Virtual world presence for pre-service teachers

Does the TAM model apply?

Vanessa Camilleri
Department of Maths, Science and Technical Education
University of Malta
Malta
vanessa.camilleri@um.edu.mt

Matthew Montebello
Department of Intelligent Computer Systems
University of Malta
matthew.montebello@um.edu.mt

Abstract: In this paper, we would like to present a model framework for testing the Technology Acceptance Model (TAM) initially proposed by Davis [5] with pre-service teachers using Virtual Worlds (VWs). The main hypothesis of this study states that the use of VWs will enhance technology acceptance by pre-service teachers, and will also facilitate adoption of technology applications within the classroom environment. There have been plenty of studies which have tested the TAM within work-related environments. Other breakthrough studies have also tried to apply the TAM for an education environment, investigating reasons for the possible lack of adoption of technology by teachers within the classroom environment. However, as yet, the model’s effectiveness has not been investigated with immersive technology applications such as VWs and their possible use and adoption within the teacher training framework.

Keywords: TAM, pre-service teachers, Virtual Worlds

1. INTRODUCTION

In this paper we would like to introduce the concept of using an adapted version of a pre-established model measuring the factors related to technology acceptance for pre-service teachers. Various educational studies show how the Technology Acceptance Model (TAM) can indeed be utilised to explain user behaviour in the adoption of technology at various levels of learning and education. A number of studies [14], [9], [1], [6] have dedicated research to validating hypothesis linking the TAM to student performance at the higher education level. Alshare et al. [1] define a proposed theoretical model as a basis to understand the relationship between computer literacy, ease of use, and perceived usefulness as determinants of computer usage. The authors refer to a number of models and theories which analyse the factors contributing to the use (or lack) of computers within industry and society. Venkatesh and Bala [13] report a decline in the production rate of a number of companies mostly due to an insufficient adoption of relevant IT practices by the employees. They have worked extensively on the production of an adapted version of the model, with the purpose of improving its predictive accuracy for users adopting technology as part of their everyday routine.

A number of researchers [4], [11], [10], have decided to further develop the TAM for the Education environment, which according to them is different from any other workplace which makes use of IT. The authors argue that within the classroom setting, adoption is not merely limited to informative and/or communication purposes, but takes on a much broader perspective. This work-in-progress proposes the use of the model to investigate the efficacy of a teacher training program which makes use of an immersive environment such as that presented by Virtual Worlds, analysing the mediation of technology use by behavioural intention using, amongst others, factors affecting Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). The rest of the paper is structured as follows: Section 1 deals with the background of the TAM model and its adaptation for the education environment. Section 2 deals with the research hypothesis which this study focuses on. Section 3 deals with the research methodology proposed while Section 4 presents the research agenda focusing on implementation interventions enhancing the potential of technology uptake by teachers within the classroom setting.

A. TAM origins

The TAM, first proposed by Davis [5] uses two determinants related to computer usage: the perceived ease of use (PEU) – “degree to which a person believes that using a particular system would be free of effort” and perceived usefulness (PU) – “degree to which a person believes that using a particular system would enhance his or her performance”.

![Figure 1 – Original TAM model [5]](image)

TAM’s origins go back to its predictive potential establishing the “individuals’ intention to use” technology [13]. The model’s original scope was that of using external constructs to explain the variance of the individuals’ adoption of IT systems within the work environment. Venkatesh and Bala [13] list four types of determinants which affect PU and PEOU. These include: “individual differences, system characteristics, social influence and facilitating conditions”. These variables relate to personal characteristics such as gender and age, as well as to features and functionality of specific information systems, and incorporate the social mechanisms which drive an individual’s perceptions about technology. Facilitating conditions are those variable which are heavily dependent on the organisation’s support for technology adoption. Venkatesh and Bala [13] in their studies identified lacunae in the research field, about the determinants which are mediated by the PU and PEOU. Following this they have proposed two extensions to the
original TAM, TAM2 & TAM3. TAM2 provides a theoretical framework sustained by two theoretical processes – the “social influence” and the “cognitive instrumental” – which are used to explain the various determinants of PU and behavioural intention (BI). Having built TAM 2 around a number of theoretical processes and models, the authors further propose a further extended model in TAM3, combining the different determinants in a network in a bid to explain the different associations for the variables mediated by the response shown. TAM3 aims to explore different relationships between PEOU and PU, Computer Anxiety and PEOU, and PEOU and BI, all moderated by experience.

The series of relationships created by Venkatesh and Bala [13] in the TAM3, indicate that:

**PU** is mediated by Subjective Norm, Image, Job Relevance, Output Quality, and Result Demonstrability determinants categorized as social influence and cognitive intelligence variants; out of these, Subjective Norm is in turn moderated by Experience.

**PEOU** is mediated by Computer Self Efficacy, Perceptions of External Control, Computer Playfulness, as anchors (Venkatesh, in [13]) as well as Perceived Enjoyment, and Objective Usability, both categorized as part of the adjustment framework in human decision making. This is indicative of emotional/affective response, with Anxiety and Playfulness being moderated by Experience.

