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Technology-enhanced assessment process: issues affecting e-assessment uptake

ACOSTA-GONZAGA, Elizabeth† and GORDILLO-MEJÍA, Abraham

UPIICSA- Instituto Politecnico Nacional

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Abstract

Educational technology plays a crucial role in automating each task and stage of the assessment process and although its use and effectiveness has already been proven, educational literature shows that there is still a huge need to develop these innovative approaches. In this study we have reviewed the literature on the current state of knowledge and practice regarding electronic assessment technologies. Knowing the factors -positive or negative- involved in the adoption of ICT in the assessment process in the Higher Education context serves as a guide for building valuable strategies to design a plan of adoption of e-assessment technologies which enables us to determine when the staff are well prepared to implement it, as well as the grade of willingness of the main stakeholders. The willingness to adopt innovative educational assessment methods will indeed make a positive difference to students' learning. There are still many opportunities that are not being taking advantage of, and the emerging research should be constructed with the aim of proposing specific strategies for developing new approaches to e-assessment.

E-learning, e-assessment, educational assessment, distance learning, education and technology.

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† Researcher contributing first author.

Introduction

ICT has touched and transformed all fields of human activities. If we add the fact that technological capability is increasing exponentially, we can expect an even bigger impact on all human activities in the future. In the educational context, ICT has played an important role, transforming the way instructors teach and students learn. ICT has helped to enhance educational methods and approaches, making them more efficient. Recently, we have seen an increasing emphasis embedding them on all educational levels.

However, some might argue that educational technologies have not changed the way the teachers instruct or the extent to which the students learn. Nevertheless, the educational tools that students use to learn are changing. These have modified the process of teaching and learning per se. The influence of ICT on the processes of teaching and learning has been significant. Researchers have turned to ICT as a way to fulfilling the requirements for learning in a modern society, and this has created great demand from a diverse range of actors ranging from businesses to institutes of higher education (Sun, Tsai, Finger, Chen, & Yeh, 2008). There are many studies regarding the benefits of ICT on the teaching and learning process. For instance, Wang & Wang (2009) point out that ICT enables communication between instructors and students by serving as a platform to facilitate teaching and learning. Also, Gunasekaran, McNeil & Shaul (2002) state that ICT encourages interaction and communication between students and instructors. The fact is that technological tools are also becoming part of the equipment required for 21st century education.

E-learning becomes an attractive learning strategy particularly when individuals cannot obtain the education they want from local sources such as when students require a specialized course that is not part of the curricula of the university, or when people have to deal with daily responsibilities either at home or at work that do not allow them to attend a course physically.

In the last few decades ICT has played a key role in the real world. Currently, organizations require a workforce consisting of people who have the abilities and skills to be able to make their own decisions, high performance in teamwork, and the ability to manage effectively complex situations, which suggests "that the ability to use technology will become a standard job-entry requirement" (Bennett, 2002). Moreover, ICT is supporting global businesses in the process of employee learning and development.

The impact of ICT has widely expanded in all fields; including applications for teaching mathematics and allied subjects. The work of Gunasekaran et al. (2002) gives evidence of the effectiveness of using ICT to do this. Their study explains how researchers (Larson & Bruning, 1996) examine perceptions in an interactive collaborative mathematics course. Their conclusions show that "the distance learning format gives teachers access to more resources, is useful for under-achieving students, and is an effective way to implement national curriculum and instruction standards". Likewise, the study of McCollum (1997) describes a professor at California State University who divided a statistics course, teaching one group in a traditional way and another in an on-line version of the course using web-based tools (website, e-mail, and an electronic chat room). The students who took the on-line course did better than the others.

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Even though some technologies, environments and tools have been developed to support the learning and teaching processes, the assessment process is still in its early stages. Some policy-makers and senior management have redesigned the assessment practices in the universities using ICT and have achieved favourable results. For instance, the work of Heinrich, Milne & Moore (2009) shows some benefits in employing technology such as improved marking quality and feedback, support for human markers, insight into student understanding through quizzes and tests, ease of electronic submission and handling of assignments. Dreher et al. (2011) argue that automated assessments are technological tools that carry the potential to improve the assessment process for all stakeholders. Students can receive immediate and objective feedback, educators can focus on teaching and giving formative feedback, and administration/management can be performed at lower costs.

