Computer-Based Assessment: Its Effects On Students' Performance And Attitude

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ABSTRACT

Assessment can be delivered through paper and pencil (Paper Based Assessment-PBA) or through computers (Computer Based Assessment-CBA). The study was done through the use of these two test modes in order to bring recent evidence as regards to the effect of Computer-Based Assessment test delivery mode on students' performances and attitudes. The descriptive research method was utilized in the assessment of the respondents towards the perceived attitudes of the examinees on CBA in terms of ease of use and learning. The study made use also of the quasi-experimental design, specifically, the pretest-posttest non-equivalent control group design to determine the effect of CBA on students' performance. The respondents of the study were students from the College of Engineering of Rizal Technological University who were enrolled in physics classes. The data were collected using the researchers' made Physics Achievement Test, Attitude Survey, and the EDMODO SNS. The study showed that different test delivery mode resulted to different student performance. There is statistically significant difference in test scores of first year undergraduate students in Physics 2 between Computer-Based and Paper-Based Assessment, with the t-test analysis -4.87 greater than the critical t-value of 1.99 which implies a better performance in favor of the CBA to that of the PBA. Likewise, the student respondents have positive views regarding their attitudes on the ease of use and learning they acquired using the CBA, The value of Pearson r = 0.1176, though low, indicates that there is a positive correlation between attitude to use of CBA and performance. Furthermore, the results indicate that there is a significant relationship between attitude to use of computer tests with performance as shown in the p-value = 0. 3.21E-09. The overall results favored the computer-based tests.

Key words: Computer-Based Assessment, Performance and Attitude

INTRODUCTION

Assessment is an elemental pursuit in the teaching/learning process that evaluates not only the learners' knowledge, understanding, abilities and skills but also can be used to evaluate the learning outcome itself, progressing through appropriate response mechanisms of the learning procedure. Assessment provides evidence of what students know and are able to do. The evidence gathered during the performance assessment provides insights as to how students understand what were taught to them, and at the same time introduces students to authentic real-world problems, which allows them to show how they can apply academic knowledge to practical situations. The benefits of performance testing are well documented. Assessment plays a significant role in determining what goes on in the classroom in terms of what, and how teachers teach and what students learn, and can have an impact on both teaching and learning'[1]. Science performance assessments can measure different types of knowledge, including declarative, procedural and schematic knowledge[2]. It is generally accepted that assessment or testing determines the magnitude to which educational objectives have been achieved as well as the extent to which educational institutions have served the needs of the community and society.Various assessment methods are used to assess academic progress of the students, examples of which are Paper-Based Assessment (PBA)or Computer Based Assessment (CBA).

PBA mode of the test refers to a general group of assessment tool in which a test taker reads questions and respond in writing. These includes tests, such as knowledge and ability tests, and inventories, such as personality and interest inventories. PBA type of testing is available for traditional classroom situations, where computer access is limited or where controlled testing environment is required. However, this traditional mode of assessment, also known as the Paper-Based

(PBA), has its limitations. The question of validity is being raised for PBA as it, in many situations, cannot measure the actual performance in a real world environment; with issues on immediate feedback, automated scoring, technology advancement, etc. it faces. Beyond the traditional mode of assessment, the Computer-Based Assessment (CBA) has found its niche in this age of technological advancement.

Computer Based Assessment has become common in many academic institutions. In the early days, CBA was confined to text-based simple question and answer sessions written by programmers. Soon after, authoring systems have been built up to come up with more user-friendly products and open access for universities. Research gives the idea of the educational motives of the CBA for every unit of instruction. CBA tests may include more interactive and engaging question types such as simulations, on-line experiments, and graphing, allowing for the measurement of skills not easily assessed by traditional paper-and-pencil tests[3]. In addition, proponents of computerized tests argue that they are a better match with the way students are accustomed to learning. It has evolved into a collection of technologies and systems that cater to different test purposes, constituencies, and population of examinees [4]. Computer-based examinations can be used to promote learning that is effective by testing a range of skills, knowledge and understanding. Accordingly, accessing and managing of information and managing and developing communication skills can possibly be measured online which cannot be done on regular paper-based examinations[5]. The major component in determining whether an assessment program is suitable depends on whether the assessment tasks are relevant to the aims and intended learning outcomes for the course, taking into consideration the attitudes and skills that are to be tested. While equivalence seems impossible for paper-based test and computer-based test, the importance of any difference appears to be specific to the task and required outcomes [1].