Based on the above relationships and assumptions, Venkatesh and Bala [13] further proposed that the determinants of influence of PEOU will not influence PU but experience will moderate the relationships acting as an intermediary between the two.

**B. Beyond TAM: Implications for Education**

Studies by Sang, Valcke, van Braak, & Tondeur [10], Teo [11], and Chen, [4] have made use of the TAM to investigate the uptake and usage of the technology applications by pre-service teachers, within a classroom environment and the predictive power this model holds for the future use of technology within the classrooms by the same teachers.

Sang et al. [10] argue how despite the fact that there is increased availability of technology-based tools and resources for use in the classroom, there still seems to be a reluctance in the adoption of these resources as part of normal classroom practice. They relate this ‘lack of enthusiasm’ to teachers’ perceptions and use of computers. To this extent their studies are directed towards the understanding of the “inner barriers” to ICT adoption in the classroom practice. These barriers are defined in terms of teacher beliefs, teacher self-efficacy and teacher attitudes. The authors propose an integrated framework which takes into account all the variables impinging on these barriers and emerge with a model which then investigates the extent which these thinking processes would influence them into adopting technology-based tools and resources in the classroom. Although the study was primarily conducted amongst Chinese participants, certain coherent results with Western cultures could be observed. The results show that within the right environmental setting, teachers’ attitudes and perceptions towards computers are affected and their uptake within the classroom is facilitated.

Teo [11] discusses how the TAM as shown in Figure 1 above might not be fully suited for the education paradigm due to the external variables which mediate the perceived usefulness (PU) and perceived ease of use (PEOU). The authors investigate how according to the theory of reasoned action, PU, attitude and computer self-efficacy are fundamental determinants in computer user behaviour whilst PEOU and the technology complexity affect behavioural intention (BI) to use directly. According to the authors additional variables to those proposed by the TAM are fundamental in the uptake of technology use by pre-service teachers. Chen [4] discusses how most of the research and the TAM described above and applied to education takes into account technology use for “informative” (such as Internet use), “expressive” (such as word processing) and “administrative” (such as lesson planning). However, educational research [8] builds up on learner-centric theories, which has also been inspired by a number of influential models of learning such as Vygotsky’s social learning model (as cited in Luckin, [8]) which places learning as an activity, that centres around the individual’s change in behaviour patterns as a result of the different interactive processes within a given context. Other models which show the cycle of learning have been proposed. These include Kolb’s experiential learning cycle [7] (as cited in [12]), which focuses upon the generation of new knowledge based upon observation and reflection, whilst Dewey’s learning model for problem solving needs has been merged with social learning models such as Vygotsky’s sociocultural theories. Lave and Wenger’s communities of practice bring together learners’ individual knowledge cycles, under one common framework placing collaborative learning theories at the centre of this research. Therefore when one considers the TAM as a model, one has to take into consideration the use of technology by educators for learner-centric facilitation during classroom sessions rather than simply investigating the use of technology for lesson preparation. Chen [4] investigates a gap in research which attempts to indicate not just the behavioural intention to use technology in education by teachers, but also aims to answer the question of how these teachers would be using technology for student-centered learning. The proposed model constructed by Chen, illustrates how measurement of variables will give descriptive results, showing pre-service teachers’ use of technology for student-centred learning.

The model shown in Figure 2, uses the Structural Equation Modelling statistical analysis, for testing causal cycles of dependent and independent variables. A number of indicators were set for each variable to support correlation models and data. The studies take into account intrinsic and extrinsic variables for pre-service teachers and seem to indicate that teacher training during the pre-service period augments self-efficacy whereas context and training gave a high correlation. The results obtained imply a gap in the research which analyses the efficacy of teacher training, mediating technology use and behavioural intention. This gap takes into
account the practical and contextual environment in which teachers would be using the technology. Cuban (as cited in

Figure 2 – Proposed theoretical model for measuring variables indicating pre-service teachers’ use of technology for student-centred learning [4]

Chen, [4]), proposes another latent variable – “the situationally constrained choice” – which can also be particularly suited to the SEM analysis and which would address the contextual nature of the teachers’ decision to use technology within the classroom setting and for specific student-centred learning.

II. RESEARCH HYPOTHESIS

The main hypothesis which this study aims to prove is that the teaching and learning process in a VW learning environment designed specifically to suit the participants’ needs, will be more effective in changing the student teachers’ perceptions for the uptake of technology in their classroom practice.

This hypothesis implies a number of complex issues and parameters which need to be taken into consideration and which will build upon a number of research questions.

Question #1: How does learning occur in the VW?
Question #2: What are the student teachers’ perceptions of learning in the online context?
Question #3: What are the student teachers’ perceptions of learning in the VW context?
Question #4: Does learning transfer from the VW to real life?
Question #5: What is the perceived usefulness of the VW context for the learners?
Question #6: How are the interactions in the VW established?
Question #7: How useful for their learning do learners find the context for the learners?

