ACCEPTABILITY OF COMPUTER BASED TESTING (CBT) MODE FOR UNDERGRADUATE COURSES IN COMPUTER SCIENCE

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Abstract
Assessment has been identified to be an important component of learning process in a formal education. The method of evaluating the learners goes a long way in determining the quality of the products. With the growing population of students in most Nigerian Universities, there is need for an automatic means of assessment. CBT approach is believed to offer such automatic evaluation. The arguments on its applicability in some courses call for this research effort to investigate its adoption in this domain based on a survey study underpinned by the modified Technology Acceptance Model (TAM) as the research framework. In this paper, the factors that can predict adoption of CBT examination mode for undergraduates courses in the department of Computer Science, University of Ilorin is investigated in a survey study involving 222 students. The three dimensions used in the study Perceived Ease Of Use (PEOU), Perceived Usefulness (PU) and Perceived Fairness (PF) all predict the adoption and thereby recommended to be considered in adoption study of this nature.

Keywords: Assessment, Computer based testing, Automatic evaluation, Technology acceptance model

Background of the Study
Globally, universities are increasingly adopting computer based testing (CBT) to replace the traditional paper and pen testing for academic assessment of students (Best, 2002; Ricketts & Wilks, 2002; Bampton, 2004; Walker & Delious, 2004; Gavin, Janet & Phil,2006; Bertolo & Lambert, 2007; McLaughlin, Kerr & Howie, 2007; Sieber & Young, 2008). The rapid adoption is due to the numerous advantages the schools derived from CBT over the traditional paper and pen testing considering the large population of students. Some of the advantages include: increased delivery, administration and scoring efficiency, improved test security, consistency and reliability, faster response rate to mention a few (Riku, Laurif & Ari, 2001;Wilks, 2002; Delious, 2004). This development calls for periodic evaluation of factors that determine students' acceptability of this new mode of assessment in order to ensure its fairness to students. As primary users of CBT, students' opinions are also needed on CBT systems to enable examiners and developers know areas requiring improvement from the user's perspective.

This paper presents the results of the research conducted to investigate factors that determine students' acceptance of CBT among computer science students using modified Technology Acceptance Model.

Literature Review
Some researchers have conducted evaluation of students' acceptance of CBT in Computer Science and other subject areas (Riku et al., 2001;Wilks, 2002; Delious, 2004). Many of the researches

earlier carried out on CBT system measured factors responsible for students' acceptance such as intention to use, perceived ease of use and perceived usefulness of system of CBT systems, but did not specifically make use of standardized model e.g Technology Acceptance Model (TAM) to measure students' usage and acceptance. Only two researches so far made use Technology Acceptance Model (TAM) to measure factors that determine students' acceptance of CBT systems.

Students' Acceptability of CBT System in Computer Science (No Use of TAM)

Riku et al. (2001) developed a CBA system, Scheme Robot to automatically assess programming exercises of high number of students in Computer Science. The authors measured students' attitude, ease of use and fairness of the system. It was concluded that there was general acceptance of the CBT system used, but the students requested for improvement on the feedback. Daly and Waldron (2002) used RoboProf CBT systems to examine the factors that enable computer science students to pass the programming exams despite low level skill in problem solving abilities. The authors found out that the students acceptance dependeds on their performance in their exams. Those that passed like the CBT systems used while those that failed did not like it. The study measured students' attitude towards the system, usefulness and fairness, but did not measure ease of use. Farrell and Leung (2004) did a comparison of two student cohorts utilizing blackboard CBT with different assessment content in Database and Data Communication aspects of computer science. Their findings showed that majority of students appreciated the CBT systems used, but they complained about design of the software. Doolan and Barker (2005) did an evaluation of computing students performance using Group Based Learning Online and Offline. They submitted that the students had a positive attitude towards the online system. The study only measured the students' attitude, but did not measure the other constructs such as usefulness, ease of use and fairness of the system.

Students' Acceptability of CBT System in other Subject Areas (No Use of TAM)

Beverly, Eric, Mike and Sid (2001) carried out a research on changing perceptions in Language Learning and Testing using Question Mark CBT Systems. The students found the CBA system used less stressful than traditional exams and also found it quite fun. Ricketts and Wilks (2001) investigated if the CBT system was good for students with teaching of numeracy and statistics to first year Biology students. The authors discovered that students' performance was poor when on-line assessment was used and students had difficulty in interacting with computer screen. Bacon (2003) also carried out an online assessment of a first year Data Handling Course within a Physics Degree Programme. The author revealed that few students found the system easy to use and majority of them perceived the marking unfair.