Whitelock & Watt (2008) point out that ICT has also contributed significantly to the educational assessment process. They mention that "the benefits gained include student retention, enhanced quality of feedback, flexibility for distance learning, strategies to cope with large student numbers, objectivity in marking and more effective use of virtual learning environments". In fact, ICT can make a huge difference in the educational process by introducing new ways of learning, teaching and assessment by using novel technological tools.

Taking into account that students as a "digital natives" engage in an educational system that was designed in a pre-digital era, they nevertheless need to teach themselves modern life-skills through participation in the networked society and must learn industry-relevant skills and knowledge on the job.

Social-technological innovations are the gateway to the future for universities. It is therefore important to examine the adoption of and resistance to educational innovations in universities (Dreher, Reiners, & Dreher, 2011).

However, the gap between understanding the benefits of on-line assessment, and having staff engaging with it in day-to-day assessment activities is significant. Thus, it is crucial to understand which are the most common factors that affect the uptake of electronic assessment technologies. The key studies were chosen we then selected the most common factors included. We classified the crucial factors which might help to build a successful implementation of electronic assessment technologies. It is also important to consider that a teacher's engagement is determined by individual educational beliefs or disciplinary differences, attitudes working with technologies and self-efficacy (Chew, Jones, & Blackey, 2010).

E-assessment

The specific process of assessment using ICT has come to be known as electronic assessment or e-assessment. It includes the entire assessment process from designing assignments to storing the results. It involves the assessment process such as coursework submission, peer-assessment, grading and feedback, traditional examination and quizzes from the perspective of students, tutors, learning establishments, awarding bodies and regulators, and the general public (JISC, 2007).

The crucial role that technology plays is building a useful link between the processes of teaching and learning and assessment creating new approaches and opportunities for enhancing learning goals.

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As Bennett points out in his paper written as early as in 1998, computer-based assessment opens up new opportunities for innovation in testing and assessment (Bennett, 1998).

However, e-assessment practices must not only be seen as an electronic tool embedded in the same traditional teaching methods; it has to reach further objectives and has to be a carefully planned process. It has to mainly be designed following pedagogical principles rather than just embedded innovative technology (Whitelock & Brasher, 2006) and/or to deliver only an automated version of item-based paper-and-pencil tests.

ICT opens new possibilities for innovative assessment practices. Universities might capitalize on the full power of ICT to innovate by providing a richer experience of student learning. Universities are becoming more aware of this and are transforming and enriching their practices by using digital assessment technologies. E-assessment also represents an attractive option for institutions looking to address the logistical problems associated with the increase in student numbers entering higher education (Walker, Topping, & Rodrigues, 2008). Furthermore, e-assessment also helps to speed up educational processes by eliminating paper-based processes such as printing and shipping, which represent a cost to both universities and students. It thus becomes an attractive strategy for administrative authorities in universities.

Dreher et al. (2011) remark on the pedagogical benefits obtained, particularly in feedback practices, by using e-assessment technologies. The technological tools allow educators to be freed of certain tasks, such as marking hundreds of assessment items, and therefore they have more time and energy to spend on giving more meaningful formative feedback to students.

Educators can thus increase the frequency of self-assessment with higher-order learning outcomes to enhance the experience and quality of the learning. Students can in turn be freed to determine their own learning path along defined milestones and assess their learning for successful performance. They mention that the real benefit for students is getting immediate feedback, which enhances their learning performance and also activates their intrinsic motivation within the learning setting. In short, it reduces staff workloads whilst improving the quality of assessment for students.

By taking advantage of the use of e-assessment, (Dreher et al., 2011) also discuss how universities report commercial benefits. In this respect, the reputation that universities want to obtain or maintain is an important issue. Since the quality of education is valued by society in successful graduations and post-graduate job performance, high quality education is a key driver for new student enrolments and a seed of research and business projects, including endowments and sponsorship. Thus the pedagogical benefits of improved assessment methods and outcomes can affect the overall university performance. Moreover, automated assessment can trigger an improvement of the administration and curriculum planning, as researchers (Dreher et al., 2011) point out precise calculations of financial costs based on the number of students and shorter time spans between exams and results.

Technological assessment is gaining more popularity in enterprises; these are now using it as a way to assess new job candidates. It is also used to evaluate their workers in order to certify job proficiency.

The two main classes of technological tools for educational assessment are broadly classified as e-testing and e-portfolios.

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Next, we shall mention some cases of e-testing which show how technology has contributed to provide innovative ways of teaching, learning and assessment. Later, we briefly mention e-portfolios.