C. Testing the hypothesis

In order to attempt an answer to the above questions one has to posit a number of hypothesis, with the scope of attempting to build the framework for measuring the efficacy of teaching and learning in the VW.

From the theories stipulated above, in relation to the TAM model and the extension applied to education, the following hypothesis need to be tested:

**H1:** Attitude (A) will have a significant influence on BI

**H2:** PEOU will have a significant influence on BI, moderated by experience

**H3:** Computer Anxiety will have a significant influence on PEOU, moderated by experience

**H4:** Subjective Norm will have a significant influence on PU

**H5:** Perceived Enjoyment will have a significant influence on PEOU

**H6:** Self-efficacy will have a significant influence on PEOU

**H7:** PEOU will have a significant influence on PU

**H8:** Perceived value of technology integration will have a significant influence on PU

**H9:** Facilitating conditions will have a significant influence on PEOU

Attitude refers to the individual’s openness to the adoption of technology within the classroom practice. Subjective Norm refers to the degree to which an individual perceives that the people around him/her think he/she should use the technology within the classroom. Self-efficacy refers to the degree to which an individual believes that he/she has the ability to lead a technology-based classroom environment. Facilitating conditions refers to the technology availability and support shown within the school context; clearly the perceptions leading to having the right environment and resources which facilitate computer use would have an impact on the teachers’ uptake of technology within the classroom.

III. METHOD

The objectives of this study are:

A. Develop an integrated model with the determinants of IT adoption and use within the classroom for pre-service teachers;

B. An empirical testing of the model proposed using the Structural Equation Modeling (SEM);

C. Presenting a research agenda for a pre- and post-implementation interventions within the teacher training program.

In order to achieve these objectives data will be collected from pre-service teachers at the University of Malta, during their academic training years. The participants include University students following a B.Ed degree course in their third year of study. Participants are all enrolled in an Educational Technology course, with the scope of facilitating use of technology adoption within the classroom.

A. Setting and Participants

A survey instrument will first be designed and handed out to all the participants, trying to establish pre-training attitude leading to behavioral intention to use. The course will then be conducted in two forms, in the traditional classroom setting and using VW’s as a platform to enhance technology use, adoption and experience.

A second questionnaire will be conducted with all the students to understand the level of effectiveness of the methodology and establish the validity of the model being proposed for determining IT adoption and use. Each determinant within the questionnaires will be measured using a
number of set indicators exploring the relationships among the variables in the study. Since the participants are limited to third year B.Ed degree students the number is limited to approx. 100. With this small number, SEM will be used to develop the model.

IV. RESEARCH AGENDA

The outcomes expected from the study, will indicate the level and quality of training which pre-service teachers need to go through facilitating the adoption and use of IT within the classroom setting not just for informative, or administrative purposes but also to help develop a more learner-centric technology process. It is expected that the findings regarding perceived usefulness and perceived ease of use will be in agreement with most research in the area [4], [13]. However the results are also expected to shed more light on the prediction of behavioural intention and use by teachers within the classroom context. With a more detailed knowledge, teacher training programs can be enhanced with the possibility of the introduction of immersive technology applications which facilitate teaching and learning effectiveness. These interventions can serve towards increasing the experience with technology use and adoption. Having a pre-training research agenda serves to minimise the resistance to the technology environment and adoption. The research agenda will list the design characteristics of an immersive technology application which can affect determinants of BI within the TAM model. The role of VWs as immersive technology applications is that of facilitating the PEOU and PU as posited in the TAM, whilst providing the right environment stimulating cross collaboration and technology-based peer communication processes. Camilleri & Montebello [2] have explored the concept that VWs without a collective scope or interest remain void and fulfil nothing more than a static representation of content transmission. This is in agreement with the statement that technology innovation is indeed a social innovation and need the human users to measure their success. Carey [3] argues that VWs are intended to be immersive social experiences which not only offer alternatives to face to face interactions but which can also provide new forms of human experiences, built upon a vast array of communication tools which can offer the same emotional satisfaction as gathered from the social exchanges happening on the daily basis. This would imply not just immersion as a diversion to the role which digital natives take up online, but also a degree of interactivity which allows users to flexibly construct their own space in the online environment.

The scope of the post-training research agenda, is to list the models and guidelines emergent within the training program and which would include the VW design focusing around the results from the interplay of the models testing the determinants, which can positively influence user acceptance and adoption within the classroom.

V. CONCLUSION

This work-in-progress aims to facilitate a framework for testing the efficacy of Virtual Worlds for technology acceptance by pre-service teachers. Research has indicated that there is more to technology acceptance when it comes technology practice in the classroom, and this study proposes to test and measure if the immersive environment of the 3D worlds can enhance more technology uptake by pre-service teachers, to move towards a more learner-centric technology mediated environment.

REFERENCES