Though the computer-based and paper-based test versions were identically worded and both allowed the students to review and change their responses, there are differences between the two[6].Such difference in students' performance arising from different test delivery modes is called "Test Mode Effect". The test mode effect produces a statistically significant difference in students' performance in favor of technology-based assessment [7]. It has been observed that in many studies, researchers have often assessed incorrect ideas, usually searching for improvements in the conventional practices as substitute of new reasoning and new concepts which might emerge from computer technology use. Transition from conventional teaching/assessment methods to computer-based methods must be welcomed as one can no longer deny that technology use is pervasive among the present generation of learners.

Literaturethat serves as a point of reference of this studyincludes principle regarding Computerized Adaptive Testing (CAT) whose evaluation frameworks can be categorized into 3 dimensions: Educational, Technical and Economical. CAT is a special case of Computer-Based Assessment or Testingthat assesses the level of a student's knowledge, proficiency, ability or performance using questions tailored specifically to each student. The system selects questions from a pool of pre-calibrated items appropriate for the level of a student offers two major benefits: higher efficiency and increased student motivation due to higher levels of interaction-it can estimate the student's level in a shorter time than any other testing method. CAT is based on either Item Response Theory (IRT) or Decision Theory.When examinees are allowed to use this process, students are more likely to decrease their anxiety and improve their scores[8]. The above-mentioned theories show that CAT has the potential to offer a more consistent and accurate measurement of examinee's abilities compared to traditional Paper-Based test.

Another essential characteristic that might affect students' performance with regard to CBA is computer attitude. There is no doubt that the examinee is highly influenced by his/her attitude or preference towards the test or the test mode. Some people are not familiar with technology and cannot keep pace with its rapid development and thus they prefer not to tackle or deal with any form of technology. They are also unwilling to apply it to their academic or social lives [9].Test anxiety is not the only emotion reported to affect test takers. Motivation levels also affect achievement and hasbeen found to be related to the respondents' ability level. Motivational differences can be attributed to

having immediate knowledge of test results, which may result in greater standardization of the test-taking environment in a computer-adaptive test mode than with traditional paper and pencil testing environments[10]. Test takers' characteristics, i.e., computer familiarity, computer attitude, testing mode preference and test taking strategies influencing students' performance on computer-based tests, and in comparison with paper-based tests found no significant difference between each testing mode and none of the factors examined had an influence on students' performance[9].

Conclusions from previous researches are not consistent regarding the effects of using computers in the classroom for testing on various aspects of the learning environment, which may also include student anxiety, teacher attitudes, student achievement and more. Consequently, it is significantly important to assess how Computer-Based Assessment (CBA) and Paper-Based Assessment (PBA) differ in terms of their effects on students' achievement how the CBA mode of assessment affects the learning attitudes of the students.
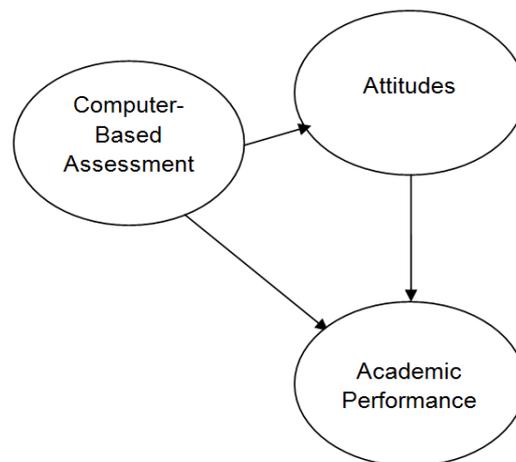
Conceptual Model

Fig. 1. Effect of CBA on Student's Performance and Attitude

Matters pertaining to equivalence among different test delivery modes are believed to be relevant in instruction. It has been shown that the test mode delivery has no significant effect on the reliability and validity of assessment, and PBA and CBA may be viewed as equivalent [9]. To further establish that CBA has a significant effect on students' performance and attitude, the above model was devised. Fig. 1 shows that the use of CBA has a significant impact on the student's performance and attitude towards learning. Likewise, it is also shown in the figure that computer attitude in terms of computer use and learning has a potential impact on students' performance.