Relating to e-testing technologies Hodgson & Pang (2012) discuss how to engage students in formative assessment practices by doing on-line multiple choice questions (MQCs). They report a strategy that help students to reinforce new concepts by encouraging students in activities that allow them to make multiple attempts in the context of a statistics course. The researchers use technology to promote students' participation in on-line tasks on a regular basis. The tasks are useful for students since they can check the correct answers and thus evaluate their own performance. Therefore, they are able to reflect on what is taught in class and think critically, in a process of continuous reflection on their performance. They show how educational technology has supported students in reflection and led them to take greater ownership of their learning.

These researchers state that tests with MCQs (one answer and a few distractors) in on-line learning environments have been widely used as a method of both formative and summative assessment. They stress that these on-line quizzes bring benefits to students by providing timely feedback and that their use motivates students to keep practising during a semester. Also, MCQs can be set to examine a broad spectrum of declarative knowledge of a subject.

A special advantage of the use of on-line MCQs for formative assessment practices is that it allows multiple attempts to answer a question, which means that these questions can be used in pre- and post-course tests.

Commonly a chosen score (highest or average) after a number of attempts can be considered as the final mark for a formative assessment. This means that students learn from feedback following their attempts.

Hodgson & Pang (2012) conclude that on-line formative assessment activities help students to realise of "the gaps in their performance through continuous feedback" from the on-line environment. A web-based environment is a good way of providing learning challenges, particularly for large classes where it is possible to apply a randomised quiz to motivate students to make multiple trials. The researchers conclude that the learning opportunities for students were enhanced. There is "more time for self-regulated learning and reflection on what was learned; students can clarify misconceptions in face-to-face discussion with peers; and peers feel more confident to ask for help in a supportive learning community". However, the point is that the usage of MCQs supports recall of memorized knowledge without checking deeper understanding as can be included in a taxonomy of educational objectives (Bloom, 1956).

The study by Gill & Greenhow (2008) reports evidence of the benefits of the interaction between students and feedback received on-line while they interact with the computer-aided assessments (CAAs). These researchers focus on providing rich feedback to the students when they answer multiple-choice and responsive numerical input-type questions that compare a student's input, an answer, against that resulting from a coded malrule (an incorrect rule for syntactic transformation of a mathematical expression).

The technological tool reports exactly where the error was made and provides a complete solution that allows students to be able to determine their errors.

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By making students engage with the feedback, they are then able to relate the aspects of the feedback to their written work, such as use of diagrams, presentation of solutions and correct notation of vectors, demonstrating that they have developed organisation and presentation skills. According to the researchers, the study shows that students are able to improve their performance in formative and summative assessments while they are engaged with the CAA assignments, especially by spending time studying the feedback.

These authors remark that students do engage with formative assessment activities, even when no marks are allocated, due to both the quality of the CAA and a structured and supportive environment (lab sessions are scheduled in students' timetables) which shows that when students engage with high-quality feedback, the benefits appear to go further than simply short-term recall.

Other researchers have also explained how a web-based learning tool can help students to improve problem-solving skills and performance. For instance, Crippen & Earl (2007) explain how a web-based testing environment providing worked examples and self-explanation prompts has the potential to improve problem-solving skills and conceptual understanding. They mention the use of worked examples, (detailed problem solutions that contain identifiable qualities and characteristics) are designed to provide students with some structure for understanding what is the solution of a example without giving them a script or algorithm.

Researchers worked through these examples with their students; their results suggest the combination of a worked example with a self-explanation promptly produces improvement in performance, problem solving skills, and self-efficacy.

Reiners et al. (2011) have pointed out that automated assessment systems only support memorized knowledge. Nevertheless, the recent technological advances in automated assessment are a convenient option. Emerging technologies on assessment intend to support interpretations of short answer and essay type questions. These educational tools would support interpretation and problem-solving levels (Reiners et al., 2011). For instance, automated essay grading tools (AEG) are computer-based tools to assign grades to essays written in an educational context. These tools are based on natural language processing and normalization techniques which compare students' written words of an essay with a model solution (normalized word vectors and their frequency from the essay are mapped to their corresponding root word in a thesaurus). The research of Nicol & Macfarlane-Dick (2006) shows that essays can assess higher-order learning.

However, Reiners et al. (2011) argue how the success of these innovative tools is being blurred by the idea that these cannot assess higher order tasks as accurately as human beings would do. In the case of assessing student's goals through electronic essays tools, there is a current belief that human markers are superior to computers at the tasks of understanding content and making comparisons between student essays and a model solution. The researchers argue that the use of automated essay grading tools (AEGs) refute the idea that computers cannot do human activities that require higher order thinking.

