Determinants of Online Assessment Adoption in Singapore Technical College

By
Dr. Caleb Or

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Table of Contents

CHAPTER 1: INTRODUCTION: DETERMINANTS OF ONLINE ASSESSMENT ADOPTION

This book is presented as a collection of four papers that have been prepared for publication. Each of the four papers presented in the book was written in the form of a journal article. The four papers prepared for submission as journal articles are presented in Chapter 2 through 5. Chapter 6 provides the summarized results, followed by a discussion of the implications for research and practice, and future directions for research that emerged from the findings. The current chapter provides a general introduction to the set of papers as a whole. The chapter first provides an overview of online assessment, and three popular technology acceptance models – the Technology Acceptance Model (TAM), the Technology Acceptance Model 2 (TAM2), and the Unified Theory of Acceptance and Use of Technology (UTAUT). The chapter summarises their history, their reported efficacy, and some of their reported criticisms. The chapter concludes with the summarized aims of the overall research and explains the structure of the book. As a professionally-oriented doctoral work, the chapter commences with a personal statement on the professional experiences that motivated me to embark on the research.

Personal Statement

The research reported in this work was designed primarily to address a professional problem I encountered in my career. The inspiration for this research was derived from my own experiences, both as an elementary school teacher for over 17 years, and as an instructional designer for over 7 years in the education sector. As an elementary school teacher, I was passionate about enhancing the learning experiences of my students through educational technologies. As I ventured into my career as an instructional designer in the last 7 years, I have implemented numerous educational technologies in the institutions in which I have worked. Through my experiences, I have observed many failed implementations due to a lack of understanding of the importance of user acceptance in technology. For example, I was

engaged as an instructional specialist in Institute of Technical Education (Singapore) to design, build and implement a learning analytics system, Academic Intelligence System (AIS). The system was designed based on more from the senior management's inputs and less from consultation from the actual users. The project was cancelled after the third year into the project by then incoming Chief Executive Officer of ITE, citing system mismatch and exorbitant development costs. Such observations have spurred me on to investigate ways to improve system implementations in these contexts by identifying the factors that influence technology acceptance. In my most recent years, I have served as a 'functional head', overseeing the implementation of online assessment in the ITE Examinations Division, and have had the opportunity to be involved the development, testing and implementation of an online assessment system. That experience prompted me to explore the acceptance of technology in the specific area of online assessment, which met with much resistance initially.

Brief Introduction to Online Assessment

In recent years, the delivery of educational assessments in many institutions has been shifted from traditional pen-and-paper methods to various forms of online assessment with the use of computer technology (Cavus, 2015; Diprose, 2013; Dube et al., 2009; Hebebci & Usta, 2015; Stone & Zheng, 2014). The term *online assessment* is often used interchangeably with the terms *electronic assessment* or *e-assessment* (Jordan, 2013), *computer-assisted assessment* (Bull & McKenna, 2003; Sim et al., 2004), *computer-mediated assessment* (Huot, 1996) and *computer-based assessment* (Fluck et al., 2009). The primary characteristic of all of these approaches is the use of some computerised technology to deliver assessment tasks (Bull, 1999; Chalmers & McAusland, 2002). Typically, online assessment is used as the delivery mode for multiple-choice questions, online or electronic submission and computerised adaptive testing (Collares & Cecilio-Fernandes, 2019; Wang & Kingston, 2019). Assessments at any stage of the learning process (i.e., for formative, diagnostic or summative purposes) can be delivered in an online format. Within university settings, online assessment allows faculties to have large candidatures selecting answers to questions on a computer that is connected to an internet site that contains a database. Instant and detailed feedback may or may not be enabled, depending on the intent of the assessment (i.e., whether it is a formative or summative task). The increased efficiency of online assessment means that educational institutions can do more with less (Alruwais et al., 2018). As Gipps (2005) noted, enhanced

efficiency and the potential to enhance pedagogical processes are the main reasons for using online assessment. With automated marking and feedback, online assessment is viewed as efficient, fast and reliable, making it useful, particularly in cases where large numbers of students are being tested. In March 2020, 150 countries closed schools and educational institutions across the world due to the coronavirus (COVID-19) pandemic, impacting over 80% of the world's student population. Educational institutions around the world scurried to change courses and programmes from face-to-face to online delivery mode. This transition had a severe impact on assessment and evaluation processes (Batmang et al., 2021; Hebebci, 2021; Hebebci, Bertiz, & Alan, 2020; Hu & Huang, 2022; Kibici, 2022; Kilincer, 2021; Paramitha et al., 2022; Paudel, 2021; Paudyal & Rana, 2021; Sahu, 2020; Unger & Meiran, 2020; Xhelili et al., 2021). The COVID-19 situation thus accelerated the development and implementation of online assessment systems in many education institutions (OECD, 2020). In some countries, examinations were either postponed or cancelled; in others, they were replaced by continuous assessments or online assessment for final examinations. The topic of technology use in education, and in particular, online assessment, has since received much attention in education research and practice (United Nations, 2020).

Computer-assisted Assessment and Online Assessment

Computer-assisted assessment, by definition, is the use of computers for assessing student learning (Bull & McKenna, 2003). Various authors have differentiated amongst types of computer-assisted assessment, with one example shown in Figure 1.

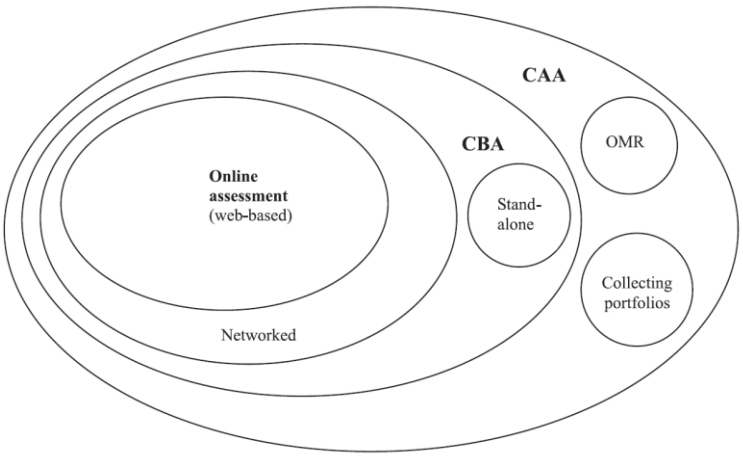

Figure 1. Different Types of Computer-assisted Assessment [Adapted from Conole, G., & Warburton, B. (2005). A review of computer-assisted assessment. ALT-J, 13(1), 17-31.]

In broad terms, computer-assisted assessment is defined as the use of computers for assessing student learning and covers the whole process of assessment involving test marking, analysis and reporting (Chalmers & McAusland, 2002; Conole, & Warburton, 2005; Bull & McKenna, 2004). For example, Optical Mark Reading (OMR) and portfolio collection are considered to be forms of computer-assisted assessment. OMR, also known as "mark sensing", remains one of the widely used computer-assisted assessment methods at present. OMR uses a computer to mark scripts composed initially on paper. It is a technique to sense the presence or absence of marks by recognizing the depth of darkness on an answer sheet, usually filled with a pencil or ballpoint pen (Deng 2008). Electronic portfolio collections, another form of com puter-assisted assessment, are the use of a computer to collect scripts or written work (McLoughlin, 2003) while computer-based assessment involves using a computer programme to mark answers that are entered directly into a computer (Fluck et al., 2009). This form is characterized by the interaction between the student and computer during the assessment process (Charman & Elmes, 1998). In computer-based assessment, test delivery and feedback provision are performed through the use of a computer. This form can be subdivided into standalone applications that only require a single computer, applications that work on private computer networks, and those that are designed to be delivered across public networks such as web-based online assessment (Conole & Warburton, 2005).

From Computer-based Assessment to Online Assessment

In order to take a closer look at online assessment, it is essential to differentiate various related terms that have been used in association with this term in recently published works. To this end, a 'desktop research' study was initially carried out to gather data on the terms used in the last two decades (from 2001 to 2020). In this study, a search was first conducted using the Education Resources Information Center (ERIC) database for abstracts containing terms related to online assessment. Each search consisted of one and only one specific phrase. For example, the phrase containing only "online assessment" was searched, and the number of times this term had appeared in abstracts between 2001 and 2020 was recorded. From the search, "Online Assessment" appeared most frequently in all publications listed, followed by "Computer-assisted Testing". Other frequently appearing terms included "Online Testing", "Computer-assisted Assessment" and "Online Examination". In Figure 2 and Figure 3, the search results from the ERIC database in 2020 are shown. "Online Assessment" remains the most frequently used term, followed by "Online Testing", "Computer-assisted Testing",

"Electronic Assessment" and "Computer-assisted Assessment". Therefore, for discussion in this paper, the phrase "online assessment" will be used consistently to refer to assessments conducted either online or with the aid of a computer device.

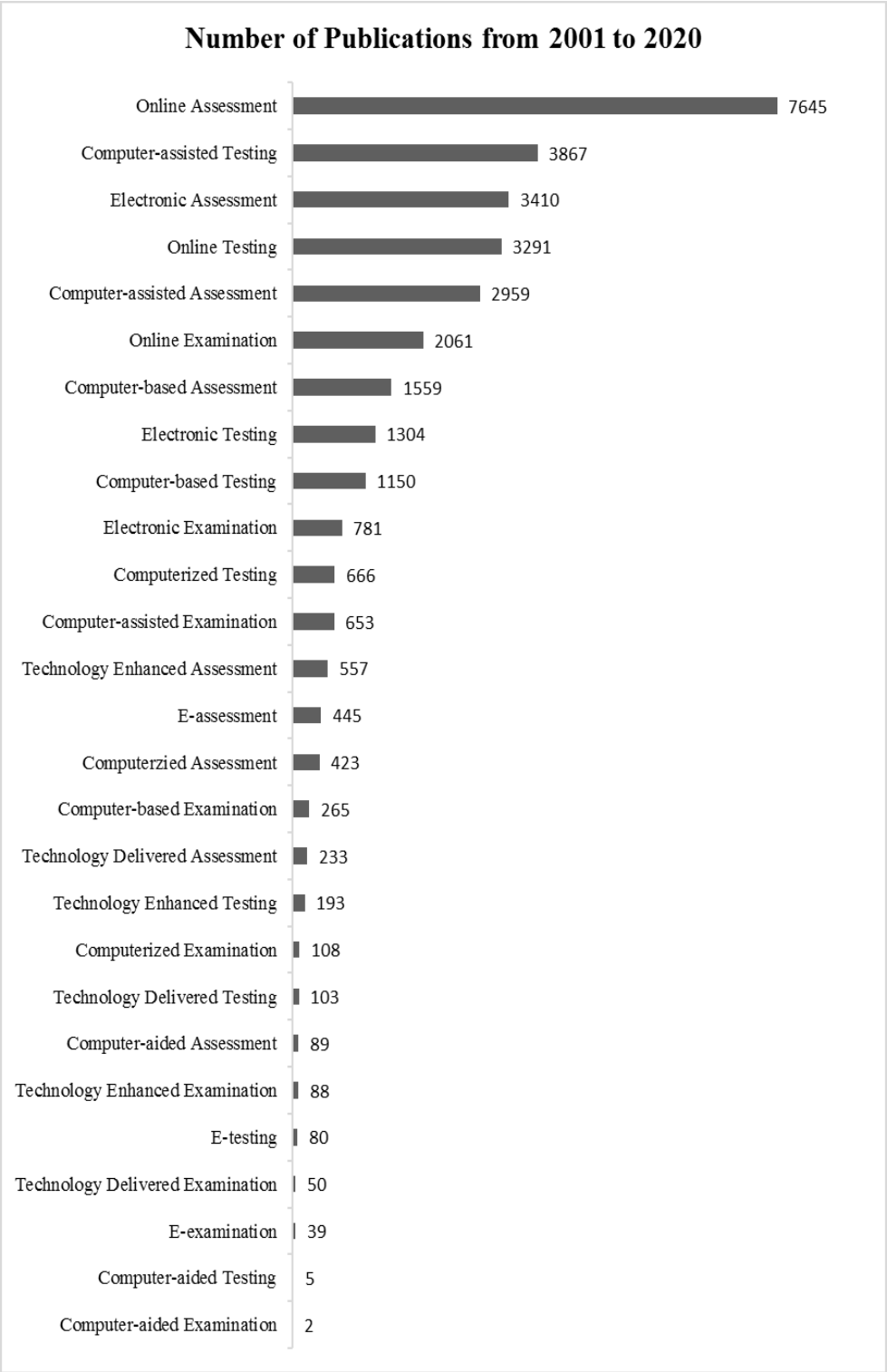

Figure 2. ERIC Database search on assessment-related abstracts from 2001 to 2020 [Number of Publications from 2001 to 2020; data extracted on 8 September 2020 From ERIC Database; https://www.eric.ed.gov/]

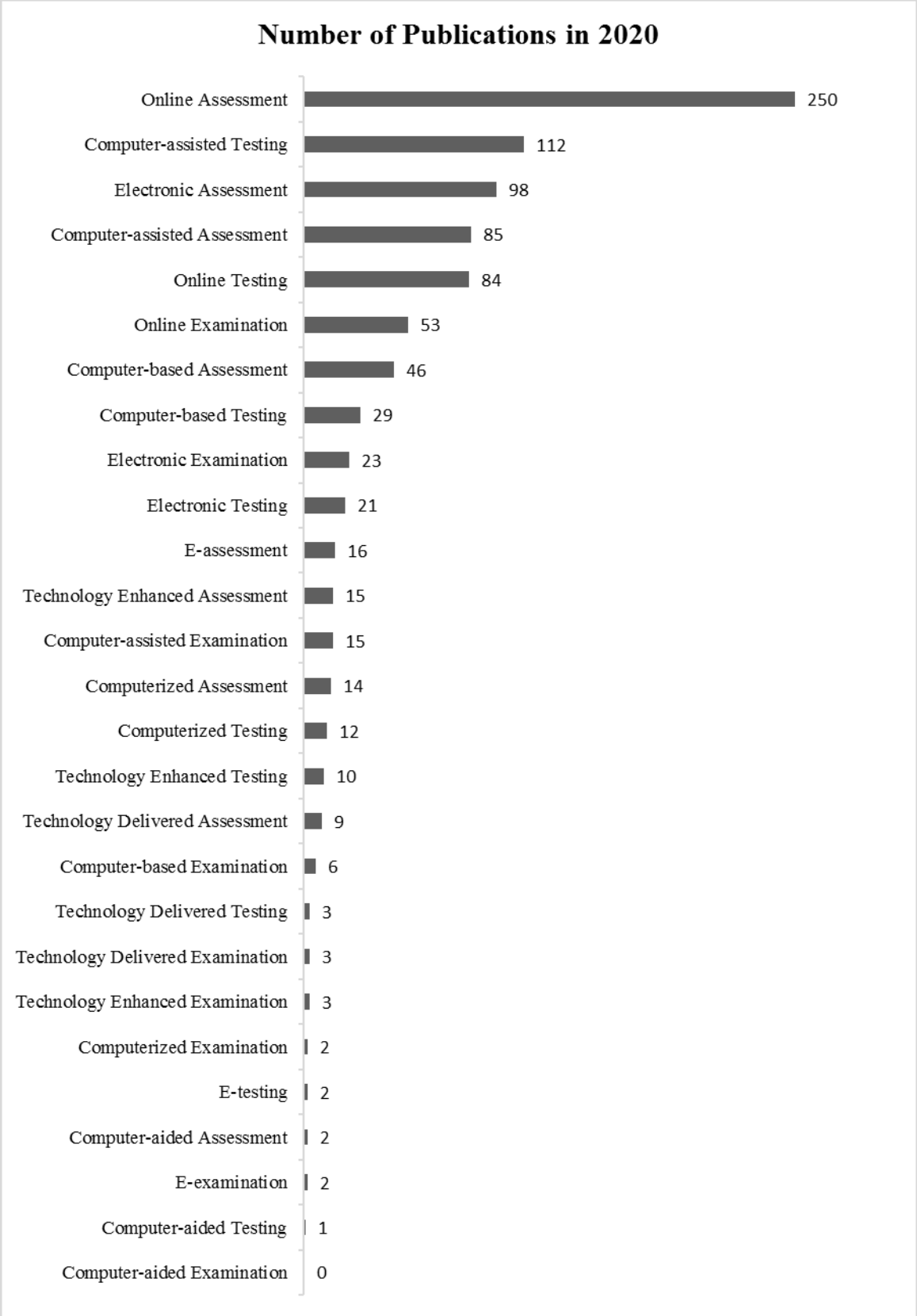

Figure 3. ERIC Database search on assessment-related abstracts in 2020 [Number of Publications in 2020; data extracted on 8 September 2020. From ERIC Database; https://www.eric.ed.gov/]

Development Phases in Online Assessment

Historically, three main phases can be seen in the development of online assessment (Figure 4). The first phase from the 1960s to 1990s involved the use of computers in assisting assessment. The second phase from the 1990s to 2000s saw the emergence of adaptive testing and the rise of the learning management systems. In the third phase that commenced in the 2000s, the use of Web 2.0 tools, artificial intelligence and analytics was introduced.

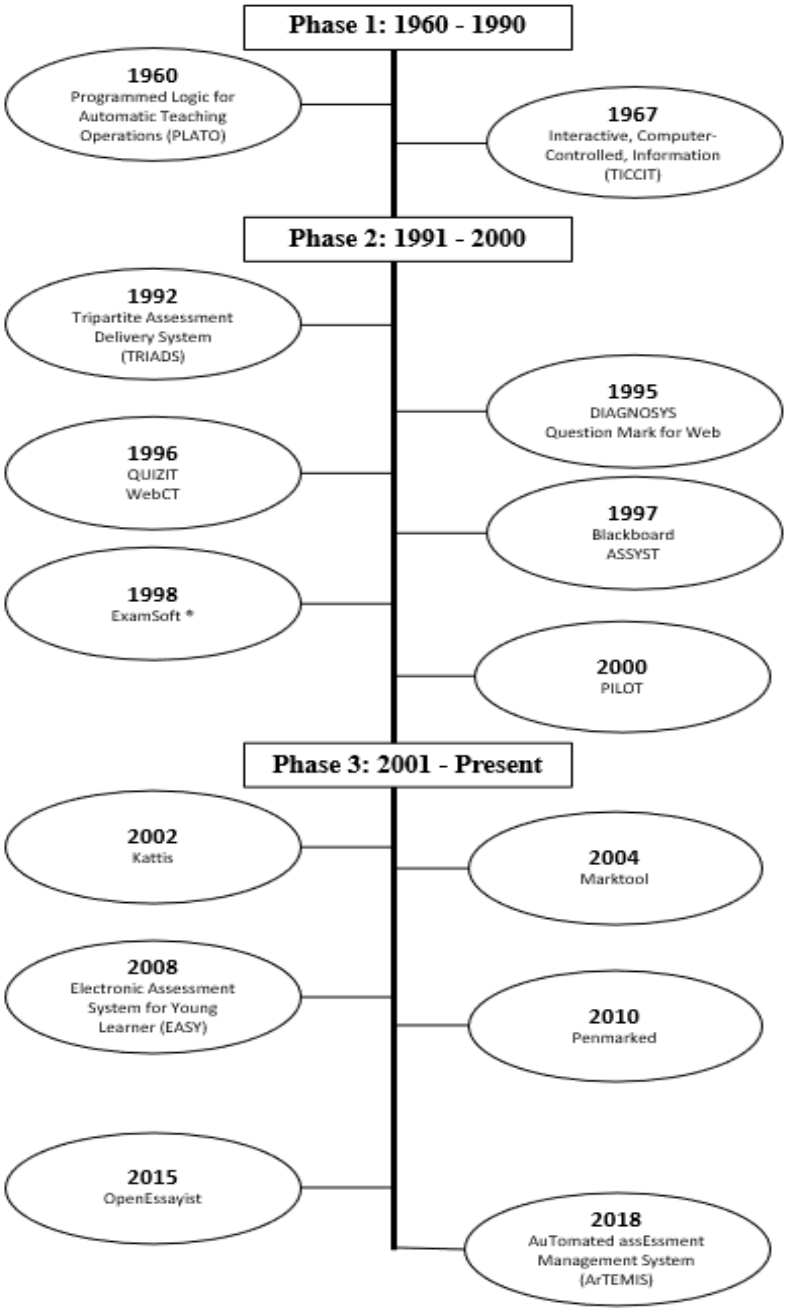

Figure 4. Computer-based Examination Systems, Online Assessment Systems and Assessment Tools (1960 to Present)

Phase 1: Computer-assisted and Computer-based Assessment (1960 – 1990)

In the period from 1960 to 1990 (Phase 1), computers were the conventional electronic means of delivering online assessment, and assessments or testing were primarily computer-assisted or computer-based. Examples of computer-assisted and computer-based tools used during this phase included databases, spreadsheets and expert systems. The first apparent attempt to use computers to assist the assessment process in the early 1960s was the *Programmed Logic for Automatic Teaching Operations* (PLATO) project, initiated by the University of Illinois (Smith & Sherwood, 1976, Woolley, 1994). The users of PLATO ranged from grade school students learning reading and mathematics, to graduate students learning complex concepts in the medical sciences.

The other example of a large-scale assessment project that used computers during this period was the Time-Shared, Interactive, Computer-Controlled, Information Television (TICCIT) in 1967 (Anderson, 1976). Other earlier attempts included the use of computers to automatically assess student programming assignments (Douce et al., 2005; Forsythe & Wirth, 1965; Hollingsworth, 1960). The assessment process was then affected by the revolution of microcomputers in the 1980s (Reiser, 2001). In the 1980s, there was an increased interest in using computers in instruction, and computers were used in automating instructional design tasks (Rottmann & Hudson, 1983). During the same period, large-scale multiple-choice tests were administered through the means of machine-readable forms, known as Optical Mark Recognition (OMR) forms, which are still in use today. In assessments facilitated by the use of OMR forms, students who are taking examinations shade their answers to selected-response questions on sheets that have been specifically designed for such a purpose (Jordan, 2013).

Phase 2: Adaptive Testing and Web-based Assessment (1990 – 2000)

Phase 2 took place from 1990 to 2000, when computer capabilities increased to provide a broader range of options such as data processing and simulations. During the same period, many other sophisticated systems had emerged like the *Tripartite Assessment Delivery System* (TRIADS) from the University of Derby in 1992, which included varied question types to test higher-order skills (Allen, 1998; Boyle & Hutchison, 2009; Burrow et al., 2005; Cox et al., 2008). TRIADS is still in development today.

Another sophisticated system that emerged then was DIAGNOSYS, an adaptive testing software designed to prepare undergraduates for the study of physics and engineering (Appleby et al., 1997). Such adaptive testing systems measure users' abilities by 'building', dynamically, an individualised test for each user (Chang & Ying, 1996). DIAGNOSYS, first developed in 1995, is based on a hierarchy of skills, in which each question delivered to a user depends upon on the previous answer given. The test items are selected sequentially, according to the current user's performance. As a consequence, the test is tailored to each user's ability by adjusting the difficulties of the items delivered to the responses given by the user. This means that higher-achieving users can avoid responding to a large number of easy items, and lower-achieving users are not confronted with a large number of items that are too difficult. During the same period that DIAGNOSYS was developed, there was the increased use of the World Wide Web, which led to the first commercial launch of web-based testing software, *Question Mark for Web* (Bull & Stephens, 1999).

Towards the end of Phase 2, a decline in computer-assisted or computer-based approaches could be seen, with an increasing emphasis on web-based assessments. The exponential growth of internet usage seen at this time was a key factor in the decline observed. For instance, Blackboard, a widely used web platform released in 1997, had the capability to provide automatic grading of multiple choice and True/False questions. Systems such as QUIZIT (Tinoco et al., 1997), WebCT (Goldberg & Salari,1996), ASSYST (Jackson & Usher, 1997), ExamSoft® (Wadley et al., 2014) and PILOT (Bridgeman et al., 2000) were also examples of web-based systems with the ability to deliver and facilitate online testing and grading. These applications reduced emphasis on the more traditional forms of computer-assisted or computer-based approaches that had been developed previously.

Phase 3: Web 2.0 Tools, Artificial Intelligence and Analytics (2000 – Present)

Phase 3 began in 2001 and incorporates developments to the present day. During this period, e-learning took the forms of virtual classrooms, computer-mediated communications and online cooperative learning. Examples of online assessment tools that appeared over these years included the use of e-portfolios, blogging, social networking and web authoring systems (Conole & Alevizou, 2010). In 2005, WebCT was acquired by Blackboard, and the web-based system was retired in 2013 (Seepersaud, 2011). Over the last two decades, other prominent learning management systems with proprietary assessment capabilities were also

released. For example, the Moodle learning management system, an open-source virtual environment, had a significant influence on the development of online assessment tools (Jordan, 2013).