Research Questions

1. What are the students' attitudes on the utilization of Computer-Based Assessment in terms of the following variables:
    1.1 computer use, and
    1.2 on-line learning and practice?
2. What is the difference between the academic performances of the group of students who used the Computer-Based Assessment and the group who used the PBA-Based Assessment?
3. What is the significant relationship between the attitude and academic performance of the students who used of the Computer-Based Assessment?

Significance of the Study

The goal of this study is to bring new evidences regarding the effects of CBA on students' performance and attitudes. The findings may lead to a learning mode that can be utilized by the education sector not only at the tertiary level but also in the secondary level as well, so as to enhance the knowledge of the learners and assist the teachers in test construction, test evaluation, and getting immediate, accurate, and detailed feedback resulting from the assessment. The learning environment has become more technical, requiring more technology-based delivery modes of teaching and assessment. Thus, educators are encouraged to find new strategies to better harness and take advantage of the technological developments towards the advancement of the educational system. This study may

also serve as justification for the shift to a technology-based learning management system which policy-makers can use. There has been a dramatic increase in technology-based communication and multi-media use for entertainment for the last decade or so. However, such magnitude of utilization of technology cannot be seen in the educational sector in this country. The time is ripe and it is just a matter of time before the educational system extensively adopts the use of computers in all aspects of learning. The need to better understand the impact of extensive technology use in delivering education is very much evident and greatly requires more research.

METHODOLOGY

Research Design

The study made use of the quasi-experimental design, specifically, the pretest-posttest nonequivalent control group design. The pre-test and posttest scores were used to evaluate the impact of the Computer-Based Assessment on the performance of the students. Quasi-experimental research involves the use of intact-groups of subject in an experiment, rather than assigning subjects at random to experimental treatments. The descriptive research method was utilized in the assessment of the respondents towards the perceived attitudes of the examinees on CBA in terms of ease of use and learning.

Samples

The respondents were students from the College of Engineering of Rizal Technological University who are enrolled in physics classes. The samples consisted of 86 first year students from the Bachelor of Science in Electrical Engineering (BSEE), Bachelor of Science in Electronics Communication Engineering (BSECE) and Bachelor of Science in Civil Engineering (BSCE) from the College of Engineering and Industrial Technology (CEIT) - 43 BSEE and BSCE students for the control group and the other 43 BSECE and BSCE students as the experimental group. The samples were matched according to their sex, age, entry exam, time of classes, and assigned teacher. The groups were chosen because of their know-how in the use of computers, which was the major tool used in this study.

Instruments

The data were collected using the researchers made Physics Achievement Test, Attitude Survey, and the EDMODO SNS. The Physics Achievement Test (PAT) was employed to measure the achievements of students in terms of their knowledge regarding the topics on work and energy for both linear and angular motion. PAT, which includes 30 multiple-choice questions, was prepared taking into account the Bloom's taxonomy skills. The second instrument employed was the attitude survey questionnaire which was designed based from the literatures obtained regarding the possible effects of the utilization of the computer based assessment on students' attitudes towards ease of use and learning. This questionnaire was validated and pilot-tested to a group of students who had similar characteristics to that of the sample so as to improve the clarity of the items presented. The third instrument used was the EDMODO, a social networking site catered especially for teaching and learning. EDMODO is a free and safe learning program designed by Jeff O' Hara and Nick Borg in 2008 for teachers, students, parents, schools, and is available at www.edmodo.com[11].