They mention that "while this may be true for many endeavours, it is no longer true for grading essays". As a result they advise that electronic assessment, particularly automated essay grading is an option that works for universities, emphasizing the idea that technology works as accurately as human markers enhancing formative feedback, saving time and money.

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Other useful e-testing technologies that have gained broad popularity are plagiarism assessment tools. These are tools that compare a document to a set of 'genuine' reference documents in order to retrieve similar patterns of text. Although these tools "do not assess learning or application of concepts/knowledge" (Reiners et al., 2011), these have been successfully applied in universities as practical and efficient tools to assess the originality of written essays.

An e-portfolio is defined as "the product, created by the learner, a collection of digital artefacts articulating experiences, achievements and learning. Behind any product, or presentation, lie rich and complex processes of planning, synthesising, sharing, discussing, reflecting, giving, receiving and responding to feedback. These processes are the focus of increasing attention, since the process of learning can be as important as the end product" (Gray, 2008). These technologies have proved to be important educational tools, that promote and support learning (Alexiou & Paraskeva, 2010) and teaching leading to more profound forms of learning, adding value to personalised learning that serves as scaffolding approach of understanding and engagement. E-portfolios also facilitate the transition between institutions and stages of education, supporting education and employment, staff appraisal and applications for professional accreditation, and supporting learners based in the workplace (Joyes, Gray, & Hartnell-Young, 2010).

The JISC in the UK is a very useful source for advice on how to implement effective practice in the use of e-portfolio systems and tools, as well as to determine their implications for teaching, learning and assessment. JISC has worked in partnership with other sectors and bodies to develop and provide guidance to institutions on effective e-portfolio practice to support lifelong learning. They have proposed the development of standards and piloted e-portfolio technologies.

The main driver for institutional e-portfolio initiatives in the UK is the Personal Developing Planning Policy (QAA, 2001). Although it has not just been the unique driver, according to Joyes et al. (2010) these have also been "the importance of retaining students, widening participation, and increasingly, reflective learning have also contributed to widening interest in e-portfolio tools and technologies".

E-portfolios systems have proved to be an important tool to enhance quality learning, according to Gray (2008) in the JISC report effective practice with e-portfolios, these electronic tools can serve to develop higher-order functions, leading to students becoming independent enquirers; creative thinkers; reflective learners; team workers; self-managers and effective participators, skills that employers and higher education want to see developed in current generations of learners. Moreover, the creation of an e-portfolio involves a critical process: reflection. This process is a key aspect in the development of deeper learning through self-reflection and self-assessment which includes developing activities such as planning, goal-setting and future reflection. The process also helps to build up a range of skills including critical thinking.

Joyes et al. (2010) report on the tangible benefits of the use of e-portfolios.

They classify the benefits as efficiency (time-savings for students, academics and, administrators), enhancement (improving quality of evidence and feedback, skill development, satisfaction and increases in recruitment and retention) and transformation (innovation and changes to institutional policy). However, they also point out the drawbacks, since e-portfolio implementation is particularly complex, in part due to the number of stakeholders involved since portfolios can be used in several contexts and purposes.

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They suggest that there are threshold concepts related to e-portfolio implementation and that developing an understanding of effective practices is not straightforward.

Regardless of the educational technology used in assessment to implement, e-portfolio or e-testing, there are some generic skills and knowledge required according to the e-assessment: guide to effective practice (2007). The guide suggests that all staff involved, irrespective of their role, should have (or be trained to have) the following skills and knowledge:

- A broad understanding of assessment principles.
- An understanding of security importance for conduct assessment and a security measures knowledge required for e-assessment (particularly to their centre).
- An overall familiarity with the e-assessment environment and delivery platform(s) especially to their centre.
- A recognition of possible malpractice in e-assessment and the precautions needed for its prevention.
- A legislation awareness relevant to the centre operation. The general regulations of relevant awarding bodies, and regulatory authority guidelines and codes of practice.

The UK government has proposed several initiatives to recognise the skills and knowledge of people involved in the delivery of e-testing such as the Level 3 Award for delivering e-testing. This initiative recognises the importance of key aspects such as security, legislation and regulations of adequate e-assessment practices.

The units that make up this Award form part of the Teacher Qualifications Framework developed by (Lifelong Learning UK, 2010).

