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Incorporating computer-assisted assessment to Bachelor of Science in industrial technology courses

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Abstract

The use of computers in education has already been established for decades. Computers have been used from lesson preparations, presentations, and student assessments. Many authors have studied the design, implementation, and impact of computer-assisted assessment (CAA) (also called computer-based testing, e-exam, or computer-based assessment) in education in many different subject areas. Apparently, among those subject areas does not include skills-oriented courses such as the Bachelor of Science in Industrial Technology (BSIT). In this research, a methodology is proposed to be used in order to incorporate both formative and summative CAA into the BSIT courses.

Keywords: Computer-assisted assessment, computer-based assessment, formative test, summative test, BS in Industrial Technology

Introduction

The use of computers in delivering Multiple Choice Questions (MCQ) started way back in the 1970s (Morgan, 1979). Since then, many studies were conducted to know if the use of the computer in assessments has an effect on the results when compared to the traditional paper-and-pencil. These, however, were conducted not to prove which is better but rather on their similarity. Noyes and Garland (2008) stated there will always be some tasks that are better suited over the other. However, as technology continues to progress, greater equivalence will be achieved.

Computers have become more diverse and its use in education has been constantly evolving. Computers are used in a variety of ways ranging from lesson preparation, presentation, and to student assessment. The use of computers in evaluating a student is called computer-assisted assessment (CAA). There are two types of approaches when conducting CAA, the use of automated marking of paper forms and the use of computer software. In the former, assessment is done with the use of hard copy questions and an optical mark reader (OMR) compatible answer sheet. The latter in contrast, the assessment is done directly onto the computer with no papers involved.

The Bachelor of Science in Industrial Technology (BSIT) is a four-year degree course that is aimed to equip students with the knowledge and the technical skills needed to prepare them for supervisory and managerial work. Students are also trained to become adept in their respective field of expertise in terms of the operation and maintenance of the technical systems and equipment in their line of work. Most major subjects in the BSIT curriculum are designed to cultivate hands-on skills based on their specialization. Students are required to perform actual operations,

maintenance, and troubleshooting skills on industry based machinery, tools, and equipment. In this regard, students are assessed on all of the cognitive levels of learning that includes knowledge, comprehension, application, analysis, synthesis, and evaluation (Bloom, 1956).

According to a survey conducted by the CAA Centre in 1999, CAA is used widely in different subject areas which include computing/IT, biomedical science, mathematics, engineering and modern languages. A number of authors have presented different methodologies in order to adopt CAA into these different subject areas (e.g. Cantillon P. et. al., 2004; Iahad N. et. al. 2004). However, there no known methodology developed on how to incorporate CAA into skills oriented subjects such as those that can be seen in BSIT courses. This paper proposes a new methodology for the adaptation of CAA into the BSIT courses subjects. Therefore, this study makes a contribution to the existing literature on how to integrate CAA in the teaching and assessing of learners in the BSIT courses.

Why use CAA?

The introduction of using computers to test knowledge and problem-solving abilities started way back in the 1960s (Swets J. D. et al., 1965). A number of authors have looked into the concept of CAA and deliberated its different aspects of outcomes when used in assessment (e.g. Bull, J., 1999; Cantillon P. et. al., 2004). They argued the factors that constitute its design, the delivery and the analysis of its results (Canole & Warburton, 2005).

The acceptance of CAA is mainly due to the advantages it offers for both tutor and learner when compared to the traditional paper-and-pencil tests. The most distinguished among these is its ability to automate markings and give instant feedback to learners, which is one of the most tedious works of a tutor. Other includes, teachers can track students' individual performance, saves time in creating tests, can be used for both formative and summative tests, questions can be reused in a number of times, different types of questions are available, able to use a wide variety of medium (video, graphics, text, animation, etc), cheating can be minimized, test can be scheduled anytime and can be delivered simultaneously in multiple locations.