Data Collection

Measurement of the effect of CBA has two parts: one taking into account its effect on student performance in major exams, and the other the students' assessment on their attitudes towards CBA use.For the assessment involving student performance, pre-tests were given to the two groups at the start of the lesson. In terms of the EDMODO, workshops were held for the experimental group in order to create accounts and explain the main features of the website. This was followed by testing sessions wherein the group took their quizzes on the said website before the administrations of the achievement test. A daily interaction between the groups and their teacher via the traditional method of teaching was done through: lessons, posting assignments, PBA as well as via EDMODO quizzes, and feedback for three weeks. On the fourth week, the control group was given the PBA assessment while the experimental group was given the computer based assessment using the EDMODO website. The following session the said group was requested to answer a questionnaire that intended to determine how they feel about their experience in using a computer based assessment.

Data Analysis

Weighted Mean was utilized to obtain the assessment of their attitudes towards CBA use in terms of ease of use and learning. Achievement test results of the experimental and control groups from the two modes of assessment were statistically processed using the t-test for independent sample means to test the hypothesis of no significant difference at the 0.05 level of significance between them. Pearson-r was utilized to assess the correlation between attitudes on the ease of use and learning and that of the students' performance.

RESULTS AND DISCUSSIONS

Difference in the Pretest Scores of the Students Using CBA and PBA

Table 1. Difference on the Pretest Mean Scores

Test	Test Mode				Computed t-value	Critical t-value	p-value	Interpretation
	With CBA		With PBA					
	$\overline{x}$	SD	$\overline{x}$	SD				
Pre-test	16.44	4.71	16.05	2.47	-0.68	1.98	0.50	*NS

*NS= not significant at α = 0.05, if p-value > 0.05;** S = significant if p-value<0.05

Data from Table 1 confirm that the pretest mean scores of the students with the CBA and PBA yield a difference of 0.39. The students exposed to the CBA is more heterogeneous in nature as shown by its standard deviation of 2.47. The computed t-value of -0.68 < critical t-value of 1.98 implies that the pretest scores of the two groups do not significantly differ. The results could be due to the method utilized in controlling variables such as age, sex, and university admission test. It is generally accepted that assessment or testing determines the magnitude to which educational objectives have been achieved as well as the extent to which educational institutions have served the needs of the community and society [12].

Difference in the Posttest Scores of the Students Using CBA and PBA

Table 2. Difference in the Posttest Mean Scores

Test	Test Mode				Computed t-value	Critical t-value	p-value	Interpretation
	With CBA		With PBA					
	$\overline{x}$	SD	$\overline{x}$	SD				
Post-test	23.98	10.02	21.12	4.77	-4.87	1.99	5.9E-06	** S

*NS= not significant at α = 0.05, if p-value > 0.05;** S = significant if p-value<0.05

To justify the effectiveness of the CBA in enhancing the performance of the experimental group in physics, the difference in the pretest and posttest scores of the experimental and control groups were considered. The posttest mean score of $\overline{X}$ = 23.9 for the students with CBA and X= 21. 1 for the students with PBA yield a difference of 6.34. Based on these data, it can be seen that the mean of every paper test is close to its computer counterpart. However, the t-test analysis proved that these differences are significant as shown in the computed t-value of -4.87 > the tabular t-value of 1.99 which implies a better performance in favor of the CBA to that of the PBA. These findings support the idea that learning could be reinforced on the basic science principles and concepts with the use of CBA. The results of the study affirmed that students using the CBA outperformed the students using the PBA. It was articulated that CBA provides scaffolding or instructional support that would help students learn [7].The students taught with computer-based instruction performed better than those taught with conventional lecture method [13]. There is a significant difference between the two testing modes-the Computer-Based Assessment and the Paper-Based Assessment[9]. With these findings, obviously, the use of CBA can be considered a good resource material that forms the basis for the so called pedagogical content knowledge that facilitates learning. On the contrary, it has been found that no significant difference existed in the test scores using the two test delivery modes[14,15].

