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The acceptance and use of computer based assessment

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ABSTRACT

The effective development of a computer based assessment (CBA) depends on students' acceptance. The purpose of this study is to build a model that demonstrates the constructs that affect students' behavioral intention to use a CBA. The proposed model, Computer Based Assessment Acceptance Model (CBAAM) is based on previous models of technology acceptance such as Technology Acceptance Model (TAM), Theory of Planned Behavior (TPB), and the Unified Theory of Acceptance and Usage of Technology (UTAUT). Constructs from previous models were used such as Perceived Usefulness, Perceived Ease of Use, Computer Self Efficacy, Social Influence, Facilitating Conditions and Perceived Playfulness. Additionally, two new variables, Content and Goal Expectancy, were added to the proposed research model. Data were collected from 173 participants in an introductory informatics course using a survey questionnaire. Partial Least Squares (PLS) was used to test the measurement and the structural model. Results indicate that Perceived Ease of Use and Perceived Playfulness have a direct effect on CBA use. Perceived Usefulness, Computer Self Efficacy, Social Influence, Facilitating Conditions, Content and Goal Expectancy have only indirect effects. These eight variables explain approximately 50% of the variance of Behavioural Intention.

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1. Introduction

Assessment is a very important supplementary of the educational process because it measures the students' learning (e.g. Joosten-ten Brinke, van Bruggen, Hermans, Burgers, Giesbers, Koper et al., 2007). Examples of new types of assessment are portfolio assessment, performance assessment, self-assessment and peer assessment (e.g. Peat & Franklin, 2002). Self-assessment in an educational setting involves students making judgments about their own work. Students can make assessment decisions regarding their own essays, reports, projects, presentations, performances, dissertations and even exams. Self-assessment can be extremely valuable in helping students critique their own work and form judgments about its strengths and weaknesses (Kaklauskas, Zavadskas, Pruskus, Vlasenko, Seniut, G. Kaklauskas et al., 2010). Recently, information and communication technology has been used in assessments. Computer based assessment (CBA) technologies have been proposed as a solution to mechanise the assessment process (Charman & Elmes, 1998; Chatzopoulou & Economides, 2010; Economides & Roupas, 2007; Triantafyllou, Georgiadou, & Economides, 2008). CBA offers enormous prospect for innovations in testing and assessment (e.g. Bennett, 1998) and it can be used in many different contexts. CBA can be categorized into formative and summative assessment. Summative assessments help to establish whether students have attained the goals set for them. Formative assessments provide prescriptive feedback to assist students in reaching their goals (Birenbaum, 1996; Economides, 2006, 2009; Moridis & Economides, 2009a).

In our days, CBA is very popular because it provides many advantages to the academics and practitioners like test security, cost and time reduction, speed of results, automatic record keeping for item analysis and distance learning (Bugbee, 1996; Drasgow & Olsen-Buchanan, 1999; Mazzeo & Harvey, 1988; Mead & Drasgow, 1993; Parshall, Spray, Kalohn, & Davey, 2002; Smith & Caputi, 2005; Thelwall, 2000; Tseng, Macleod, & Wright, 1997).

Previous studies show that students prefer the computerized than the written assessment. Students find the use of CBA more promising, credible, objective, fair, interesting, fun, fast and less difficult or stressful (Croft, Danson, Dawson, & Ward, 2001; Sambell, Sambell, & Sexton,

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1999). This paper tries to figure out which factors affect the students' acceptance and intention to use of CBA. Although there are previous studies on acceptance of learning management systems (LMS), there was not any previous study on acceptance of CBA. The next section describes the most related previous studies. After the literature review, the methodology and the results of the proposed research model are described. Finally, the results are discussed, along with some conclusions and future research.

2. Literature review

Learning systems acceptance models were based on previous research regarding information systems acceptance. There are nine principal models in the field of IT acceptance. These models have been used in numerous previous studies. Each model tried to explain the determinants of IT acceptance and especially usage behavior. To continue, we describe each model and the variables that were proposed as the main ancestors of IT acceptance.

The first model was the theory of reasoned action (TRA) (Fishbein & Ajzen, 1975). TRA was ancestor of the IT acceptance models. Attitudes and subjective norms are the two major constructs in TRA. Based on TRA, the technology acceptance model (TAM) was developed to predict IT acceptance by using Perceived Usefulness and Perceived Ease of Use (Davis, 1989). TAM is the most popular model and it has been used in numerous studies regarding technology acceptance.

In parallel, the motivational model (MM) was employed by Davis, Bagozzi, and Warshaw (1992) using the constructs of Extrinsic Motivation and Intrinsic Motivation. Another important model was the theory of planned behaviour (TPB) (Ajzen, 1991). TPB is also based in TRA. TPB added the construct of Perceived Behavioural Control in TRA. TAM and TPB were combined in a hybrid model called the combined TAM and TPB (C-TAM-TPB) (Taylor & Todd, 1995). In 2000, TAM2 was suggested by adding the construct of Subjective Norm in the original TAM (Venkatesh & Davis, 2000). Other major models in the field of IT acceptance are the social cognitive theory (SCT) (Bandura, 1986; Compeau & Higgins, 1995), the model of PC utilisation (MPCU) (Thompson, Higgins, & Howell, 1991; Triandis, 1977) and the innovation diffusion theory (IDT) (Moore & Benbasat, 1991; Rogers, 2003). Finally, Venkatesh, Morris, Davis, & F.D. Davis (2003) proposed a unified model, called the unified theory of acceptance and use of technology (UTAUT), which uses constructs from the eight models mentioned above.

UTAUT explains that the core determinants of IT acceptance are four variables and the other four variables are moderators of the main relationships. UTAUT states that Performance Expectancy which is an extension of Usefulness from TAM, Effort Expectancy which is an extension of Ease of Use from TAM, Social Influence and Facilitating Conditions are determinants of Behavioural Intention or Use Behaviour, and that Gender, Age, Experience and Voluntariness of use have moderating effects on the acceptance of IT.

However, computerized learning systems are used by a specific user group. Thus, previous models cannot fully reflect e-learners' motives, requiring a search for additional intrinsic motivation factors (Ong, Lai, & Wang, 2004).

