INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) AND ITS ROLE IN EDUCATIONAL ASSESSMENT

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ABSTRACT

This paper identifies the role of ICT in assessment practices in education. The significant factors that schools and teachers should consider include the benefits it can provide to improve and enhance assessment. The primary focus of this paper is: What are the roles ICT can provide to support assessment in education? ICT has several roles and supports in educational assessment practices. This paper emphasizes its roles in two parts: testing, and tasks. ICT can be used in testing to administer tests, to score the tests, to analyse the result and to facilitate teachers in assessing learning outcomes. Besides, ICT can be integrated in completing student's task such as portfolio and project-based assessment. ICT provides opportunities for students to create electronic versions of their portfolio. ICT can also support students to complete their project. It is essential for teachers to realise that the rubric used to assess e-portfolios and projects must also assess students' technology use.

Keywords: *ICT; assessment; technology-based assessment*

INTRODUCTION

Schools in the modern day have become more sophisticated in terms of the development of their instruction infrastructure and facilities. Previously, the school environment was limited to having a class with chairs, tables and a board. Most of the instruction activities were conducted in class in front of students and most of the assessment processes were performed in class with paper and pencil tests. Given that technology has developed very rapidly and has influenced every aspect of life,

including education, technology, computers and the Internet should be integrated into education to support instruction and assessment processes.

In ICT environment, instructional activities do not have to occur in class all the time. Teachers and students can also communicate through email or other online media. Specifically, in relation to assessment, ICT are used to support assessment practice in various ways. Computers can be used as the medium for testing, to score students' tests using automatic scoring software and as a tool for doing assessment tasks. This phenomenon is considered as a new way of measuring educational outcomes and is well known as technology-based assessment. John and Wheeler (2008) state that because of current advances in ICT, assessment of learning is now experiencing change in ways that have lead it to revision of the methods, rationale and process of testing. In addition, Jonassen et al (2009) point out that the use of technology to support assessment is not only done by converting traditional forms of assessment into a digital format, such as computer-based testing, quizzes or surveys, but it can also be used to assess higher-order learning outcomes.

This article investigates the notion of ICT-based assessment or e-assessment and its role in education. It is hoped that it would make assessment in education more beneficial and effective in the future.

ICT TO SUPPORT ASSESSMENT PRACTICE

Education constitutes one of the important aspects in developing nations because it is through education that people will be able to develop their human capital. Quality education needs good assessment. Nitko and Brookhart (2011, p. 3) define assessment as 'a process for obtaining information that is used for making decisions about students; curricula, programs, and schools; and educational policy'. Based on studies of classrooms, Stiggins et al (as cited in Nitko & Brookhart, 2011) state that teachers should use many sources of information to assess students' achievement. Therefore, to gain complete and accurate information about students, it is better for teachers to use a wide range of assessments.

In education, one aspect that raises much research and study is the importance of ICT use in assessment practice. In many ways, ICT can support assess-

ment practice. ICT can also be used to support formative and summative assessment.

According to the Organization for Economic Co-operation and Development (OECD) (2001), there are three main rationales for the importance of including ICT in education. First, the economic aspect: the OECD states that 21st Century employers consider workers with ICT skills to be preferable. Therefore, learners are now aware that acquiring ICT skills is important for their future career. Second, the social aspect: ICT is considered to be a requirement for social participation in the community and workplace since ICT now is seen in the same position as literacy and numeracy. In addition, the wider use of ICT will lead to some benefits in education, such as a good relationship between home and school, greater parental involvement in student progress and better chances for the interactive involvement of educational institutions in society. Third, the pedagogical aspect: ICT plays significant roles in broadening and enriching teaching and learning.

These three aspects are most likely related to using ICT in assessment. Students who are encouraged to use ICT in working and completing their assignments will be more familiar with ICT. Current issues in educational assessment can be acknowledged by communicating with experts in any educational institution via email, websites, conference calls and other media. Since assessment is part of teaching and learning, it can also be enriched and broadened through ICT to support a variety of needs in assessment.