Despite its benefits, there are reasons why many are still unable to implement CAA. These includes the generality that it favors objective types of question which commonly uses MCQs, formulating good questions for the question banks requires expertise in the subjects, and proper training to have a good grasp of the software is also necessary. Others are also reluctant to shift to CAA because of its impact on the administration of the institute. The initial cost of the development or software licenses can be expensive. Not to mention of having more additional computers that are technologically capable of running the software in order to avoid breakdowns during examinations. A computer server may be needed, depending on the design of the software. And the dedicated technical staff is necessary to oversee the network setup, maintenance, and training of the faculty and students in the proper operation of the software.

Data from several sources have identified that computer anxiety and computer experience has an effect on the output scores of the takers as compared to paper-and-pencil test. However, their findings are contradictory. Early studies showed that the takers without prior computer experience are those likely to have low scores (Bugbee, 1996; Lee, Moreno & Sympson, 1986). This is in contrary to the later findings of other authors stating that the performance between computerized and paper-and-pencil test has no relationship with computer inexperience or anxiety (Mills, 2002; Smith & Caputi, 2004; Wise & Plake, 1989). However, according to Domino (2006), high math-achiever takers showed significantly higher state anxiety when taking CAA with instant feedback.

Question types

Using computers for assessment is often associated with objective types of questions because most economically developed CAA is using it. Seale (2002) presented in her study that there are other kinds of questions that can be used in a CAA system. Among these includes assertion-reason questions, completion questions, field simulation, labeling and building questions, multiple response questions, sore finger questions, build up images, drag and drop, graphical hotspot questions, matching questions, ranking questions, text/numerical questions, crossword puzzles, drawing questions, image identification questions, matrix questions, sequencing questions, true/false questions, case studies, essay questions, justification questions, multiple choice questions, short answer questions and yes/no questions. Each of these can be combined or used separately in giving an assessment.

The review of literature conducted by Sim et. al (2004), presented that although there are different possible question formats for CAA, classified them into four distinct groups based on its human interaction requirement. These groups are point and click, move an object, text entry and draw the object.

Point and click method operates by pointing then clicking the appropriate answer of the given question. This method includes multiple choice questions, yes/no questions, true/false questions, sequencing question, multiple response questions, matching questions, assertion-reason questions, graphical hotspot questions, ranking questions and image identification questions. **Move object** is focused on the movement of items into its proper positions on the screen. Build up images, drag and drop, labeling and building questions, ranking questions and matching questions are used in this method. **Text entry method** comprises of an input of short predetermined answer. Types of questions in this method include text/numerical questions, matching questions, sore finger questions, completion questions, crossword puzzles, essay questions and justification questions. **Draw object** is associated with the drawing of simple objects such as lines, and circles. The effectiveness of this method presents very little evidence in the literature most likely due to the fact that common commercial CAA software does not offer them.

These methods can be used to test the lower cognitive levels of learning of the learners through objective types of questions. However, developing MCQs into assertion-reasoning questions leads to

testing higher cognitive skills (Bull & McKeanna, 2001). Accordingly, Haladyna (1999) argues that multiple choice testing is an efficient and effective way to assess a wide range of knowledge, skills, attitudes and abilities and MCQ remains one of the most commonly used assessment formats.

Suggested methods

Assessment is defined as the measurement of the learner's achievement and progress in a learning process (Keeves, 1994; Reeves & Hedberg, 2009) and is a core component of effective learning (Bransford et. al., 2000). Assessment is important in the teaching and learning process in order measure the transfer of knowledge gained by the learner and ratifies the pedagogy effectiveness.

The study of Knight (2001) identified fifty varied techniques in administering assessments in higher education. These techniques, however, does not include all the methods developed using CAA. New assessment methodologies continue to emerge as technology and computers continue to evolve. However, Cantillon et. al. (2004) argues that CAA is applied in four different applications which include diagnostic assessment, self-assessment, formative assessment and summative assessment. These types of assessments can be used in the BSIT subjects. However, self-assessment is advised only for self-paced learning which is not the case for classroom-based learning.

Diagnostic assessment

This assessment is given to the learner prior to the learning process. It is aimed to determine the current state of knowledge and/or skills of the learner on the subject matter to be undertaken. This is performed also for the purpose of knowing the baseline of the teacher on where to focus on the learning process of the learners.