From the previous models many variables have been used to explain the acceptance and the intention to use an e-learning system (e.g. Ong et al., 2004; Teo, 2009). Perceived Usefulness and Perceived Ease of Use from TAM has been used in many studies regarding e-learning acceptance (e.g. Ong et al., 2004; Yi & Hwang, 2003). UTAUT has been also used to explain an e-learning system adoption (e.g. Wang, Wu, & Wang, 2009). Other researchers used only some variables like Facilitating Conditions or Social Influence in their proposed models (e.g. Teo, 2009). Moreover some studies added variables more relevant with the learning procedure. Wang et al. (2009) used Perceived Playfulness from Moon and Kim (2001) and Self-Management of Learning which is defined as the self-discipline and the ability in autonomous learning (Smith, Murphy, & Mahoney, 2003), in order to explain intention to use. Yi & Hwang, 2003 used Enjoyment which explains that using a computer system is perceived to be personally enjoyable in its own right aside from the instrumental value of the technology (Davis et al., 1992). Moreover, they introduced Learning Goal Orientation which was defined as the individual's approach to a task in order to understand something new or to enhance his/her level of competence, and Application Specific Self Efficacy (Yi & Hwang, 2003). Van Raaij and Schepers (2008) added Personal Innovativeness in the domain of IT, which is defined as the willingness of an individual to try out any new information technology (Agarwal & Prasad, 1999). Shih (2008) contributes to the IT acceptance literature with two variables: Personal Outcome Expectations, which is the outcome expectancy estimated by an individual regarding whether a particular behavior will result in requisite outcomes (Bandura, 1977); and Perceived Behavioral Control, which is the individual perceptions of his/her control over the Web-based system for learning (Shih, 2008). In addition, many researchers developed causal models to explain a learner's satisfaction (e.g. Sun, Tsai, Finger, Chen, & Yeh, 2008; Wang, 2003). Table 1 summarizes the constructs and the related causal links that we used from previous studies to develop our model.

Table 1
Summary of selected constructs & causal links.

Construct	Related causal links	Support evidence
Perceived Usefulness	PU → Intention to Use	Landry, Griffeth, & Hartman, 2006; Lee, 2008; Liao & Lu, 2008; Ong et al., 2004; Ong & Lai, 2006; Padilla-Melendez et al., 2008; Teo, 2009; Van Raaij & Schepers, 2008; Yi & Hwang, 2003
Perceived Ease of Use	PU → Attitude	Ngai, Poon, & Chan, 2007
	PEOU → Intention to Use	Landry et al., 2006; Lee, 2008; Ong et al., 2004; Ong & Lai, 2006; Padilla-Melendez et al., 2008; Teo, 2009; Van Raaij & Schepers, 2008; Yi & Hwang, 2003
Social Influence	PEOU → Attitude	Ngai et al., 2007
Perceived Playfulness	SI → Intention to Use	Van Raaij & Schepers, 2008; Wang et al., 2009
Self-management of learning	PP → Intention to Use	Wang et al., 2009
Computer Self-Efficacy	SMOL → Intention to Use	Wang et al., 2009
	CSE → Intention to Use	Padilla-Melendez et al., 2008
Facilitating conditions	CSE → PU, PEOU	Ong et al., 2004; Ong & Lai, 2006; Teo, 2009
	FC → Attitude	Teo, 2009; Teo, Lee, & Chai, 2008
Learning Goal Orientation	FC → Attitude	Yi & Hwang, 2003
Personal Outcome Expectations	LGO → E, ASSE	Shih, 2008
Content	POE → Intention to Use, Attitude	Shih, 2008
	Content → Satisfaction	Shee & Wang, 2008; Wang, 2003

Moreover, other previous studies suggested that e-learning adoption could be framed around three key factors: individual, system and organisational. Analysis of these factors suggests that each key factor could be further framed around sub factor groupings (Nanaykkara, 2007). Another study used six dimensions to assess the adoption's factors, including student dimension, instructor dimension, course dimension, technology dimension, design dimension, and environment dimension (Sun et al., 2008). Based on the literature review of the e-learning adoption and the CBA, this paper develops a causal model to explain the intention to use of a CBA (Fig. 1).

3. Research model and hypotheses

3.1. Perceived Playfulness

Perceived Playfulness (PP) was first introduced in an acceptance model as an intrinsic salient belief that is formed from the individual's subjective experience with the system (Moon & Kim, 2001). Moon and Kim based on the Csikszentmihalyi's (1975) and Deci and Ryan (1985) works extended TAM by adding the Perceived Playfulness. Perceived Playfulness is defined by three dimensions:

- Concentration: If the user is concentrated on the activity.
- Curiosity: If the user's cognitive curiosity is aroused (Malone, 1981a; 1981b).
- Enjoyment: If the user enjoys the interaction with the system.

These three dimensions are linked and interdependent, but they are not always observed together in practice. Thus each dimension does not reflect the total interaction. These three dimensions of Perceived Playfulness are very important factors for the successful implementation of a CBA. A CBA must hold the learner's concentration, curiosity and enjoyment at high levels. Thus, we believe that Perceived Playfulness will have a positive effect on the Behavioural Intention. Therefore we hypothesized:

H1: Perceived Playfulness will have a positive effect on the Behavioural Intention.

3.2. Perceived Usefulness

Perceived Usefulness (PU) is defined as the degree to which a person believes that using a particular system will enhance his/her job performance (Davis, 1989). Many researchers provide evidences of the effect of Perceived Usefulness on the Behavioural Intention to use a learning system (e.g. Lee, 2008; Ong & Lai, 2006; Van Raaij & Schepers, 2008). Likewise, learners may believe that a CBA system will improve their knowledge, comprehension and performance for the course. Moreover, if the CBA is useful for the learner then it will help to increase the learner's concentration, curiosity and probably enjoyment. So, we expect a positive effect of Perceived Usefulness on Perceived Playfulness. This link creates an indirect effect of Perceived Usefulness on the Behavioural Intention through the Perceived Playfulness. Therefore, we hypothesized:

H2: Perceived Usefulness will have a positive effect on the Behavioural Intention to use CBA.

H3: Perceived Usefulness will have a positive effect on Perceived Playfulness.