Besides the growth in the number of learning management systems with online assessment features, many online assessment tools have also emerged in the market in recent years. These online assessment tools focused more on supporting teachers' assessments and grading than on automated evaluation. For instance, MarkTool (Heinrich & Lawn, 2004) introduced an onscreen marking tool that allows markers to annotate PDF documents sent by students with formative feedback. The annotations are either textual and graphical and can be recorded and linked to each student. Penmarked (Plimmer, 2010), another software solution, supports the marking and annotating of students' assignments with free-form ink annotations and associated marking tasks, like gathering and returning assignments, and recording grades.
The last decade also ushered in systems that utilized more advanced techniques to enrich the assessment process, such as semantics, artificial intelligence, natural language processing, or personalised questionnaires. For instance, Hirata and Brueckner (2008) used AI devices such as neural networks, decision trees, and inference engines to support the creation of questions and to keep track of students' learning. They proposed a framework for an Electronic Assessment System for Young learners (EASY). The approach generates results at the end of an assessment and permits revision, as well as a follow-up stage, by using the records of the answers. The specific methods used are: (1) clustering techniques, which enable the system to group the characteristics of the learning objects; (2) forward chaining, which is used to identify objects that users are thinking of when using the system; and (3) backward chaining, which checks the answers and allows for revisions based on these answers.

In another example of an advanced assessment system, Jordan and Mitchell (2009) proposed a natural language-based system, Intelligent Assessment Technologies (IAT), deployed by the UK Open University, to create and mark short-answer, free-text assessment tasks. Evaluations of the answer matching process provided by this system has been demonstrated to have similar or higher accuracy to that of expert human markers. Students attempt the questions online and are given detailed feedback on incorrect and incomplete responses, and can repeat the task immediately to learn from the feedback provided. Also in the area of natured language-based systems, the *Supportive Automated Feedback for Short Essay Answers* (SAEeSEA) project uses a Natural Language Analytics engine to provide feedback

on students' essays for summative assessment (Ras at al., 2015). OpenEssayist, which was part of the SAEeSEA, is a real-time learning analytics tool which provides automated feedback on a draft essay, operating through a linguistic analysis engine that is imbedded within a web-based application.

In the context of assessing computer programming abilities, automated assessments for computer science courses were also developed such as the Kattis in 2002 (Basnet et al., 2018; Enström et al., 2011). Krusche and Seitz (2018) also introduced AuTomated assEssment Management System (ArTEMiS) that automatically assesses solutions to programming exercises and provides instant feedback so that students can iteratively solve the problems presented. ArTEMiS provides an online code editor with interactive exercise instructions. The system is programming language agnostic and applies to a variety of computer science courses. Using ArTEMiS, students gain experiences in version control, dependency management and continuous integration while attempting to solve programming tasks. ArTEMiS is suitable for beginners in programming, and helps students to realise their progress and gradually improve their programming solutions. In doing so, it can also reduce workloads for computer science instructors with large classes, and enhance students' learning experiences.

As we trace the development phases of online assessment, from the first use of computers to assist assessment to the current auto-marking web-based assessment, it is clear that technology has had a significant impact on assessment. As more and more educational institutions adopt online assessment, it raises questions on how teachers and students accept and use new assessment approaches. However, numerous questions have not yet been addressed on the subject of how these new approaches are being adopted in practice by educational institutions. According to Stödberg (2012), who examined a total of 76 articles published in three journals from 2006 to 2012, empirical studies on e-assessment had mainly focused on formative assessments by that time. Research approaches in this field have been highly disparate, and have typically focused on specific applications within particular contexts. As a result, it is often not possible to compare results across studies. Thus, in addition to an obvious need for further research on how teachers and students accept new technologies in assessment, there is also a need for a more systematic approach to the study of online assessment adoption in research.

Brief Introduction to Technology Acceptance

The use of technology in education has been ever-increasing, and it has become an essential tool for a wide range of activities, from administrative tasks to teaching and learning. However, various authors have noted that the success of technology-related implementations will depend heavily on levels of user acceptance (Abu-Al-Aish & Love, 2013; Al-Adwan et al., 2013, Gibson et al., 2008; Ma et al., 2005, Salloum et al., 2019), and several technology theories and models related to how such user acceptance should be measured have now been developed. Studies of this kind are useful in assisting the design and implementation of systems based on an understanding of the factors that will affect users' inclinations to apply the systems in their educational practices. In the context of the current work, this begs a focus on the intentions of lecturers to adopt online assessment systems within their courses.

The Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003) is the most recent widely applied and validated model which focuses on factors that influence users to adopt and use technology in various contexts. The UTAUT model was developed as a theoretical advancement over existing theories that were being adopted at the time to examine technology acceptance and usage. The authors reviewed, mapped and integrated constructs from eight earlier technology acceptance theories and models, and developed a unified model which incorporated common constructs across the eight theories. The following sections will examine prominent models that have appeared in the literature such as the Technology Acceptance Model (TAM) and TAM2, and how they eventually evolved into the UTAUT.

Across all of these models, user acceptance of technology is operationalized in terms of either one or two 'outcome' variables. Consistently, the models incorporate Behavioural Intention (i.e., the respondent's intention or otherwise to use the technology) as one index of user acceptance, and in many studies, this will be the only index that is incorporated. Some studies also, however, include an outcome variable called 'Use Behaviour' or alternatively, 'Actual Use' as another index of acceptance. These two variables measure either self-reported actual usage (e.g., as a frequency of use within a specified period) or can be based upon actual logs taken from the relevant system.

Technology Acceptance Model (TAM)

TAM, first proposed by Davis in 1986, is a widely applied theoretical model designed to explain and predict user behaviour with respect to information technology (Legris et al., 2003). The model is based on an adapted form of the Theory of Reasoned Action (TRA) put forward by Ajzen and Fishbein (1980). Davis (1986) adapted the TRA model by dropping the subjective norms and added perceived usefulness (PU) and perceived ease of use (PEOU) as belief variables. PU is the extent to which a user believes that using a specific system or technology enhances his or her job performance. PEOU is the extent to which a user believes that using a specific system or technology will involve physical and mental effort, to predict the user's attitude towards a system (Figure 5). According to Davis's (1986) initial proposal, a user's overall attitude toward using a system was proposed to be a function of PU and PEOU, while PEOU had a significant effect on PU. However, Davis (1986) found that attitude did not fully mediate the effect of PU and PEOU on actual system use (David 1989).

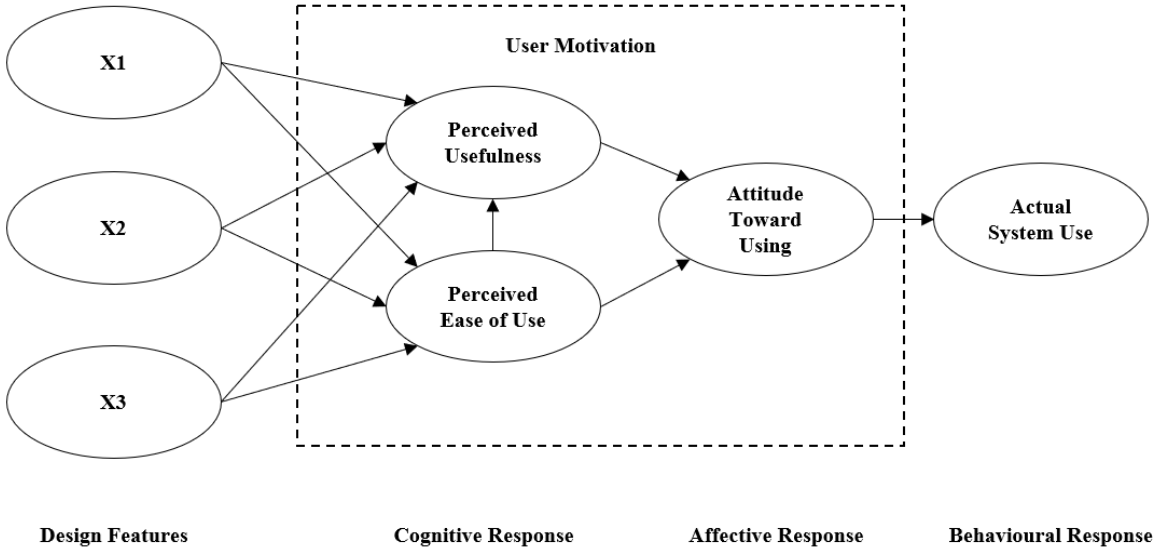

Figure 5. Original Technology Acceptance Model [Adapted from Davis, F. D. (1986). A technology acceptance model for empirically testing new end-user information systems: Theory and results (Doctoral dissertation, Massachusetts Institute of Technology)]

Davis, Bagozzi and Warshaw (1989) later modified the TAM model by adding attitude as a mediator between the belief constructs and intention to use (see Figure 6). The intent behind this modification was to increase TAM's ability to predict users' technology acceptance from their intentions, and its ability to explain users' intentions in terms of their attitudes,

subjective norms, PU, PEOU, and related variables (Davis et al., 1989; Lai, 2017). In a longitudinal study with 107 users, the findings indicated that PU strongly influenced intentions and that PEOU had a small but significant effect on intentions as well, although the effect diminished over time. Attitude, on the other hand, partially mediated the effects of PU and PEOU on intentions, while subjective norms had no effect on intentions (Davis, 1989). Another modification by Davis et al. (1989) was the introduction of external variables that might influence the beliefs of a user towards a system. Examples of external variables are system characteristics, user training, user participation in system design and the nature of the implementation process.

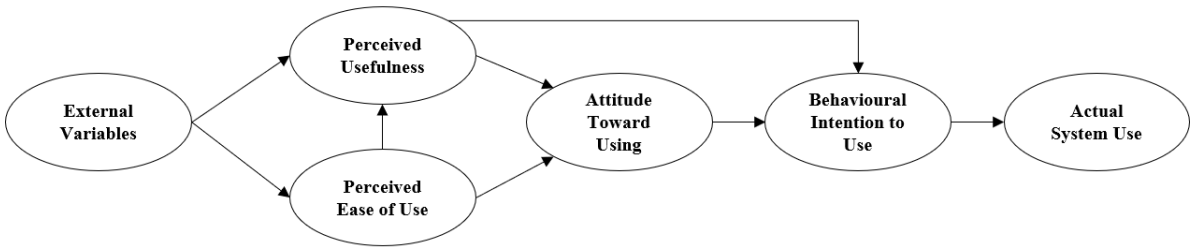

Figure 6. Modified Technology Acceptance Model [Adapted from Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. Management Science, 35(8), 982-1003]

However, in the final TAM model proposed by Venkatesh and Davis (1996), attitude was removed as a mediator based on findings that PU and PEOU had a direct influence on behavioural intention (Venkatesh & Davis, 1996). The final version of TAM is shown in Figure 7.

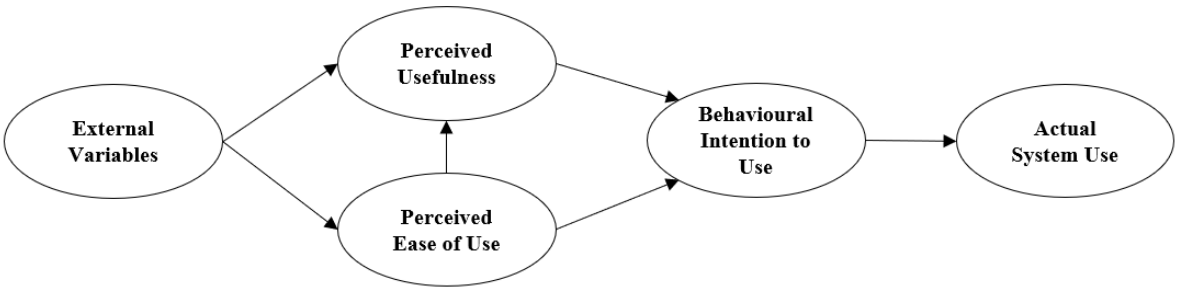

Figure 7. Final Technology Acceptance Model [Adapted from Venkatesh, V., & Davis, F. D. (1996). A model of the antecedents of perceived ease of use: Development and test. Decision Sciences, 27(3), 451-481.]

Views on the original TAM have varied, and limitations of the studies conducted to evaluate its efficacy have been highlighted. For example, Legris, Ingham and Collerette (2003) reviewed 22 selected articles published from 1980 to 2001 on TAM. While the researchers agreed that TAM was a useful theoretical model in explaining use behaviour in information system implementation, they underlined three limitations. First, nine of the studies reviewed involved students, though the intent was to evaluate user acceptance in industry. The researchers posed that results obtained with students may not generalise well to business environments (Lee et al., 2003; Yousafzai et al., 2007). Second, they noticed that most TAM studies examined the introduction of office automation software or system development applications, and posed that research would benefit from examining the introduction of business process applications. Third, they noted that most of the TAM studies did not measure actual system use, but rather, variance in *self-reported* use. Yousafzai et al. (2007) similarly pointed out in their meta-analysis of TAM findings that self-reported usage is subjective, and that actual usage or frequency recorded by the computerised system is a more useful measure of TAM's efficacy in predicting behaviour.

In contrast, various authors have affirmed TAM as a useful model for studying technology acceptance. For example, King and He (2006) conducted a meta-analysis of 88 TAM empirical studies from 1998 to 2003. They concluded that the TAM constructs of PU and BI were significant measures for technology acceptance and could be used in a variety of contexts. However, the authors also made a note of the fact that even when professionals' acceptance of technology was the actual target of study, the empirical results of TAM studies were often based on students as surrogates for professionals (Legris et al., 2003). Yousafzai et al. (2007) argued that students may not provide a good representation of a 'typical user' owing to their age range, limited experience with technology, relatively low income, and different motivations for the use of technology. The fact that students' use of technology is generally voluntary, unlike the use of technology in real work-place environments was cited as an additional limitation to the generality of results obtained in such studies.

There have also been study findings which suggest that TAM studies conducted in different cultural contexts yield disparate results. For instance, Schepers and Wetzels (2007) compared TAM in Western and non-Western contexts and found that subjective norms had a more significant impact on behavioural intentions in Western studies. PU also seemed important in Western cultures, while PEOU had more relevance in non-Western studies.

In another meta-analysis study, Turner et al. (2010) examined 79 relevant empirical studies and found that most studies had small sample sizes. The authors also argued in this study that was a need to use an objective measure like actual usage that includes a computer-recorded usage or system logs. This echoed one of the concerns raised by Legris et al. (2003), who called attention to the fact that in many studies, self-reported usage had been assumed to reflect actual usage, though this assumption could be questioned. The researchers also recommended that TAM studies report more contextual information about the technology being evaluated and the populations being sampled in future studies.

In their study on adopting TAM in mandatory environments, Hwang et al. (2016) pointed out that the parsimony of the model (i.e., its theoretical simplicity) has been both its strength and limitation. They argued that while its simplistic approach had attracted many researchers to adopt the model in their studies, TAM had added very little to the technology acceptance literature over the years. In other words, in the view of these authors, the TAM model offers limited knowledge and understanding of the acceptance phenomenon and technology implementation processes.

In summary, among the many criticisms, TAM remains a popular and credible model for examining various technological implementation in education contexts (Granić & Marangunić, 2019; King & He; 2006). TAM's constructs, PEOU and PU, have been shown to be prominent factors that predict technology acceptance. In particular, PU has been shown to be an important determinant of the adoption of various educational technologies. Despite this, there are various limitations of the model in the views of many authors within the field.

Technology Acceptance Model 2

Venkatesh and Davis (2000) extended the original TAM to include additional constructs like social influence (subjective norms, voluntariness, and image), cognitive instrumental processes (job relevance, output quality, and result demonstrability) and experience to explain PU and usage intentions (see Figure 8). The new model, the Technology Acceptance Model 2 (TAM2), retained all of the original TAM constructs (i.e. PU, PEOU, Intention to Use and Usage Behaviour), but extended the model by adding the following constructs:

(i) subjective norms, which refer to a person's perception that people who are important to him/her think encourage the behaviour in question (Fishbein & Ajzen, 1975);

(ii) image, which refers to the degree to which use of an innovation is perceived to enhance a person's status in one's social system (Moore & Benbasat, 1991);

(iii) job relevance, defined as a user's perceptions of the degree to which the system applies to his or her job (Venkatesh & David, 2000);

(iv) output quality, defined as an individual's perception of how well the system performs relevant tasks (Davis et al., 1992); and

(v) result demonstrability, which refers to the tangibility of the results of using the innovation (Moore & Benbasat, 1991)

TAM2 also included two moderator variables (i.e., variables that change the strength or direction of the effects of other constructs in the model) - voluntariness and experience. Voluntariness is the extent to which potential system adopters perceive the adoption decision to be mandatory or optional (Venkatesh & Davis, 2000). Experience refers to the level of experience that users have in adopting the systems investigated. In the extended model, Venkatesh and Davis posited that the direct effect of subjective norms on usage intentions might subside over time with increased system experience.

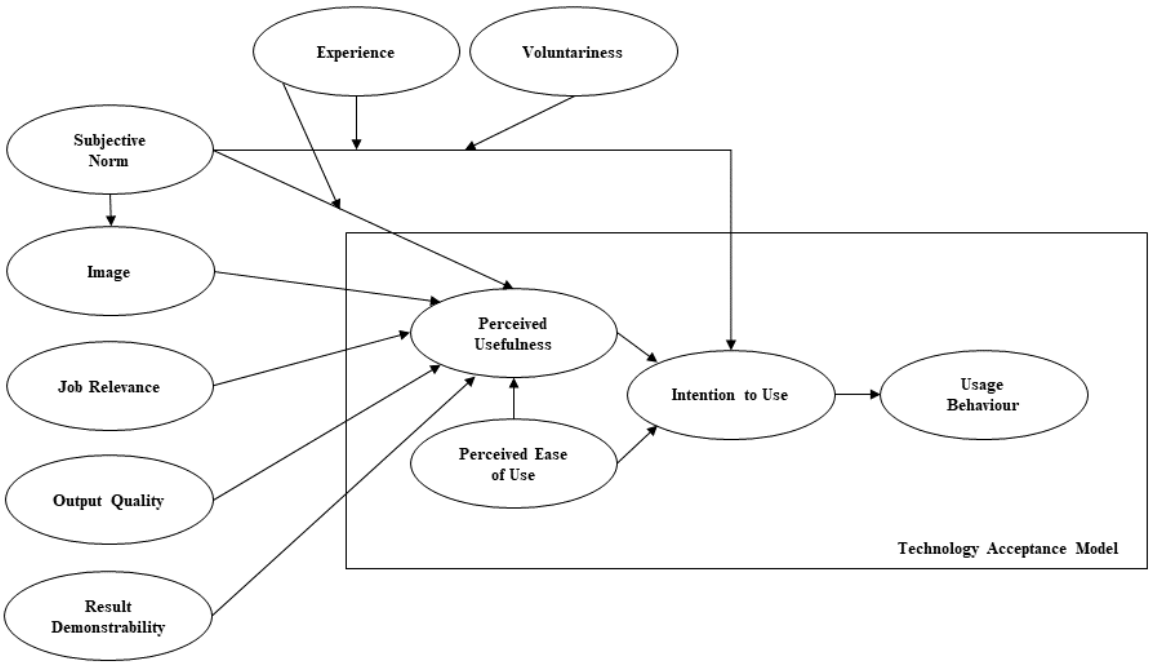

Figure 8. Technology Acceptance Model 2 [Adapted from Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. Management Science, 46(2), 186-204.]

While retaining TAM's original relationships between PU, PEOU, intention to use and usage behaviour, TAM2 posits that subjective norms, image, job relevance, output quality and results demonstrability will also be direct determinants of PU. In TAM2, subjective norms are also posed to be a direct determinant of both image and intention to use, while experience moderates the influence of subjective norms on both PU and image. Voluntariness, however, is posed to moderate the influence of subjective norms on use intentions. Studies adopting TAM2 to explore user acceptance have shown that this model can account for between 40% and 60% of variance in users' perceptions of the usefulness of a given system, and between 34% and 52% of the variance in their usage intentions. Both social influence processes (i.e. subjective norm, voluntariness and image) and cognitive instrumental processes (i.e. job relevance, output quality, result demonstrability and perceived ease of use) have been found to significantly influence user acceptance levels (see Venkatesh & Davis, 2000).

However, when Tang and Chen (2011) compared the technology acceptance models, they found that the explained variance of TAM2 was much lower than that of TAM. In TAM, intention to use explained 45% of the variance, while it was only 34% in TAM2. In short, the inclusion of subjective norms to the TAM did not appear to improve the model's ability to explain a user's intention to use technology. This conclusion was later supported by Rondan-Cataluña et al. (2015), who made a similar finding (i.e., that TAM2 did not offer a better explanation for technology acceptance when they compared different versions of technology acceptance models). Hwang et al. (2016) explained the relatively poor prediction achieved for the TAM2 in terms of the TAM's origins in the TRA. Like TRA, TAM was developed to explain and predict user behaviour. The other observed mechanisms were not central to the theory, and added little to the prediction and explanation of user intention and behavior. Put simply, Hwang et al. argued that the influence of the added variables would be mediated by the main variables, and as a result, these additional variables did not improve overall prediction.

Unified Theory of Acceptance and Use of Technology Model

More recently, Venkatesh et al. (2003) consolidated the previous TAM theories (Davis, 1989, Taylor & Todd, 1995) and models (Ajzen, 1991; Compeau et al., 1999; Fishbein & Ajzen, 1975; Moore & Benbasat, 1991; Thompson et al., 1991) and proposed the Unified Theory of Acceptance and Use of Technology (UTAUT) (see Figure 9). In the UTAUT, four constructs

play a significant role as direct determinants of user acceptance and use behaviour (UB): (1) performance expectancy (PE), (2) effort expectancy (EE), (3) social influence (SI); and (4) facilitating conditions (FC). As theorised, attitude toward using technology, self-efficacy and anxiety are not direct determinants of behavioural intention (BI).

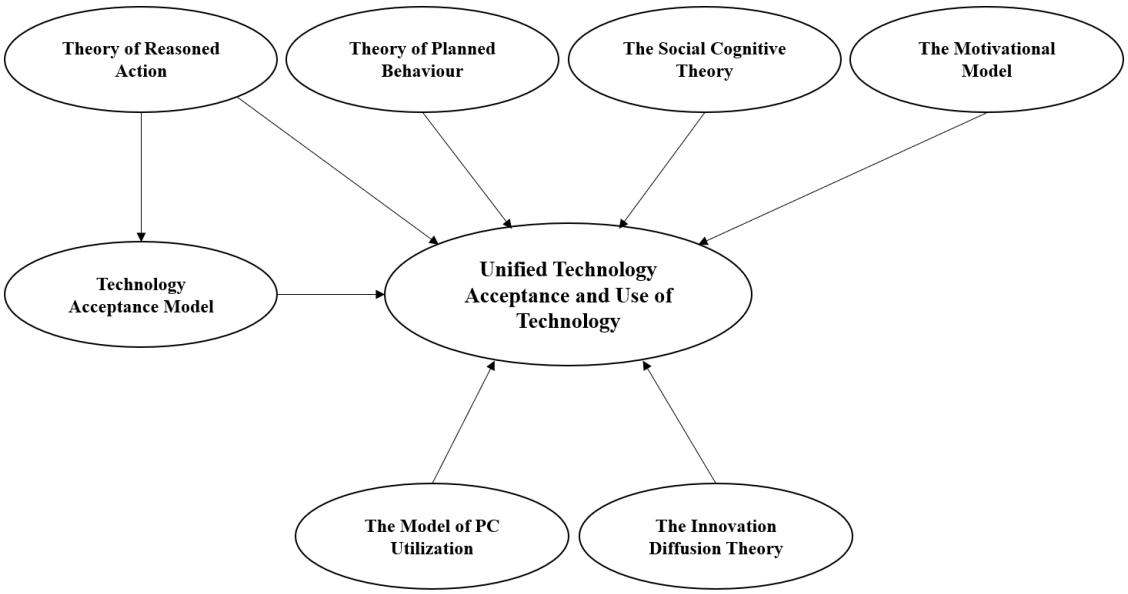

Figure 9. Background Theories and Unified Theory of Acceptance and Use of Technology

In the model, PE is the extent to which an individual believes that using the system will enable him or her to achieve gains in job performance, while EE is referred to as the degree of ease associated with the use of the system. SI is the extent to which an individual perceives that important others believe he or she should use the system, and FC is the extent to which an individual believes that there is an existing organisational and technical infrastructure to support the use of the system. In the UTAUT, PE, EE, and SI are all proposed to be predictors of BI, and via BI as a mediator, of UB. Conversely, FC is not theorized to operate via BI, but more directly on UB, unless other predictors in the model are not present. Specifically, Venkatesh et al. (2003) pointed out that if EE is not included as a predictor of BI, FC will act as a significant predictor of BI. However, in the presence of both PE and EE, FC will not be a significant predictor of BI.