In order to gain a wider perspective of emerging technologies that will impact the future of educational systems, the Horizons Reports (HRs) are a good starting point. These reports are produced by The New Media Consortium, NMC (2014) and the EDUCAUSE Learning Initiative, ELI (2014). NMC is an international community of experts in educational technology whose role is to help universities, colleges, museums, and organizations drive innovation across their campuses. ELI is a community of higher education institutions and organizations committed to the advancement of learning through the innovative application of technology. Since 2004 both have made yearly predictions of the impact of ICT by using three temporal horizons: the year of the report (short-term predictions), the next two years (mid-term predictions), and the four years following the report (long-term predictions).

Regarding assessment practices, the Horizon Report 2014 (NMC Horizon Report, 2014) discusses the actual trend of learning analytics provides statistical and data mining tools that can improve student services, retention and aims through adaptive learning strategies.

On-line learning platforms are generating a large amount of data about student activity and dashboards provide both students and teachers with an overview of this data. This can help students realize how they are doing and help teachers identify students who might need more help and support, making improvements to students' performance and personalizing in the learning experience.

The increasing importance of assessment practices in educational systems is a global phenomenon.

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Countries such as the UK have seen the e-learning movement and e-assessment as important strategic initiatives whose growth potential is enormous. The UK has set government strategies to include innovative assessment practices. These assessment practices include; assessment feedback, plagiarism/academic integrity, assessing and recording student achievement, and methods of assessment such as essay-type, MCQ, portfolio, etc., and formative versus summative assessments. These practices should have been included in all UK universities by 2010, (Higher Education Academy, 2010). However, others countries such as Mexico have made insufficient investments in science, technology and innovation. As a result, the potential increase in their economy is inferior to that necessary to reach the level of other countries and achieve a comparable competitiveness to that of other emerging economies.

In accordance with all other available indicators the general level of innovation in Mexico is really low, not only in comparison with other Organisation for Economic Co-operation and Development (OECD) countries but also with the most dynamic emerging economies (perspectivas OCDE: Mexico reformas para el cambio OCDE, 2012).

Issues inhibiting e-assessment uptake

We will focus on the factors that limit the adoption of ICT at universities in order to possibly avoid repeating the same mistakes. It is believed that not only is it useful to figure out the main barriers, it is also important to know what facilitates adoption; it is also very valuable to focus on what strategies have been successful for universities in order to implement e-assessment.

We will identify facilitators and barriers to the adoption of educational technology for the assessment process.

This demonstrates how well a university is prepared for it, whether the university's staff have the skills to carry out the plan and to what the extent all stakeholders are involved in the plan. This will help us to design and implement electronic assessment plans successfully. On the other hand, it also helps in designing future policies for the adoption of e-assessment as well as help to establish a context for commercial agreements related to the assessment by computers.

In order to obtain a clear view, we take into account the model of Ocak (2011), who identifies categories and themes to classify and examine the impediments that face faculty members in the adoption of blended learning environments. The study identifies three categories and eight themes as results of faculty members' problems with blended courses. The categories were classified as instructional processes, community concerns, and technical issues.

The themes derived from these categories were identified as 1. complexity of the instruction, 2. lack of planning and organization, 3. lack of effective communication, 4. need for more time, 5. lack of institutional support, 6. changing roles, 7. difficulty for adoption of new technologies and 8. lack of electronic means. Considering this model as a reference, we identify the categories and themes that affect the adoption of electronic assessment technologies which we have classified as “administrative structures”, “faculty concerns” and “technological infrastructure and systems” categories and their related themes that we have represented in Table 1.

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Administrative structures	
Institutional policies	-Lack of incentives (tenure, promotion) -Lack of resources, equipment, infrastructure -Ineffective dissemination of e-assessment
Administrative structures	-Changing of roles -Lack of support on legal matters, such as plagiarism, data protection, intellectual property rights -Lack of skill and understanding -Health and safety issues -Lack of key roles for administration, support services and departments -Resources withheld by senior management
Communication	-Lack of interdepartmental communication -Lack of communication with academic staff
Funding	-Not enough investment for technological infrastructure -Lack of new projects -High cost of licences
Faculty concerns	
Pedagogical research	-Inability to evaluate higher levels skills -Is viewed as a secondary to authoring, marking, reporting -Not appropriate for particular subject -Lack of development of examination procedures -Making ICT the focus instead of pedagogical matters
Attitudinal issues	-Lack of willingness -Lack of confidence and reliability -Fear of failure -Feelings of isolation -Wrong expectations -Fear of anonymous submission of assignments -Threat of reductions of faculty members -Feelings of discrimination by "non-digital natives"
Training	-Lack of computer literacy -Lack of expertise in the design -Complexity of instruction
Time	-Lack of time
Technological infrastructure and systems	
Systems, applications and environments	-Limited functionality -Incompatibility -Limited availability -Lack of reliability -High risk of technological failure -Limited availability of internet-connection
Pilot projects	-Difficulty of adoption -Insufficient funding
Technical support plans	-No backup plans -Lack of follow up -Lack of technical support
Security issues	-Passwords, cheating, impersonation
Upgrade technology	-Lack of plans for renewing systems