3.3. Perceived Ease of Use

Perceived Ease of Use (PEOU) is defined as the degree to which a person believes that using the system would be free of effort (Davis, 1989). Previous research has shown that the Perceived Ease of Use is expected to influence directly Perceived Usefulness and Behavioral Intention to Use (Agarwal & Prasad, 1999; Hu, Chau, Sheng, & Tam, 1999; Venkatesh, 1999; Venkatesh & Davis, 1996). Perceived Ease of Use

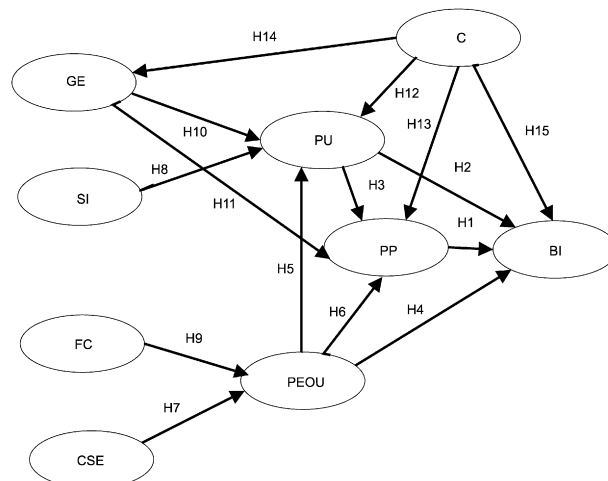


Fig. 1. Research model (CBAAM).

will enhance Perceived Playfulness, because ease of use provides a smooth use of the system without annoying disturbances. So, we expect a positive effect of Perceived Ease of Use on Perceived Playfulness. Furthermore, Perceived Ease of Use affects indirectly the Behavioural Intention to use, through its effect on Perceived Usefulness and on Perceived Playfulness.

H4: Perceived Ease of Use will have a positive effect on the Behavioural Intention to use CBA.

H5: Perceived Ease of Use will have a positive effect on Perceived Usefulness.

H6: Perceived Ease of Use will have a positive effect on Perceived Playfulness.

3.4. Computer self efficacy

Computer Self Efficacy (CSE) is defined as the individual's perceptions of his/her capacity to use computers (Compeau & Higgins, 1995). Previous results show that a causal link exists between Computer Self Efficacy and Perceived Ease of Use (Agarwal, Sambamurthy, & Stair, 2000; Padilla-Melendez, Garrido-Moreno, & Del Aguila-Obra, 2008; Venkatesh & Davis, 1996). Thus CSE has an important direct effect on PEOU and an indirect on Behavioural Intention to use the system.

In a CBA, computer self efficacy affects students in various ways. For example, students with better IT skills gain significant time by clicking or typing quicker. Time is a very important factor in a CBA. So, the CSE variable must be included for a better explanation of CBA acceptance.

H7: Computer Self Efficacy will have a positive effect on Perceived Ease of Use.

3.5. Social influence

Taylor and Todd (1995) suggest the Social Influence (SI) as the effect of other people's opinion, superior influence, and peer influence. Social Influence can be defined by three elements: Subjective Norm, Image and Voluntariness (Karahanna & Straub, 1999). Previous models used the following constructs to measure social influence: Social factors (MPCU), Image (IDT) and Subjective Norm (TRA, TPB, C-TAM-TPB and TAM2) (Venkatesh, Morris, Davis, & Davis, 2003). TAM2 proposes that Subjective Norm and Image will influence users' perceptions about the system's usefulness. TAM2 also suggests that subjective norm has no direct effect on the Behavioural Intention if the usage of the system is voluntary. Finally, in the UTUAT model which summarizes the previous eight models, Social Influence is one of the four major determinants of Behavioural Intention. A number of technology acceptance studies used Social Influence into their proposed models and found useful results (e.g. Agarwal & Karahanna, 2000; Karahanna & Straub, 1999; Lu, Yu, Liu, & Yao, 2003; Taylor & Todd, 1995; Venkatesh & Davis, 2000; Venkatesh et al., 2003). Likewise Social Influence has been used into proposed models for LMS (e.g. Wang et al., 2009).

Many students feel insecure regarding the use of CBA. They may have never used before a similar system. They are discussing among them about CBA. We believe that students will consider the opinions of their colleagues, their friends and their seniors. Furthermore, the major topic in their discussions is the Perceived Usefulness and the added value of the system. Thus, Social Influence will have a direct effect on Perceived Usefulness. In our case, CBA is voluntary. Based on the suggestion for the voluntariness in TAM2, we will not examine the effect of the Social Influence on Behavioural Intention.

H8: Social Influence will have a positive effect on Perceived Usefulness.

3.6. Facilitating conditions

Facilitating Conditions (FC) are factors that influence an individual's belief to perform a procedure. FC have many different aspects. FC's definition depends on the system and the process or the persons that will provide them. For example, an aspect of FC could be technical support such as helpdesks and online support services. Another given explanation is that FC have to do with resource factors such as time and money (Lu, Liu, Yu, & Wang, 2008). FC can also be defined by the policies, regulations, and legal environment of a system. Communication activities and active participation of organisational staff could be also defined as FC (Bueno & Salmeron, 2008).

In our study we define as FC mainly the support during the CBA. The CBA must have tools to help students when they meet difficulties with the system. Furthermore, if the CBA take place in the university, an expert has to attend during the CBA to overcome students' queries concerning the use of CBA or even the content of the questions. So, we hypothesized a positive effect of FC on PEOU.

H9: Facilitating Conditions will have a positive effect on Perceived Ease of Use.

3.7. Goal Expectancy

Previous studies described the need of self-direction and goal orientation in distance learning (Smith et al., 2003; Yi & Hwang, 2003). Smith et al. (2003) proposed self-management of learning as the extent to which an individual feels he/she is self-disciplined and can engage in autonomous learning. Furthermore, Yi and Hwang (2003) introduced Learning Goal Orientation as an indirect determinant of e-learning acceptance based on Nicholls (1984) research. Nicholls (1984) proposed that there are two types of goals. The first is Learning Goal Orientation and the second is Performance Goal Orientation. Individuals with Learning Goal Orientation want to understand something new or to enhance their level of competence. In contrast, individuals with Performance Goal Orientation see ability as a fixed entity that reveals their intellectual capacity. Moreover, Shih (2008) introduced Personal Outcome Expectations as an ancestor of intention to use based on Vroom' (1964) and Bandura's (1986) works. Vroom proposed that increased outcome expectancy also increases individual motivation to perform the act. Bandura's (1986) results enforced this theory, because he proposed that expectations regarding the consequences of a behavior strongly influence individual actions.