In addition to proposing the base UTAUT model described, Venkatesh et al. (2003) also proposed that various 'moderating variables' (i.e., variables that affect the direction or strength of the relationships between variables in the base model) may be important in

different contexts (see Figure 10). For example, the developers posed that effect of EE on BI may be moderated by both gender and age, such that this effect decreases with users' experience in adopting given systems. They also posed that age and experience could moderate the relationship between FC and BI, such that as experience increases, the relationship between these elements may become more significant, especially in older groups. While the potential impact of such moderators are recognised here, these factors are not typically included in studies that are based on the UTAUT. In light of this fact, potential moderating influences were not explored in the present research.

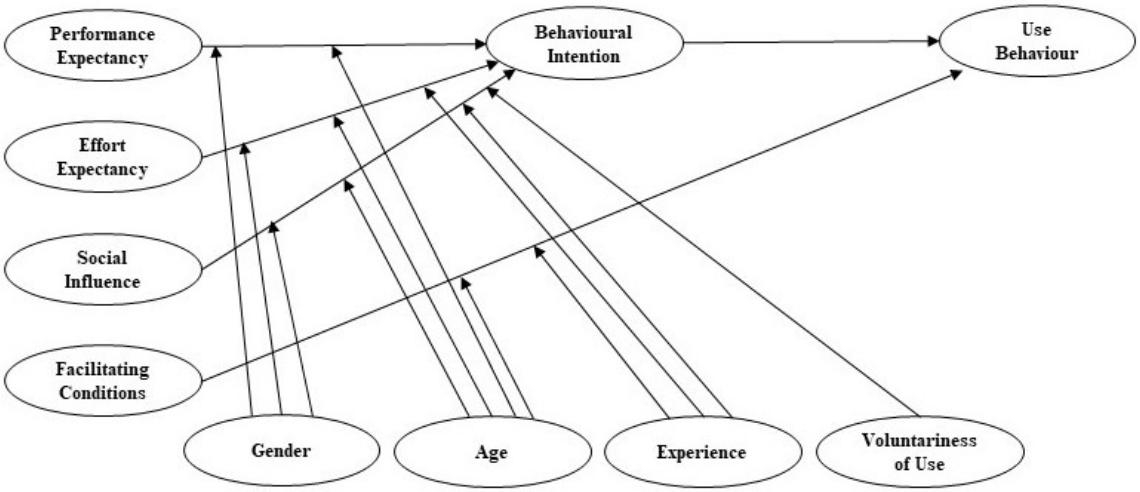

Figure 10. Unified Theory of Acceptance and Use of Technology Model [Adapted from Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 425-478.]

Summary of Technology Acceptance Research to Date

This chapter traced the development of technology acceptance models from TAM and TAM2 to the eventual UTAUT. Amongst the differences and commonalities, each of these models has made unique contributions to the literature on technology acceptance in the last three decades. Generally, TAM specifies general determinants of individual technology acceptance and therefore can be and has been used to explain or predict user behaviours across a wide range of learning technologies and user groups (Davis et al., 1989; Samaradiwakara & Gunawardena, 2014). TAM2 is an extension of TAM with new constructs. While the intent was to include subjective norms to the model, this was found to lower the model's ability to explain intention to use (Tang & Chen, 2011).

Two of UTAUT constructs are similar to TAM constructs. PE can be mapped to PU, whereas EE can be mapped to PEOU. The other two constructs, SI and FC, are from the Theory of Planned Behaviour (Ajzen, 1991). When the predictive power of the UTAUT has been compared to TAM and TAM2, it has emerged as a better model for predicting users' intentions to use technology, typically explaining around 70% of the variance in intentions, almost twice as much as TAM2 (Tang & Chen, 2011; Samaradiwakara & Gunawardena, 2014). Momani (2020) referred to the UTAUT as the most comprehensive model designed simplistically to examine actual usage behaviour with a small number of constructs and moderating variables, and noted that this model could be modified and applied in studies of any new technology and information system.

There have also been UTAUT studies conducted to examine whether findings would vary when conducted in different cultural contexts. The UTAUT model was tested in the United States and China, and it was found that culture played an essential role in affecting technology adoption (Venkatesh & Zhang, 2010). The role of SI varied across these two countries, while the effects of other factors were similar to previous studies. In another study, Im et al. (2011) also found that the effects of EE on BI and the effects of BI on UB were more modest in a Korean sample than had been reported in previous, US-based studies. Based on these results, the degree of relationship between variables in the UTAUT model may vary across different countries and cultures.

Current Issues on Technology Acceptance Models

One of the observations from the examination of the three models is the removal of attitude as a construct after the development of TAM2. Rondan-Cataluña et al. (2015) argued that when the attitude construct was removed from TAM2, the explained variance of the model dropped drastically. Interestingly, attitude was also absent as a construct in the later UTAUT. According to Yousafzai et al. (2007) in their meta-analysis of TAM, they pointed out that although attitude had been removed from later TAM models, research indicated it correlated strongly with usage behaviour, especially in environments where usage was mandatory. That raises a question on whether attitude should rightfully be restored to technology acceptance models.

Venkatesh et al. (2003) had suggested that later UTAUT research should focus on identifying constructs that could add to the prediction of BI and UB over and above what was already known and understood by the researchers. In a later review, Venkatesh et al. (2016) examined and synthesized the information system literature on UTAUT from September 2003 until December 2014. The researchers made a classification on the types of extensions that could be made to the UTAUT model to enhance its prediction in different contexts. These included:

(i) the inclusion of new exogenous constructs (i.e., independent constructs, or those that are not dependent on other constructs in the model) and mechanisms;

(ii) the inclusion of new endogenous constructs (i.e., constructs that are dependent on other constructs in the model) and mechanisms;

(iii) the inclusion of new moderating constructs or mechanisms (i.e., factors that influence either the strength or valence of relationships between variables in the core model); and

(iv) the inclusion of new outcome constructs (i.e., end-point endogenous variables) and mechanisms.

Details of the Present Research Program

UTAUT has been used in a wide variety of technology contexts and has been found a useful model in most of these contexts. For instance, Wedlock et al (2019) concluded that the UTAUT model and its instrument could be used in the educational research settings to test the relationships between antecedent and posterior constructs of technology usage, user attitudes, integration intentions, and post-adoptive behavior, when the researchers traced the evolution of education technologies. This argument was corroborated by an European validation study by Nistor et al. (2013) on UTAUT as an educational technology model with a large sample (n=4589). The large-scale validation concluded that the UTAUT questionnaire displayed adequate validity and reliability. A similar large-scale study (n=1723) was also conducted in Turkey using the UTAUT model in the educational technology context (Gogus et al., 2012). As such, the UTAUT model proves to be a suitable candidate for examining educational technologies like online assessment in this research study.

There has been a lack of research studies using the UTAUT model to study online assessment adoption, the closest being the study by Tan (2013) on students' adoptions and attitudes towards computerised placement tests. Online assessment has always been linked to online

learning and its delivery system, as many learning management systems have both assessment features and functions. This standalone study on online assessment adoption presents an opportunity for an in-depth examination of the factors that may affect its adoption.

The research reported in this work is presented as a series of standalone papers, drawing primarily on survey data gathered from lecturers within the Institute for Technical Education (ITE) in Singapore. The overarching purpose of the research was to explore how a modified version of the UTUAT model could be used to study users' acceptance of online assessment in a higher education setting. Specifically, the modified UTAUT developed here was applied to study lecturers' acceptance of a given online assessment used within ITE in Singapore.
Paper 1 is a conceptual paper which proposes an extended UTAUT model, incorporating additional constructs alongside those in the original model. As noted previously, while the original UTAUT has been widely adopted in many studies, this original model excludes the attitude construct incorporated in previous models such as the TAM. The extended model presented in this paper re-incorporates the attitude construct, based on empirical research that has affirmed its utility for predicting users' intentions. Another two constructs, usability and learnability, were also introduced to enrich the extended UTAUT model. Previously unexamined relationships among the constructs are also proposed in the extended model.

Paper 2 is also a conceptual paper, in which research on the acceptance of online assessment by teachers and students is discussed. Although there are various studies on online assessment acceptance, these have largely focused upon students' acceptance levels. In this paper, it is argued that lecturers' acceptance levels will be a key determinant of whether online assessment systems are eventually adopted. This area of study has not attracted the same level of attention as research on students' attitudes, which provides a key rationale for the research program conducted here. The UTAUT is then presented as a model that has the potential to integrate research within the field of user acceptance in online assessment.

Paper 3 is an empirically-based paper. In the research reported in this paper, an instrument to study lecturers' online assessment acceptance was adapted from the original UTAUT questionnaire. Additional items for usability, learnability and attitude constructs were included in the questionnaire, and a bipolar response format used to measure responses.

Evidence of the validity of this questionnaire in terms of its content, response processes, and internal structure is presented within the paper.

Paper 4 focuses on examining the determinants of online assessment acceptance in ITE lecturers using structural equation modelling. The study examined whether the original UTAUT constructs, PE, SI and FC had significant positive direct effects on BI and UB. It also examines whether the component of attitude, included in the extended UTAUT, had significant direct and indirect effects on both behavioural intention and usage behaviour. The relationships between the two additional constructs included (usability and learnability) and other elements of the model were also explored. Papers 1-4 are presented in Chapters 2-5 of this book, respectively. Chapter 6 then provides a general conclusion from the research as a whole and discusses potential future research studies, as well as practical implications, that emerged from the findings.

References

Abu-Al-Aish, A., & Love, S. (2013). Factors influencing students' acceptance of m-learning: An investigation in higher education. *International Review of Research in Open and Distributed Learning, 14*(5), 82-107. https://doi.org/10.19173/irrodl.v14i5.1631

Ajzen, I. (1991). The theory of planned behavior. *Organisational behavior and human decision processes*, *50*(2), 179-211. *https://doi.org/10.1016/0749-5978*(*91*)*90020-T*

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behaviour*.

Al-Adwan, A., Al-Adwan, A., & Smedley, J. (2013). Exploring students acceptance of e-learning using technology acceptance model in jordanian universities. *International Journal of Education and Development using Information and Communication Technology,* *9*(2), 4-18. https://search-proquest-com.ezproxy.library.uwa.edu.au/scholarly-journals/exploring-students-acceptance-e-learning-using/docview/1437252040/se-2?accountid=14681

Allen, R. (1998). The Web: interactive and multimedia education. *Computer Networks and ISDN Systems*, *30*(16-18), 1717-1727. *https://doi.org/*10.1016/S0169-7552(98)00200-1

Alruwais, N., Wills, G., & Wald, M. (2018). Advantages and Challenges of Using E-assessment. *International Journal of Information and Education Technology, 8*(1), 34-37. https://doi.org/10.18178/ijiet.2018.8.1.1008.

Anderson, S. J. (1976). TICCIT Project. http://https://files.eric.ed.gov/fulltext/ED134226.pdf

Appleby, J., Samuels, P., & Treasure-Jones, T. (1997). Diagnosys—a knowledge-based diagnostic test of basic mathematical skills. *Computers & Education*, *28*(2), 113-131. *https://doi.org/*10.1016/S0360-1315(97)00001-8

Bagozzi, R. P. (2007). The legacy of the technology acceptance model and a proposal for a paradigm shift. *Journal of the association for information systems, 8*(4), 3. *https://doi.org/*10.17705/1jais.00122

Basnet, R. B., Doleck, T., Lemay, D. J., & Bazelais, P. (2018). Exploring computer science students' continuance intentions to use Kattis. *Education and Information Technologies*, *23*(3), 1145-1158. *https://doi.org/*10.1007/s10639-017-9658-2

Batmang, B., Sultan, M., Azis, A., & Gunawan, F. (2021). Perceptions of Pre-Service Teachers on Online Learning during the COVID-19 Pandemic. *International Journal of Education in Mathematics, Science, and Technology (IJEMST), 9*(3), 449-461. https://doi.org/10.46328/ijemst.1595

Bervell, B., & Umar, I. N. (2017). Validation of the UTAUT Model: Re-Considering Non-Linear Relationships of Exogeneous Variables in Higher Education Technology Acceptance Research. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(10), 6471-6490.

Boyle, A., & Hutchison, D. (2009). Sophisticated tasks in e-assessment: what are they and what are their benefits? *Assessment & Evaluation in Higher Education*, *34*(3), 305-319. *https://doi.org/*10.1080/02602930801956034

Bridgeman, S., Goodrich, M. T., Kobourov, S. G., & Tamassia, R. (2000, May). PILOT: An interactive tool for learning and grading. In ACM SIGCSE Bulletin (Vol. 32, No. 1, pp. 139-143). ACM. *https://doi.org/*10.1145/331795.331843

Buabeng-Andoh, C., & Baah, C. (2020). Pre-service teachers' intention to use learning management system: an integration of UTAUT and TAM. *Interactive Technology and Smart Education.* https:// doi/10.1108/ITSE-02-2020-0028

Bull, J. (1999). Computer-assisted assessment: Impact on higher education institutions. *Educational Technology & Society*, *2*(3), 123-126.

Bull, J., & McKenna, C. (2003). *A blueprint for computer-assisted assessment*. Routledge.

Bull, J., & Stephens, D. (1999). The use of Question Mark software for formative and summative assessment in two universities. *Innovations in education and training international*, *36*(2), 128-136. *https://doi.org/*10.1080/1355800990360205

Burrow, M., Evdorides, H., Hallam, B., & Freer-Hewish, R. (2005). Developing formative assessments for postgraduate students in engineering. *European Journal of Engineering Education*, *30*(2), 255-263. *https://doi.org/*10.1080/03043790500087563

Cavus, N. (2015). Distance learning and learning management systems. *Procedia-Social and Behavioral Sciences*, *191*(2), 872-877. *https://doi.org/*10.1016/j.sbspro.2015.04.611

Chalmers, D., & McAusland, W. D. M. (2002). Computer-assisted assessment. *The Handbook for Economics Lecturers: Assessment, Bristol: Economics LTSN*, http://www. economicsnetwork. ac. uk/handbook.

Chang, H. H., & Ying, Z. (1996). A global information approach to computerised adaptive testing. *Applied Psychological Measurement*, *20*(3), 213-229. *https://doi.org/*10.1177/014662169602000303

Charman, D., & Elmes, A. (1998). Computer Based Assessment (Volume 1): A guide to good practice. *SEED (Science Education, Enhancement and Development), University of Plymouth.*

Collares, C. F., & Cecilio-Fernandes, D. (2019). When I say… computerised adaptive testing. *Medical education, 53*(2), 115-116. *https://doi.org/*10.1111/medu.13648

Compeau, D., Higgins, C. A., & Huff, S. (1999). Social cognitive theory and individual reactions to computing technology: A longitudinal study. *MIS quarterly*, 145-158. *https://doi.org/10.2307/249749*

Conole, G., & Alevizou, P. (2010). A literature review of the use of Web 2.0 tools in Higher Education. *A report commissioned by the Higher Education Academy.* https://s3.eu-west-2.amazonaws.com/assets.creode.advancehe-document-manager/documents/hea/private/conole_alevizou_2010_1568036804.pdf

Conole, G., & Warburton, B. (2005). A review of computer-assisted assessment. *ALT-J*, *13*(1), 17-31. *https://doi.org/*10.3402/rlt.v13i1.10970

Cox, M. J., Schleyer, T., Johnson, L. A., Eaton, K. A., & Reynolds, P. A. (2008). Making a mark–taking assessment to technology. *British dental journal*, *205*(1), 33. *https://doi.org/*10.1038/sj.bdj.2008.566

Davis, F. D. (1986). A technology acceptance model for empirically testing new end-user information systems: Theory and results (Doctoral dissertation, Massachusetts Institute of Technology). https://dspace.mit.edu/handle/1721.1/15192

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 319-340. *https://doi.org/*10.2307/249008

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management Science*, *35*(8), 982-1003. *https://doi.org/*10.1287/mnsc.35.8.982

Deng, H., Wang, F., & Liang, B. (2008, December). A low-cost OMR solution for educational applications. In 2008 *IEEE International Symposium on Parallel and Distributed Processing with Applications* (pp. 967-970). IEEE. *https://doi.org/*10.1109/ISPA.2008.130

Diprose, M. (2013). Learning and assessment credibility: The design of examination strategies in a changing learning environment. *Knowledge Management & E-Learning: An International Journal*, *5*(1), 104-116. *https://doi.org/*10.34105/j.kmel.2013.05.008

Douce, C., Livingstone, D., & Orwell, J. (2005). Automatic test-based assessment of programming: A review. *Journal on Educational Resources in Computing (JERIC)*, *5*(3), 4. *https://doi.org/10.1145/1163405.1163409*

Dube, T., Zhao, Z., & Ma, M. (2009). E-assessment and Design Methodology Management. http://eprints.hud.ac.uk/id/eprint/23208

Enström, E., Kreitz, G., Niemelä, F., Söderman, P., & Kann, V. (2011, October). Five years with kattis—using an automated assessment system in teaching. In *2011 Frontiers in Education Conference (FIE)* (pp. T3J-1). IEEE. *https://doi.org/*10.1109/FIE.2011.6142931

Fishbein, M., & Ajzen, I. (1975). Belief, attitude, intention and behavior: An introduction to theory and research.

Fluck, A., Pullen, D., & Harper, C. (2009). Case study of a computer-based examination system. *Australasian Journal of Educational Technology*, *25*(4). *https://doi.org/*10.14742/ajet.1126

Forsythe, G. E., & Wirth, N. (1965). Automatic grading programs. *Communications of the ACM*, *8*(5), 275-278. *https://doi.org/10.1145/364914.364937*

Gibson, S. G., Harris, M. L., & Colaric, S. M. (2008). Technology acceptance in an academic context: Faculty acceptance of online education. *Journal of Education for Business, 83*(6), 355-359. https://doi.org/10.3200/joeb.83.6.355-359

Gipps, C. V. (2005). What is the role for ICT-based assessment in universities? *Studies in Higher Education*, *30*(2), 171-180. *https://doi.org/*10.1080/03075070500043176

Gogus, A., Nistor, N., Riley, R. W., & Lerche, T. (2012). Educational Technology Acceptance across Cultures: A Validation of the Unified Theory of Acceptance and

Use of Technology in the Context of Turkish National Culture. *Turkish Online Journal of Educational Technology-TOJET*, *11*(4), 394-408.

Goldberg, M., & Salari, S. (1996). WebCT. *Computer software]. Vancouver: UBC*.

Granić, A., & Marangunić, N. (2019). Technology acceptance model in educational context: A systematic literature review. *British Journal of Educational Technology, 50*(5), 2572-2593. *https://doi.org/*10.1111/bjet.12864

Hebebci, M. T. (2021). The Bibliometric Analysis of Studies on Distance Education. *International Journal of Technology in Education (IJTE), 4*(4), 796-817. https://doi.org/10.46328/ijte.199

Hebebci, M. T., Bertiz, Y., & Alan, S. (2020). Investigation of Views of Students and Teachers on Distance Education Practices during the Coronavirus (COVID-19) Pandemic. *International Journal of Technology in Education and Science (IJTES), 4*(4), 267-282.

Hebebci, M. T. & Usta, E. (2015). Blended Learning Tendencies in Turkey: A Literature Review. *Adıyaman University Journal of Social Sciences Institute*, (19), 195-219. http://dx.doi.org/10.14520/adyusbd.23061

Heinrich, E., & Lawn, A. (2004). Onscreen marking support for formative assessment. In *EdMedia+ Innovate Learning* (pp. 1985-1992). Association for the Advancement of Computing in Education (AACE). https://www.learntechlib.org/primary/p/12754/

Hirata, E., Snae, C., & Brueckner, M. (2008). E-assessment system for young learners (EASY). *Proceedings of WorldCALL*. https://ktisis.cut.ac.cy/bitstream/10488/3273/2/proceedings.pdf#page=241

Hollingsworth, J. (1960). Automatic graders for programming classes. *Communications of the ACM*, *3*(10), 528-529. https://doi.org/10.1145/367415.367422

Hu, H. & Huang, F. (2022). Application of Universal Design for Learning into Remote English Education in Australia amid COVID-19 Pandemic. *International Journal on Studies in Education (IJonSE), 4*(1), 55-69. https://doi.org/10.46328/ijonse.59

Huot, B. (1996). Computers and assessment: Understanding two technologies. *Computers and Composition*, *13*(2), 231-243. https://doi.org/10.1016/S8755-4615(96)90012-2

Hwang, Y., Al-Arabiat, M., & Shin, D. H. (2016). Understanding technology acceptance in a mandatory environment: A literature review. *Information Development, 32*(4), 1266-1283. https://doi.org/10.1177/0266666915593621

Im, I., Hong, S., & Kang, M. S. (2011). An international comparison of technology adoption: Testing the UTAUT model. *Information & management, 48*(1), 1-8. https://doi.org/10.1016/j.im.2010.09.001

Jackson, D., & Usher, M. (1997, March). Grading student programs using ASSYST. In *Proceedings of the twenty-eighth SIGCSE technical symposium on Computer science education* (pp. 335-339). https://doi.org/10.1145/268085.268210

Jordan, S. (2013). E-assessment: Past, present and future. *New Directions in the Teaching of Physical Sciences*, (9), 87-106. https://doi.org/10.29311/ndtps.v0i9.504

Jordan, S., & Mitchell, T. (2009). e-Assessment for learning? The potential of short-answer free-text questions with tailored feedback. *British Journal of Educational Technology*, *40*(2), 371-385. https://doi.org/10.1111/j.1467-8535.2008.00928.x

Kibici, V. B. (2022). Effects of Online Constructivist 5E Instructional Model on Secondary School Music Lessons. *International Journal of Technology in Education (IJTE), 5*(1), 117-131. https://doi.org/10.46328/ijte.241

Kilincer, O. (2021). An Investigation of Pre-service Music Teachers' Attitudes towards Online Learning during the COVID-19 Pandemic. *International Journal of Technology in Education and Science (IJTES), 5*(4), 587-600. https://doi.org/10.46328/ijtes.304

King, W. R., & He, J. (2006). A meta-analysis of the technology acceptance model. *Information & Management, 43*(6), 740-755. https://doi.org/10.1016/j.im.2006.05.003

Krusche, S., & Seitz, A. (2018, February). ArTEMiS: An automatic assessment management system for interactive learning. In *Proceedings of the 49th ACM Technical Symposium on Computer Science Education* (pp. 284-289). ACM. https://doi.org/10.1145/3159450.3159602

Lai, P. C. (2017). The literature review of technology adoption models and theories for the novelty technology. JISTEM-Journal of Information Systems and Technology Management, 14(1), 21-38. http://dx.doi.org/10.4301/s1807-17752017000100002

Lee, Y., Kozar, K. A., & Larsen, K. R. (2003). The technology acceptance model: Past, present, and future. *Communications of the Association for information systems*, *12*(1), 50.

Legris, P., Ingham, J., & Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. *Information & Management*, *40*(3), 191-204. https://doi.org/10.1016/s0378-7206(01)00143-4

Ma, W. W. K., Andersson, R., & Streith, K. O. (2005). Examining user acceptance of computer technology: An empirical study of student teachers. Journal of computer assisted learning, 21(6), 387-395. https//doi.org/10.1111/j.1365-2729.2005.00145.x

Marangunić, N., & Granić, A. (2015). Technology acceptance model: a literature review from 1986 to 2013. Universal access in the information society, 14(1), 81-95. https://doi.org/10.1007/s10209-014-0348-1

McLoughlin, C. (2003). Broadening assessment strategies with information. *Learning & Teaching with Technology: principles and practices*, 193. http://widyo.staff.gunadarma.ac.id/Downloads/files/58454/Learning+and+Teaching+with+Technology.pdf#page=197

Momani, A. M. (2020). The Unified Theory of Acceptance and Use of Technology: A New Approach in Technology Acceptance. *International Journal of Sociotechnology and Knowledge Development (IJSKD), 12*(3), 79-98. https://doi.org/10.4018/IJSKD.2020070105

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information systems research*, *2*(3), 192-222. https://doi.org/10.1287/isre.2.3.192

Nguyen, Q., Rienties, B., Toetenel, L., Ferguson, R., & Whitelock, D. (2017). Examining the designs of computer-based assessment and its impact on student engagement, satisfaction, and pass rates. *Computers in Human Behavior, 76*, 703-714. https://doi.org/10.1016/j.chb.2017.03.028

Nistor, N., Göğüş, A., & Lerche, T. (2013). Educational technology acceptance across national and professional cultures: a European study. Educational Technology Research and Development, 61(4), 733-749. https:// 10.1007/s11423-013-9292-7

Organisation for Economic Co-operation and Development (OECD). (2020). Remote online exams in higher education during the COVID-19 crisis. http://www.oecd.org/education/remote-online-exams-in-higher-education-during-the-covid-19-crisis-f53e2177-en.htm

Paramitha, S. T., Komarudin, Fitri, M., Anggraeni, L., & Ramadhan, M. G. (2022). Rethinking the Relationship between Technology and Health through Online Physical Education during the Pandemic. *International Journal of Education in Mathematics, Science, and Technology (IJEMST), 10*(1), 132-144. https://doi.org/10.46328/ijemst.2165

Paudel, P. (2021). Online Education: Benefits, Challenges and Strategies During and After COVID-19 in Higher Education. *International Journal on Studies in Education (IJonSE), 3*(2), 70-85.