Table 1 The main factors affecting the adoption of e-assessment technologies

Table 1 gives a wide view of the current landscape of electronic assessment. It identifies the main barriers to the adoption that affects all stakeholders involved in the electronic assessment process recognizing the key points which allow us to clearly identify strategies and tactics that may help to minimize the cited barriers.

The table is divided into three categories. We call the top level "administrative structures" which represents policy-makers, senior management and university staff who propose, design and implement the policies and educational plans related to the adoption of technologies, including technologies of e-assessment.

We call the second level "faculty concerns" which represents the faculty members' needs and problems to embrace ICT in their teaching and assessing practices. This includes important matters such as pedagogical and attitudinal issues, training concerns as well as spending time learning educational technologies.

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The bottom level called “technological infrastructure and systems” includes matters related to availability and efficiency of the use of ICT resources. These factors are crucial in adopting ICT, particularly for teachers (Bhuasiri, Xaymoungkhoun, Zo, Rho, & Ciganek, 2012). Teachers who perceive that these requirements are attended and also satisfied should be more willing to use assessment technologies.

As seen in Table 1, for teachers a common and continuous barrier is the lack of time to learn and use an e-testing environment (Whitelock, Mackenzie, Whitehouse, Ruedel, & Rae, 2006), (Sim, Holifield, & Brown, 2004).

However, educational research shows also that the use of ICT can compensate for time spent in grading/scoring practices which are commonly considered as tedious and time consuming practices.

The time invested in creating high-quality materials for e-assessment is another important barrier. This also includes training and experience to develop creative questions (Brasher & Whitelock, 2006). Bull (2000) proposes some strategies to overcome these barriers such as building up banks of questions and to share common questions. Although there is plenty of material available on the web, Bull advises that their quality is often low. In the same way, she points out that security issues, copyright and organization are serious obstacles for the effective use of question banks.

Importantly, the activities must be recognised as valid academic products that must be developed by teachers, and should be included in a regular timetable. However, Bull also mentions that until it becomes a mainstream activity the efforts to release time for these activities will be lacking.

Likewise, “difficulty with using systems” (Warburton, 2009) and “lack of adequate computer training policies” (Whitelock et al., 2006) are two common barriers mentioned in literature. Not including plans for renewing systems or inadequate technology upgrade plans is an important barrier. In the day to day of academic activities it is common to hear complaints about "the system has failed" which can cause both teachers and students to feel discouraged in using the systems. The key point here is to implement appropriate policies and plans that keep systems running. This clearly depends on organisational structures, for their implementation and follow-up.

On the other hand, we want to highlight an important finding which must be carefully taken into consideration. It is related to teacher's perception that use of ICT has been imposed by institutions regardless their needs. It makes teachers feel unwilling to use ICT, as they think it can affect their autonomy. To avoid this McCann (2010) advocates guidelines to manage cultural change that includes choosing a leader, defining a vision, starting with pilot projects, motivating teachers with hands-on training and informing them about the system with particular emphasis on results and impact. The above points show that many of the obstacles are related to academic staff (Whitelock et al., 2006).

Other important drawbacks are that the selection of ICT for teaching, learning and assessment is an approach that does not include enough detail of a pedagogical plan, which deters the adequate use of technology (Heinrich et al., 2009). The combination of deep skills and technology and pedagogy knowledge for e-assessment are not common questions. To develop pedagogical and technological strategies and make them accessible to all those involved, is an effective way to cope with it.

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The provision of training sessions for teachers, resources, advice and guidance is also a way to overcome this barrier.

To obtain tangible results in universities will require a clear support by policy-makers at the institutional and national level.

From the students' point of view, although they are very familiar with the use of technology, they are still worried about the security of testing (Cassady & Gridley, 2005), possibilities of cheating (King, Guyette, & Piotrowski, 2009) and the fairness of question banks (Dermo, 2009). If students do not have enough confidence in a test, that can affect their levels of engagement and cooperation (Domino & Domino, 2006).