Motivated by such previous studies, we proposed Goal Expectancy (GE). Goal Expectancy (GE) is a variable that influences an individual's belief that he/she is prepared properly to use CBA. We define two dimensions of this variable. Firstly, in a summative assessment like our experiment, students have to study and be prepared in order to answer correctly the questions. So, the first dimension is student's preparation to take the CBA. This dimension measures if a student is satisfied with his/her preparation, it does not measure preparation from qualitative or quantitative aspects. The second dimension involves the desirable level of success for each student. Before the assessment, each student tries to predict his/her performance based on his/her study and the hypothetical difficulty level of the assessment. The student sets a goal regarding a percentage of correct answers that provide him/her a satisfying performance. We believe that GE is highly correlated with Perceived Usefulness. However, the sign of the effect of GE on PU depends on the assessment's type. In a summative assessment, we expect that GE will have a positive effect on PU. The reason is that a well prepared student will find more useful the assessment, because he/she will be able to understand the questions and answer them. On the contrary, in a formative assessment the effect might change sign. In this type of assessment the added value is the feedback that a CBA provides to the students in order to understand better the educational material. Students use formative assessment more to learn than to test their knowledge. So, GE might have negative effect on the PU of a formative assessment. Thus we examine the positive effect of GE on PU. Furthermore, GE is expected to have a positive impact on Perceived Playfulness (PP). A well prepared student will satisfy better the three dimensions of PP. The student will stay focus on the CBA, because he/she wants to satisfy his/her expectations for a good performance. Moreover, the well prepared student with great expectations will enjoy the interaction with the system since he/she will be able to answer the questions correctly. Thus we hypothesized:

H10: Goal Expectancy will have a positive effect on Perceived Usefulness.

H11: Goal Expectancy will have a positive effect on Perceived Playfulness.

3.8. Content

E-learning systems use ICT in order to automate content transmission. Based on Doll and Torkzadeh (1988), Wang (2003) proposed Content as one of the determinants of e-learner satisfaction. Wang's items for the construct Content examined if the content was up-to-date, sufficient, and useful and if the content fitted users' needs. Moreover, Shee and Wang (2008) proposed that System Content variable has great value in learners' satisfaction. They also mentioned the need of non-technical experts, such as teachers during the construction, the operation and the maintenance of the system.

Certainly, CBA is highly correlated with the content of the course. The questions of the CBA are based on the course content. Instructors use CBA to identify students' progress. Likewise, students have the opportunity to identify their weaknesses using the CBA. Students may use CBA in order to learn and practice better the content of the course. In our study, we examine two different dimensions of the Content. Firstly, it is the course's content. We believe that the content could affect CBA's usefulness and playfulness. Students evaluate their courses with regards to their content. The content may affect if a course is difficult or easy, interesting or boring, useful or not useful. The second dimension concerns questions' content in the CBA. Critical issues rise up for the content of the questions. In our research, we examine if the questions were clear, understandable and relative with the course's content. Since we examine content using new items different from the previous studies and for different purpose, we can support that Content in our study is a different construct. Thus we examine if the Content variable will have direct effect on Behavioural Intention, Perceived Usefulness, Perceived Playfulness and Goal Expectancy.

H12: Content will have a positive effect on Perceived Usefulness.

H13: Content will have a positive effect on Perceived Playfulness.

H14: Content will have a positive effect on Goal Expectancy.

H15: Content will have a positive effect on the Behavioral Intention to Use CBA.

4. Methodology

4.1. Research participants and data collection

The participants in this study were 173 first-year students enrolled in an introductory informatics course, in the Department of Economic Sciences of a Greek University. The course was composed of two modules: Theory and Practice. The theoretic module introduced general concepts of ICT and the practical module introduced the use of Word Processing and Internet use. The assessment had questions from both theory and practice.

From the construct Computer Self Efficacy with mean = 5.03 and SD = 1.2, we are able to understand that students perceived that they knew the basic use of a Personal Computer (PC). The main reasons of students' familiarity with the PC were that most of them attended computer lessons at high school and used PC for internet browsing and video game playing. The use of the CBA was voluntary. There were 117 females (67%) and 56 males (33%). The average age of students was 18.4 (SD = 1.01). The duration of the CBA was 45 min for 45 multiple choice questions. Each question had 4 possible answers. The questions' appearance was randomized. After the end of the CBA, each student had to answer the survey which consisted of 29 questions (Appendix 1).

The use of the CBA system was very simple. The student had only to choose the right answer and then he/she had to push the "next" button. Fig. 2 shows the assessment's interface through a sample question. Each page had the question, the four possible answers and the "next" button. The text was in Greek. So, teachers did not give any other special instruction at the beginning. They only helped few students that were not very comfortable with the use of the assessment and they asked information on its use. The design and the aesthetics of the system were very simple on purpose, because we would like our model to be uninfluenced from the effects of these two factors. The CBA was build in a Windows XP machine using JavaScript with Perl CGI on Apache web server with MySQL (Fig. 3) (Moridis & Economides, 2009b).

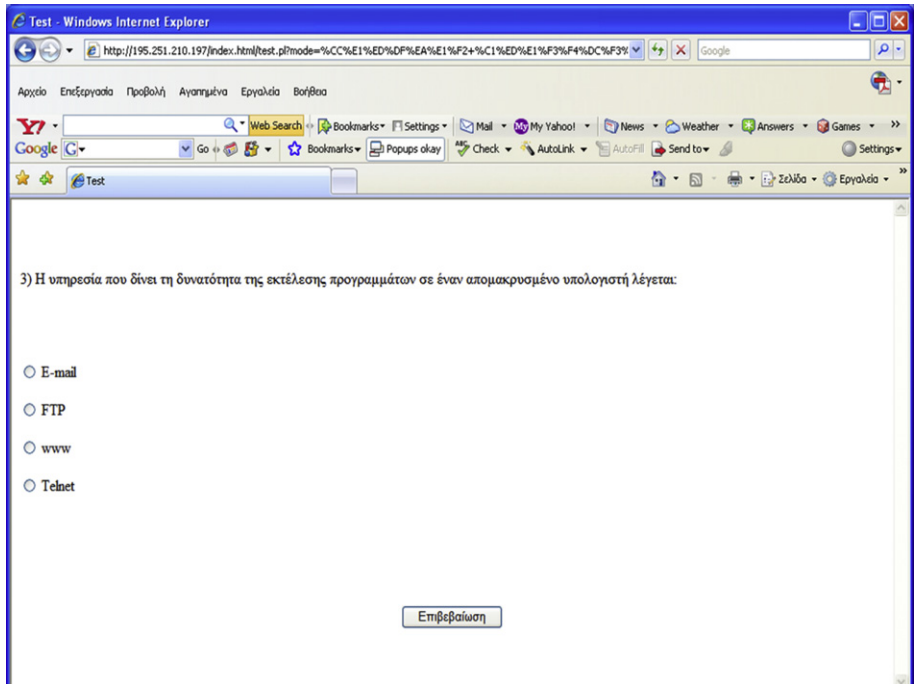


Fig. 2. Sample question.