Assessment on Attitudes towards Ease of Use of CBA

Table 3 summarizes the results of the assessment of the students on their perceived attitude towards ease of use with the CBA. It is clearly evident that the students preferred to use the CBA because of its easy feedback. The majority of the studentslooks positively at the CBA test delivery mode with a general weighted mean of 4.09. Seemingly, the respondents have less anxiety in using the

computer; they were not intimidated or fearful in its use; in other words, they were confident and at-ease while in the process of taking the computer-based examination. However, there were few who felt uneasy in the CBA, but these were outperformed by the majority. The respondents' strong agreement on CBA use may be attributed to the following test characteristics: computer familiarity, simple setting and configuration, getting feedbacks easily. Findings affirmed also the resultswherein participants were very positive about computer-based testing because it seemed less difficult, more useful and engaged their attention more than paper-based testing[9,10]. The participants positively evaluate also the use of computer-based assessment because of their exposure to CBA, which is justified by the result of this study and other studies as well. Students and teachers as well look at the idea of adapting the use of the Computer-Based Assessment. This is manifested in the results students got from their test scores. The results of the study pointed to the idea of the positive acceptance of the respondents on the use of the Computer-Based Assessment.

Table 3.Attitude of Students towards Ease of Use with CBA

Item A	Weighted Mean	Verbal Interpretation
1. I have less anxiety in taking computer based tests than paper and pencil tests.	4.12	A
2. I like to take CBA because I get instant feedback on my scores.	4.51	SA
3. I would rather answer questions on a computer than in a test paper.	3.96	A
4. The questions presented in the computer examination make me feel at ease.	2.96	MA
5. I have a positive attitude towards computer based assessment because it is comprehensive	3.86	A
6. The use of computers in examinations is safe for the health of the students	3.54	A
7. Computer tests make me feel comfortable because I can understand them.	4.14	A
8. Computer aided assessments encourage me because they seem so simple.	3.67	A
9. Procedures in computer-based assessment are interesting because they are easy to learn.	3.78	A
10. I gladly use computer-based assessment for I feel confident that I can correct the errors I make.	3.86	A
11. I prefer on using a computer test because it has a direct approach towards instruction..	3.67	A
12. I feel confident about my ability to answer a computer-based assessment.	3.67	A
13. I readily use computers in the test because some programs are user- friendly.	3.73	A
14. I use computer-based assessment because it is familiar to me.	4.12	A
15. I feel at ease using computer- based assessment because I understand its computer settings and configurations.	4.32	A
General Weighted Mean	**4.09**	**A**

Assessment on Attitudes towards Learning with CBA

Table 4 displays the attitudinal responses of the students regarding the effects of CBA towards their learning. A considerable number of respondents have positive attitude on the use computer-based assessment. They strongly agreed that computer based exams with immediate scoring help improve their understanding, make them acquire new information and things, thus, improving their

performance. A good majority also agreed that the use of this on-line technology makes learning more enjoyable, stimulating, and interesting leading to the development of their skills and competencies.

Table 4.Attitude of Students towards Learning with CBA

Item B	Weighted Mean	Verbal Interpretation
1. .Computer based exams with immediate scoring help me evaluate my own understanding and performance.	4.56	SA
2. Computer based assessments support my daily learning tasks.	4.33	A
3. Computer tests give me opportunities to learn many new things such as finding information about the new lesson.	4.51	SA
4. Working with a computer during exams makes my learning process more enjoyable and stimulating.	4.49	A
5. I developed a positive attitude toward technology use when taking the test on a computer.	4.53	SA
6. I appreciate computer web- based assessment because I learn something from it.	4.47	A
7. Innovative and sophisticated item formats, immediate feedback, and advance security encourage me to learn	4.47	A
8. Computer aided assessment is helpful to provide intensive and detailed feedback on how to solve a problem.	4.28	A
9 I benefit from using computer tests in learning since I have computer access at home.	4.02	A
10 Computer tests increase my achievement scores since I can ask questions from the internet.	4.07	A
11. Using the computer-based assessment increases my understanding of the complex parts of the lessons.	4.23	A
12. I gain more confidence once provided with opportunities for multiple practices and receiving immediate feedback for improvement.	4.30	A
13 I found enjoyment in using the computer based testing thus focusing my attention on learning more about the lessons at hand.	3.47	MA
14. In using a computer based assessment tool, teachers can integrate the different content areas of the lessons thus, developing my' competence.	3.67	MA
15 In computer-aided assessment, the use of online technology helps me learn and succeed..	3.63	MA
General Weighted Mean	**4.20**	**A**

The results of the study points to the idea that the students have a positive attitude toward technology usage within an academic setting[16]. In the same vein, it was found out that many examinees positively preferred CBT for several reasons such as time efficiency, focusing attention, enjoyment and confidence[9].This implies that test mode of using computer and interrelated technologies provides a relevant instrument that meet the new challenges of designing and implementing assessment methods that go beyond the conventional practice. This would ensure facilitated learning among learners thus, improving their cognitive skills and knowledge.