Other important barriers are highlighted by Bull (2000) in their annual report on Computer-Assisted Assessment (CAA) in the UK. The report points out that a "lack of understanding of the limitations and potential of the method of assessment and the assumption that it is not possible to test higher order skills using CAA" are two important obstacles for the implementation of CAA. The report advocates "to include staff development at a generic and departmental level; to provide good examples of materials in a particular discipline". This is a powerful way to show that CAA can test higher order skills. However, the report advises that because of the high level of skill needed to create such materials, these are difficult to make.

This is also shown in the research of Warburton (2009), where it is stated that factors such as "fear of CAA failure, ineffective dissemination of good CAA practice, difficulty using the systems and resources withheld by senior management" are other obstacles.

Concern over security issues is another factor restricting the adoption of electronic assessment technologies. Bull (2000) points out that this results in "techno panic, a phenomenon which manifests itself as a demand for much more stringent security measures than would be adopted for paper-based assessments".

The causes are: "an inherent unwillingness to participate, resulting in identifying difficulties and reasons for failure; unrealistic expectations of technology; and a misguided belief that students will only consider cheating if they are using technology". The strategies to overcome this issue include encouraging a more sensible approach to security measures and awareness of developments in technology which help the security of examinations. These are also important within the context of assessment strategies and strategies in general.

Aspects of reliability and validity are important in designing electronic exams/test. For educators the main concern is keeping marking reliable, particularly for larger classes (Heinrich et al., 2009). Students are more interested in efficiency, transparency and fairness of their assessment activities, which influences the degree of engagement shown in their studies (Iannone & Simpson, 2013).

Factors driving e-assessment uptake

To recognize the factors that facilitate the adoption of technology, we will now consider the strategies and tactics that enable its use.

To successfully adopt technology one has to be convinced of its usefulness; to identify which factors are driving each stakeholder to get involved in the assessment process. We have included below the most common factors that encourage their use.

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A major factor often mentioned in literature is active institutional and administrative senior management support (Buzzetto-More & Alade, 2006), that strongly supports the proposal of strategies for academic staff development and training (Whitelock et al., 2006), (Warburton 2009), (Heinrich et al., 2009).

This is not surprising, as policy-makers and administrators should be the first to be convinced that educational technology can greatly enrich the assessment practices.

The role that policy-makers and senior management play is crucial for educational technology adoption for the e-assessment process.

Their support serves as motivation for teachers and students to adopt ICT, as is highlighted in Whitelock et al. (2006), who point out that the main facilitator of effective implementation of e-assessment is the support of the school manager, combined with staff development and pedagogical and technical support. Likewise, Heinrich et al. (2009) notes that teachers need more support from the university management when using automated assessments.

This is also stated in the work of Bhuasiri et al. (2012), whose research tries to identify factors that influence the acceptance of e-learning systems in developing countries. The results of this study are particularly applicable in our research, since e-assessments are an important part of the e-learning technologies. They identify 6 dimensions and 20 critical success factors (CSF) that affect the adoption of e-learning. They define the dimensions; learner's characteristics, instructor's characteristics, e-learning environment, institution and service quality, infrastructure and system quality, course and information quality and motivation.

As the principal factors involved in e-learning adoption. Their conclusions show that the "infrastructure and system quality dimension" is the most important from the teachers' perspective. Therefore, it seems that active institutional support is crucial, as we have already pointed out above.

Likewise, Heinrich et al. (2009) points out that successful e-assessment adoption depends on the flexibility (willingness) of the academic staff.

Another important factor, is the willingness of staff to develop material, which clearly requires specific training to develop teachers' abilities and skills.

The opinions and experiences of educators can influence colleagues' willingness to use a specific educational environment (Heinrich et al., 2009), (Warburton 2008). This suggests that a teacher can agree to use a certain system and disagree to use another one. In this way, his/her opinions can affect colleagues' perceptions and opinions and therefore modify their willingness to use a system. The ideas cited by researchers (Heinrich et al., 2009), (Whitelock et al. 2006) show the importance that pedagogy plays in a technology adoption plan. As Heinrich says "the selection of the technology should be guided by pedagogical design of the assessment" and not as often, the other way around.

They also point out that other important factors that facilitate the adoption of electronic assessment are "the removal of geographic limitations, reduction of losing work risk, saving time and resources if printing is not required, the availability of a long-term archive of student work based on the ease of storage of electronic material, and fast return of marked student work" which can also serve as strategies for educators who want to enhance their teaching.