4.2. Measures

In order to examine the nine latent constructs of the model, we adapted items based on previous studies. A modification of the items was necessary regarding the students' language and the use of the CBA, in order to be relevant to our study. The first modification of the items was the substitution of the word Learning System or Information System with the word CBA. For example, the item "Using the e-learning system enhances my effectiveness" was substituted by the "Using the CBA enhances my effectiveness". Moreover, the questionnaire was developed in English and then translated into Greek. The translation was made by certified translators to ensure linguistic equivalence. All items were measured on a seven point Likert-type scale with 1 = strongly disagree to 7 = strongly agree. These items have been used extensively in several previous studies of acceptance. For Perceived Usefulness (PU) three items were adopted from Davis (1989). From the same study we adopted three items for Perceived Ease of Use (PEOU) (Davis, 1989). For Computer Self Efficacy (CSE) we used four items adapted from Compeau and Higgins (1995) which also have been used by other studies (e.g. Teo, 2009). Four items from the UTUAT were adapted for the Social Influence (SI) construct (Venkatesh et al., 2003). For Facilitating Conditions (FC) we used two items (Thompson et al., 1991). The four Items for Perceived Playfulness (PP) were based on two studies (Moon & Kim, 2001; Wang et al., 2009). Content and Goal Expectancy (GE) constructs were measured using four and three items respectively that were developed by us. Finally, for Behavioral Intention to Use, we adapted 3 items from Davis (1989). To conclude, our measurement instrument consists of 30 items and our research model consists of nine constructs (Appendix 1).

5. Data analysis

The technique of partial least-squares (PLS) analysis was used to analyze the measurement and the structural model. PLS (Chin, 1998; Falk & Miller, 1992; Wold, 1982) and Linear Structural Relations (LISREL) (Jöreskog & Sörbom, 1993) are the most common structural

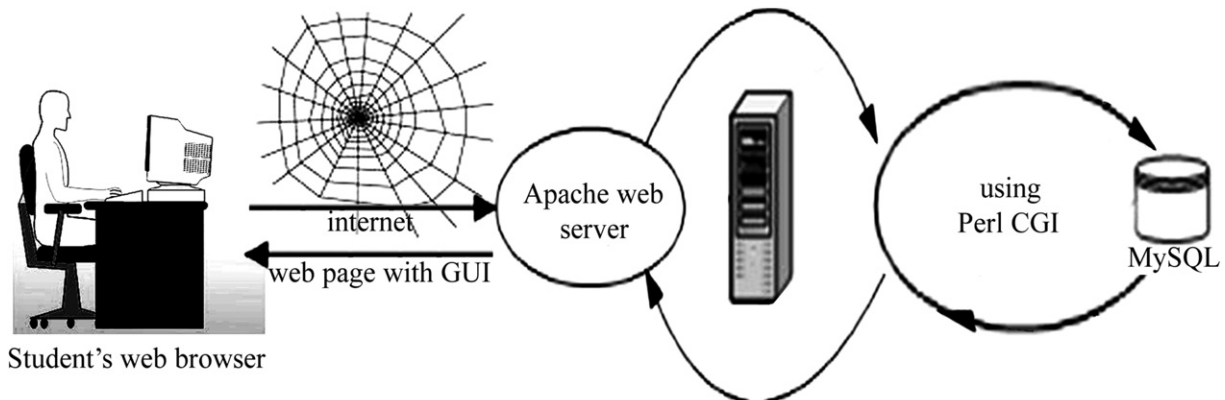


Fig. 3. Assessment's architecture.

equation modeling (SEM) techniques. LISREL is a covariance-based SEM technique and it uses a maximum likelihood function to obtain estimators in models. On the other side, PLS is component-based and uses a least-squares estimation procedure. PLS is more suitable for our research because it provides several advantages. The main advantages of PLS for testing are: (1) fewer demands on residual distributions; (2) smaller sample; (3) wider number of constructs and/or indicators (Chin, 1998; Falk & Miller, 1992); (4) testing theories in early stages of development (Fornell & Bookstein, 1982); (5) better for prediction.

Regarding sample size, the minimum recommended value is defined by the two following guidelines: (a) 10 times larger than the number of items for the most complex construct; (b) 10 times the largest number of independent variables impacting a dependent variable (Chin, 1998). If the larger value of the two guidelines is supported then the sample size is large enough. The proposed model has four independent variables impacting a dependent variable (Perceived Usefulness). Thus, our sample of 173 participants exceeded the recommended value of 40. Previous PLS studies for technology adoption have found reliable results using smaller sample sizes (So & Bolloju, 2005; Venkatesh & Davis, 2000). In addition, many studies on technology acceptance on learning systems used PLS analysis (e.g. Han, 2003; Hsu, Chen, Chiu, & Ju, 2007; Van Raaij & Schepers, 2008; Yi & Hwang, 2003; Zhang, Zhao, & Tan, 2008).

The internal consistency, convergent validity and discriminant validity prove the reliability and validity of the measurement model (Barclay, Higgins, & Thompson, 1995; Wixom & Watson, 2001). The first step of analysis is the assessment of items' factor loadings on the corresponded constructs. A value higher than 0.7 is acceptable (e.g. Teo, 2009). Moreover, items should load more strongly on their own corresponded variables than on other variables in the model to satisfy the discriminant validity. Regarding the discriminant validity, we also have to measure AVE (Average Variance Extracted). AVE should be larger than 0.5 and the AVE's squared root of each construct should be greater than any correlation with every other construct (Barclay et al., 1995; Chin, 1998; Fornell & Larcker, 1981). Furthermore, a composite reliability greater than 0.7 is considered adequate (Agarwal & Karahanna, 2000; Compeau, Higgins, & Huff, 1999).

The structural model and hypotheses are assessed mainly by two criteria: (1) by examining the variance measured (R^2) by the antecedent constructs. Cohen (1988) proposed 0.2, 0.13 and 0.26 as small, medium and large variance respectively; (2) the significance of the path coefficients and total effects by using bootstrapping procedure and calculating the t-values.