Campbell (2005) states that rather than only using computer-assisted assessment (CAA) to assess students, CAA technology can also be used to assist in the assessment process. CAA technology such as computer-based testing (CBT) helps teachers in assessing students' achievement by marking test items and analyzing the test results. It is usually used for examination, quiz and questionnaire type testing. The other important use of CAA is to help teachers to do assessments where professional judgment is involved. Campbell (2005) developed an e-marking tool as part of his PhD research study. He states that the e-marking tool aims to lessen the busy work of marking, such as adding up marks and recording and spell-checking comments by hand. As a result, teachers are able to spend more of their time on quality

feedback, reflection and moderation. The e-marking tool has been applied to oral presentations, posters, essays, tutorial papers, tutorial presentation concept maps and exams. The e-marking tool he developed is about moving marking process off the desk and onto the computer by combining and integrating spreadsheet features, word process and database applications.

Meanwhile, ICT can also be used for students to do their assignment. ICT is not only used to assess students' tasks, but also is used to prepare and complete the tasks. For example, students use ICT to complete assessment tasks like technology-based projects such as science projects, creating podcasts or photo stories and e-portfolios. It is important for teachers to notice that, to assess assessments tasks that integrate ICT, they have to assess the technology skills as well.

Furthermore, Burgstahler (2010) states that computers can be used to facilitate people with disabilities to enhance their independence, productivity and capabilities. However, the computer needs adaptive or assistive hardware and software that can help people with disabilities. For example, to be readily used, a standard computer needs built-in access devices or unique combinations of software and hardware used for certain disabilities such as for voice or Braille output. This benefit of ICT in education, particularly assessment, will really assist people with disabilities to do their assessment more effectively. In addition, it also helps teachers to avoid discrimination and to be fair in a way that every student can be assessed according to their conditions and needs.

Thus, it is clearly explained that the inclusion of ICT in education cannot be avoided. The use of ICT by teachers and students will support the assessment process. For teachers, they can catch up with the development in educational technology so that they can be digital teachers. For students, the use of ICT will prepare their computer skills so that they will be ready to be digital learners and workers.

TESTING AND ICT

Testing is defined as 'a method of measuring a person's ability, knowledge, or performance in a given domain' (Brown, 2004, p. 3). Brown further explains that the terms 'testing' and 'assessment' are sometimes used interchangeably, but actual-

ly have different meanings. Assessment is a much broader term, and testing is part of assessment. Assessment can be conducted in many forms and in an ongoing process, while testing has a more formal administrative procedure and occurs at certain times in a curriculum to provide measurement and evaluation. McDonald (2007) asserts that testing aims to obtain relevant and accurate data to make important decisions with a minimal amount of error.

Burkhardt and Pead (2003) state that the potential use of computers as a tool for assessment has been in the minds of educators for years, but has not yet produced many practices in classroom assessment. However, since the massive growth of computers and the Internet in the 1990s, there has been the possibility of replacing traditional examinations with online testing. Essentially, the use of ICT in testing can be conducted in either the online or offline setting.

Some examples of assessment tools that are used in the online setting given by Dawley (2007) include course surveys, exams and testing tools, Internet assessment tools such as HotPotatoes, Quia, ExamBuilder, rubric tools like Rubi Star and quiz creation tools such as QuizStar. In addition, some survey tools are available such as Survey Monkey, Zoomerang, Survey Pro, SurveyGold and Survey Gizmo. These tools are used to create questions such as multiple choice, essay, true/false, matching, fill-in-the-blank and ordering types of questions in online testing. When students are required to take the tests, the Internet availability is necessary. For the offline setting, a set of questions can be designed by using certain software, such as Adobe Dreamweaver, which can make an offline version of the test as well as generating the score. The testing programs can be accessed in a computer independent of an Internet connection. It is important for teachers who are committed to using ICT in assessment to acknowledge these tools and be able to use them. These tools are very useful for helping to create tests in digital settings.

In testing, terms such computer based testing (CBT) and computerised adaptive testing (CAT) are some of the test systems that use ICT as the basis for administrating the test. To gain more insight, the various uses of ICT in testing are elaborated.

COMPUTER AS SCORING TOOL IN TESTING

Testing has been used to assess students for years, especially on large-scale assessments such as national examinations and the CPNS test (Indonesian civil service admission test), and various language proficiency tests such as the IELTS and TOEFL for English, Goethe Zertificate for German, and many others. Tucker (2009) states that "fill-in-the-bubble" testing has dominated student assessment practices in local, state and national assessments since the invention of the IBM Type Test Scoring Machine in 1938.