Paudyal, G. R., & Rana, K. (2021). How University Lecturers and Students Interpret Opportunities and Challenges of Online Mode of Learning. *International Journal of Research in Education and Science (IJRES), 7*(4), 1006-1022. https://doi.org/10.46328/ijres.2383

Plimmer, B. (2010, January). A comparative evaluation of annotation software for grading programming assignments. *In Proceedings of the Eleventh Australasian Conference on User Interface-Volume 106* (pp. 14-22). Australian Computer Society, Inc. https://crpit.scem.westernsydney.edu.au/confpapers/CRPITV106Plimmer.pdf

Ras, E., Whitelock, D., & Kalz, M. (2015). The Promise and Potential of E-Assessment for Learning. In *Measuring and Visualising Learning in the Information-Rich Classroom* (pp. 37-56). Routledge. https://doi.org/10.4324/9781315777979-9

Reiser, R. A. (2001). A history of instructional design and technology: Part I: A history of instructional media. *Educational technology research and development*, *49*(1), 53. https://doi.org/10.1007/bf02504506

Rondan-Cataluña, F. J., Arenas-Gaitán, J., & Ramírez-Correa, P. E. (2015). A comparison of the different versions of popular technology acceptance models. *Kybernetes: The International Journal of Systems & Cybernetics, 44*(5), 788-805. https://doi.org/10.1108/k-09-2014-0184

Rottmann, R. M., & Hudson, H. T. (1983). Computer Grading as an Instructional Tool. *Journal of College Science Teaching*, *12*(3), 152-56. https://www.jstor.org/stable/42988506

Sahu, P. (2020). Closure of universities due to Coronavirus Disease 2019 (COVID-19): impact on education and mental health of students and academic staff. *Cureus, 12*(4). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7198094/

Salloum, S. A., Al-Emran, M., Shaalan, K., & Tarhini, A. (2019). Factors affecting the E-learning acceptance: A case study from UAE. *Education and Information Technologies, 24*(1), 509-530. https://doi.org/10.1007/s10639-018-9786-3

Samaradiwakara, G. D. M. N., & Gunawardena, C. G. (2014). Comparison of existing technology acceptance theories and models to suggest a well-improved theory/model.

International Technical Sciences Journal, *1*(1), 21-36. https://enos.itcollege.ee/~edmund/inf-hw/seminaritoo/itsj-spec-1-1-3.pdf

Schepers, J., & Wetzels, M. (2007). A meta-analysis of the technology acceptance model: Investigating subjective norm and moderation effects. *Information & Management*, *44*(1), 90-103. https://doi.org/10.1016/j.im.2006.10.007

Seepersaud, D. J. (2011). Making the transition from WebCT to Blackboard Learn v9. 1. *Distance Learning*, *8*(4), 63. https://web-b-ebscohost-com.ezproxy.library.uwa.edu.au/ehost/pdfviewer/pdfviewer?vid=2&sid=74adc315-0e8b-41af-bb4b-bd0be1f80a92%40pdc-v-sessmgr02

Sim, G., Holifield, P., & Brown, M. (2004). Implementation of computer-assisted assessment: lessons from the literature. *ALT-J*, *12*(3), 215-229. https://doi.org/10.3402/rlt.v12i3.11255

Smith, S. G., & Sherwood, B. A. (1976). Educational uses of the PLATO computer system. *Science*, *192*(4237), 344-352. https://dpi.org/10.1126/science.769165

Stone, D. E., & Zheng, G. (2014). Learning management systems in a changing environment. *In Handbook of research on education and technology in a changing society* (pp. 756-767). IGI Global.

Stödberg, U. (2012). A research review of e-assessment. Assessment & Evaluation in Higher Education, 37(5), 591-604. http://doi.org/10.1080/02602938.2011.557496

Tan, P. J. B. (2013). Students' adoptions and attitudes towards electronic placement tests: A UTAUT analysis. American Journal of Computer Technology and Application, 1(1), 14-23.

Tang, D., & Chen, L. (2011, May). A review of the evolution of research on information Technology Acceptance Model. *In 2011 International Conference on Business Management and Electronic Information* (Vol. 2, pp. 588-591). IEEE. https://doi.org/10.1109/ICBMEI.2011.5917980

Taylor, S., & Todd, P. A. (1995). Understanding information technology usage: A test of competing models. *Information systems research*, *6*(2), 144-176. https://doi.org/10.1287/isre.6.2.144

Thompson, R. L., Higgins, C. A., & Howell, J. M. (1991). Personal computing: toward a conceptual model of utilisation. *MIS quarterly*, 125-143. https://doi.org/10.2307/249443

Tinoco, L. C., Barnette, N. D., & Fox, E. A. (1997). Online evaluation in WWW-based courseware. *ACM SIGCSE Bulletin*, *29*(1), 194-198. https://doi.org/10.1145/268085.268156

Turner, M., Kitchenham, B., Brereton, P., Charters, S., & Budgen, D. (2010). Does the technology acceptance model predict actual use? A Systematic Literature Review. *Information and Software Technology*, *52*(5), 463-479. https://doi.org/10.1016/j.infsof.2009.11.005

UNESCO. UNESCO's support: Educational response to COVID-19. (2020, May 28). https://en.unesco.org/covid19/educationresponse/support

Unger, S., & Meiran, W. R. (2020). Student Attitudes Towards Online Education during the COVID-19 Viral Outbreak of 2020: Distance Learning in a Time of Social Distance. *International Journal of Technology in Education and Science (IJTES), 4*(4), 256-266.

United Nations. (2020). *Policy Brief: Education during COVID-19 and beyond.* https://unsdg.un.org/resources/policy-brief-education-during-covid-19-and-beyond.

Venkatesh, V., & Davis, F. D. (1996). A model of the antecedents of perceived ease of use: Development and test. *Decision Sciences, 27*(3), 451-481. https://doi.org/10.1111/j.1540-5915.1996.tb00860.x

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, *46*(2), 186-204. https://doi.org/10.1287/mnsc.46.2.186.11926

Venkatesh, V., & Zhang, X. (2010). Unified theory of acceptance and use of technology: US vs. China. *Journal of global information technology management*, *13*(1), 5-27. https://doi.org/10.1080/1097198x.2010.10856507

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS quarterly*, 425-478. https://doi.org/10.2307/30036540

Wadley, M., Weaver, S. B., Curry, C., & Carthon, C. (2014). Pharmacy students' perceptions of ExamSoft® as the primary assessment tool in an integrated therapeutics course. *Currents in Pharmacy Teaching and Learning*, *6*(6), 815-821. https://doi.org/10.1016/j.cptl.2014.07.002

Wang, W., & Kingston, N. (2019). Adaptive Testing with a Hierarchical Item Response Theory Model. *Applied psychological measurement*, *43*(1), 51-67. https://doi.org/10.1177/0146621618765714

Wedlock, B. C., & Trahan, M. P. (2019). Revisiting the Unified Theory of Acceptance and the Use of Technology (UTAUT) Model and Scale: An Empirical Evolution of Educational Technology. *Research Issues in Contemporary Education*, *4*(1), 6-20. https://files.eric.ed.gov/fulltext/EJ1244613.pdf

Woolley, D. R. (1994). PLATO: The emergence of online community.

Xhelili, P., Ibrahimi, E., Rruci, E., & Sheme, K. (2021). Adaptation and Perception of Online Learning during COVID-19 Pandemic by Albanian University Students. *International Journal on Studies in Education (IJonSE), 3*(2), 103-111.

Yousafzai, S. Y., Foxall, G. R., & Pallister, J. G. (2007). Technology acceptance: a meta-analysis of the TAM: Part 1. *Journal of Modelling in Management, 2*(3), 251-280. https://doi.org/10.1108/17465660710834453

Citation

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CHAPTER 2: AN EXTENDED UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY MODEL FOR EDUCATION CONTEXTS

In early 2020, education institutions around the world were faced with unprecedented circumstances, as schools and universities closed their doors to contain the spread of COVID-19 (UNESCO, 2020). Responses in higher education were diverse, ranging from approaches in which established courses were offered with minimal adaptation through online meeting platforms such as Zoom and Microsoft teams, to the complete redevelopment of course curricula, allowing these to be offered in fully online, self-directed format (Crawford et al., 2020). The degree of challenge confronted by institutions in the shift from face-to-face to virtual or online delivery modes is likely to depend on many factors, including technological factors, e-learning system quality, and cultural factors, in addition to self-efficacy and trust factors (Almaiah et al., 2020). One variable that has been cited consistently as a possible impediment to the success of such initiatives is that of end-user acceptance.

Even prior to the rapid developments seen in response to the COVID-19 crisis, numerous studies had documented the variable uptake of learning technologies in universities based on end-users' acceptance levels (Al-Adwan et al., 2013; Fathema et al., 2015; Scherer et al., 2019). In connection with this research, many theoretical models have been proposed and applied to examine technology acceptance and usage in education over the last few decades. These include the *Theory of Reasoned Action* (TRA), the *Technology Acceptance Model* (TAM), the *Theory of Planned Behaviour*, and the *Model of Personal Computer Utilization* (Ajzen 1991; Davis 1989; Davis et al., 1989; Fishbein & Ajzen, 1975; Thompson et al., 1991). These models offer different accounts of the factors that influence technology acceptance, which include specific attributes of the technology and contextual factors.

Within this group, one of the original user acceptance models was the TAM, proposed by Davis in 1986. TAM, which is based on the TRA, is designed to explain why a user accepts

or rejects information technology (Ajzen & Fishbein, 1980; Davis, 1989; Davis et al., 1989). Within the model, Perceived usefulness (PU) is the extent to which an individual believes that using a particular system or technology will enhance his or her job performance. Perceived ease of use (PEOU) is the extent to which an individual believes that using a particular system or technology will require physical and mental effort. According to the TAM, one's actual use of a technology system will be directly or indirectly influenced by the PU and PEOU of the system, as well as by one's behavioural intentions and attitudes. The TAM also proposes that external factors (e.g., system design) will affect intention and actual use through mediated (i.e., indirect) effects on PU and PEOU (Davis, 1989).

In 2003, Venkatesh et al. (2003) then developed the Unified Theory of Acceptance and Use of Technology (UTAUT) by consolidating eight previous TAM theories (Davis, 1989, Taylor & Todd, 1995) and models (Ajzen, 1991; Compeau et al., 1999; Fishbein & Ajzen, 1975; Moore & Benbasat, 1991; Thompson et al., 1991). The UTAUT has since been used extensively by researchers to explain technology acceptance and use in a variety of contexts. Researchers have also analysed the strength and robustness of the UTAUT for predicting user behaviours, and have confirmed its strong explanatory power (Khechine et al., 2016). The current paper reviews research on the UTAUT model and proposes an extended UTAUT model which may enhance its power to predict technology acceptance in the context of educational technologies. The next sections will examine the UTAUT model and its applicability across various types of educational technology. The proposed extended UTAUT model is then described.

Unified Theory of Acceptance and Use of Technology Model

In the UTAUT, four constructs play a significant role as direct determinants of user acceptance and UB: (1) performance expectancy (PE), (2) effort expectancy (EE), (3) social influence (SI); and (4) facilitating conditions (FC). In the UTAUT, attitude toward using technology, self-efficacy and anxiety are not direct determinants of behavioural intentions (BI). A diagrammatic representation of the UTAUT model is shown in Figure 11.

In the UTAUT, PE is the degree to which an individual believes that using a system will benefit him or her in terms of job performance. EE is the degree of ease with which users can adopt the system (Venkatesh et al., 2003). SI is the extent to which an individual perceives

that 'important others' consider that he or she should use the system (Venkatesh et al., 2003). FC is the extent to which an individual believes that there is an existing organisational and technical infrastructure to support the use of the system (Venkatesh et al., 2003). BI is the individual's intention to use the technology.

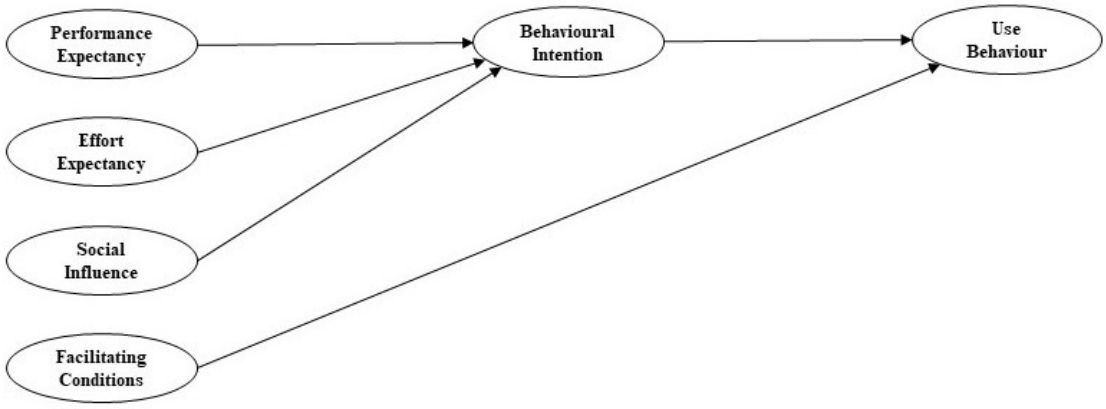

Figure 11. Unified Theory of Acceptance and Use of Technology [Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 425-478.]

With respect to the importance of these factors for predicting BI and UB, PE, EE, and SI are all proposed to be predictors of BI, and via BI as a mediator, of UB. Conversely, FC is not theorized to operate via BI, but more directly on UB, unless other predictors in the model are not present. Specifically, Venkatesh et al. (2003) pointed out that if EE is not included as a predictor of BI, FC will act as a significant predictor of BI. However, in the presence of both PE and EE, FC will not be a significant predictor of BI.

Empirical Research using the UTAUT

Since its development, the UTAUT has been used in numerous empirical studies to explore relationships between situational factors and technology use behaviour. For example, Bouzif (2017) examined students' continued intentions towards the use of a learning management system using the UTAUT model, while Al-Adwan et al. (2018) studied mobile learning adoption in higher education. In some of these studies, the UTAUT has been used in its original form (Bervell & Umar, 2017; Liao, Shim et al., 2004; Prasad et al., 2018). In others, it has been used as a part of the primary theoretical model or has been used alongside at least

one other theoretical model (termed a UTAUT 'integration' study by Venkatesh et al., 2016). An example of a UTAUT integration study was conducted by Chen and Hwang (2019). They examined self-regulation in terms of metacognition and motivation using the UTAUT model, to determine influences upon 312 Taiwanese college students' behavioural intentions to continue online courses. In a different context, Yang et al. (2019) examined a model that integrated UTAUT and the Connected Classroom Climate (CCC) model, in a study with 289 college students in China. Similar applications of the UTAUT model have been reported by other researchers such as Radovan and Kristl (2017) and Thongsri et al. (2018).

Many of the studies using the UTAUT, however, have incorporated part of or the complete UTAUT as a baseline model, but have modified the model to incorporate additional mechanisms (termed a UTAUT 'extension' study by Venkatesh et al., 2016). Four types of UTAUT extensions have been proposed in this literature: (1) the inclusion of new exogenous constructs (i.e., independent constructs, or those that are not dependent on other constructs in the model) and mechanisms; (2) the inclusion of new endogenous constructs (i.e., constructs that are dependent on other constructs in the model) and mechanisms; (3) the inclusion of new moderating constructs (i.e., factors that influence either the strength or valence of relationships between variables in the core model) and mechanisms; and (4) the inclusion of new outcome constructs (i.e., end-point endogenous variables) and mechanisms. As an example of a UTAUT extension study, Al-Adwan et al. (2018) added the new factors of trust expectancy, self-management of learning and system functionality to study BI to use mobile learning. Table 1 summarises studies that have applied the UTAUT in education contexts, either in its original form or as part of an integration or extension study.

Table 1. UTAUT in Educational Contexts

Technology / Theoretical Framework	Author(s)	Constructs	Additional Construct(s)
Web-based Learning	Liao et al. (2004)	PE; EE; SI; FC; Intention to Use the System; System Usage	-
	Yakubu & Dasuki (2018)	PE; EE; SI; FC; BI; Actual Use	-

Technology / Theoretical Framework	Author(s)	Constructs	Additional Construct(s)
Learning Management System	Bouznif (2017)	PE; EE; Superior Influences; Continued Usage Intention	Satisfaction
	Bervell & Umar (2017)	PE; EE; SI; FC; BI; UB	-
Blended Learning	Prasad et al. (2018)	PE; EE; SI; FC; BI; User Behaviour	-
e-Learning	Salloum & Shaalan (2018)	PE; EE; SI; FC; BI	-
Online Learning	Chen & Hwang (2019)	PE; EE; SI; BI	Metacognition; Motivation
Mobile learning	Wang et al. (2009)	PE; EE; SI; BI to use m-learning	Perceived Playfulness; Self-management of Learning
	Iqbal & Qureshi (2012)	SI; FC; Intention to Adopt M-learning	Ease of Use; Perceived Usefulness; Perceived; Playfulness
	Abu-Al-Aish & Love (2013)	PE; EE; BI to Use M-learning	Influence of Lecturers; Quality of Service; Personal Innovativeness
	Mtebe & Raisamo (2014)	PE; EE; SI; FC; BI	-
	Al-Adwan et al. (2018).	PE; EE; SI; BI	Trust Expectancy; System Functionality; Self-management of Learning
	Ali & Arshad (2018)	PE; EE; SI; FC; BI	Learners' Autonomy; Content Quality Design
	Alasmari & Zhang (2019)	EE; SI; FC; BI to Use Mobile Learning Technology; UB of Mobile Learning Technology	Learning Expectancy; M-Learning Technology Characteristics; Self-management of Learning
Desktop Video Conferencing technology	Lakhal et al. (2013)	PE; EE; FC; BI	General SI; Peer SI; Autonomy

Technology / Theoretical Framework	Author(s)	Constructs	Additional Construct(s)
Interactive Whiteboards	Wong et al. (2013)	PE; EE; SI; FC; BI	-
Software Engineering tools	Wrycza et al. (2017)	PE; EE; SI; FC; BI; UB	Professional Training Diffusion; Model Interchange
Video-based Instruction	Kissi et al. (2018)	PE; EE; SI; FC; BI	Task-Technology Fit; Perceived Control Over Time; Learning-Family Conflict
Wiki	Yueh et al. (2015)	PE; EE; SI; FC; BI; Actual Use	-
Computer-supported Collaborative Environment	Lin & Lin (2019)	PE; EE; SI; FC; BI; UB	Social Network Awareness
Open Educational Resources	Mtebe & Raisamo (2014)	PE; EE; SI; FC; BI to Adopt and Use OER; Actual Use of OER	-
Online Information Services	Oh & Yoon (2014)	PE; EE; SI; FC; BI; UB	Flow experience; Trust

Based on the literature cited in Table 1, the UTAUT has been applied extensively in empirical research on technology use behaviours. This is likely to reflect the high predictive power of the model compared with alternatives in the field. In their evaluations of various technology acceptance models, Samaradiwakara and Gunawardena (2014) compared existing theories and models and concluded that the UTAUT had the highest explanatory power amongst available models for explaining users' technology usage intentions. They concluded that this was because the determinants of BI and UB in the UTAUT incorporated eight earlier technology acceptance models. During the development of UTAUT, longitudinal data from entertainment, telecom services, banking, and public administration were used. The conceptualised UTAUT model was empirically tested using original data from the four organisations and then cross-validated using new data from another two organisations from the financial services and retail electronics industries. This careful approach to development ensured that the UTAUT integrated elements of different models that had appeared previously, enhancing its ability to predict user behaviours across a variety of contexts.

Empirical Results on the Predictions of the UTAUT Model

PE as a Predictor of BI

Venkatesh et al. (2003) posited that of the various predictors in the UTAUT, PE would have the strongest influence on BI, a proposition that has been borne out in many later empirical studies. Liao et al. (2004) adopted the UTAUT in its original form and found a significant positive influence of PE on the variable 'Intention to Use the System' in their study of student acceptance of web-based environments. Similarly, Prasad et al. (2018) found in their study on international students' reactions to blended learning that PE had a significant influence on BI. PE has also been found to remain an influencing factor on BI in 'UTAUT extension' studies (i.e., when additional constructs are included within the model).

For instance, in addition to all original UTAUT constructs, Oh and Yoon (2014) extended the UTAUT to include 'flow experience' (the overall sense that a person is acting with full consciousness) and trust mechanisms (the degree of confidence with which one can depend on others), and found that PE continued to have a significant positive influence on BI. In another study by Wrycza et al. (2017), the model was extended with professional training elements (i.e., the perceived flexibility and expressiveness of a training tool) and model interchange constructs (i.e., the capability of the tool to integrate seamlessly). PE continued to have a significant positive effect on BI, despite the inclusion of these additional constructs.

EE as a Predictor of BI

In contrast to the consistent results obtained for PE, the empirical results on EE as a predictor have been largely inconsistent. This has been true irrespective of whether the model tested is the original UTAUT or an extended form of the model. For instance, EE had a negative influence on BI in the study by Liao et al. (2004), but had a significant positive impact on BI in studies by Mtebe & Raisamo (2014) and Prasad at al. (2018).

Disparate results have also been obtained in extended UTAUT studies, with EE found to have varying influences on BI across different contexts (Ali & Arshad, 2018; Lakhal et al., 2013; Kissi et al., 2018; Lin & Lin; 2019; Wrycza et al., 2017). These inconsistent results may be attributable to the variable types of technology explored across studies. For instance, in UTAUT studies on learning management systems, EE has often been found to have no

significant effect on BI (Ali & Arshad, 2018; Bouznif, 2017; Liao et al., 2004; Salloum & Shaalan, 2018). However, when the UTAUT model has been applied in mobile learning studies, EE has often been found to have a significant effect on BI (Abu-Al-Aish & Love, 2013; Al-Adwan et al., 2018; Alasmari & Zhang, 2019; Almaiah et al., 2019; Mtebe & Raisamo, 2014; Wang et al, 2009).

SI as a Predictor of BI

The empirical results of SI as a predictor of BI have also not been entirely consistent across studies that have used the UTAUT model. In those that tested the original UTAUT, SI has been found to have a significant positive influence on BI (Liao et al., 2004; Prasad et al., 2018; Yueh et al., 2015; Mtebe & Raisamo, 2014; Salloum & Shaalan, 2018). However, in other studies, such as that by Wong et al. (2013), SI did not have any significant influence on BI. Similar disparities have also appeared across studies of extended UTAUT models. For example, Wang et al. (2009) extended the UTAUT by adding the constructs of perceived playfulness and self-management of learning in a study of 330 Taiwanese participants from five organisations (i.e., Aerospace Industrial Development Corporation, IBM Taiwan, National Changhua University of Education, Chung Chou Institute of Technology and Yuanlin Community University) and found that SI had a positive effect on BI, while Iqbal and Qureshi (2012) did not in their study of an extended UTAUT model (which included ease of use, perceived playfulness and perceived usefulness) with 250 students from 10 universities in Pakistan.

FC as a Predictor of UB

In many studies that appeared subsequent to the original UTAUT development studies, UB has often been omitted as a construct, and as a result, FC as a predictor of UB has also often been omitted. For instance, in the UTAUT study on interactive whiteboard acceptance by Wong et al. (2013), UB was omitted. For UTAUT studies that have included UB as a construct, however, findings have again been inconsistent. Some studies have reported that FC has significant influence on UB (Oh & Yoon, 2014; Prasad et al., 2018; Salloum & Shaalan, 2018) while various others have not (Alasmari & Zhang, 2019; Mtebe & Raisamo, 2014; Yueh et al., 2015). Therefore, the role of FC in predicting UB is unclear.