Other researchers with subject areas were Best (2002) – Diagnostic Radiography; Ricketts and Wilks (2002) – Biology, Geography, Business and Computing; Bampton (2004) – Law; Walker and Delious (2004) – Mathematics; Bertolo and Lambert (2007) – Chemistry; McLaughlin, Kerr and Howie (2007) – English Language; and Sieber and Young (2008) – Medical Sciences. The reviews carried out on previous studies showed that none of these studies made use of Technology Acceptance Model or any other standardized models of measuring user's acceptance of Information Technology. This motivates the interest of the researchers to fill this gap.

Students' Acceptance of CBT System using Technology Acceptance Model (TAM)

The need for having a standard model for predicting systems use came as a result of increasing failure of system adoption in organizations (Mohammed, 2009). In order to address this problem, Davis (1989) proposed Technology Acceptance Model in his doctoral thesis as a model to predict user acceptance of information systems. TAM posited that two particular beliefs, Perceived Usefulness (U) and Perceived Ease of Use (E) are of primary relevance for computer acceptance behaviors.

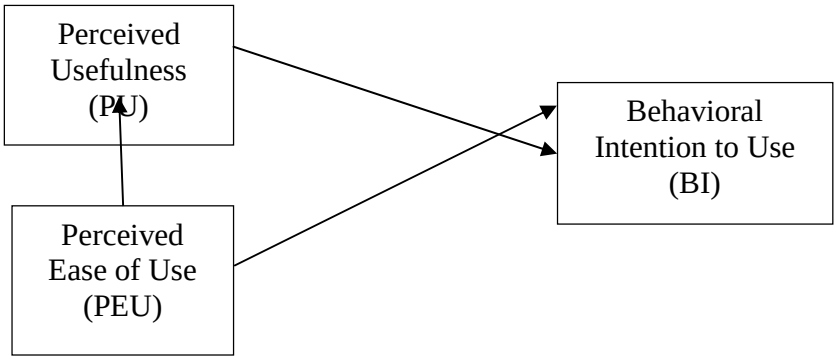

Figure 1: Technology Acceptance Model (TAM): Davis (1989)

Davis (1989) first applied Technology Acceptance Model to validate the use of E-mail among the employees working for IBM in Toronto, Canada. The results showed that usage of the E-mail systems at IBM was significantly correlated with PEOU and PU.

The findings of a meta-analysis of 145 articles published on TAM showed that TAM had been widely used for many Information systems such as Email, voicemail, fax, dial-up system, e-commerce application, groupware, word processor, spreadsheet, presentation software, database program, case tools, hospital IS, Decision support system, Expert support system, and telemedicine technology (Terzis & Vasileios, 2011). Nurcan (2010), in his master thesis identified factors that affect students' acceptance of web-based assessment tools within the context of higher education. In addition to the original three constructs of TAM (intention, perceived ease of use and perceived usefulness) to this research model are computer attitude and anxiety. He submitted that perceived usefulness was the most important determining factor in students' willingness to use CBT systems.

Terzis and Vasileios (2011) carried out the second research on the use of TAM for determining students' acceptance of CBT. The researchers also extended TAM with new variables; Content and Goal Expectancy in addition to constructs from previous models. The authors concluded that Perceived Ease of Use and Perceived Playfulness have a direct effect on CBA use while Perceived Usefulness, Computer Self Efficacy, Social Influence, Facilitating Conditions, Content and Goal Expectancy have only indirect effects.

However, this current study also made use of Technology Acceptance Model (TAM) to determine the CBT acceptance among the computer science students, but extended to include one new construct i.e Perceived Fairness. The total constructs used in the proposed model are four (Perceived Usefulness, Perceived Ease of Use, Perceived Fairness and Behavioral Intention).

Formulation of Research Model and Hypotheses

Based on existing literature, the applicability of Technology Acceptance Model can be verified with a series of hypotheses developed as follow. Variables involved include the original constructs of Davis (1989) i.e. PU, PEOU & BI. In addition, the model was extended with additional one new construct (Perceived Fairness, PF). Figure 2 shows the research model employed to formulate the research hypotheses.

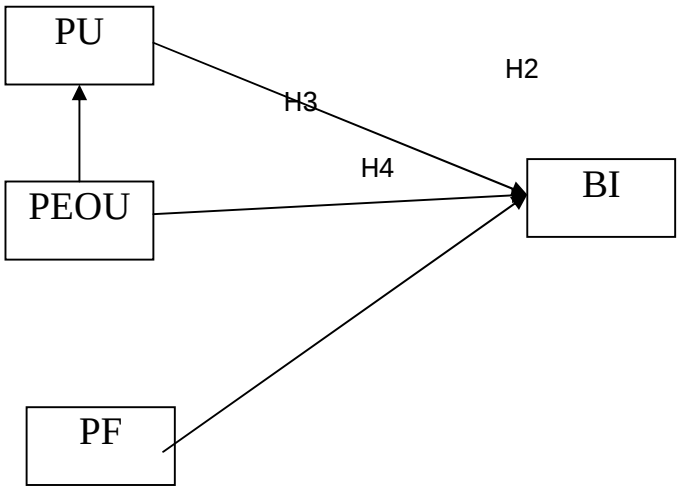

Figure 2: Research Hypothesized Model

Based on figure 2, four alternative hypotheses were developed:

Ho_1: Perceived Ease of Use (PEOU) of CBT will positively influence Perceived Usefulness (PU).
Ho_2: Perceived Usefulness (PU) of CBT will positively influence Behavioral Intention (BI).
Ho_3: Perceived Ease of Use (PEU) of CBT will positively influence Behavioral Intention (BI)
Ho_4: Perceived Fairness (PF) of CBT will positively influence Behavioral Intention (BI).

Methodology

This research was carried out among the undergraduate computer science students of University of Ilorin, Nigeria using quantitative approach. Survey questionnaires (developed based on the research model) were administered to a sample of 222 students using stratified random sampling technique. The returned questionnaires were 210 which indicates a response rate of about 98%. Data analysis was done quantitatively using various tools of PSPP 0.7.9 (an open source alternative to SPSS).

Results and Discussion

Regression Analysis

Simple Regression analysis was chosen for hypotheses testing and analyzing how independent variables can be used to predict a dependent linear regression variable based on the correlation between the variables. The table 1 below contains the summary of the analysis findings.

Table 1: Result of hypothesis testing

Hypothesis Number	Independent Variable	Dependent Variable	Findings
Ho_1	Perceived Ease of Use	Perceived Usefulness	R^2 = 0.23 i.e. 23% of the variance in PU is explained by PEOU Standard coefficients beta value 0.48 was obtained with (sig < 0.05)

Ho_2	Perceived Usefulness	Behavioral Intention	R^2 = 0.30 i.e. 30% of the variance in BI is explained by PU Standard coefficients beta value 0.55 was obtained with (sig < 0.05)
Ho_3	Perceived Ease of Use	Behavioral Intention	R^2 = 0.10 i.e. 10% of the variance in BI is explained by PEOU Standard coefficients beta value 0.31 was obtained with (sig < 0.05)
Ho_4	Perceived Fairness	Behavioral Intention	R^2 = 0.130 i.e. 13% of the variance in BI is explained by PF Standard coefficients beta value 0.36 was obtained with (sig < 0.05)

Cconclusion

Testing of the formulated hypotheses gave rise to some findings. Conclusions drawn on the findings are hereby presented as follows:

Hypothesis One: Perceived Ease of Use (PEOU) of CBT will positively influence Perceived Usefulness (PU).

Findings: R^2 = 0.23 i.e. 23% of the variance in PU is explained by PEOU
Standardized Coefficients Beta Value = 0.48 (sig < 0.05)

Conclusion: There is sufficient evidence to support the claim that the PEOU of CBT among the undergraduate computer science students, University of Ilorin, Nigeria directly influences PU significantly.

Hypothesis Two: Perceived Usefulness (PU) of CBT will positively influence Behavioral Intention (BI).

Findings: R^2 = 0.30 i.e. 30% of the variance in BI is explained by PU
Standardized Coefficients Beta Value = 0.55 (sig < 0.05)

Conclusion: There is sufficient evidence to support the claim that the PU of CBT systems directly influences BI significantly.

Hypothesis Three: Perceived Ease of Use (PEOU) of CBT will positively influence Behavioral Intention (BI)

Findings: R^2 = 0.10 i.e. 10% of the variance in BI is explained by PEOU
Standardized Coefficients Beta Value = 0.31 (sig < 0.05)

Conclusion: There is sufficient evidence to support the claim that the PEOU of CBT systems directly inflences the BI significantly.

Hypothesis Four: Perceived Fairness (PF) of CBT will positively influence Behavioral Intention (BI).

Findings: R^2 = 0.13 i.e. 13% of the variance in BI is explained by PF
Standardized Coefficients Beta Value = 0.36 (sig < 0.05)

Conclusion: There is a sufficent evidence to support the claim that PF of CBT systems directly influences the BI.

Discussion of Findings

The main findings of the research are (i) PEOU of CBT positively influences its PU and (ii) PEOU, PU and PF of CBT systems have statistical significant effect on Behavioral Intention of students to accept the CBT systems.

Finding 1 supported the first hypothesis that PEOU of CBT systems will positively influence its PU. This means that students believe that a well designed CBT interface (user friendly) informs the CBT usefulness as well. For instance, students' ability to view questions clearly on screen and easy navigation influence students' positive perception of the CBT usefulness. This finding underscores the negative effect a badly designed CBT interface could have on students as confirmed in studies conducted by Ricketts and Wilks (2001) and Farrell and Leung (2004). The finding replicates a similar finding in a study on students' acceptance of e-assessment conducted by Nurcan (2010) and also in conformity with the original TAM study by Davies (1989).