Until recently, there was not any overall goodness-of-fit criterion for the PLS analysis. Nevertheless, a global criterion of goodness of fit (GoF) has been proposed by Tenenhaus, Amato, and Esposito Vinzi (2004). GoF provides an overall prediction performance of the model based on the performance of the measurement and the structural model together. The GoF is estimated as the geometric mean of the average communality in the measurement model (AVE) and the average R^2 of the endogenous variables. Based on the acceptable values of AVE and R^2 , we assumed that the values of GoF were defined as small (0.10), medium (0.25) and large (0.36).

SmartPLS 2.0 was used for data analysis (Ringle, Wende, & Will, 2005). SmartPLS uses the partial least squares (PLS) method. It is similar to the PLS-Graph. We preferred SmartPLS because it is a freeware with improved graphical interface.

6. Results

6.1. Convergent validity

In this section we demonstrate the data analysis' results. As we mentioned in the previous section, convergent validity can be shown by three measurements: (1) item reliability of each measure by using factor loading (>0.7), (2) composite reliability of each construct (>0.7) and (3) the average variance extracted (>0.5). Table 2 confirms the convergent validity. All the factor loadings of the items in the measurement model exceed the demand value. Moreover, the composite reliability and the average variance extracted exceed the adequate values, respectively.

6.2. Discriminant validity

This study used Fornell and Larcker (1981) test to verify the discriminant validity. Discriminant validity is supported when the square root of the average variance extracted (AVE) of a construct is higher than any correlation with another construct. This means that a construct correlation with its indicators is higher than with any other construct. In Table 3 the diagonal elements are the AVEs. All the AVEs are greater than any other correlation. Thus, the discriminant validity of the proposed research model is verified.

6.3. Testing hypotheses

SmartPLS 2.0 was also used to examine the statistical significance of the relations in the model. A bootstrap procedure with 1000 resamples was applied. Fig. 4 and Table 4 summarize the results for the hypotheses. Regarding the Behavioral Intention to Use, we find a direct positive effect of Perceived Playfulness and Perceived Ease of Use but no direct effect of Perceived Usefulness and Content. Perceived Usefulness, Perceived Ease of Use, Content and Goal Expectancy have a direct positive effect on Perceived Playfulness. Social Influence, Perceived Ease of Use, Content and Goal Expectancy have a direct positive impact on Perceived Usefulness. Computer Self Efficacy and Facilitating Conditions both have a direct effect on Perceived Ease of Use. Finally, Content has a direct positive effect on Goal Expectancy. Thus, all the hypotheses were supported except the direct effects of Perceived Usefulness and Content on Behavioral Intention. However, the structural model has not only direct effects, but also indirect and total effects. Table 5 shows the direct, indirect and total effects. Total effects have all statistical significance. So, even if the direct effects of Perceived Usefulness and Content on Behavioral Intention were not supported, the total effects are supported.

Moreover, in the PLS analysis the R^2 values are used as a goodness-of-fit measure (Hulland, 1999). The model explains almost the 50% of variance in Behavioral Intention to Use. The total effects of PP (0.443), PU (0.229), PEOU (0.347) and C (0.300) are strong. This indicates that these 4 constructs are very important for the explanation of the Behavioral Intention to Use. Furthermore, C (0.411), PU (0.250), PEOU (0.256) and GE (0.262) explain 47% of the variance in Perceived Playfulness. These four variables are very important for the explanation of the variance in PP, but Content is the most important. Moreover, C (0.322), GE (0.260), SI (0.180), and PEOU (0.272) explain 47% of the variance in

Table 2
Results for the Measurement Model.

Construct Items	Mean	Standard Deviation	Factor Loading (>0.7) ^a	Cronbach α (>0.7) ^a	Composite Reliability (>0.7) ^a	Average variance extracted (>0.5) ^a
Perceived Playfulness	5.46	1.02		0.8444	0.8955	0.6822
PP1			0.7672			
PP2			0.8501			
PP3			0.8411			
PP4			0.8426			
Perceived Usefulness	5.77	0.96		0.8183	0.8920	0.7336
PU1			0.8322			
PU2			0.8797			
PU3			0.8568			
Perceived Ease of Use	5.77	1		0.7900	0.8782	0.7072
PEOU1			0.8424			
PEOU2			0.9046			
PEOU3			0.7704			
Computer Self Efficacy	5.03	1.2		0.9009	0.9301	0.7690
CSE1			0.8655			
CSE2			0.8642			
CSE3			0.9015			
CSE4			0.876			
Social Influence	6.1	0.86		0.7952	0.8676	0.6227
SI1			0.8292			
SI2			0.8732			
SI3			0.7257			
SI4			0.717			
Facilitating Conditions	6.62	0.69		0.8755	0.9411	0.8888
FC1			0.9511			
FC2			0.9343			
Goal Expectancy	5.02	1.01		0.7241	0.8385	0.6339
GE1			0.8293			
GE2			0.7722			
GE3			0.786			
Content	5.63	0.86		0.7898	0.8625	0.6113
C1			0.8211			
C2			0.7582			
C3			0.72			
C4			0.8233			
Behavioral Intention to Use	6.00	1.06		0.8873	0.9306	0.8175
BI1			0.9461			
BI2			0.9149			
BI3			0.8487			

^a Indicates an acceptable level of reliability and validity.

Perceived Usefulness. CSE (0.270) and FC (0.363) explain 24% of the variance in Perceived Ease of Use. Finally, Content (0.494) explains 25% of the variance in Goal Expectancy (Fig. 4, Table 4).

6.4. Overall Model Fit

Regarding the Overall Model Fit we used the Goodness of fit (GoF) criteria (Tenenhaus et al., 2004). As we mentioned in the previous section, GoF is defined as small (0.10), medium (0.25) and large (0.36). Our model has a value of **GoF = 0.55**. This means that our research model has a good fit.

7. Discussions

Computer Based Assessment (CBA) is part of e-learning technologies. The aim of this study is to extend prior knowledge about the technology acceptance model and customize it for CBA. The results demonstrate that Perceived Playfulness and Perceived Ease of Use have

Table 3
Discriminant validity for the measurement model.