Implications for the Application of UTAUT across Different Forms of Technology

The UTAUT has been found to have a high level of general applicability. In other words, elements of this model have been found to be able significantly to predict user intentions and behaviours across a vast array of user groups, situations, and forms of technology. Venkatesh et al. (2016) summarised UTAUT research contexts according to (1) types of users (e.g. students, teachers, government employees and physicians); (2) types of technology (e.g. tablet PC, internet, web-based learning environment); (3) types of task (e.g. learning, research, social networking); (4) the timepoint at which users' adoption decisions were studied (e.g. adoption, use or adoption and use); (5) types of organisations (e.g. educational institutions, academic societies, government organisations); (6) geographical locations; and (7) the types of relationships that were studied (e.g., only UTAUT main effects, or the influence of UTAUT moderating variables).

The next sections summarise some of the research that has been conducted using the UTAUT across different forms of technology within education. These applications have indicated different relationships between the constructs within UTAUT depending on the form of technology that is being studied. Various studies have incorporated extensions to the UTAUT depending again on the type of technology under study, with these kinds of study being particularly prevalent in the mobile learning area.

UTAUT and Web-based Learning Management Systems

A web-based learning management system (LMS) is an online software application that presents and manages educational content and determines and evaluates educational objects (Forouzesh & Darvish, 2012). The UTAUT model has been utilised in various studies on the acceptance of web-based LMSs. For example, the UTAUT has been applied to study undergraduates' acceptance of LMSs in different countries (Bounzif, 2017; Liao et al., 2004; Salloum & Shaalan, 2018; Yakubu & Dasuki, 2018). In Australia, Prasad et al. (2018) also used the UTAUT to study postgraduate students' behavioural intentions in the use of blended learning programs. In Malaysia, Bervell and Umar (2017) identified new relationships among the UTAUT constructs in a study on LMS acceptance by tutors, while Chen and Hwang (2019) adopted an UTAUT model to examine how metacognition and motivation influenced students' behavioural intentions to continue online LMS-based courses in a Taiwanese

college. All of these studies have indicated that elements of the UTAUT significantly predicted users' intentions and behaviours in the LMS setting.

Numerous studies that have explored the use of the UTAUT model to study user acceptance in web-based LMS settings have, however, suggested that EE has no significant influence on BI (Ali & Arshad, 2018; Bouznif, 2017; Liao et al., 2004; Salloum & Shaalan, 2018) and that similarly, SI has no significant influence on BI (Bervell & Umar, 2017; Bouznif, 2017; Prasad et al., 2018; Yakubu & Dasuki, 2018). These observations are consistent with those reported outside the LMS setting (Ali & Arshad, 2018; Lakhal et al., 2013; Lin & Lin; 2019; Wrycza et al., 2017). One possible explanation for this is that the main participants in the studies on web-based LMSs have been university students, who do not use the LMS voluntarily. When the use of the system is non-voluntary, it is intuitively reasonable that the effect of EE and SI would be minimal. There is also likely to be no effect on BI as the students are simply required to use the system, which would make their peers' or instructors' expectations to do so irrelevant. Thus, the results of UTAUT studies in the LMS context are tenable.

UTAUT and Mobile Learning

Mobile learning refers to learning mediated with handheld devices (Barzegar, 2016). As compared to UTAUT studies in other educational technologies, a higher proportion of studies in mobile learning have extended the model to include other variables and constructs. For instance, in the studies conducted by Wang et al. (2009) and Iqbal and Qureshi (2012), the construct of 'perceived playfulness' was incorporated in the UTAUT model when studying mobile learning adoption. Self-management is another variable that has been of considerable interest to researchers in the mobile learning area. For example, studies by Al-Adwan et al. (2018) at four Jordanian universities, Alasmari and Zhang (2019) at a Saudi Arabian higher education institution, and Wang et al. (2009) at five organisations (i.e. Aerospace Industrial Development Corporation, IBM Taiwan, National Changhua University of Education, Chung Chou Institute of Technology and Yuanlin Community University) all introduced self-management as an additional construct in their UTAUT-based studies.

Other, more situation-specific extensions to the UTAUT have also been studied with respect to users' acceptance of mobile learning systems. For instance, Iqbal and Qureshi (2012)

included ease of use while Abu-Al-Aish and Love (2013) included the additional constructs of influence of lecturers, quality of service, and personal innovativeness to examine the factors influencing the acceptance of mobile learning in the study of 250 university students. Ali and Arshad (2018) added learners' autonomy and content quality as constructs to the original UTAUT when studying 386 students' acceptance of mobile learning. Besides examining self-management, Al-Adwan et al. (2018) also added trust expectancy and system functionality, whereas Alasmari and Zhang (2019) extended the UTAUT model by adding Learning Expectancy and M-Learning Technology Characteristics in a study of 1203 users' acceptance levels.

Among the studies that have applied the UTAUT model to explore the acceptance of mobile learning, the findings have mostly been aligned with Venkatesh et al.'s (2003) predictions. Specifically, PE, EE and SI have been found to be significant determinants of mobile learning acceptance, across numerous contexts (Abu-Al-Aish & Love, 2013; Al-Adwan et al., 2018; Alasmari & Zhang, 2019; Chao, 2019; Wang et al., 2009). However, some important departures have been evident. Specifically, several studies have suggested that FC directly influences BI, which departs from the theorisation in the original UTAUT model (Ali & Arshad, 2018; Almaiah et al., 2019; Bervell & Umar, 2017; Lakhal et al., 2013; Radovan & Kristl, 2017). For mobile learning acceptance studies, however, the relationship between BI and UB has rarely been examined.

UTAUT and Instructional Devices

UTAUT has also consistently been extended to study educational technology tools (Lakhal et al., 2013). For example, Wrycza et al. (2017) introduced two constructs, professional training diffusion (i.e. the perceived flexibility and expressiveness of a training tool) and model interchange (i.e., the capability of the tool to integrate seamlessly) to the original UTAUT model, to examine the acceptance of software engineering tools within Information Systems Development courses. Kissi et al. (2018) extended the UTAUT model by introducing constructs such as Learning–Family Conflict (i.e. household chores or outdoors activities that impede and interfere on students' attention to study at home), Perceived Control Over Time and Task-Fit Technology to investigate urban-rural high school students' acceptance of video-based instruction in the flipped learning approach. Findings in these contexts have been similar to those in applications of the UTAUT model to explore users' responses to web-

based LMSs. In other words, the findings typically showed that: (1) EE has no significant influence on BI (Kissi et al., 2018; Lakhal et al., 2013; Wrycza et al., 2017) and that (2) SI had no significant influence on BI (Kissi et al., 2018; Lakhal et al., 2013; Wong et al., 2013; Wrycza et al., 2017).

UTAUT and Online Collaboration Tools

Online educational services refer to any education-related information and services provided over the Internet. Mtebe and Raisamo (2014) adopted the UTAUT to examine barriers to instructors adopting and using open educational resources. Oh and Yoon (2014) added two additional constructs, 'flow experience' and 'trust' to the original UTAUT in their study on predicting the use of online information services. In both studies, EE was found to have a positive influence on BI. However, results for other relationships between elements of the model have been more variable. For instance, Mtebe and Raisamo (2014) found that FC, PE and SI did not have a significant effect on BI.

From the literature, some general observations can be drawn from the UTAUT research findings on various forms of educational technology. The original UTAUT model posits that PE will be the strongest determinant of BI. However, in the UTAUT studies on online collaboration tools, PE was found to have no significant influence on BI. In other words, the belief that online collaboration tools may not necessarily improve user performance did not deter them from using the technology. Among the UTAUT studies on web-based LMSs, instructional devices and online collaboration tools, EE was not found to influence BI in several studies. That is, in these studies, even when educational technologies were not perceived to be easy to use, prospective users still intended to use them for the affordances that they might bring. SI also did not consistently influence BI across all studies. Based on the diverse findings reported here, it appears that while the UTAUT has been found to be a versatile predictive model across contexts, the power of the constructs in the model to predict users' intentions can vary depending on the specific form of technology under study.

The Proposed Extended UTAUT Model

As noted previously, various researchers have proposed extensions to the original UTAUT model, incorporating additional constructs within specific settings. This has been particularly

apparent in research that has applied the UTAUT to study mobile learning applications. Here, we propose an extended UTAUT to study the factors that predict users' adoption of technology within education contexts (see Figure 12). This extended model includes two additional exogenous constructs (usability and learnability), which are proposed as predictors of PE, FC and SI. The construct of attitude, which is included in earlier TAM models, has also been re-incorporated as a predictor within the extended UTAUT model proposed.

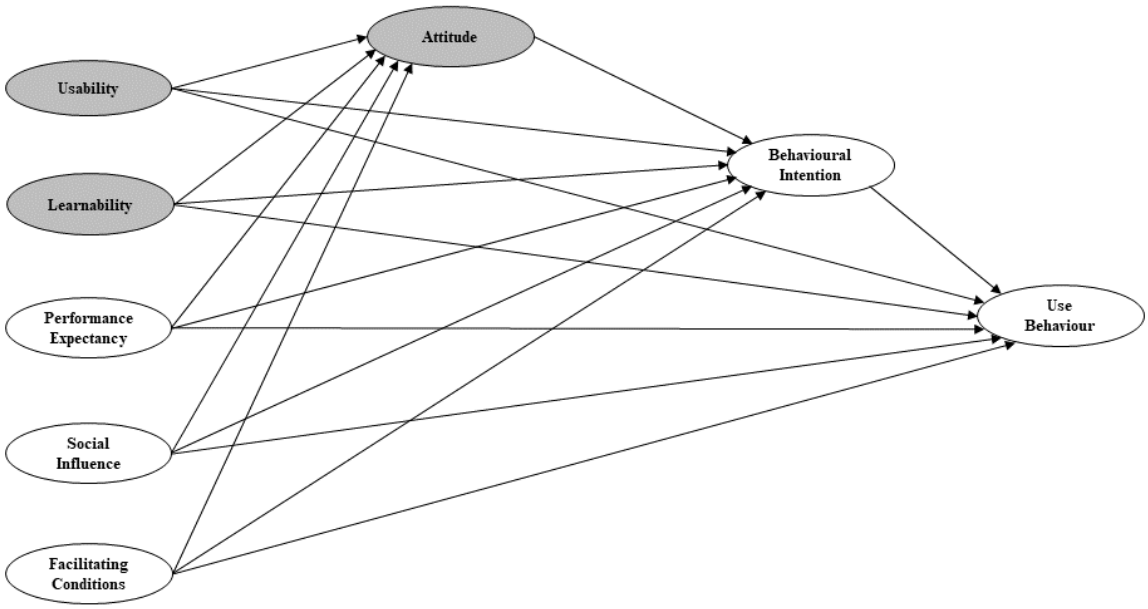

Figure 12. Extended UTAUT Model [Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 425-478.]

Usability is referred to as the degree of ease of use, to achieve system objectives with effectiveness, efficiency and satisfaction (Bevan et al., 2015; Jokela et al., 2003; Shackel, 2009). This new construct has been proposed because various studies outside the UTAUT literature have reported that factors of this kind have a significant influence on users' acceptance of educational technologies (Holden & Rada, 2011; Juarez Collazo et al., 2014; Lah et al., 2020; Lin, 2013; Tsakonas & Papatheodorou, 2008).

Learnability is defined as the ease and speed with which learners can become familiar with the the features and capabilities of a system, which will depend heavily on the quality of the system interfaces (Jeng, 2005; Nielsen, 1994). Although Zbick et al. (2015) had included usability and learnability in an earlier TAM model to study mobile learning adoption, the two

constructs have yet to be used in a UTAUT study. Learnability has been incorporated in light of findings outside the UTAUT literature that have reported that the ease with which systems can be learned can significantly influence user acceptance levels (Burney et al., 2017; Chiou et al., 2009; Jeng, 2005; Zbick et al., 2015).

From previous studies, PE is posed to be the strongest predictor of BI in the original UTAUT model (Venkatesh et al., 2003). While attitude has been omitted in the initial UTAUT development, follow-up studies have shown significant relationships between the UTAUT constructs and attitude (Botero et al., 2018; El-Gayar et al., 2011; Jairak et al., 2009; Shuhaiber, 2015; Šumak et al., 2010; Yakubu & Dasuki, 2018). Nassuora (2012) also found in the study on students' acceptance of mobile learning that FC had a positive influence on attitude towards behaviour. Past studies had also found that SI is positively related to attitude (Botero et al., 2018; Nassuora, 2012; Shuhaiber, 2015; Šumak et al., 2010).

Attitude, which was adapted from the TRA, was included in an earlier user acceptance model – the TAM (Ajzen & Fishbein, 1980; Davis, 1986; Davis et al., 1989). The TAM explains that the individual's attitude towards a given situation combines with subjective norms to shape behavioural intentions, which in turn influences the individual's actual behaviour. While attitudes were included in earlier TAM studies, it was excluded as a construct in the development of UTAUT. Despite this, in the UTAUT studies on tablet PC adoption by El-Gayar and Moran (2006), Moran et al. (2010) and El-Gayar et al. (2011), attitude toward using technology was found to have a significant influence on BI. Attitude has also found to have a significant influence on BI in studies on mobile learning adoption (Jairak et al., 2009; Nassuora, 2012; Thomas et al., 2013) and acceptance of educational technology tools like virtual lecturing system, mobile-assisted language learning system and social learning platforms (Botero et al., 2018; Khechine, & Augier, 2019; Shuhaiber, 2015).

Conclusion

While the UTAUT has been found to be a reliable and robust model to study and explain technology acceptance and use across various educational contexts, Venkatesh et al. (2003) proposed that the UTAUT could be further developed and extended in future studies across contexts. The extended UTAUT model proposed in this paper incorporates three new constructs: usability, learnability and attitude, which are proposed potentially to enhance the

predictive power of the UTAUT. With the proposed model, not only it addresses both the affective and cognitive aspects of technology acceptance (Taherdoost, 2018), it further examines possible relationships between the various constructs not theorised in the original UTAUT model.

Although the extended UTAUT model proposed here was designed primarily for application in educational contexts, the additional constructs incorporated might also be relevant in user acceptance studies in business and government institutions. Future research is clearly needed to validate the utility of the extended model, perhaps comparing this with the original to determine which of the two have the highest explanatory power across different contexts. The power of this and other extensions of the UTAUT to predict users' acceptance could then be compared across different types of users, types of technology and contexts, to provide a range of different models that are suitable for use in specific contexts. Such research would provide researchers and practitioners with a range of possible models that can be selected based on needs and objectives in given situations.

References

Abu-Al-Aish, A., & Love, S. (2013). Factors influencing students' acceptance of m-learning: an investigation in higher education. *The International Review of Research in Open and Distributed Learning*, *14*(5). https://doi.org/10.19173/irrodl.v14i5.1631

Ajzen, I. (1991). The theory of planned behavior. Organisational behavior and human decision processes, *50*(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Ajzen, I., & Fishbein, M. (1980). Understanding attitudes and predicting social behaviour.

Al-Adwan, A. S., Al-Adwan, A., & Berger, H. (2018). Solving the mystery of mobile learning adoption in higher education. *International Journal of Mobile Communications*, *16*(1), 24-49. http://www.academia.edu/download/57080624/IJMC_161_Paper2.pdf

Al-Adwan, A., Al-Adwan, A., & Smedley, J. (2013). Exploring students acceptance of e-learning using Technology Acceptance Model in Jordanian universities. *International Journal of Education and Development using ICT*, *9*(2). https://search-proquest-com.ezproxy.library.uwa.edu.au/docview/1437252040?accountid=14681

Alasmari, T., & Zhang, K. (2019). Mobile learning technology acceptance in Saudi Arabian higher education: an extended framework and A mixed-method study. *Education and*

Information Technologies, 24(3), 2127-2144. https://doi.org/10.1007/s10639-019-09865-8

Ali, R. A., & Arshad, M. R. M. (2018). Empirical Analysis on Factors Impacting on Intention to Use M-learning in Basic Education in Egypt. *The International Review of Research in Open and Distributed Learning*, *19*(2). https://doi.org/10.19173/irrodl.v19i2.3510

Almaiah, M. A., Al-Khasawneh, A., & Althunibat, A. (2020). Exploring the critical challenges and factors influencing the E-learning system usage during COVID-19 pandemic. *Education and Information Technologies*, 1. https://doi.org/10.1007/s10639-020-10219-y

Al-Adwan, A. S., Al-Adwan, A., & Berger, H. (2018). Solving the mystery of mobile learning adoption in higher education. *International Journal of Mobile Communications*, *16*(1), 24-49. http://www.academia.edu/download/57080624/IJMC_161_Paper2.pdf

Barzegar, R. (2016). Revolution in E-Learning by the Modern Educational Model in Mobile Learning. *Journal of Advances in Computer Engineering and Technology*, *2*(1), 45-52. http://jacet.srbiau.ac.ir/article_8871_c5eff43b13e1c71816821b2579ee912b.pdf

Bervell, B., & Umar, I. N. (2017). Validation of the UTAUT Model: Re-Considering Non-Linear Relationships of Exogeneous Variables in Higher Education Technology Acceptance Research. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(10), 6471-6490. https://www.ejmste.com/download/validation-of-the-utaut-model-re-considering-non-linear-relationships-of-exogeneous-variables-in-5041.pdf

Bevan, N., Carter, J., & Harker, S. (2015, August). ISO 9241-11 revised: What have we learnt about usability since 1998?. *In International Conference on Human-Computer Interaction* (pp. 143-151). Springer, Cham. https://doi.org/10.1007/978-3-319-20901-2_13

Botero, G. G., Questier, F., Cincinnato, S., He, T., & Zhu, C. (2018). Acceptance and usage of mobile assisted language learning by higher education students. *Journal of Computing in Higher Education*, *30*(3), 426-451. https://doi.org/10.1007/s12528-018-9177-1

Bouznif, M. (2017). Business Students' Continuance Intention toward Blackboard Usage: An Empirical Investigation of UTAUT Model. *International Journal of Business and Management*, *13*(1), p.120. https://doi.org/10.5539/ijbm.v13n1p120

Burney, S. A., Ali, S. A., Ejaz, A., & Siddiqui, F. A. (2017). Discovering the correlation between technology acceptance model and usability. *IJCSNS*, *17*(11), 53. http://paper.ijcsns.org/07_book/201711/20171107.pdf

Chao, C. M. (2019). Factors determining the behavioral intention to use mobile learning: An application and extension of the UTAUT model. *Frontiers in psychology*, *10*, 1652. https://doi.org/10.3389/fpsyg.2019.01652

Chen, P. Y., & Hwang, G. J. (2019). An empirical examination of the effect of self-regulation and the Unified Theory of Acceptance and Use of Technology (UTAUT) factors on the online learning behavioural intention of college students. *Asia Pacific Journal of Education*, 1-17. https://doi.org/10.1080/02188791.2019.1575184

Chiou, W. C., Perng, C., and Lin, C. C. (2009, July). The relationship between technology acceptance model and usability test-case of performing E-learning task with PDA. In 2009 WASE International Conference on Information Engineering (Vol. 1, pp. 579-582). IEEE. https://doi.org/10.1109/ICIE.2009.207

Compeau, D., Higgins, C. A., & Huff, S. (1999). Social cognitive theory and individual reactions to computing technology: A longitudinal study. *MIS quarterly*, 145-158. https://doi.org/10.2307/249749

Crawford, J., Butler-Henderson, K., Rudolph, J., & Glowatz, M. (2020). COVID-19: 20 Countries' Higher Education Intra-Period Digital Pedagogy Responses. *Journal of Applied Teaching and Learning (JALT)*, *3*(1). https://eprints.utas.edu.au/34123/2/138340%20-%20COVID-19.%2020%20countries%27%20higher%20education%20intra-period%20digital%20pedagogy%20responses.pdf

Davis, F. D. (1986). *A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory and Results*». Diss. Massachusetts Institute of Technology. https://dspace.mit.edu/bitstream/handle/1721.1/15192/14927137-MIT.pdf

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 319-340. https://doi.org/10.2307/249008

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management Science*, *35*(8), 982-1003. https://doi.org/10.1287/mnsc.35.8.982

El-Gayar, O. F., & Moran, M. (2006). College students' acceptance of Tablet PCs: An application of the UTAUT Model. *Dakota State University*, *820*, 2845-2850.

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.120.2667&rep=rep1&type=pdf

El-Gayar, O., Moran, M., & Hawkes, M. (2011). Students' acceptance of tablet PCs and implications for educational institutions. *Journal of Educational Technology & Society*, *14*(2). https://search-proquest-com.ezproxy.library.uwa.edu.au/docview/2139143267?accountid=14681

Fathema, N., Shannon, D., & Ross, M. (2015). Expanding the Technology Acceptance Model (TAM) to examine faculty use of Learning Management Systems (LMSs) in higher education institutions. *Journal of Online Learning & Teaching*, *11*(2). http://jolt.merlot.org/Vol11no2/Fathema_0615.pdf

Fishbein, M., & Ajzen, I. (1975). Belief, attitude, intention and behavior: An introduction to theory and research.

Forouzesh, M., & Darvish, M. (2012). Characteristics of Learning Management System (LMS) and its Role in Education of Electronics. *eLearning & Software for Education*, (1). https://search.proquest.com/docview/1287983492?accountid=40699

Holden, H., & Rada, R. (2011). Understanding the influence of perceived usability and technology self-efficacy on teachers' technology acceptance. *Journal of Research on Technology in Education*, *43*(4), 343-367. https://doi.org/10.1080/15391523.2011.10782576

Iqbal, S., & Qureshi, I. A. (2012). M-learning adoption: A perspective from a developing country. *The International Review of Research in Open and Distributed Learning*, *13*(3), 147-164. https://doi.org/10.19173/irrodl.v13i3.1152

Jairak, K., Praneetpolgrang, P., & Mekhabunchakij, K. (2009, December). An acceptance of mobile learning for higher education students in Thailand. *In Sixth International Conference on eLearning for Knowledge-Based Society, Thailand* (Vol. 17, No. 18, pp. 361-368). http://ijcim.th.org/SpecialEditions/v17nSP3/36_Full_Kallaya%20Jairak_Online.pdf

Jeng, J. (2005). Usability assessment of academic digital libraries: effectiveness, efficiency, satisfaction, and learnability. *Libri*, *55*(2-3), 96-121. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.106.1655&rep=rep1&type=pdf

Jokela, T., Iivari, N., Matero, J., & Karukka, M. (2003, August). The standard of user-centered design and the standard definition of usability: analysing ISO 13407 against

ISO 9241-11. *In Proceedings of the Latin American conference on Human-computer interaction* (pp. 53-60). https://doi.org/10.1145/944519.944525

Juarez Collazo, N. A., Wu, X., Elen, J., & Clarebout, G. (2014). Tool use in computer-based learning environments: Adopting and extending the technology acceptance model. *International Scholarly Research Notices*, *2014*. https://doi.org/10.1155/2014/736931

Khechine, H., Lakhal, S., & Ndjambou, P. (2016). A meta-analysis of the UTAUT model: Eleven years later. *Canadian Journal of Administrative Sciences/Revue Canadienne des Sciences de l'Administration*, *33*(2), 138-152. https://doi.org/10.1002/cjas.1381

Khechine, H., & Augier, M. (2019, January). Adoption of a Social Learning Platform in Higher Education: An Extended UTAUT Model Implementation. *In Proceedings of the 52nd Hawaii International Conference on System Sciences*. https://scholarspace.manoa.hawaii.edu/bitstream/10125/59446/1/0006.pdf

Kissi, P. S., Nat, M., & Armah, R. B. (2018). The effects of learning–family conflict, perceived control over time and task-fit technology factors on urban-rural high school students' acceptance of video-based instruction in flipped learning approach. *Educational Technology Research and Development*, *66*(6), 1547-1569. https://doi.org/10.1007/s11423-018-9623-9

Lah, U., Lewis, J. R., & Šumak, B. (2020). Perceived usability and the modified Technology Acceptance Model. *International Journal of Human–Computer Interaction*, 1-15. https://doi.org/10.1080/10447318.2020.1727262

Lakhal, S., Khechine, H., & Pascot, D. (2013). Student behavioural intentions to use desktop video conferencing in a distance course: integration of autonomy to the UTAUT model. *Journal of Computing in Higher Education*, *25*(2), 93-121. https://doi.org/10.1007/s12528-013-9069-3

Liao, Q., Shim, J. P., & Luo, X. (2004). Student acceptance of web-based learning environment: An empirical investigation of an undergraduate IS course. *AMCIS 2004 Proceedings*, 377. https://pdfs.semanticscholar.org/08a6/61f75a828e418911ecc5e7bb5a28455cc58a.pdf

Lin, C. C. (2013). Exploring the relationship between technology acceptance model and usability test. *Information Technology and Management*, *14*(3), 243-255. https://doi.org/10.1007/s10799-013-0162-0

Lin, J. W., & Lin, H. C. K. (2019). User acceptance in a computer-supported collaborative learning (CSCL) environment with social network awareness (SNA) support.