In testing that uses a computer as the scoring tool, the tests are administered by using a paper-pencil test, in which the questions are printed on paper and students are required to fill in the bubble score sheets, basing their answers on multiple-choice question types and, in some tests, filling in the gaps. Then, to obtain the score of the test, the computer scans the score sheets. Here, the computer acts as scoring tool to help test administrators in the scoring process, which is usually the time-consuming part of assessing multiple-choice tests.

Tucker (2009) asserts that the computer, as scoring tool, replaces the conventional paper-based multiple-choice or filling the gaps test with computerised versions. The limitations of multiple-choices tests are still there. However, it is essential to keep in mind that the use of computers facilitates a more efficient and effective scoring system, and it is expected to be able to minimise errors.

Regarding computers as marking tools, Burkhardt and Pead (2003) maintain that even though artificial intelligence has been developing for more than 40 years, the reliable interpretation of open responses in natural language by computers is still a problem. It needs to be remembered that computers with developed artificial intelligence are able to mark open response tasks, but the reliability is still questionable. In this case, teachers still have a main role in assessing or marking open responses tasks. For essay marking, Burkhardt and Pead (2003) state that there are several available marking systems, but the systems will not assess semantic analysis. Rather, they assess things such as sentence length and 'rare' word frequencies. However, the possibility of cheating the system arises if students know the marking algorithms. Given such concerns, a human marker is still needed, with a computer used as

backup. If the computer mark and the human mark have very significant differences, a second human marker is called in.

To sum up, scoring student assignments like multiple choice tests, and marking reports, projects or oral tasks need a lot of time and effort to produce a fair and accurate scoring. Teachers are usually perform as both the test administers and scorers. Moreover, the existence of technology and computers can help teachers to do the scoring process faster, which can save a lot of time. However, it needs to be taken into consideration that in some situations, a computer cannot replace a teacher to do marking. The better thing to do if a computer is going to take part in the process of scoring is a mutual contribution of computer and human.

COMPUTER–BASED TESTING (CBT)

In testing, the method of using a computer that acts as the test deliverer is called computer-based testing (CBT). According to Jonassen et al. (2009), computer-based testing has been used to make the testing process simpler for teachers and administrators and to facilitate faster scoring of students' work by using scanned sheets and asking students to perform the test on a computer. In computer-based testings, the functions of the computer are as the test medium and as the scorer. The computer can also analyse the test results to check the test item's performance. Mils et al. (2002) state that nowadays, many tests for licensure, certification and admission are done using CBT as a common form of test delivery. CBT has been an option or sole means of test delivery by many large-scale, high-stakes testing programs. In essence, the use of computers as the basis of assessment has spread widely.

Most computer-based tests consist of fixed and close-ended responses, which are scored by using an automatic electronic scoring machine. However, in some computer-based tests, such as TOEFL, they offer a written essay section and an oral production section. These sections are scored by humans (Brown & Abeywickrama, 2010). However, Jamieson (2005) discusses the contribution of corpus linguistics in recent developments of computer-based assessment to providing more authenticity by designing more complex tasks and structures and by recording written and orals score by using speech and writing recognition software. As technologies burgeon

and become progressively more sophisticated, it is possible that in the coming years, computers and technology will have a wider role in assessment practice, not only in multiple-choice testing, but also in written and oral tests.

COMPUTERISED ADAPTIVE TESTING (CAT)

The development of computer technology and psychometric theories have triggered a change in the way tests are administered from conventional paper-and-pencil tests to Computerised Adaptive Testing (CAT) (Leung, Chang, & Hau, 2003). CAT is a specific type of computer-based test (CBT) that is assisted by a computer program which replaces a human administrator. The test taker performs this test on a computer. It begins by giving the test taker a moderately difficult question which is immediately scored. The difficulty level of the next question depends on the test taker's ability to answer previous questions correctly or incorrectly (Brown & Abeywickrama, 2010). Brown and Abeywickrama (2010) describe CAT as an instrument in which test takers receive a set of questions that meet test specifications and are generally appropriate for their performance level. In short, CAT is about a computer program calculating an estimate of a person's proficiency to choose appropriate questions.

