V. THE E-ASSESSMENT SYSTEM FOR ICT SKILLS

A. Design Decisions and Architecture

To ensure interoperability with existing systems, the system was integrated with the university's LMS, Moodle, that exploited the use of student management functionality on one hand, while ensuring that the system remains a separate and independent component on the other, a service-oriented approach to the system architecture was adopted. Implemented through Simple Object Access Protocol (SOAP), services are platform independent reusable software components that can be integrated to solve a problem or establish and execute a business process [16].

B. Development Approach

To address the urgency for making the system available at the beginning of the spring semester of 2015/2016 academic year, a Rapid Application Development (RAD) was employed. A highly collaborative development environment was established that engaged stakeholders, both students and teachers, who created prototypes and test cases. This interactive process led to the continuous evolvement of the users' requirements and their implementation within the system [17].

In this context, Moodle served as the workbench for all testing stages of development whereby components were tested by students and teachers during the learning process.

C. Components of System Architecture

Although the current implementation requires the standard MS Office 2010 or higher version to be installed on the student machine, the system could equally operate using a cloud-based solution such as MS Office 365.

Access to the system is possible through Moodle when students log in with their credentials thus providing a unified learning and assessment experience to the student. Seamless and transparent data exchange is

achieved using the Extended Mark-up Language (XML) standard [18]. At the end of the assessment process students can view a performance report and task items' grades accumulated at the student's station are transmitted and stored in Moodle's gradebook. Both instructors and students can then process and view them. The system architecture and the user interface are shown in figs. 1 and 2.

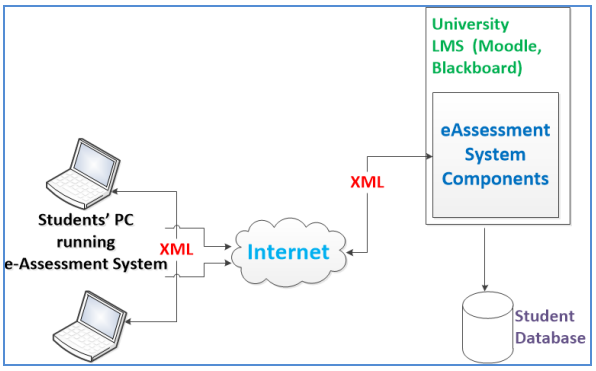

Fig. 1 E-Assessment System Architecture

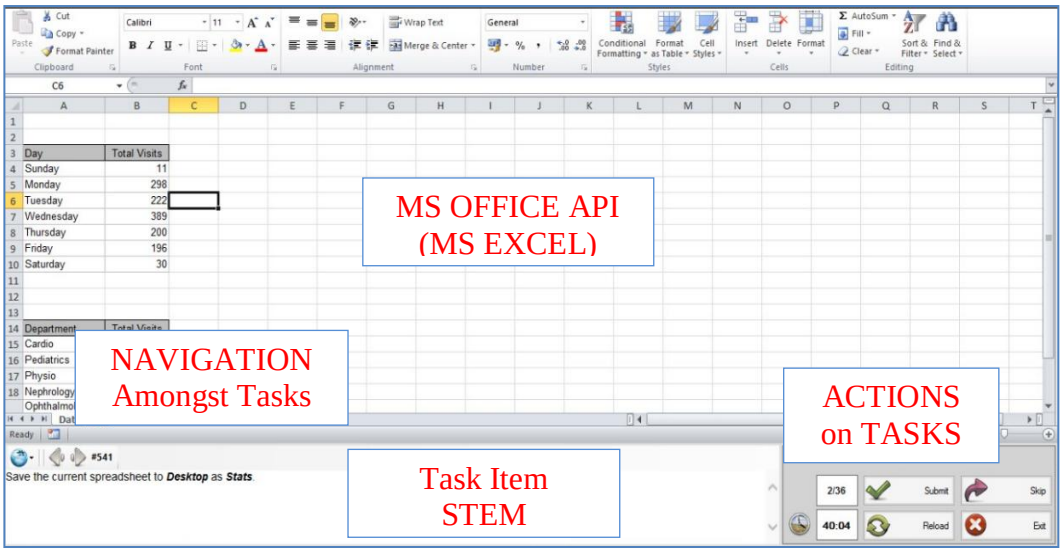

Fig. 2 E-Assessment System User Interface

D. ICT Skills Assessment Domains

The system comprises of two major components that assess ICT skills in the domains of spreadsheets and databases respectively. A group of nine subject matter experts that included nursing and ICT academics and professionals undertook the validation of the set of skills in the two domains that comprise the assessments developed.

VI. QUASI-EXPERIMENTAL DESIGN

To assess the effectiveness of the developed system in the learning process, a quasi-experimental design was undertaken within the framework of a first year course in the nursing department of the Cyprus University of Technology. 41 nursing students participated in the experimental and 39 in the control group with the former using the e-assessment system and the latter following a traditional instructor-led learning process. Both a pre-test and a post-test were administered to both groups. As the results of pre-tests in both domains were not significantly different, it could be concluded that students in the two groups initiated their learning from an equal footing. However, results of the post-tests indicate that students in the experimental group achieved a significantly different performance than the

students in the control group; thus leading to the conclusion that the use of the e-assessment system had a catalytically positive effect on the performance of the students in the experimental group.

The table below depicts the results of t-test analysis for difference performed on the pre-tests and post-tests.

TABLE I
T-TEST ANALYSIS FOR DIFFERENCES BETWEEN EXPERIMENTAL AND CONTROL GROUPS

Test	Group	N	Mean	SD	T	Df	Sig.	Mean diff.
Pre-test Spreadsheets (MS Excel)	Experimental	41	13,85	5,64	-1,781	78	,079	-2,12
	Control	39	15,98	4,99				
Post-test Spreadsheets (MS Excel)	Experimental	40	23,95	4,37	3,706	75	,000	4,11
	Control	37	19,84	5,33				
Pre-test Databases (MS Access)	Experimental	41	3,29	1,83	1,892	76	,062	1,02
	Control	37	2,27	2,87				
Post-test Databases (MS Access)	Experimental	41	28,88	2,76	7,840	50,25	,000	7,59
	Control	35	21,29	5,13				

VII. CONCLUSIONS

Education as a service (EaaS), an analogue derived from the technology concept of software as a service (SaaS), is the foundation of the success of Massive Online Open Courses (MOOC). The lack of ICT skills assessment course offerings on the popular MOOC platforms of edX [19] and Coursera [20] opens horizons of opportunities for universities to invest in the field thus reaching millions of students, employees and career seekers whose common denominator is the proof of their ICT skills.

Within universities, resolving the educational paradox remains a challenge. It can be addressed if university authorities take a holistic approach to their e-business of education provision and establish e-assessment as equally important pillar to e-learning that jointly contribute to the maximization of students' learning experience and performance in the short-term, and serve their strategy and vision to become e-universities in the long-term. Until then, e-assessment will remain the missing link in the e-business of education chain.

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(Arranged in the order of citation in the same fashion as the case of Footnotes.)

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