Australasian Journal of Educational Technology, *35*(1), 100-115. https://doi.org/10.14742/ajet.3395

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information systems research*, *2*(3), 192-222. https://doi.org/10.1287/isre.2.3.192

Moran, M., Hawkes, M., & Gayar, O. E. (2010). Tablet personal computer integration in higher education: Applying the unified theory of acceptance and use technology model to understand supporting factors. *Journal of Educational Computing Research*, *42*(1), 79-101. https://doi.org/10.2190/ec.42.1.d

Mtebe, J., & Raisamo, R. (2014). Investigating students' behavioural intention to adopt and use mobile learning in higher education in East Africa. *International Journal of Education and Development using ICT*, *10*(3). https://search-proquest-com.ezproxy.library.uwa.edu.au/docview/1561442025?accountid=14681

Nassuora, A. B. (2012). Students acceptance of mobile learning for higher education in Saudi Arabia. *American Academic & Scholarly Research Journal*, *4*(2), 24-30. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.402.6814&rep=rep1&type=pdf

Nielsen, J. (1994). *Usability engineering*. Morgan Kaufmann.

Oh, J. C., & Yoon, S. J. (2014). Predicting the use of online information services based on a modified UTAUT model. *Behaviour & Information Technology*, *33*(7), 716-729. https://doi.org/10.1080/0144929x.2013.872187

Prasad, P. W. C., Maag, A., Redestowicz, M., & Hoe, L. S. (2018). Unfamiliar technology: Reaction of international students to blended learning. *Computers & Education*, *122*, 92-103. https://doi.org/10.1016/j.compedu.2018.03.016

Radovan, M., & Kristl, N. (2017). Acceptance of Technology and Its Impact on Teachers' Activities in Virtual Classroom: Integrating UTAUT and CoI into a Combined Model. *Turkish Online Journal of Educational Technology-TOJET*, *16*(3), 11-22. https://search-proquest-com.ezproxy.library.uwa.edu.au/docview/1953141374?accountid=14681

Salloum, S. A., & Shaalan, K. (2018, September). Factors Affecting Students' Acceptance of E-Learning System in Higher Education Using UTAUT and Structural Equation Modeling Approaches. *In International Conference on Advanced Intelligent Systems and Informatics* (pp. 469-480). Springer, Cham. https://doi.org/10.1007/978-3-319-99010-1_43

Samaradiwakara, G. D. M. N., & Gunawardena, C. G. (2014). Comparison of existing technology acceptance theories and models to suggest a well-improved theory/model. *International Technical Sciences Journal*, *1*(1), 21-36. https://enos.itcollege.ee/~edmund/inf-hw/seminaritoo/itsj-spec-1-1-3.pdf

Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. *Computers & Education*, *128*, 13-35. https://doi.org/10.1016/j.compedu.2018.09.009

Shackel, B. (2009). Usability–Context, framework, definition, design and evaluation. *Interacting with computers*, *21*(5-6), 339-346. https://doi.org/10.1016/j.intcom.2009.04.007

Shuhaiber, A. (2015). Students' Willingness to Accept Virtual Lecturing Systems: An Empirical Study by Extending the UTAUT Model. *World Academy of Science, Engineering and Technology, International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, *9*(4), 1169-1173. https://pdfs.semanticscholar.org/7869/ae3f1c2378bac6b1c1501de1c5f0df409a6c.pdf

Šumak, B., Polancic, G., & Hericko, M. (2010, February). An empirical study of virtual learning environment adoption using UTAUT. In *2010 Second international conference on mobile, hybrid, and on-line learning* (pp. 17-22). IEEE. https://doi.org/10.1109/eLmL.2010.11

Taherdoost, H. (2018). A review of technology acceptance and adoption models and theories. *Procedia manufacturing*, *22*, 960-967. https://doi.org/10.1016/j.promfg.2018.03.137

Taylor, S., & Todd, P. A. (1995). Understanding information technology usage: A test of competing models. *Information systems research*, *6*(2), 144-176. https://doi.org/10.1287/isre.6.2.144

Thomas, T., Singh, L., & Gaffar, K. (2013). The utility of the UTAUT model in explaining mobile learning adoption in higher education in Guyana. *International Journal of Education and Development using ICT*, *9*(3). https://search-proquest-com.ezproxy.library.uwa.edu.au/docview/1491114969?accountid=14681

Thompson, R. L., Higgins, C. A., & Howell, J. M. (1991). Personal computing: toward a conceptual model of utilisation. *MIS quarterly*, 125-143. https://doi.org/10.2307/249443

Thongsri, N., Shen, L., Bao, Y., & Alharbi, I. M. (2018). Integrating UTAUT and UGT to explain behavioural intention to use M-learning. *Journal of Systems and Information Technology*. https://doi.org/10.1108/JSIT-11-2017-0107

Tsakonas, G., & Papatheodorou, C. (2008). Exploring usefulness and usability in the evaluation of open access digital libraries. *Information processing & management*, *44*(3), 1234-1250. https://doi.org/10.1016/j.ipm.2007.07.008

UNESCO. *UNESCO's support: Educational response to COVID-19*. (2020, May 28). https://en.unesco.org/covid19/educationresponse/support

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS quarterly*, 425-478. https://doi.org/10.2307/30036540

Venkatesh, V., Thong, J. Y., & Xu, X. (2016). Unified theory of acceptance and use of technology: A synthesis and the road ahead. *Journal of the Association for Information Systems*, *17*(5), 328-376. https://doi.org/10.17705/1jais.00428

Wang, Y. S., Wu, M. C., & Wang, H. Y. (2009). Investigating the determinants and age and gender differences in the acceptance of mobile learning. *British journal of educational technology*, *40*(1), 92-118. https://doi.org/10.1111/j.1467-8535.2007.00809.x

Wong, K. T., Teo, T., & Russo, S. (2013). Interactive whiteboard acceptance: Applicability of the UTAUT model to student teachers. *The Asia-Pacific Education Researcher*, *22*(1), 1-10. https://doi.org/10.1007/s40299-012-0001-9

Wrycza, S., Marcinkowski, B., & Gajda, D. (2017). The enriched UTAUT model for the acceptance of software engineering tools in academic education. *Information Systems Management*, *34*(1), 38-49. https://doi.org/10.1080/10580530.2017.1254446

Yakubu, M. N., & Dasuki, S. I. (2019). Factors affecting the adoption of e-learning technologies among higher education students in Nigeria: A structural equation modelling approach. *Information Development*, *35*(3), 492-502. https://doi.org/10.1177/0266666918765907

Yang, H. H., Feng, L., & MacLeod, J. (2019). Understanding College Students' Acceptance of Cloud Classrooms in Flipped Instruction: Integrating UTAUT and Connected Classroom Climate. *Journal of Educational Computing Research*, *56*(8), 1258-1276. https://doi.org/10.1177/0735633117746084

Yueh, H. P., Huang, J. Y., & Chang, C. (2015). Exploring factors affecting students' continued Wiki use for individual and collaborative learning: An extended UTAUT

perspective. *Australasian Journal of Educational Technology*, *31*(1). https://doi.org/10.14742/ajet.170

Zbick, J., Nake, I., Milrad, M., & Jansen, M. (2015, July). A web-based framework to design and deploy mobile learning activities: Evaluating its usability, learnability and acceptance. *In 2015 IEEE 15th International Conference on Advanced Learning Technologies* (pp. 88-92). IEEE. https://core.ac.uk/download/pdf/192383918.pdf

Citation

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CHAPTER 3: STUDENTS' AND TEACHERS' ACCEPTANCE OF ONLINE ASSESSMENT IN HIGHER EDUCATION: RECOMMENDATIONS FOR FURTHER RESEARCH

Educational technologies have evolved over the years to become an integral part of teaching and learning processes in the higher education sector. The early 1960s marked the first attempt to use computers to assist education assessment processes (Woolley, 1994), with web-based online testing software then introduced in the 1990s (Bull & Stephens, 1999). In more recent times, with reduced teaching resources and increased student numbers, teachers across all levels of education have needed to do more with less by adopting technology (Donnelly, 2014; Nicol, 2007). This trend has given rise to the rapid growth of online learning and assessment approaches within the higher education sector. As a consequence, over the last two decades, online assessment has come to replace paper-based assessments in many colleges and universities (Boitshwarelo et al., 2017).

The novel coronavirus (COVID-19) pandemic saw education systems around the world confront tremendous challenges due to the shutting down of schools and university campuses. In this context, such institutions were forced to find ways to continue teaching and learning activities without the physical attendance of staff members or students (UNESCO, 2020). Inevitably, many schools and universities turned to online learning platforms to address this need. The same challenges were seen in terms of implementing student assessments, and UNESCO (2020) listed a shift to online assessment as one of the five main strategies that countries had adopted to manage high-stakes assessments during the COVID-19 crisis.

In the next few sections, we discuss different forms of online assessment, as well as the potential of online assessment to enhance processes and outcomes in education institutions. This includes a consideration of how students and teachers have been reported to respond to online assessment, based on the existing literature. We then propose the need for an integrated theoretical model to direct future research on users' acceptance of online

assessment approaches. The paper focuses exclusively on the use of online assessment within higher education, given that the challenges confronted by end-users within schools are likely to differ from those of users based in colleges and universities.

Forms and Potential Advantages of Online Assessment

The term online assessment is often used interchangeably with the terms, *electronic assessment* or *e-assessment* (Jordan, 2013), *computer-assisted assessment* (Bull & McKenna, 2003; Sim et al., 2004), *computer-mediated assessment* (Huot, 1996) and *computer-based assessment* (Fluck et al., 2009). While there are subtle differences in the way that these terms are used across publications, all refer to the use of some computerised technology to deliver assessment tasks (Bull, 1999). Various types of computer-assisted assessment have been described in the research literature, including:

- Optical mark reading (OMR), also known as "mark sensing", in which a computer is used to mark scripts composed initially on paper. This is a technique which senses the presence or absence of marks by recognising their depth of darkness on an answer sheet, filled with a pencil or ballpoint pen (Deng et al., 2008).
- Online or e-portfolios, in which a computer is used to collect scripts or written work (McLoughlin, 2003).
- Computer-based assessment, which involves a computer program marking answers, entered directly into digital form (Fluck et al., 2009). This approach can be subdivided into stand-alone applications that only require a single computer with applications that work on private networks, and those designed to be delivered across public networks such as web-based online assessment (Conole & Warburton, 2005).

Online assessment approaches have been reported to offer several advantages over paper-based assessment. These include:

(i) *Providing immediate and anonymous feedback to students on assignments and assessments* (Barkley, 2002; Llamas-Nistal et al., 2013; Spivey & McMillan, 2014; Ridgway et al., 2004). Immediate feedback rewards well-prepared students and encourages students who did not perform well to enhance their performance. Teachers also have more control over when feedback is given using this approach. For example, teachers can set feedback to be delivered after a specific time interval once questions are completed. Varying degrees of feedback such as test scores, test scores with correct

answers, or test scores with detailed solutions may be provided.

(ii) *Making assessment more efficient, particularly in cases where large candidatures are assessed* (Gipps, 2005). With online assessment, teachers can test students on a wide range of topics in one short test easily (Boitshwarelo et al., 2017; Brady, 2005). The ability to create, manage, and deploy online assessment means that a large part of the manual grading work can be automated. This not only reduces the instructional and administrative costs of teaching courses with large enrolments, but also indirectly affects the amount of learning that takes place in the course by lowering the costs of administering more frequent assessments.

(iii) *Reducing costs*. Placing course material online can result in significant cost savings because paper, copying, and distribution expenses are all reduced or sometimes eliminated. Copying and delivery of assignments to classes with massive enrolments are often costly and inefficient (Barkley, 2002). Faculties wanting to reduce expenditures are likely to support the transition from paper assignments and assessments to online assessment.

(iv) *Increasing assessment reliability*. Online assessment has been found to improve examination and testing reliability with machine marking, improved impartiality, and enhanced question styles that incorporate interactivity and multimedia (James et al., 2002; Mora et al., 2012).

(v)*Moving examinations out of regular class time, allowing teachers to cover more content or the same content in more depth* (Barkley, 2002; Barua, 1999). Online assessment also allows the offering of flexible testing times, delivery periods and frequent testing (Spivey & McMillan, 2014).

(vi) *Facilitating distance-learning courses*. As online assessment only requires a computer device and internet connection, there is no need for students to be on campus. As such, online assessment has the potential to transform teaching and learning by removing the constraints of time, distance and space (Cirit, 2015; Lei & Gupta, 2010).

Students' Acceptance of Online Assessment

Various studies have affirmed that testing format typically has little or no effect on actual academic performance (Anakwe, 2008; Bloom et al., 2018; Escudier et al., 2011; Spivey & McMillan, 2014; Wadley et al., 2014; Zandvliet & Farragher, 1997). Based on the results of this kind, students do not appear typically to be disadvantaged through the use of online

assessment approaches. Despite these findings and the potential advantages of the approach, the success and adoption of online assessment in education settings will inevitably hinge upon its acceptance by end-users - namely, the educators and students. As a result, we must look at how educators and students perceive and respond to this approach, as well as its impact on the teaching and learning process.

The majority of student acceptance studies that have appeared with respect to online assessment have focused on its use in medical and/or health education (Bloom et al., 2018; Boevé et al., 2015; Deutsch et al., 2012; Jawaid et al., 2014; Lewis & Sewell, 2007; Usir & Ahamad, 2017; Wadley et al., 2014), with a smaller number examining its use in subject areas such as engineering (Riera Guasp et al., 2018), foreign language studies (Fageeh, 2015) and social science education (Hewson & Charlton, 2019). This section presents a brief review of studies that have appeared internationally across these discipline areas.

Deutsch et al. (2012) conducted a study at Leipzig Medical School, in which all enrolled fourth-year medical students in one year took a web-based 'mock' examination. The majority of participants indicated that they felt confident in dealing with computers, with female students being significantly less convinced of their abilities in this regard. Students' views of online assessment were also found to improve after completing the assessment, with respect to their overall attitudes towards online assessment; its perceived ease of use; the perceived objectivity of the assessment; and their acceptance of computer or web-based methods in the teaching and learning process. Differences in attitudes across male and female students seemed to be attributable to differences in their perceptions of computer self-efficacy. Initially, females' reservations about technical problems affecting the accomplishment of online assessment were significantly higher than those of males. However, female students' overall attitudes towards online assessment were found to shift positively after undergoing the assessment. Although different before the test, male and female students' attitudes were found to be similar after the exposure to the web-based examination.

Kumar et al. (2013) surveyed 126 first-year medical students on the use of an online portal for assessment in India. Results indicated that students felt comfortable in using the online assessment approach and that they had favourable attitudes toward the immediate feedback this approach afforded. Other comments from students indicated that they saw additional advantages to the approach, which included the reduced potential for errors, the potential for

to enhance the testing of knowledge depth, and the flexibility afforded by the approach (e.g., the ease with which respondents can deselect answers on re-considering their choices).

Jawaid et al. (2014) conducted a study with 173 Dow University of Health Sciences postgraduate residents on their perceptions of online assessment and their preferences for paper-based or online assessment. Results indicated that while 23.6% of the residents were not entirely confident in using the approach before sitting the online assessment, 64.8% were either confident or extremely confident in undertaking online assessments after their initial experiences with it. A common problem (28.9%) encountered by students was logging in, which would typically be an issue that is easily addressed. In all, 61.8% rated online assessment as better overall than paper-based assessment after experiencing it for the first time.

Several studies have been conducted to examine students' responses to online assessment in other health science disciplines. For example, in 2013, the Campbell University College of Pharmacy and Health Sciences adopted the use of ExamSoft® assessment program in all required courses in the Doctor of Pharmacy program (Bloom et al., 2018). In a survey of 269 students who completed the assessments, findings showed no significant differences in perceived comfort with the approach based on gender, age, or prior experience with online courses or assessment. Although the student population as a whole felt comfortable using ExamSoft®, there was evidence that specific sub-populations held different perceptions. Younger male students were found to be more likely to be comfortable with ExamSoft®, which was attributed to a higher level of prior familiarity with computers. Students using computers for daily routine tasks, like taking notes in the class were also more likely to report that the feedback provided after the online exam was useful for understanding their performance. The same group of students was also less likely than those who reported difficulties in using ExamSoft® to perceive a negative impact on their examination performance.

Cirit (2015) conducted a study with pre-service teachers to access their perceptions towards paper-based, online and alternative assessments and to examine whether their attitudes changed toward the types of assessment after Web 2.0 tools were implemented. The analysis of the survey data with 155 participants showed a positive attitude towards the use of online assessment methods. In particular, participants felt that online assessment appealed to

different types of learners, and was helpful because teachers did not have to be in the same physical location as the students. The participants reported a highly positive attitude towards online assessment for English language and teaching skills. They felt that online assessment could provide authentic tools that other assessment methods could not in English methodology courses. Most importantly, these participants agreed they would like to use online assessment methods in their English courses when they graduated and become teachers.

A few studies on attitudes toward online assessment have also appeared focusing on students in engineering, computer science, foreign language and social science education. In one study focusing on first-year engineering students, Riera Guasp et al. (2018) studied perceptions of online examinations in the context of blended assessment with 463 students from Universitat Politècnica de València, Spain. In this study, Auto-scored Computer-Based Assessment (ACBA) was used as part of the blended assessment in the subject of physics for first-year Engineering degrees. Results showed that there was an overall positive perception of the ACBA tool, especially with respect to its ease of use, and its utility during the learning process, because the ACBA tests helped students prepare for their examinations. Despite this, students were critical of the rigidity of the automatic scoring process used.

In the area of foreign language studies, Fageeh (2015) reported that students were willing to convert to web-based assessment activities in a study of students' and faculty members' attitudes towards online testing using the Blackboard learning management system. The survey was conducted with 400 students and 25 faculty members, at the Faculty of Languages & Translation, King Kalid University. Findings indicated that the students were confident in taking the online assessments, and enjoyed using Blackboard for this purpose. They reported perceiving this approach as useful for undertaking their language assessments.

In contrast to the positive results reported above, in a study with 401 first-year psychology students at the University of Groningen in the Netherlands, Boevé et al. (2015) found that approximately 50% of the students they surveyed indicated a preference for paper-based multiple-choice examinations before taking their first computer-based examinations, with 25% indicating no preference for the medium of assessment, and only 25% indicating a preference for computer-based assessment. After completing their first computer-based assessment, 16% remained positive, 43% of students felt more positive, 12% remained

negative, 14% felt more negative, and 15% remained indifferent towards computer-based examinations.

It is clear from this review that while the majority of studies conducted thus far have suggested an overall positive response from students toward online assessment, findings from others have been more mixed. Such mixed responses accumulated from system usage problems faced by students as well as the negative and indifferent attitudes towards online assessment system, and the automatic scoring process within (Boevé et al., 2015; Jawaid et al., 2014; Riera Guasp et al., 2018). While the level of detail provided in these papers did not allow for the identification of the critical factors that moderated students' responses, it is likely that the specific characteristics of the online assessment approaches or systems used in each study contributed to this variability.

Teachers' Acceptance of Online Assessment

While various studies have appeared on students' perceptions of, and attitudes towards, online assessment, studies on *teachers'* responses to online assessment have been more scarce. Among these studies, Jamil et al. (2012) surveyed 314 teachers in Pakistan universities on their perceptions on computer-based and paper-based examinations. Results indicated that while the majority of the teachers disagreed with the statement that computer-based testing was the 'worst' tool for assessment, they did note the need for a 'master plan' to introduce computer-based examinations at the national level. Collectively, they also agreed that using computers minimised clerical mistakes and that computer-based examinations allowed them to assess more students in less time. In an online study with a random sample of 25 teachers from the English department in King Khalid University, Fageeh (2015) confirmed that most teachers were willing to convert to web-based assessment activities using the Blackboard learning management system. Findings showed that teachers had positive attitudes to apply e-testing technology in delivering formative and summative assessment online, believing that this technology was an assistive learning tool that was complementary to e-learning. However, when the effect of age on attitudes on online assessment was examined, there was a difference in attitudes towards online testing across different age groups of teachers. The findings did not indicate which age group was more positive. This finding, however, does suggest a potentially important moderator variable in educators' attitudes to the introduction of online assessment methods.

Hamsatu et al. (2016) conducted a study with 30 teachers in a Nigerian higher institution and found that although these teachers agreed that online assessment was helpful, the potential benefits were not reflected in students' assessment performances. Teachers commented in this study that the use of online assessment might provide too much opportunity for the students to check their answers, and thus, could encourage 'laziness' in the students. The teachers also expressed the view that the assessment process should not be over-dependent on technology. However, the majority affirmed that online assessment was time-saving and lessened the burden associated with examination processing.

Bloom et al. (2018) reported that faculty members had difficulties with computers when an ExamSoft® assessment program was implemented at the Campbell University College of Pharmacy and Health Sciences. Of the 35 faculty members who responded to the survey, 68% reported they had trouble at least once while creating an online examination, and 59% reported having had at least one problem during the administration of an examination. The faculty members did not perceive an impact on examination performance due to the adoption of ExamSoft®, and the analysis of examination grades indicated no significant performance differences across paper-based and ExamSoft® examinations. Despite the difficulties encountered, educators in this study saw the benefits of ExamSoft®, and indicated preferring it to paper-based examinations.

Amante et al. (2019) conducted a survey with 130 teachers and 424 students from Public Universities and Polytechnic Institutes of Portugal on the factors influencing digital assessment. Findings showed that approximately 70% of the teachers felt that there was a lack of knowledge on the use of technology in the teaching subject area (68%), as well as how online activities were assessed (67%). Other difficulties cited were the extra time commitments needed by teachers to implement the approach (38%), the additional effort needed to learn on the part of teachers (35%) and fears related to potential technical problems (35%). The researchers concluded that teachers' perceptions of digital assessment were not directly related to the teachers' age groups. Similar results were reported by Rolim and Isaias (2018), in which 168 higher education teachers in Portugal were surveyed on their views about using e-assessment approaches. The majority reported considering digital assessment as a beneficial alternative to paper-based assessments, but also cited "insufficient knowledge" as a potentially influential factor in whether online assessment would be accepted by colleagues and students.

Although the studies reviewed revealed that teachers had responded well to the transition to online assessment, implementation issues and challenges were also uncovered. For instance, additional workload and efforts to learn were required to use online assessment systems effectively (Amante et al., 2019; Rolim & Isaias; 2018). Like in the studies on students' acceptance, the trust of online assessment process also casted a shadow on teachers' confidence in the online assessment system and its automatic grading processes (Bloom et al., 2018; Hamsatu et al., 2016).

Need for an Integrated Model to Direct Research on Users' Acceptance of Online Assessment Approaches

To ensure that the advantages of online assessment for higher education are fully realised, this approach must ultimately be accepted favourably by its end-users. Most studies on the acceptance of online assessment to date have focused on students, with research on teachers' acceptance of online assessment being comparatively limited (Chien et al., 2014; Imtiaz & Maarop, 2014). This is surprising, given that it is the teachers who design, administer and deliver the online assessments, and thus, will be the primary decision-makers in terms of whether the approach is adopted, the extent to which it is used, and the success with which it is integrated into ongoing teaching and learning processes (Amante et al., 2019).

Many disparate studies on the factors that can impact teachers' intentions to use technology-based pedagogical and assessment tools have appeared within the literature (Amante et al., 2019; Bloom et al., 2018; Fageeh, 2015; Hamsatu et al., 2016; Jamil et al., 2012). For example, various authors have suggested that administrators should implement online assessment systems that are user-centric in their designs, providing simple, clearly explained and consistent navigations that allow both teachers and students to navigate through assessment items with ease (Webb et al., 2013). This remains, however, an area in which much progress could still potentially be made. In the authors' views, progress within this field has been hampered by the absence of an integrating theoretical framework. Many papers published thus far, therefore, have focused on a range of factors that may be quite idiosyncratic to their specific contexts. We argue that a more general, systematic approach, drawing upon sound theoretical frameworks, is needed for the field to move along.

Among the many technology acceptance models that have appeared to date, the United

Theory of Acceptance and Use of Technology (UTAUT) is a sound candidate for addressing such a need. In developing the UTAUT, Venkatesh et al. (2003) consolidated various previous Technology Acceptance Model (TAM) theories (Davis, 1989, Taylor & Todd, 1995) and related models of behaviour (Ajzen, 1991; Compeau et al., 1999; Fishbein & Ajzen, 1975; Moore & Benbasat, 1991; Thompson et al., 1991). In the UTAUT, four constructs play a significant role as direct determinants of user acceptance and use behaviour: (1) performance expectancy, or the degree to which an individual believes that using the system helps him or her to attain gains in his or her job performance; (2) effort expectancy, or the degree of ease with which the user can deploy the system; (3) social influence, or the extent to which an individual perceives that important others believe he or she should use the system; and (4) facilitating conditions, or the degree to which an individual believes that there is an existing organisational and technical infrastructure to support the use of the system (see Figure 13). In the original UTAUT, attitude toward using technology, self-efficacy and anxiety are not direct determinants of behavioural intentions to use technology, though the exclusion of these elements has been contested by other researchers (Dulle & Minishi-Majanja, 2011; El-Gayar & Moran, 2006; El-Gayar et al., 2011; Khechine & Augier, 2019; Moran et al., 2010).