CAT and other computerised tests are different from paper-and-pencil tests. The National Council on Measurement in Education in the United States (2002) mentions that the paper-and-pencil test has a component called 'test form', which is a set of items in a test booklet. Several test forms consisting of mostly unique test items are produced by a large testing program each year, and the number of items in a test form is easy to determine. Whereas in CAT, the test does not have such test forms in paper-and pencil testing. All items with varying difficulties are stored in the CAT item pool, which contains a large number of calibrated items. In every CAT test, the items are drawn from the item pools by the item selection algorithm, by which the difficulty level of the items is adapted to each individual examinee's level.

CBT and CAT are forms of assessment that use a computer as the medium of delivering the test. A testing program or software has been made and saved into a computer or website depending on whether the test is an online or offline version. Students will sit in front of a computer to do their test by answering questions and the

computer will manage administration of the test and the scoring process. Burkhardt and Pead (2003) state that computer-delivered testing offers:

1. Economies in the delivery of traditional paper tasks;
2. Automatic collection of student responses if the responses consist of simple alphanumeric text, multiple-choice answers and short-answer papers or 'drag-and-drop' responses;
3. Automatic marking of simple student responses without using human judgement or interpretation; and
4. New types of task presentation using interactive multimedia elements.

Computerised assessments provide some potential opportunities to test examinees and assist examiners in many ways such as: saving time and paper, effective and efficient test administration and an automatic marking process. It also benefits students in that the test can be conducted at any available time since it is computerised. The shortcomings of testing still exist in the computerised version of test. However, it offers benefits that make the testing process more feasible and efficient and test scoring more fair and accurate.

ELECTRONIC PORTFOLIO

One form of assessment that can be utilised by teachers is the portfolio. Butler and McMunn (2006) define portfolios as being written and integrated collections of students' work showing effort, progress or a degree of proficiency. The tendency to use ICT in assessment also influences portfolio assessment, in which electronic versions of portfolios are developed in many educational institutions. Therefore, an overview of e-portfolio applications in assessment will be elaborated. Things such as the organisation and benefits of e-portfolios are discussed.

Electronic portfolios benefit students just like the hard copy portfolio does since an electronic portfolio is basically trying to replicate the traditional portfolio. Instead of using paper or manually collecting students' works in bundles, the works are collected in an electronic or computer-based format and saved in computer data storage or online data storage. This is what Meyer and Latham (2008) state as the most evident advantage of the e-portfolio, which is eliminating the physical storage

problem which occurs with the paper-based portfolio. In addition, the ICT environment provides opportunities to present material that cannot be readily incorporated into a print-based format such as animation, recording and video. Further, an e-portfolio enables very rapid access to material in the portfolio in a flexible way. The same material could be indexed in different ways to meet different needs.

There are many software programs that can be used for an electronic portfolio in either offline or online format. For an online portfolio, Ferrara (2010) suggests that to have portfolio assessment program online, an educational institution must have high commitment to providing the most suitable technologies to suit students' needs. In addition, for online e-portfolios, the availability of Internet access is required to access the e-portfolio program, since it is a web-based program, even though some e-portfolio programs also provide offline versions that also need Internet access, but not necessarily for accessing the program. Strudler and Wetzel (2005) mention two routes of portfolio creation that can be taken by educational institutions. Some can use off-the-shelf tools such as Microsoft Office and various Web authoring applications while others can use commercial Web-based systems (e.g., Chalk and Wire, John Hopkins' Portfolio System, Live Text, Professor Portfolio and TaskStream).

Given the fact that the e-portfolio provides many advantages for students, teachers and schools, the application of e-portfolio as part of student assessment needs to be considered. However, the application of e-portfolio might be not easy, but it is possible as long as it is adjusted to the situation and available resources.

PROJECT-BASED ASSESSMENT AND TECHNOLOGY

In assessment, the project is considered as an alternative assessment for a constructivist classroom that provides students opportunity to express what they have learned and help them to define their own view of the topic (Tiene & Ingram, 2001). Nitko and Brookhart (2011) recognise two types of project: the individual student project and the group project. The purpose of an individual student project is to show the student's ability to apply and integrate a wide range of abilities and knowledge as well as using creativity, originality and aesthetics. The purpose of the group project is for students to demonstrate their ability to work collaboratively and

appropriately to create a high-quality project. In view of the fact that a project is an interesting alternative assessment that supports students' knowledge application into an authentic constructivist project, several uses of ICT in projects are reviewed.