This kind of assessment should focus on the knowledge contents of the subject matter. The student should have an overall glimpse of the technical concepts of the subject to be learned. Using point and click is best suited for this type of assessment. This should be administered before any learning process takes place. Automated feedback is suggested to be presented to identify the suited pedagogy.

Summative assessment

Summative assessment measures what students have learned at the end of an instructional unit, end of a course, or after some defined period (Hargreaves, 2008). It can also refer to ascertaining that the desired goals of learning have been met or certifying that the required levels of competence have been achieved (Challis, 2005). Summative assessment is administered to measure the broad understanding of the learner regarding the subject matter. It is also associated with the giving of a numerical value on the achievement of the learner. This assessment has been the conventional type of assessment in both traditional and CAA. It is mostly used for long objective assessments and major examinations.

A wide range of understanding on the subject matter is needed for a summative assessment. To address this, a combination of all of the question types should be done. This will ensure that most of the lower cognitive levels of learning will be subjected to testing. A proper scoring methodology should be used for this assessment such as negative marking and partial credit, in order to guarantee that fairness is given to all takers especially if

the move object type is used. Otherwise, one to one ratio scoring is most appropriate.

Formative assessment

Formative assessment is commonly applied in the classroom as a source of ongoing feedback with the aim to improve teaching and learning (Hargreaves, 2008). This assessment is administered during the learning process with the aim to monitor the learner's understanding and to modify pedagogy to further improve learning until the desired level of knowledge and mastery of the learner is achieved. This can be in the form of short objective assessment and immersion of problem-based and case-based scenarios for role-playing activities.

Institutions with limited tools and equipment to conduct practical assessments may adopt CAA as a substitute for continuous learning. Administering build up images question types may temporarily replace hands-on assessment, provided that the pictures of the actual device are used. This can be performed in a predetermined number of times, in order to assure that the learner is knowledgeable enough to perform the assessment, thus securing the welfare of the device and avoiding the risk of damage. Safety precautions also can be incorporated to assure the learner's well-being when operating the actual device.

The immediate feedback should be the most suitable type for this assessment. This enables the learner to know instantly if he or she made the correct choice, choices, or order of arrangement depending on the type of question used. However, the answer will not be revealed not until the learner supplies all the correct answer or answers; or until a predetermined number of tries has been reached. Repetitively taking the assessment and re-learning the lesson or activity increases the chance of properly accomplishing the task at hand thus, learning is greatly enhanced.

Automated marking in this kind of assessment is possible by adjusting the highest remark gained depending on the number of tries the learner has made. A tolerable base score should also be defined in the order set a basis to whether a learner is already considered knowledgeable in the subject area. A skip score will also be computed to determine the score to be subtracted from the highest score based on the trials performed. A general formula is given below:

$$Skip\ Score\ (sk) = \frac{highest\ score\ (hs) - base\ score(bs)}{No.of\ trials\ (nt)}$$

$$Learner\ Score\ (S) = hs - (sk * nt)$$

This equation is only applicable if the number of trials is set. If the number of trials is defined, the computed skip score may not return a whole number. It is, therefore, necessary to round off the answer in order to get a valid score. However, in the case of an unknown number of trials, a maximum value can be computed using the formula given. It can be seen that in this case, the Skip Score will automatically become equal to one.

$$No.of\ trials\ (nt) = highest\ score\ (hs) - base\ score(bs)$$

For example, if the highest score is 10 and the base score is 5, the allowable number of trials will be the difference of the highest score and the base score, which in this case is 5 (10 – 5 = 5). Supplying the computed number of trials into the skip score formula will yield to a value of 1. If the learner completed the assessment on the first try, then the given score should be 10. On the second try, a point is subtracted and the score will be 9. This pattern continues until the number of trials has been used. In case the learner fails to achieve a passing remark on the maximum number of trials, the lowest possible score should be given. It learner should then be allowed to perform unlimited trials until a passing score is achieved.

Conclusion and recommendations

Computer assisted assessment has been used for decades and continues to evolve to cater different subject areas in assessing the different cognitive levels of learning. The methodology presented in this paper is a means to incorporate CAA in the BSIT course subjects. It discussed how should the different kinds of assessments can be included and scored. However, further study should be conducted to determine the effectiveness and the applicability of this methodology in actual application.

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