Relationship of Computer Attitude on Use of CBA with Performance

Table 5.Significant Relationship on Use of CBA and Performance

		Mean of CBA
	Pearson Correlation	3.21E-09**
Computer Attitude Scale	Significant at 2-tailed	0.0000
	N	43

*NS= not significant at α = 0.05, if p-value > 0.05;** S = significant if p-value<0.05

Table 5 shows the correlations of attitude on the use of computer tests with performance. The value of Pearson r = 0.1176, though low, indicates that there is a positive correlation between attitude to use of CBA and performance. Furthermore, the results indicate that there is a significant correlation between attitude to use of computer tests with performance as shown in the p-value = 0. 3.21E-09taken atthe 0.05 level of significance. The overall correlation favored the computer-based tests. There existed a comparison of paper and computer-based testing, it was observed that test takers' characteristic of computer liking is significantly correlated to the computer based score of the students[9]. Meaning, feelings of test anxiety, higher or lower test-taker motivation, and impartiality in computer experience, all have consequences when considering inferences made from computerized-based test scores and should be sensibly weighed when developing computerized-basedtests.This could be explained by the fact that little research has been carried out in the area of the relationship between the computer familiarity of test-taker and their performance on computer-based testing.

Relationship of Computer Attitude on Learning with CBA on Performance

Table 6. Significant Relationship Between Learning with CBA and Perfromance

		Mean of CBA
	Pearson Correlation	0.1931**
Computer Attitude Scale	Significant at 2-tailed	0.0000
	N	43

*NS= not significant at α = 0.05, if p-value > 0.05;** S = significant if p-value<0.05

From Table 6, it can be seen that there is a low correlation between computer attitude on learning CBA, which is the interest of the student, and the other variable the performance. However, the correlation is significant as seen in the value of p=0. 000 derived at 0.05 level of significance. Data confirms the result that there is significant correlation between computer liking and computer-based scores. Accordingly, learner characteristics associated with higher, faster performance for the web-based group (relative to the traditional group) included learner ability, computer familiarity, and non-competitiveness. The results of the study could be explained by the fact that examinee found enjoyment in the convenience of computer-based-assessment over PBA. Students found to have a positive attitude toward technology usage within an academic setting [16]. While other studies have reported that students prefer computer-based assessments over PBA tests. It should be noted in several studies that correlations between enjoyment of computer-based tests and achievement have been found to be weak. In other words, students' preference for taking tests on computers does not necessarily translate into higher test scores[17].There is less research assessing the attitude of the students to a computer-based test in order to determine performance in an academic setting [18].

CONCLUSIONS

The study concluded that the two groups got low achievement with a very marginal difference on the pretest results. Both the experimental and control groups show an increase in their post test scores when compared to the pretest. Moreover, it is concluded that the use of CBA increases the performance of the participants in the study as compared to the PBA test. In addition, when evaluated on the perceived attitude on the use of the computer, they look positively at the CBA test delivery mode. They were confident and at ease. Accordingly, learner characteristics associated with a performance for the Computer-Based group relative to the traditional group include learner ability and computer familiarity. The learning environment has become more technical, requiring more technology-based delivery modes of teaching and assessment. Thus, educators are encouraged to find new strategies to better harness and take advantage of the technological developments towards the advancement of the educational system.

RECOMMENDATIONS

Introducing the Computer-Based Assessment is one way of orienting the students to our fast developing and advancing technological world. In line with this, the University should continuously modernize the method of instruction by formulating policies towards the wider implementation of the automation of the results of the study. Likewise, teachers should be encouraged to develop and use Computer-Based Assessment in instructions in order to provide alternative and challenging test

delivery modes for their learners. Thus, there should be in-service seminars and training of teachers on the development and usage of Computer-Based Assessment in teaching their subjects.

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