We propose that an extended model that draws upon the strong theoretical foundations of the original UTAUT model could provide a systematic basis for further research into teachers' intentions to use online assessment methods. This proposed extended model is depicted in Figure 14.

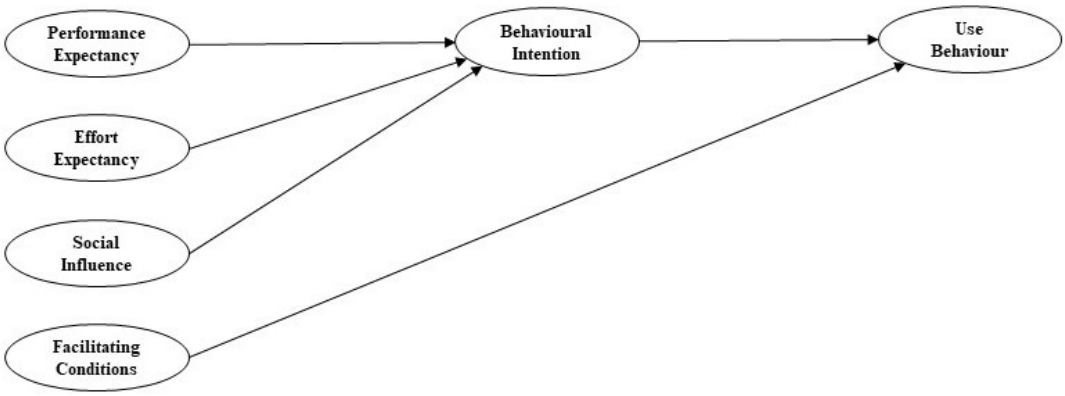

Figure 13. Unified Theory of Acceptance and Use of Technology [Adapted from Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 425-478.]

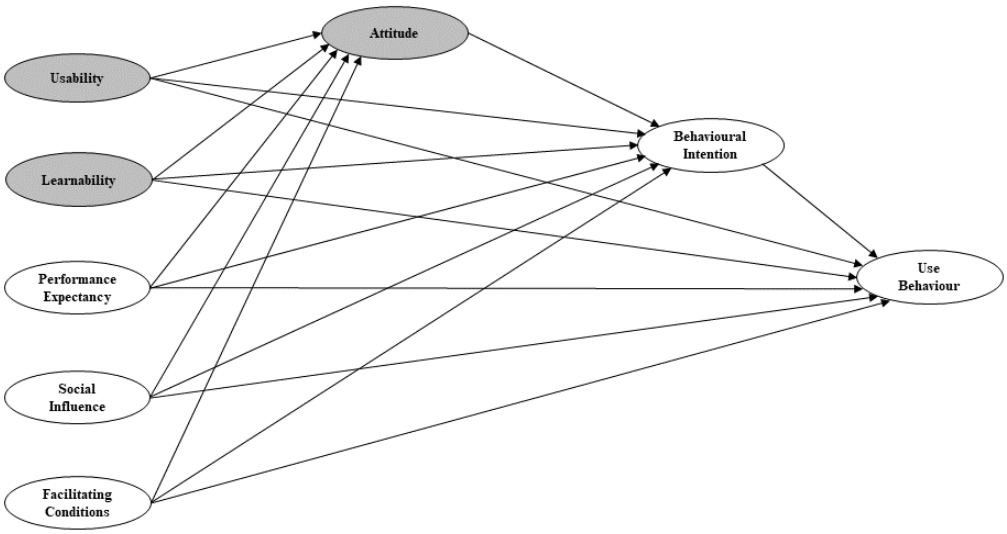

Figure 14. Extended UTAUT Model [Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 425-478.]

In the proposed extended model, attitude has been introduced as a construct. The rationale for including attitude into the proposed extended model is that many previous UTAUT extension studies have found that attitude significantly influences users' behavioural intentions (Botero et al., 2018; El-Gayar and Moran, 2006; El-Gayar et al., 2011; Jairak et al., 2009; Khechine & Augier, 2019; Moran et al., 2010; Nassuora, 2012; Shuhaiber, 2015; Thomas et al., 2013). The proposed extended model also includes two new constructs: usability and learnability. Usability is the degree of ease with which users can adopt the system to achieve their objectives with effectiveness, efficiency and satisfaction (Bevan et al., 2015; Jokela et al., 2003; Shackel, 2009). Learnability refers to the extent to which users can quickly become familiar with the application and make use of all relevant features and capabilities, which will depend heavily on the quality of the system interfaces (Jeng, 2005; Nielsen, 1994). These additional constructs have been incorporated into the extended model based on findings that both usability and learnability have a significant impact on user's acceptance of technology in different contexts (Jeng, 2005; Joo et al., 2011; Zbick et al., 2015).

Conclusions and Recommendations

To ensure that the advantages of online assessment for higher education are fully realised, the implementation must be accepted favourably by its end-users. Most studies on the acceptance

of online assessment to date have focused on students, with research on teachers' acceptance of online assessment being comparatively limited (Chien et al., 2014; Imtiaz & Maarop, 2014). This can make it difficult for administrators who wish to introduce online assessment systems to determine how this can best be done.

In this paper, we have argued that an extended UTAUT can be used to better integrate research into enhancing the adoption of online assessment within universities by teaching staff members. In the extended UTUAT, users' responses to technology still depend on factors such as performance expectancy (PE), facilitating conditions (FC) and social influence (SI), as in the original UTAUT. However, users' attitudes, and the perceived usability and learnability of systems are also proposed to have a significant impact on users' intentions to adopt the system (BI). The extended UTAUT is proposed here as a model that may increase the power with which teaching staff's acceptance of online assessment systems can be predicted.

Moving beyond questions of design, the context in which online assessment approaches are introduced is also likely to be an essential factor in users' acceptance of the approaches. The success of any shift to online assessment will require 'buy-in' from both the students and the teachers. The level of buy-in seen from teachers is likely to be a product of myriad factors, including the nature of the technology, the organisational context, and the model used to manage the change process (Legris et al., 2003; Orlikowski & Hoffman, 1997). Hence, faculties need to consider carefully how they should enact the change process when introducing new online assessment systems. The following strategies may help to ensure that teachers respond more favourably to shifts from paper-based to online assessment systems.

(i) *Ensure that proper scaffolding is applied in introducing teachers to the online assessment systems.* This strategy will be important regardless of how useable and learnable a system is. Yuen and Ma (2008) commented that this step is crucial to build up teachers' confidence in using technology in general. Increased confidence will, in turn, increase willingness to use other forms of instructional technology in the future. Intuitively, more straight-forward user interfaces are likely to appeal to teachers with little prior experience in online assessment systems. However, with increased experience, these teachers may also be willing to use more sophisticated systems.

(ii) *Provide effective ongoing professional development to assist teachers in the adoption of online assessment tools*. Studies have shown that the most effective professional

development programmes that improve teaching practices are those with activities that are ongoing and sustained over time (Tournaki et al., 2011). Besides providing professional development programmes, ongoing institutional support provision will also be essential. Buchan and Swann (2007) suggested a three-level support approach which includes real-time training and professional development, helpdesk troubleshooting, and self-help resources. High-quality technical support structures for different staff groups must also be readily available and accessible throughout the assessment periods.

(iii) *Ensure that the additional initial learning requirements are factored into teachers' workloads*. The extent to which this must be considered will vary in part with how well the system is designed (i.e., systems that are more 'learnable' will entail a lower workload commitment than those less so). However, this factor is likely to be a significant moderator of responses to the introduction of online assessment or any other technology-based tool. In the study by Amante et al. (2019), teachers cited reasons such as "extra time spent by teachers" and "additional effort to learn by teachers" for not using online assessment tools. Results of this kind underscore the importance of considering the impact on workload as a potential barrier to the introduction of online assessment systems.

(iv) *Offer different levels of induction that can be tailored to the needs of individuals*. As cited previously, some studies have highlighted significant relationships between age, experience and teachers' attitudes towards online assessment. These results suggest that different levels of support in the introduction of online assessment may be needed for different teacher cohorts. Again, the extent to which this factor needs to be considered may be a product of the learnability of the system.

Universities need to manage the paradigm shift from paper-based to online assessment well for such implementations to succeed (Amante et al., 2019). At present, however, only a limited body of evidence exists to guide higher education institutions on the best approaches to achieve this goal, and in particular, on how teachers are likely to respond to these shifts. Further research into teachers' responses to online assessment, and into ways to overcome perceived barriers to its use in real settings, will be critical to ensure that its benefits are seen in improved teaching and learning outcomes. The extended UTAT model proposed here may assist in integrating research within this important field, to ensure that the benefits of online assessment methods are harnessed fully within the higher education sector.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, *50*(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Amante, L., Oliveira, I. R., & Gomes, M. J. (2019). E-Assessment in Portuguese Higher Education: Framework and Perceptions of Teachers and Students. *In Handbook of Research on e-Assessment in Higher Education* (pp. 312-333). IGI Global. https://www.academia.edu/download/58437616/E-Assessment-in-Portuguese-Higher-Education_-Framework-and-Perceptions-of-Teachers-and-Students._2.pdf

Anakwe, B. (2008). Comparison of student performance in paper-based versus computer-based testing. *Journal of education for business*, *84*(1), 13-17. https://doi.org/10.3200/JOEB.84.1.13-17

Barkley, A. P. (2002). An analysis of online examinations in college courses. *Journal of Agricultural and Applied Economics*, *34*(3), 445-458. https://doi.org/10.1017/S1074070800009238

Barua, J. (1999). *Computer-based testing on campus*. Syllabus, 51, 52.

Bevan, N., Carter, J., & Harker, S. (2015, August). ISO 9241-11 revised: What have we learnt about usability since 1998?. *In International Conference on Human-Computer Interaction* (pp. 143-151). Springer, Cham. https://doi.org/10.1007/978-3-319-20901-2_13

Bloom, T. J., Rich, W. D., Olson, S. M., & Adams, M. L. (2018). Perceptions and performance using computer-based testing: One institution's experience. *Currents in Pharmacy Teaching and Learning*, *10*(2), 235-242. https://doi.org/10.1016/j.cptl.2017.10.015

Boitshwarelo, B., Reedy, A. K., & Billany, T. (2017). Envisioning the use of online tests in assessing twenty-first-century learning: a literature review. *Research and Practice in Technology Enhanced Learning*, *12*(1), 16. https://doi.org/10.1186/s41039-017-0055-7

Boevé, A. J., Meijer, R. R., Albers, C. J., Beetsma, Y., & Bosker, R. J. (2015). Introducing computer-based testing in high-stakes exams in higher education: Results of a field experiment. *PloS one*, *10*(12), e0143616. https://doi.org/10.1371/journal.pone.0143616

Botero, G. G., Questier, F., Cincinnato, S., He, T., & Zhu, C. (2018). Acceptance and usage of mobile-assisted language learning by higher education students. *Journal of Computing in Higher Education*, *30*(3), 426-451. https://doi.org/10.1007/s12528-018-9177-1

Brady, A. M. (2005). Assessment of learning with multiple-choice questions. *Nurse Education in Practice*, *5*(4), 238-242. https://doi.org/10.1016/j.nepr.2004.12.005

Buchan, J. F., & Swann, M. (2007). A Bridge too Far or a Bridge to the Future? A case study in online assessment at Charles Sturt University. *Australasian Journal of Educational Technology*, *23*(3). https://doi.org/10.14742/ajet.1260

Bull, J. (1999). Computer-assisted assessment: Impact on higher education institutions. *Educational Technology & Society*, *2*(3), 123-126. https://www.jstor.org/stable/jeductechsoci.2.3.123

Bull, J., & McKenna, C. (2003). A blueprint for computer-assisted assessment. Routledge.

Bull, J., & Stephens, D. (1999). The use of Question Mark software for formative and summative assessment in two universities. *Innovations in education and training international*, *36*(2), 128-136. https://doi.org/10.1080/1355800990360205

Chien, S. P., Wu, H. K., & Hsu, Y. S. (2014). An investigation of teachers' beliefs and their use of technology-based assessments. *Computers in Human Behavior*, *31*, 198-210. https://doi.org/10.1016/j.chb.2013.10.037

Cirit, N. C. (2015). Assessing ELT Pre-Service Teachers via Web 2.0 Tools: Perceptions toward Traditional, Online and Alternative Assessment. *Turkish Online Journal of Educational Technology-TOJET*, *14*(3), 9-19. https://search-proquest-com.ezproxy.library.uwa.edu.au/docview/1728238463?accountid=14681

Compeau, D., Higgins, C. A., & Huff, S. (1999). Social cognitive theory and individual reactions to computing technology: A longitudinal study. *MIS quarterly*, 145-158. https://doi.org/10.2307/249749

Conole, G., & Warburton, B. (2005). A review of computer-assisted assessment. *ALT-J*, *13*(1), 17-31. https://doi.org/10.3402/rlt.v13i1.10970

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 319-340. https://doi.org/10.2307/249008

Deng, H., Wang, F., & Liang, B. (2008, December). A low-cost OMR solution for educational applications. *In 2008 IEEE International Symposium on Parallel and Distributed Processing with Applications* (pp. 967-970). IEEE. https://doi.org/10.1109/ISPA.2008.130

Deutsch, T., Herrmann, K., Frese, T., & Sandholzer, H. (2012). Implementing computer-based assessment–a web-based mock examination changes attitudes. *Computers & Education*, *58*(4), 1068-1075. https://doi.org/10.1016/j.compedu.2011.11.013

Donnelly, C. (2014). The use of case-based multiple choice questions for assessing large group teaching: implications on student's learning. *Irish Journal of Academic Practice*, *3*(1), 12. https://doi.org/10.21427/D7CX32

Dulle, F. W., & Minishi-Majanja, M. K. (2011). The suitability of the Unified Theory of Acceptance and Use of Technology (UTAUT) model in open access adoption studies. *Information development*, *27*(1), 32-45. https://doi.org/10.1177/0266666910385375

El-Gayar, O. F., & Moran, M. (2006). College students' acceptance of Tablet PCs: An application of the UTAUT Model. Dakota State University, *820*, 2845-2850. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.120.2667&rep=rep1&type=pdf

El-Gayar, O., Moran, M., & Hawkes, M. (2011). Students' acceptance of tablet PCs and implications for educational institutions. *Journal of Educational Technology & Society*, *14*(2), 58-70. https://search-proquest-com.ezproxy.library.uwa.edu.au/docview/2139143267?accountid=14681

Escudier, M. P., Newton, T. J., Cox, M. J., Reynolds, P. A., & Odell, E. W. (2011). University students' attainment and perceptions of computer delivered assessment; a comparison between computer-based and traditional tests in a 'high-stakes' examination. *Journal of Computer Assisted Learning*, *27*(5), 440-447. https://doi.org/10.1111/j.1365-2729.2011.00409.x

Fageeh, A. I. (2015). EFL student and faculty perceptions of and attitudes towards online testing in the medium of Blackboard: Promises and challenges. *JALT CALL Journal*, *11*(1), 41-62. https://doi.org/10.29140/jaltcall.v11n1.183

Fishbein, M., & Ajzen, I. (1975). Belief, attitude, intention and behavior: An introduction to theory and research.

Fluck, A., Pullen, D., & Harper, C. (2009). Case study of a computer based examination system. *Australasian Journal of Educational Technology*, *25*(4). https://doi.org/10.14742/ajet.1126

Gipps, C. V. (2005). What is the role for ICT-based assessment in universities? *Studies in Higher Education*, *30*(2), 171-180. https://doi.org/10.1080/03075070500043176

Hamsatu, P., Yusufu, G., & Mohammed, H. A. (2016). Teachers' Perceptions and Undergraduate Students' Experience in E-Exam in Higher Institution in Nigeria. *Journal of Education and Practice*, *7*(23), 158-166. https://files.eric.ed.gov/fulltext/EJ1112920.pdf

Hewson, C., & Charlton, J. P. (2019). An investigation of the validity of course-based online assessment methods: The role of computer-related attitudes and assessment mode preferences. *Journal of Computer Assisted Learning*, *35*(1), 51-60. https://doi.org/10.1111/jcal.12310

Huot, B. (1996). Computers and assessment: Understanding two technologies. *Computers and Composition*, *13*(2), 231-243. https://doi.org/10.1016/S8755-4615(96)90012-2

Imtiaz, M., & Maarop, N. (2014). Feasibility study of lecturers' acceptance of E-assessment. ACIS. https://core.ac.uk/download/pdf/56364754.pdf

James, R., McInnis, C., & Devlin, M. (2002). Assessing learning in Australian universities. Melbourne: *The University of Melbourne Centre for the Study of Higher Education*. http://www.ntu.edu.vn/Portals/96/Tu%20lieu%20tham%20khao/Phuong%20phap%20danh%20gia/assessing%20learning.pdf

Jairak, R., Praneetpolgrang, P., & Mekhabunchakij, K. (2009, December). An investigation of Trust in e-Learning for Instructors and Students in Private and Public Universities. *In Proc. 6th eLearning for Knowledge-Based Society Conf., Thailand* (pp. 17-18). http://ijcim.th.org/SpecialEditions/v17nSP3/36_Full_Kallaya%20Jairak_Online.pdf

Jamil, M., Tariq, R. H., & Shami, P. A. (2012). Computer-Based vs Paper-Based Examinations: Perceptions of University Teachers. *Turkish Online Journal of Educational Technology-TOJET*, *11*(4), 371-381. https://search-proquest-com.ezproxy.library.uwa.edu.au/docview/1288340335?accountid=14681

Jawaid, M., Moosa, F. A., Jaleel, F., & Ashraf, J. (2014). Computer-based assessment (CBA): perception of residents at Dow University of Health Sciences. *Pakistan journal of medical sciences*, *30*(4), 688. https://doi.org/10.12669/pjms.304.5444

Jeng, J. (2005). Usability assessment of academic digital libraries: effectiveness, efficiency, satisfaction, and learnability. *Libri*, *55*(2-3), 96-121. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.106.1655&rep=rep1&type=pdf

Jeng, J. (2005). What is usability in the context of the digital library and how can it be measured?. *Information technology and libraries*, *24*(2), 3. https://doi.org/10.6017/ital.v24i2.3365

Joo, S., Lin, S., & Lu, K. (2011). A usability evaluation model for academic library websites: efficiency, effectiveness and learnability. *Journal of Library and Information Studies*, *9*(2), 11-26. https://jlis.lis.ntu.edu.tw/files/journal/j33-2.pdf

Jokela, T., Iivari, N., Matero, J., & Karukka, M. (2003, August). The standard of user-centered design and the standard definition of usability: analyzing ISO 13407 against ISO 9241-11. *In Proceedings of the Latin American conference on Human-computer interaction* (pp. 53-60). https://doi.org/10.1145/944519.944525

Jordan, S. (2013). E-assessment: Past, present and future. *New Directions in the Teaching of Physical Sciences*, (*9*), 87-106. https://doi.org/10.29311/ndtps.v0i9.504

Khechine, H., & Augier, M. (2019, January). Adoption of a social learning platform in higher education: an extended UTAUT model implementation. *In Proceedings of the 52nd Hawaii International Conference on System Sciences.* https://scholarspace.manoa.hawaii.edu/bitstream/10125/59446/1/0006.pdf

Kumar, L. R., Bedra, A., & Karkera, R. (2013). Perception of medical students on e-assessment conducted through Yengage portal. *Archives of Medicine and Health Sciences*, *1*(1), 61. https://doi.org/10.4103/2321-4848.113577

Legris, P., Ingham, J., & Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. *Information & management*, *40*(3), 191-204. https://doi.org/10.1016/s0378-7206(01)00143-4

Lei, S. A., & Gupta, R. K. (2010). College Distance Education Courses: Evaluating Benefits and Costs From Institutional, Faculty and Students' Perspectives. *Education*, *130*(4). https://web-a-ebscohost-com.ezproxy.library.uwa.edu.au/ehost/pdfviewer/pdfviewer?vid=3&sid=b1d52f9d-b57f-45d7-ae71-64ba90bc57bd%40sessionmgr4007

Lewis, D. J., & Sewell, R. D. (2007). Providing formative feedback from a summative computer-aided assessment. *American Journal of Pharmaceutical Education*, *71*(2), 33. https://doi.org/10.5688/aj710233

Llamas-Nistal, M., Fernández-Iglesias, M. J., González-Tato, J., & Mikic-Fonte, F. A. (2013). Blended e-assessment: Migrating classical exams to the digital world. *Computers & Education*, *62*, 72-87. https://doi.org/10.1016/j.compedu.2012.10.021

McLoughlin, C. (2003). Broadening assessment strategies with information. *Learning & Teaching with Technology: principles and practices*, 193. http://widyo.staff.gunadarma.ac.id/Downloads/files/58454/Learning+and+Teaching+with+Technology.pdf#page=197

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information systems research*, *2*(3), 192-222. https://doi.org/10.1287/isre.2.3.192

Mora, M. C., Sancho-Bru, J. L., Iserte, J. L., & Sánchez, F. T. (2012). An e-assessment approach for evaluation in engineering overcrowded groups. *Computers & Education*, *59*(2), 732-740. https://doi.org/10.1016/j.compedu.2012.03.011

Moran, M., Hawkes, M., & Gayar, O. E. (2010). Tablet personal computer integration in higher education: Applying the unified theory of acceptance and use technology model to understand supporting factors. *Journal of educational computing research*, *42*(1), 79-101. https://doi.org/10.2190/ec.42.1.d

Nassuora, A. B. (2012). Students acceptance of mobile learning for higher education in Saudi Arabia. *American Academic & Scholarly Research Journal*, *4*(2), 24-30. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.402.6814&rep=rep1&type=pdf

Nicol, D. (2007). E-assessment by design: using multiple-choice tests to good effect. *Journal of Further and higher Education*, *31*(1), 53-64. https://doi.org/10.1080/03098770601167922

Nielsen, J. (1994, April). Usability inspection methods. *In Conference companion on Human factors in computing systems* (pp. 413-414).

Orlikowski, W., & Hoffman, D. (1997). An improvisational model for change management: The case of groupware technologies. *Inventing the Organizations of the 21st Century*, *265*, 16-27.