Using a project as an assessment task benefits students in ways that provide them with a real opportunity to implement their knowledge rather than just acquiring it verbally from teachers in class. It facilitates students working in groups to build communication and collaboration skills. For assessment purposes, Butler and McMunn (2006) suggest that projects can assess not only the products of learning, such as reports, but also the process of learning, such as performance in project preparation. Nevertheless, it needs to take into consideration that teachers need to develop a good project plan and a good rubric in order to assess students effectively.

Tiene and Ingram (2001) mention several uses of technology to help construct educational projects which support constructivist learning that emphasises students expressing what they have learnt in meaningful ways. They mention several technology-related projects such as developing a PowerPoint presentation, a Web page or a short television program. It is essential for teachers to realise that there are many ways of using ICT in project-based assessment.

The other technology-related project is producing a shot television program. Tiene and Ingram (2001) mention several advantages of performing this project in a classroom assessment. It motivates students and encourages them to investigate a subject thoroughly by writing a script. It also helps to develop a variety of skills, such as imagination and creativity, research, writing ability, organisation, social sensitivity and some technical expertise. Producing video for assessment purposes will be a lot of fun for students to do in class.

Given the fact that project-based assessment provides the opportunity for students to implement their knowledge in creative and productive ways, it is essential for teachers to design a project that supports constructivist learning by integrating the use of ICT in the process of completing the project. It needs to take into account that project-based assessment can be implemented in all subject areas in class such as biology, geography, art and so on. However, teachers need to consider school

resources and their students' level of ICT skill before planning a project in order to create an effective project-based assessment.

ASSESSING TECHNOLOGY USE IN PORTFOLIO AND PROJECT

Portfolios and projects are forms of performance assessments. According to Nitko and Brookhart (2011), performance assessment is any assessment technique that requires students to physically demonstrate their understanding of certain knowledge by carrying out a complex, extensive process (e.g. an oral argument presentation, a musical play or knotted rope climbing) or by producing an important product (e.g. a poem, an experiment report or a painting). The use of ICT in portfolios and projects will make a difference in the assessment process compared to traditional portfolios and projects. Not only will the contents of portfolios and projects be assessed, but also the ability of students' to demonstrate their ICT skills in creating e-portfolios and projects. In other words, a rubric used to assess performance that involves ICT, has to assess both a student's knowledge and mastery of technology.

Projects as performance assessments must have clear details and descriptions of how they will be graded and this must be completed before they are assigned to students. A rubric helps to give students a standard for making a correct project. Loveland (2005) points out the importance of standard-based assessment for project-based learning. He recommends the creation of standard-based rubrics, which consist of a set of criteria for a level of performance that must be achieved by students in order to be considered successful, and a set of performance levels which indicate several levels of student attainment, from low to high.

In summary, Brown and Abeywickrama (2010) assert that designing an effective and successful rubric is not an easy job for teachers; it needs effort, care and precision. Teachers should also make sure the criteria in a rubric reflect the purposes of the assessment. Finally, it is vital for teachers to realise that using rubric-reference assessment is valuable for performance-based assessment.

CONCLUSION

The discussions of this paper suggest that ICT can be applied to support educational assessment practice in several ways. Computers can help in scoring stu-

dents' assignments, such as multiple-choice tests and marking reports, essays and projects. The use of an automatic scoring machine to score fill-in-the-bubble testings or a marking system for teachers to mark essays is some examples of using ICT as a marking tool.

Computer can be used as the medium for testing, scoring tests and test score analysis. Computer-Based Testing (CBT) and Computerised-Adaptive Testing (CAT) are two examples of ICT application in assessment practice in which students perform the test in front of a computer. It also assists students to complete their assessment tasks such as the use of electronic portfolios and project-based assessment. Teachers will assess the e-portfolio and project by using a rubric that assesses not only the process and product, but also their students' use of technology.

There are many ways of incorporating ICT in assessment practices. Schools and other educational institutions can find the most appropriate method that suits their context. Therefore, it is now essential for schools to encourage themselves to strengthen their commitment to developing a better assessment practise which can support teachers, students and other stakeholders.

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