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It is noteworthy that the practical benefits for educators are the reduced effort and time spent on assessment practices. When teachers adopt technology in their class, they acquire new skills that improves their performance.

Once they have used the technology, they do not want to go back to using traditional practices (Heinrich et al., 2009). Electronic assessment practices facilitate the opportunities for anonymous participation and marking which support group activities, and improve the quality of marking and feedback. Whitelock et al. (2006) mentions that technical support for teachers is an essential facilitator (including technical services and the design of electronic assessment tasks).

We will also analyse the impact of this factor on teachers' willingness to adopt e-testing technologies.

More recent research, e.g. Reiners et al. (2011), point out other factors that help the dissemination of strategies of automated assessment technology such as demonstrations, case studies, and hands-on experiences (e.g. 3D Virtual Worlds). Technologies such as advanced plagiarism detection have also been successful promoting advanced automated assessment technologies.

Conclusions

In this study we have reviewed the literature on the current state of knowledge and practice regarding electronic assessment, and wish to conclude with some useful insights that summarize the adoption of ICT in the assessment process. Knowing these factors - positive or negative- enables us to determine when the staff are well prepared to implement a plan to adopt technology, as well as the grade of willingness of the main stakeholders.

For teachers the lack of time to develop questions or even to learn the software (Dermo, 2007); (McCann, 2010); (Whitelock & Brasher, 2006); (Warburton, 2009) are important barriers for the adoption of e-assessment.

Nevertheless, the literature shows that adopting electronic assessment practices can help teachers save time (Whitelock et al., 2006), which compensates for the time spent in learning and developing e-assessment strategies.

Teachers' training in computer literacy and test construction is another important lesson. (Sim et al., 2004), (Warburton, 2009), (Purvis, Aspden, Bannister, & Helm, 2011), (Dermo, 2007), (Ashton, Beevers, & Thomas, 2008).

Another important factor is the design and development of a technology plan that considers sufficient details of pedagogical strategies.

It is fundamental to include aspects of validity and reliability in designing a useful plan for adopting technology to educational assessment, because it depends to a large extent on the level of trust and confidence that students embrace in the assessment practices. This will also be reflected in students' efforts in their learning (Iannone & Simpson, 2013).

In the research of Bhuasiri et al. (2012), the infrastructure and system quality are the most significant categories from a faculty perspective at the universities and found to be also at the educational organizations. Hence, it might be interesting for policy-makers and senior management to initiate strategies regarding funding the development of new educational projects that enhance the assessment practices by the use of ICT. As Whitelock et al. (2006) remark, a successful implementation of electronic assessment depends on active institutional and administrative support.

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It must not be forgotten that the adequate design of electronic assessment methods must include technology for the right pedagogical reasons as educational research advocates, the use of technology for its own sake does not improve educational assessment (Heinrich et al., 2009).

As is shown in the experience of other countries such as UK, where e-learning has been recognized as a movement with a huge growth. The UK government has focused on developing new initiatives to recognize the electronic assessment process as an important strategic initiative. Policy-makers and senior management have the power to foment and create these changes. Also, teachers must be involved in a steady and continuous change.

Their strategies must be extended to include all stakeholders involved in the educational processes.

Not surprisingly, teachers also need to take into account that there are wide political and business issues in the background that affect the appropriate development of electronic assessment at universities. To deal with this situation, policy-makers and senior management must learn the best strategies to obtain real progress to all related stakeholders.

ICT has revolutionized the education system by making it more accessible to modern society.

This should be an advantage to students, teachers and universities. Technology enables education to be available to more students, including those from the social stratum of the needy. This not only can meet actual demands for higher education, but also offers innovative teaching, learning and assessment methods that undoubtedly will be attractive to new generations of students.

Educational technology also plays a crucial role in automating each task and stage of the assessment process and although its use and effectiveness has already been proven, educational literature shows that there is still a huge need to develop these innovative approaches. Research in e-assessment includes a huge variety of perspectives that leads to continuous change. There is no single solution to the challenge of effective education.

However, the willingness to adopt innovative educational assessment methods will indeed make a positive difference to students' learning. We conclude by citing the idea of Stödberg (2012), who points out that knowledge in this area is quickly expanding and there is a need for more studies related to e-assessment.

There are still many opportunities that are not being taking advantage of, and the emerging research should be constructed with the aim of proposing specific strategies for developing new approaches to e-assessment.

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