Finding 2 supported the second hypothesis that PU of CBT systems will positively influence students' Behavioral Intention to use it. This finding means that students' acceptability of CBT system is based on its perceived usefulness to students. This could be interpreted that the students found the CBT systems better in writing their exams than the traditional paper and pen testing. This finding also replicates the findings of Beverly et al. (2001), Walker and Delicious (2004) and Sieber and Young (2008). The finding replicates Davis (1989) study as well.

Finding 3 supported the third hypothesis that PEOU of CBT systems will positively influence students' Behavioral Intention to use it. This finding again re-emphasizes the importance of a friendly CBT designed interface to students acceptance. Like other information systems users, students readily accept a CBT systems that is easy to learn and use. The finding replicates findings of Ricketts and Wilks (2001) which established that CBT could be acceptable to students when a friendly interface is used.

Finding 4 supported the fourth hypothesis that PF of CBT systems will positively influence students' acceptance of CBT system. This means students' acceptance of CBT system is also influenced by their perception of CBT to being fair to them. The students' performance in their exams determine their remark on the fairness of CBT. The frequency descriptive analysis did on questionnaire question “CBT enables me to get a better score.” revealed that majority of students agreed that they scored better. Those students that perform well are likely to adjudge CBT to being fair, whereas those that do not score well are likely to see CBT as being unfair to them. This finding replicates the finding of a study conducted by Daly and Waldron (2002) that students who did better in exam liked CBT more.

There have been series of studies to examine the established relationships in other various domains. However, such research efforts is still scanty in this domain of study (CBT Systems). Many more studies in this domain using other subjects and traits are required to further validate the result. It should be noted that usage of the CBT system in this study is a mandatory setting as it is compulsory for all students to write exams (summative) with CBT systems. More studies are encouraged in this domain with certain degree of voluntariness to use the CBT systems for formative tests since voluntariness has been identified to moderate predictive effect of PU and PEOU on BI (Chau & Hu, 2002; Venkantesh & Bala, 2008). Another gap identified with this study is the inability to assess the programming skills of students with CBT systems because the University is currently using Fixed Response CBT systems (multiple choice). Future studies should encourage the use of

Free Response type CBT systems suitable for assessing programming skills. The final result is summarized in Table 2 and depicted in Figure 3.

Table 2: Summary of research findings

Hypothesis	R^2	Standardized Beta Coefficient @ Sig. < 0.05	Remark
H1: PEOU ⇒ PU	0.230	0.48 @ Sig. < 0.05	Accepted
H2: PU ⇒ BI	0.30	0.55 @ Sig. < 0.05	Accepted
H3: PEOU ⇒ BI	0.10	0.31 @ Sig. < 0.05	Accepted
H4: PF ⇒ BI	0.13	0.36 @ Sig.< 0.05	Accepted

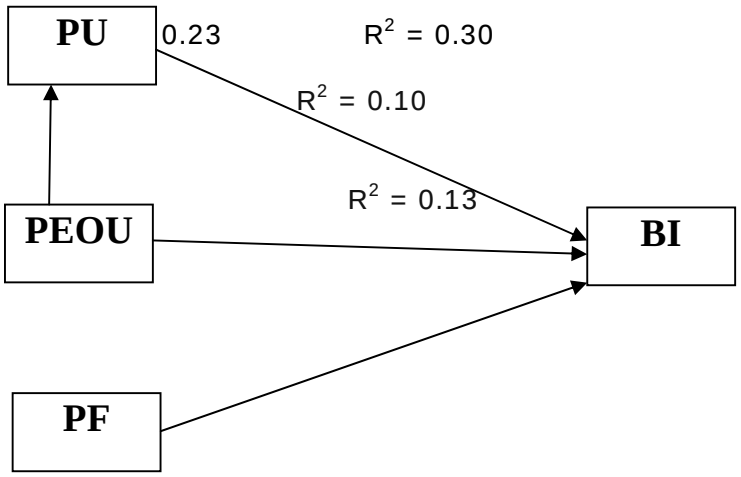

Figure 3: Final Research Model

Recommendations

The findings of the study inform the following recommendations:

(i) PEOU has been found to have postive significant effect on both the PU of CBT systems and BI of students, the university authority should therefore put in more efforts to ensure that the CBT systems interface is more user friendly and easy to learn by the students.

(ii) PU of the system should be evaluated on regular basis as a feedback mechanism.

(iii) The University should endeavour to deploy a CBT system specifically for Computer Science Department to enable it assess students' programming skill which is a core aspect of Computer Science. CourseMarker CBT System is recommended.

(iv) All necessary infrastructural support that can facilitate interesting usage experience of the systems should be provided so as to keep PEOU at its maximum.

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