Construct	PP	PU	PEOU	CSE	SI	FC	GE	C	BI
PP	0.826								
PU	0.577	0.857							
PEOU	0.496	0.514	0.841						
CSE	0.377	0.256	0.330	0.877					
SI	0.463	0.489	0.358	0.256	0.789				
FC	0.286	0.258	0.408	0.166	0.518	0.943			
GE	0.497	0.515	0.295	0.217	0.439	0.187	0.796		
C	0.567	0.554	0.522	0.403	0.504	0.483	0.494	0.782	
BI	0.656	0.522	0.524	0.345	0.325	0.287	0.382	0.502	0.904

Bold values: the square root of the average variance extracted (AVE) of each construct.

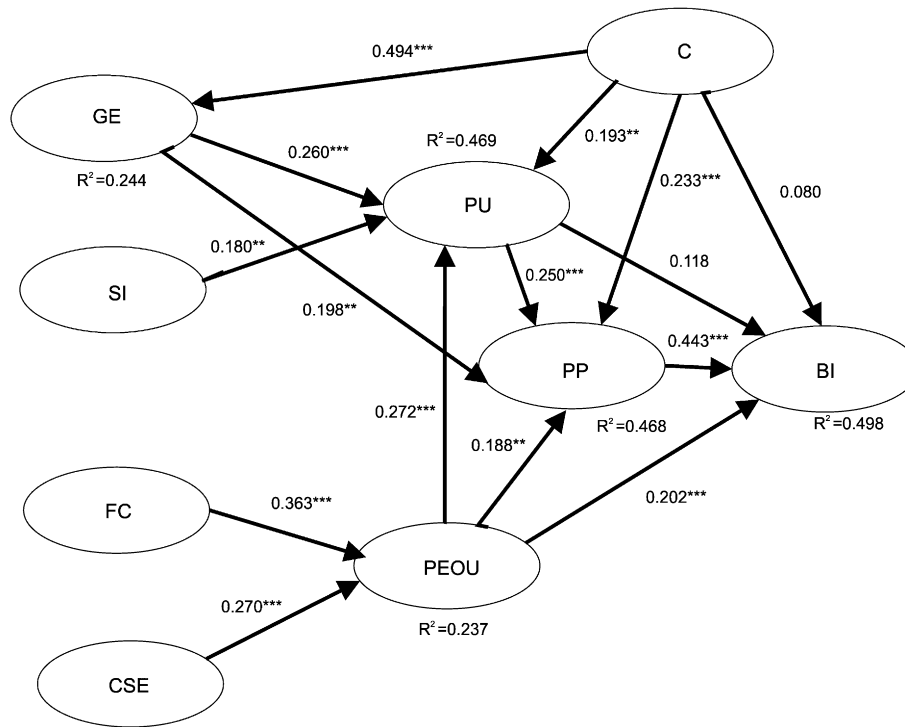


Fig. 4. Path coefficients of the research model (CBAAM).

direct effect on Behavioural Intention to Use, while Perceived Usefulness, Content, Computer Self Efficacy, Facilitating Conditions, Social Influence, and Goal Expectancy have an indirect impact on Behavioural Intention to use. Our study confirms prior studies and the data supports our research measurement and structural model.

According to the direct effects on Behavioural Intention to Use, we conclude that when a CBA is playful and easy to use, it would be more likely for students to use it. This confirms previous studies. Perceived Ease of Use is one of the major constructs in TAM and the direct effect on Behavioural Intention was expected. Likewise, direct effect of Perceived Playfulness has been proved in previous studies (Moon & Kim, 2001; Wang et al., 2009).

To our best knowledge, Content is a construct that it has not been introduced before in an acceptance model in this manner. Our hypothesis for a direct impact of the Content on Behavioural Intention was not confirmed. However, Content has a significant direct effect on the Perceived Usefulness, Perceived Playfulness and Goal Expectancy. Thus, Content has a strong indirect effect on Behavioural Intention through the three intervening variables. Based on our results, when a CBA's Content is designed carefully, CBA would be more useful and playful for the students, so it would be more likely to be used. Moreover, students' Goal Expectancy is affected by the CBA's Content.

Another new construct is Goal Expectancy. Our model shows that a student with expectations regarding the CBA would be more likely to find it useful and playful. In section 3, we explained that the positive effect exists only in summative assessments. Moreover, the positive effect of Social Influence on Perceived Usefulness strongly supports the relationship established in TAM2 (Lu, Yaob, & Yu, 2005; Venkatesh & Davis, 2000).

Furthermore, Computer Self Efficacy and Facilitating Conditions have a direct positive effect on Perceived Ease of Use. For CSE, it means that a student who feels comfortable using computers, probably he/she will find easy to use the CBA. Regarding FC, a CBA which provides

Table 4
Hypothesis testing results.

Hypothesis	Path	Path coefficient	t value	Results
H1	PP → BI	0.443***	5.378	support
H2	PU → BI	0.118	1.316	not support
H3	PU → PP	0.250***	3.213	support
H4	PEOU → BI	0.202***	2.734	support
H5	PEOU → PU	0.272***	3.269	support
H6	PEOU → PP	0.188**	2.120	support
H7	CSE → PEOU	0.270***	4.779	support
H8	SI → PU	0.180**	2.512	support
H9	FC → PEOU	0.363***	4.087	support
H10	GE → PU	0.260***	3.327	support
H11	GE → PP	0.198**	2.101	support
H12	C → PU	0.193**	2.475	support
H13	C → PP	0.233***	2.752	support
H14	C → GE	0.494***	8.481	support
H15	C → BI	0.080	0.942	not support

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 5
R² and Direct, Indirect and Total effects.

Dependent Variables	R ²	Independent Variables	Direct effect	Indirect effect	Total effect		
Perceived behavioral intention	0.498	Perceived Playfulness	0.443	0.000	0.443***		
		Perceived Usefulness	0.118	0.111	0.229**		
		Perceived Ease of Use	0.202	0.145	0.347***		
		Computer Self Efficacy	0.000	0.094	0.094***		
		Social Influence	0.000	0.041	0.041***		
		Facilitating Conditions	0.000	0.126	0.126***		
		Goal Expectancy	0.000	0.147	0.147***		
		Content	0.080	0.220	0.300*		
		Perceived Playfulness	0.468	Perceived Usefulness	0.250	0.000	0.250**
				Perceived Ease of Use	0.188	0.068	0.256***
Computer Self Efficacy	0.000			0.069	0.069*		
Social Influence	0.000			0.045	0.045*		
Facilitating Conditions	0.000			0.093	0.093**		
Goal Expectancy	0.198			0.064	0.262***		
Content	0.233			0.178	0.411***		
Perceived Usefulness	0.469			Perceived Ease of Use	0.272	0.000	0.272***
				Computer Self Efficacy	0.000	0.073	0.073***
				Social Influence	0.180	0.000	0.180**
		Facilitating Conditions	0.000	0.099	0.099***		
		Goal Expectancy	0.260	0.000	0.260***		
		Content	0.193	0.129	0.322***		
		Perceived Ease of Use	0.237	Computer Self Efficacy	0.270	0.000	0.270***
				Facilitating Conditions	0.363	0.000	0.363***
				Content	0.494	0.000	0.494***
		Goal Expectancy	0.244				

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

support to the students through the system or through the staff is more likely to be ease of use. In sequence, regarding a CBA's easy to use, it is more likely to be playful and useful.

Our analysis shows that the Perceived Usefulness has no direct effect on Behavioural Intention to Use. This is a controversial result. Prior studies support a very strong effect of Perceived Usefulness on Behavioural Intention to use (e.g. TAM). On the other hand, Perceived Usefulness has a significant positive indirect effect on Behavioural Intention to use through the Perceived Playfulness. Thus, if a CBA is useful, it is more likely to be playful. Students fulfil better the three dimensions of playfulness through a useful CBA. This means that the students will have probably concentration, curiosity and enjoyment when they use a useful CBA. So, the students use Playfulness to connect Usefulness with Behavioural Intention to Use. Further studies have to be developed in order to show if Perceived Usefulness has no direct effect on Behavioural Intention to Use a CBA.

8. Conclusions

This study investigated the factors that impact the Behavioural Intention to Use a computer based assessment. Our measurement and structural model were supported from our data. Our research came up to the following conclusions:

- (1) Goal Expectancy is defined by Content.
- (2) Perceived Ease of Use is significantly attributed to Computer Self Efficacy and to Facilitating Conditions.
- (3) Perceived Usefulness is significantly attributed to Content, Goal Expectancy, Social Influence and Perceived Ease of Use.
- (4) Perceived Playfulness is explained by Usefulness, Ease of Use, Content and Goal Expectancy.
- (5) Behavioural Intention to Use a CBA is significantly attributed to Perceived Playfulness and Perceived Ease of Use.

Perceived Playfulness is a mediator for four constructs to Behavioural Intention to use. Thus, Perceived Playfulness is a very powerful and crucial variable.

The two new constructs (Goal Expectancy and Content) have also important roles in the explanation of the model.

This study provides useful results to practitioners and researchers. Regarding practitioners and developers, this study defines the crucial variables that a computer based assessment system has to satisfy in order to be used by the students. Thus, the results show that a CBA must be playful, ease to use and useful with careful design of the content. Moreover, the social environment and the facilitating conditions play an important role for the acceptance of a CBA. So, practitioners and educators have to promote effectively the CBA in order to create an acceptable image by the students.

Educators should also provide rich, useful and playful content. Our model shows that the content is a very crucial construct for the acceptance of a CBA. For a successful implementation of a summative assessment, the students must have expectations of achieving a good performance. Educators should develop students' expectations through the courses and through the effective support during the academic season.

Previous studies were mainly focused on the e-learning environments. Thus, our study provides a first step toward the analysis of acceptance for a CBA. Our analysis confirms the previous studies on IT acceptance. Moreover, it suggests two new constructs that are very important for the explanation of a CBA's acceptance. Goal Expectation is a new construct, which measures how students felt before and during their assessment and how this construct impacts usefulness and playfulness of the system. Furthermore, Content is another variable that has not been used extensively and it is a very crucial ancestor of usefulness and playfulness.

However, our study has some limitations. Since it is the first attempt for the development of a CBA acceptance model, other important variables should be added by the future studies. Second, this study used a very specific sample of students to respond regarding their beliefs. CBA acceptance model has to be applied in other groups with other characteristics (e.g. age, occupation) or organizations (e.g. companies) for further confirmation. Third, validity and reliability of Goal Expectancy and Content have to be studied further and confirmed from other researchers too. Fourth, this study finds that there is no direct relationship between Perceived Usefulness and Behavioural Intention to Use, which is in contradiction to previous studies.

To conclude, this paper:

- (1) Proposes an acceptance model for computer based assessment (CBAAM).
- (2) Introduces two new constructs: Goal Expectancy and Content oriented to assessment.
- (3) Demonstrates the effects of the two new variables on the other variables in the model and especially on the Behavioral Intention of students regarding computer based assessment acceptance.
- (4) CBAAM explains approximately 50% of the variance of Behavioural Intention.

Appendix 1

Constructs	Items	
Perceived Usefulness	PU1	Using the Computer Based Assessment (CBA) will improve my work.
	PU2	Using the Computer Based Assessment (CBA) will enhance my effectiveness.
	PU3	Using the Computer Based Assessment (CBA) will increase my productivity.
Perceived Ease of Use	PEOU1	My interaction with the system is clear and understandable.
	PEOU2	It is easy for me to become skilful at using the system.
	PEOU3	I find the system easy to use.
Computer Self Efficacy	CSE1	I could complete a job or task using the computer.
	CSE2	I could complete a job or task using the computer if someone showed how to do it first.
	CSE3	I can navigate easily through the Web to find any information I need.
	CSE4	I was fully able to use the computer and Internet before I began using the Computer Based Assessment (CBA).
Social Influence	SI1	People who influence my behaviour think that I should use CBA.
	SI2	People who are important to me think that I should use CBA.
	SI3	The seniors in my university have been helpful in the use of CBA.
	SI4	In general, my university has supported the use of CBA.
Facilitating Conditions	FC1	When I need help to use the CBA, someone is there to help me.
	FC2	When I need help to learn to use the CBA, system's help support is there to teach me.
Content	C1	CBA's questions were clear and understandable.
	C2	CBA's questions were easy to answer.
	C3	CBA's questions were relative with the course's syllabus.
	C4	CBA's questions were useful for my course.
Goal Expectancy	GE1	Courses' preparation was sufficient for the CBA
	GE2	My personal preparation for the CBA.
	GE3	My performance expectations for the CBA.
Perceived Playfulness	PP1	Using CBA keeps me happy for my task.
	PP2	Using CBA gives me enjoyment for my learning.
	PP3	Using CBA, my curiosity stimulates.
	PP4	Using CBA will lead to my exploration.
Behavioural Intention to use CBA	BI1	I intend to use CBA in the future.
	BI2	I predict I would use CBA in the future.
	BI3	I plan to use CBA in the future.

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