Rolim, C., & Isaias, P. (2018). Examining the use of e-assessment in higher education: teachers and students' viewpoints. *British Journal of Educational Technology*. *50*(4), 1785-1800. https://doi.org/10.1111/bjet.12669

Ridgway, J., McCusker, S., & Pead, D. (2004). *Literature review of e-assessment*. http://dro.dur.ac.uk/1929/1/Ridgway_Literature.pdf

Riera Guasp, J., Ardid Ramírez, M., Gómez-Tejedor, J. A., Vidaurre, A., & Meseguer Dueñas, J. M. (2018). Students perception of auto-scored online exams in blended assessment: feedback for improvement. *Educacion XX1*, *21*(2), 79-103. https://doi.org/10.5944/educxx1.19559

Shackel, B. (2009). Usability–Context, framework, definition, design and evaluation. *Interacting with computers*, *21*(5-6), 339-346. https://doi.org/10.1016/j.intcom.2009.04.007

Shuhaiber, A. H. (2015). Students' Willingness to Accept Virtual Lecturing Systems: An Empirical Study by Extending the UTAUT Model. *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, *9*(4),

11531157. https://pdfs.semanticscholar.org/7869/ae3f1c2378bac6b1c1501de1c5f0df409a6c.pdf

Sim, G., Holifield, P., & Brown, M. (2004). Implementation of computer assisted assessment: lessons from the literature. *ALT-J*, *12*(3), 215-229. https://doi.org/10.3402/rlt.v12i3.11255

Spivey, M. F., & McMillan, J. J. (2014). Classroom versus online assessment. *Journal of Education for Business*, *89*(8), 450-456. https://doi.org/10.1080/08832323.2014.937676

Taylor, S., & Todd, P. A. (1995). Understanding information technology usage: A test of competing models. *Information systems research*, *6*(2), 144-176. https://doi.org/10.1287/isre.6.2.144

Thomas, T., Singh, L., & Gaffar, K. (2013). The utility of the UTAUT model in explaining mobile learning adoption in higher education in Guyana. *International Journal of Education and Development using ICT*, *9*(3). https://search-proquest-com.ezproxy.library.uwa.edu.au/docview/1491114969?accountid=14681

Thompson, R. L., Higgins, C. A., & Howell, J. M. (1991). Personal computing: toward a conceptual model of utilization. *MIS quarterly*, 125-143. https://doi.org/10.2307/249443

Tournaki, E., Lyublinskaya, I., & Carolan, B. (2011). An ongoing professional development program and its impact on teacher effectiveness. *The Teacher Educator*, *46*(4), 299-315. https://doi.org/10.1080/08878730.2011.604711

UNESCO. UNESCO's support: Educational response to COVID-19. (2020, May 28). https://en.unesco.org/covid19/educationresponse/support

Usir, E., & Ahamad, M. N. (2017). Pharmacy Students' Experiences, Preferences and Perceptions on Online Assessment. *Indian Journal of Pharmaceutical Education and Research,* *51*(3), 373-379. https://www.ijper.org/sites/default/files/10.5530ijper.51.3.63.pdf

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 425-478. https://doi.org/10.2307/30036540

Wadley, M., Weaver, S. B., Curry, C., & Carthon, C. (2014). Pharmacy students' perceptions of ExamSoft® as the primary assessment tool in an integrated therapeutics course. *Currents in Pharmacy Teaching and Learning*, *6*(6), 815-821. https://doi.org/10.1016/j.cptl.2014.07.002

Webb, M., Gibson, D., & Forkosh-Baruch, A. (2013). Challenges for information technology supporting educational assessment. *Journal of Computer Assisted Learning*, *29*(5), 451-462. https://doi.org/10.1111/jcal.12033

Woolley, D. R. (1994). PLATO: The emergence of online community. *Social Media Archeology and Poetics, MIT Press, Cambridge.*

Yuen, A. H., & Ma, W. W. (2008). Exploring teacher acceptance of e-learning technology. *Asia-Pacific Journal of Teacher Education*, *36*(3), 229-243. https://doi.org/10.1080/13598660802232779

Zandvliet, D., & Farragher, P. (1997). A comparison of computer-administered and written tests. *Journal of Research on Computing in Education*, *29*(4), 423-438. https://doi.org/10.1080/08886504.1997.10782209

Zbick, J., Nake, I., Milrad, M., & Jansen, M. (2015, July). A web-based framework to design and deploy mobile learning activities: Evaluating its usability, learnability and acceptance. *In 2015 IEEE 15th International Conference on Advanced Learning Technologies* (pp. 88-92). IEEE. https://core.ac.uk/download/pdf/192383918.pdf

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CHAPTER 4: DEVELOPMENT AND VALIDATION OF AN INSTRUMENT TO MEASURE ONLINE ASSESSMENT ACCEPTANCE IN HIGHER EDUCATION

With technological advances, assessment processes have shifted increasingly from traditional pen-and-paper methods to online forms in many education contexts (Cavus, 2015; Diprose, 2013; Dube et al., 2009; Stone & Zheng, 2014). The term *online assessment* is often used interchangeably with terms such as *electronic assessment* (Jordan, 2013), *computer-assisted assessment* (Bull & McKenna, 2003; Sim et al., 2004), *computer-mediated assessment* (Huot, 1996) and *computer-based assessment* (Fluck et al., 2009). These terms refer to the use of information technology to present, deliver, administer, or score assessment tasks (Bull, 1999; Chalmers & McAusland, 2002). Online assessment can range from a relatively minimal use of technology, such as the online or electronic submission of assignments, to more involved usages such as the delivery and scoring of multiple-choice questions and computerised adaptive testing (Collares & Cecilio-Fernandes, 2019; Wang & Kingston, 2019).

Various potential benefits of online assessment have been cited by authors in the field, such as increased efficiency and accuracy of marking (e.g., Barkley, 2002; Boitshwarelo et al., 2017; Brady, 2005; Cirit, 2015; Gipps, 2005; James et al., 2002; Lei & Gupta, 2010; Mora et al., 2012; Llamas-Nistal et al., 2013; Ridgway et al., 2004; Spivey & McMillan, 2014). Despite this, studies that have explored students' and teachers' acceptance of this approach have produced mixed results (Amante et al., 2019; Bloom et al., 2018; Boevé et al., 2015; Cirit, 2015; Deutsch et al., 2012; Fageeh, 2015; Hamsatu et al., 2016; Jamil et al., 2012; Jawaid et al., 2014; Kumar et al., 2013; Riera Guasp et al., 2018).

One of the factors that has been cited as a possible explanation for these mixed results is that teachers may be reticent to adopt online forms of assessment, and as a result, may use these approaches in a minimal or suboptimal way (Amante et al., 2019; Bloom et al., 2018; Fageeh, 2015; Hamsatu et al., 2016; Jamil et al., 2012; Rolim & Isaias, 2018). This literature relates to

teachers' acceptance of online assessment, which is often operationalised in terms of their intentions to make use of the technology and, in some cases, their actual or reported use of that technology (Chien et al., 2014; Imtiaz & Maarop, 2014).

Various studies on factors that can impact teachers' intentions to use technology-based pedagogical and assessment tools have appeared within the literature (AlDahdouh, 2019; Barnett, 2018; Boz & Adnan, 2017; Bradley, 2021; Kaleli, 2021; Khashaba, 2020; Kibici & Sarıkaya, 2021; Or & Chapman, 2021; Schneberger et al., 2008; Suryaratri, Komalasari, & Medellu, 2022; Terzis & Economides, 2011; Terzis et al., 2013a; Terzis et al., 2013b; Thompson & McDowell, 2019; Wiggins & van der Hoff, 2021). For example, several authors have suggested that to enhance educators' acceptance of online assessment methods, administrators should implement systems that are user-centric in their designs, providing simple, clearly explained and consistent navigations, which allow both teachers and students to navigate through the items in the assessment with ease (Webb et al., 2013). The efficacy of these approaches for enhancing educators' acceptance levels, however, has not yet been affirmed conclusively.

The subject of educators' acceptance of online assessment remains one in which much progress could potentially be made. In the authors' views, progress within the area has been hampered by the absence of an integrating theoretical framework. Many papers published thus far, therefore, have focused on a range of factors that may be quite idiosyncratic to their specific contexts. We argue that a more general, systematic approach, drawing upon sound theoretical frameworks, is needed for the field to progress. We propose here that the Unified Theory of Acceptance and Use of Technology (UTAUT) is a suitable candidate for addressing this need.

Samaradiwakara and Gunawardena (2014) reported, in their comparison of various existing theories and models in technology adoption, that the UTAUT had the highest explanatory power of all technology behavioural intention models that had appeared. The models against which the UTAUT was compared in that study included the Theory of Reasoned Action (Fishbein & Ajzen 1975); the Technology Acceptance Model (TAM - Davis, 1989); the Technology Acceptance Model – 2 (TAM2 - Venkatesh & Davis, 2000); the Motivation Model (Davis et al., 1992); the Decomposed Theory of Planned Behavior (Taylor & Todd, 1995a); the Combined Technology Acceptance Model and Theory of Planned Behavior

(Taylor & Todd, 1995b); the Model of PC Utilization (Thompson et al., 1991); the Innovation Diffusion Theory (Rogers, 2010; Rogers and Shoemaker, 1971); and Social Cognitive Theory (Festinger, 1957).

The Unified Theory of Acceptance and Use of Technology

Venkatesh et al. (2003) consolidated previous Technology Acceptance Model (TAM) theories (Davis, 1989; Taylor & Todd, 1995a) and models (Ajzen, 1991; Compeau et al., 1999; Fishbein & Ajzen, 1975; Moore & Benbasat, 1991; Thompson et al., 1991) to propose the UTAUT (see Figure 15). The UTAUT has been widely regarded since its inception as a model that synthesises past technology theories. The UTAUT was first tested empirically using data from four organisations, then cross-validated using new data from another two organisations from the financial services and retail electronics industries. Venkatesh et al. (2003) suggested that while the UTAUT was initially designed for research use in business contexts, the model could be further modified or extended to incorporate alternative or additional measures of users' behavioural intentions and usage in education contexts.

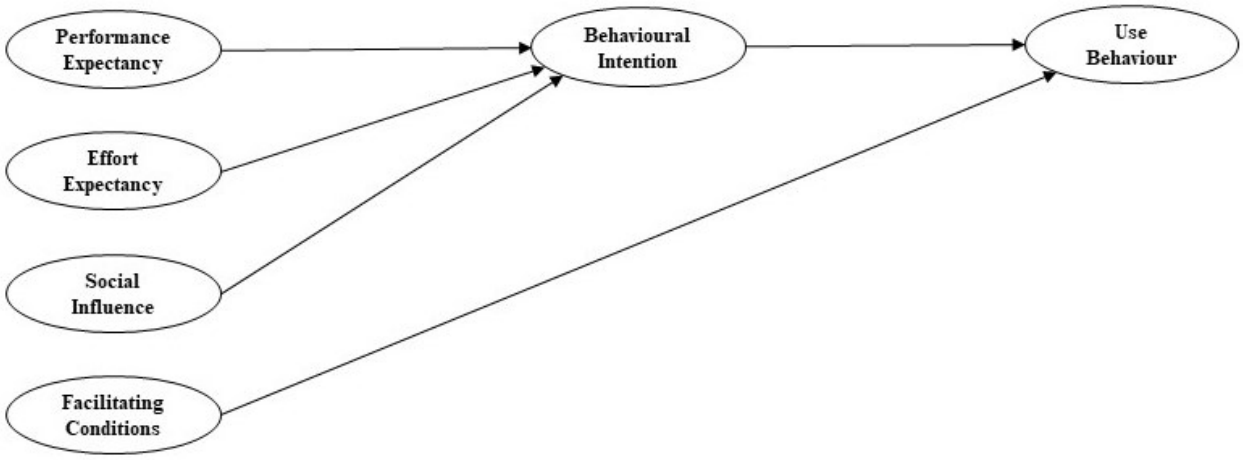

Figure 15. Unified Theory of Acceptance and Use of Technology Model [Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS quarterly, 425-478.]

The original UTAUT posited that behavioural intention (BI) and actual behaviour use (BU) associated with a given technology would be influenced by four main factors: performance expectancy (PE), effort expectancy (EE), social influence (SI) and facilitating conditions (FC). PE is the extent to which a user believes that using a system will help him or her to

achieve gains in job performance. EE is the degree of ease with which a system can be used, while SI is the extent to which a user perceives that 'important others' believe that he or she should use the system. Finally, FC is the extent to which an individual believes that there are existing organisational and technical infrastructures to support the use of the system. The authors also acknowledged that the influence of the four primary factors might be moderated by factors such as gender, age, experience and voluntariness. These 'moderating factors', however, are not part of the primary model, and are typically not included in empirical studies on the UTAUT.

The Extended UTAUT Model

An extended UTAUT model has been proposed by first author as depicted in Figure 16.

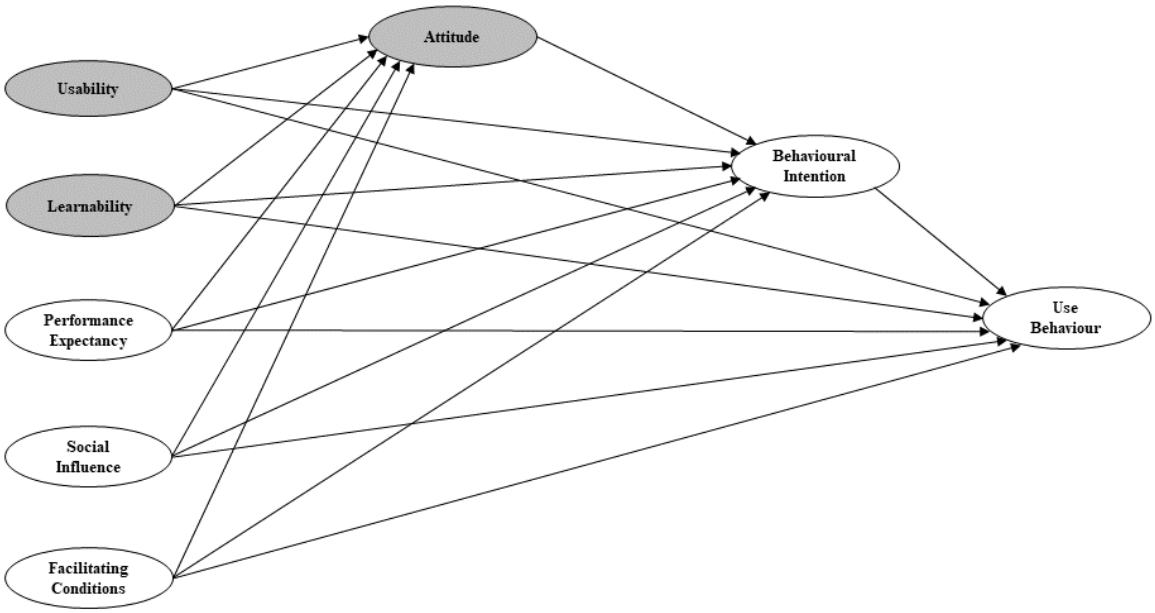

Figure 16. Extended Unified Theory of Acceptance and Use of Technology Model [Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS quarterly, 425-478.]

In this model, additional exogenous constructs, usability and learnability, have been incorporated as potential influences on both BI and UB. In the extended UTAUT model, PE, SI and FC have been retained as these have all been shown to be significant predictors of behavioural intention and usage behaviour. EE has not been included in the extended model, as many UTAUT studies have shown that its influence has not been as consistent that of the

other original constructs (Ali & Arshad, 2018; Alshehri et al., 2019; Bouznif, 2017; Chao, 2019; Kissi et al., 2018; Lakhal et al., 2013; Lin & Lin, 2019; Salloum & Shaalan, 2018; Thongsri et al., 2018; Wrycza et al., 2017). Finally, attitude as a construct has been added, as this was first included in an earlier TAM model and reintroduced later in many extended UTAUT studies. Attitude has since been demonstrated to be a significant predictor of BI in numerous empirical evaluations (Botero et al., 2018; Dulle & Minishi-Majanja, 2011; El-Gayar & Moran, 2006; El-Gayar et al., 2011; Khechine & Augier, 2019; Moran et al., 2010; Nassuora, 2012; Shuhaiber, 2015; Šumak et al., 2010; Thomas et al., 2013). All exogenous constructs in the extended UTAUT model are posited potentially to have an influence on attitude, BI and UB.

The Present Study

Many instruments have been used to measure various aspects of the original UTAUT in previous empirical studies (El-Gayar & Moran; 2006, Raman et al., 2014; Šumak et al., 2010; Šumak & Šorgo, 2016; Yueh et al., 2015). However, no validated instrument has yet been developed which incorporates the additional constructs of attitude, usability and learnability within the extended model proposed by the first author. The aim of this study, therefore, was to develop and validate an instrument suitable for assessing educators' acceptance of online assessment based on this extended UTAUT model.

The study was conducted within one Institute of Technical Education (ITE) in Singapore, and the instrument developed referred specifically to the online assessment system used within that institution (the Integrated Assessment System, or IAS). ITE is a vocational institute in Singapore that provides pre-employment training to secondary school graduates and continuing education and training to working adults. The institution offers trade-related certifications and vocational diplomas for skilled technicians and workers in supporting roles in professions like engineering, accountancy, business administration, nursing, medicine, architecture, and law. IAS, which the first author was an administrator and system tester before its launch, has capabilities across areas of online assessment: authoring, delivery and marking and is supported with other features like analysis and reporting. The assessment system delivers online tests throughout the academic terms and online examinations quarterly.

An initial list of 34 items was first compiled based on an extensive search of literature that reported on related instruments that had been developed and published previously. This was later reduced to a final list of 20 items based on data collected from a pilot group of participants. The final questionnaire is shown in Table 2.

Table 2. Extended UTAUT Questionnaire (20 Items)

Construct	Statement		
Performance Expectancy (PE) (Venkatesh et al., 2003)	Using IAS slows me down in accomplishing tasks	↔	Using IAS enables me to accomplish tasks quickly
	Using IAS decreases my productivity terribly	↔	Using IAS increases my productivity greatly
Social Influence (SI) (Venkatesh et al., 2003)	My supervisor thinks that I should not use IAS	↔	My superior thinks that I should use IAS
	My colleagues think that I should not use IAS	↔	My colleagues think that I should use IAS
	In general, the organisation has been unsupportive in the use of IAS	↔	In general, the organisation has been supportive in the use of IAS
Facilitating Conditions (FC) (Venkatesh et al., 2003)	I do not have any resource available to use IAS	↔	I have all the resources available to use IAS
	IAS is incompatible with systems I use	↔	IAS is compatible with all other systems I use
	No specific person (or group) is available for assistance with IAS difficulties	↔	A specific person (or group) is easily and readily available for assistance with IAS difficulties
Usability (Brooke, 1996)	I think IAS is extremely difficult to use	↔	I think IAS is extremely easy to use
	I think the various functions in IAS are not integrated	↔	I think the various functions in IAS are well-integrated
	I think there are too many	↔	I think there is overall

Construct	Statement		
	inconsistencies in IAS		consistency in IAS
Learnability (Brooke, 1996)	I need the support of a technical person to be able to use IAS	↔	I am able to use IAS on my own without any help
	I need to learn a lot of things before I could get going with IAS	↔	I need not learn new things before I could get going with IAS
Behaviourial Intention (BI) (Venkatesh et al., 2003)	Given a choice, in the next 6 months:		
	I do not intend to use IAS	↔	I intend to always use IAS
	I do not plan to use IAS	↔	I plan to always use IAS
Attitude (Davis, 1989)	All things considered, using IAS is:		
	Bad	↔	Good
	Unfavourable	↔	Favourable
	Negative	↔	Positive
Use Behaviour (UB) (Venkatesh et al., 2003)	I seldom use IAS	↔	I always use IAS
	I spend little time on IAS	↔	I spend great amount of time on IAS

Method

Instrument Development

The original UTAUT questionnaire published by Ventakesh et al. (2003) was used as a basis for developing the extended UTAUT questionnaire. Various revisions, however, were incorporated in the instrument developed in the present study, including a change to the response scale used. The original UTAUT questionnaire used 5-point Likert scales. In the present study, the items from the UTAUT were converted to bipolar statements. Chin et al. (2008) referred to bipolar scales as essentially semantic differential scales in which the rating options are similar to Likert scales. The labels are devised as good/bad, weak/strong and efficient/inefficient (Osgood, 1952). Bipolar scales have been deployed in many studies on technology acceptance (Behrenbruch et al., 2013, Hsu & Kulviwat, 2006; Huang, 2005;

Leem & Sung, 2019; Pedersen & Nysveen, 2003; Toft et al., 2014). An example of a converted UTAUT item from Likert scale can be seen in Figure 17.

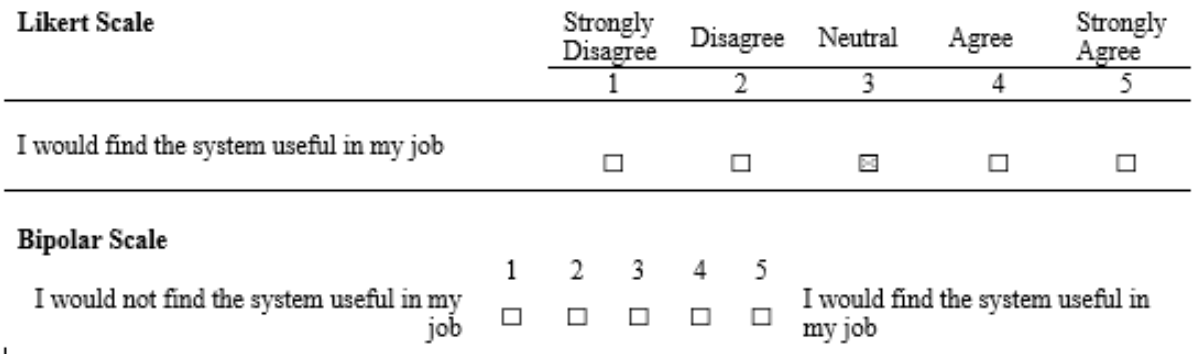

Figure 17. Conversion of UTAUT Item to Bipolar Scale

The argument for using a bipolar scale in this study is that the odd-numbered Likert scale may lead participants to confuse the mid-point response, 'neutral' with the response 'N/A' or 'do not know'. There have also been various concerns about the functioning of Likert-based item formats in the literature (Göb et al., 2007; Jamieson, 2004; Norman, 2010). Although bipolar items have been said to increase participants' cognitive demands and random errors in measurement, these have often been found to function in a superior way compared to Likert scales (Chin et al., 2008; Friborg et al., 2006; Hawkins et al., 1974; Van Auken & Barry, 1995; Verhagen et al., 2015; Wirtz & Lee, 2003). While there was some initial concern over the increased number of words required for a bipolar scale, given that this instrument is designed for use with adults, this was deemed ultimately not to be a significant problem.

Validation of the Instrument

According to Messick (1988), the validity of an instrument is best examined through an overall evaluative judgement of the measure. Such a judgement is based on empirical evidence and theoretical rationales that support the adequacy and appropriateness of inferences and actions made. Messick (1995) proposed five criteria upon which new and existing instruments could be evaluated in terms of validity:

(i) Evidence based on test content, i.e., whether the content of the test is aligned with the intended focus of the instrument, which is commonly assessed by obtaining feedback from individuals who can reasonably make such judgements;

(ii) Evidence based on response processes, i.e., whether what the respondents need to do in order to answer the questions is aligned with the intended focus of the instrument, which is commonly assessed using a 'cognitive interview' with representative participants;

(iii) Evidence based on internal structure, i.e., whether the factor structure and internal consistencies for the instrument support the proposed theoretical structure;

(iv) Evidence based on relationships with other variables, i.e., whether the instrument scores correlate in predicted ways with scores from instruments that are theoretically related to the target construct/s;

(v) Evidence based on the consequences of usage, i.e., whether the uptake or adoption of the instrument has a positive washback effect on practices.

The validation of the instrument using the survey data was conducted to address three of the five criteria stipulated by Messick (1995). Specifically, this validation considered the instrument properties in terms of evidence based on the instrument's content, associated response processes, and internal structure. The validation did not explore evidence based on relationships with other variables, as this was beyond the scope of the data collection possible within the institution. The other criterion that was not addressed was evidence based on the consequences of testing, which cannot be evaluated until the instrument has been used widely over a period of time.

In line with Messick's (1995) criteria, for the development and validation of the instrument to assess the acceptance of online assessment based on the extended UTAUT model proposed, a three-stage approach was used. Stage 1 involved the evaluation of the constructs and items through a content validity study. Stage 2 involved a cognitive interview with selected participants from the ITE. Following these two stages, a revision of the instrument items was conducted, and a final version of the questionnaire items generated. The final stage, Stage 3, involved a large sample of educators to assess the internal structure of the instrument.

Participants and Procedures

Prior to conducting the research, ethics approval was obtained from the researchers' institution, and approval was also obtained from the ITE board. Stage 1 commenced with the evaluation of the constructs and items through the conduct of a content validity study.

Content validity is a product of the degree to which items in an instrument are relevant to, and representative of, their intended constructs (Haynes et al., 1995; Lawshe, 1975; Messick 1987). Tojib and Sugianto (2006) presented a literature review on content validity in information system research studies and found that qualitative approaches to investigating content validity were preferred.

A qualitative pilot study was therefore used here with a group of 7 lecturers to explore the initial 34-item questionnaire. The participants were all IAS users from ITE who were involved in the initial pilot implementation phase and had delivered at least an online test and examination prior to this study. The participants each reviewed the questionnaire items for readability, clarity and comprehensiveness during individual interviews. They also suggested whether the items should be included in the final questionnaire, based on their judgments on their relevance, and representativeness. The content validity study during the pilot ensured a similar understanding of the item wordings between the researchers and the respondents. Participants were also asked to provide recommendations on ways to improve the sentence structures to ensure clarity and conciseness based on any difficulties encountered in comprehending the questionnaire instructions, questions and statements.

In the pilot study, the amount of time required to complete the questionnaire was also estimated. Given that this indicated that a significant investment of time would be required to respond to all 34 items, the set was ultimately reduced to a collection of 20 items after reviews by the researchers. Items were chosen for retention by the researchers based on the perceived clarity of the items used to represent each of the model constructs.

Stage 2 involved a cognitive interview (Presser et al., 2004) with three selected participants from the ITE. This was conducted to examine the thought processes that would be involved in interpreting the questions and arriving at responses for the questionnaire items. The purpose of the cognitive interview was to inform item revision decisions, and to provide further evidence on the clarity and relevance of item and response processes (Castillo-Diaz & Padilla, 2013). The staff members from the ITE headquarters were recruited to participate in the cognitive interview, who were heavily involved in the system development during user acceptance testing and like the first author, were administrators of the online assessment system.

The participants were chosen as they were familiar with the online assessment system and were deemed not in any conflicting power relationship with the researcher. Using verbal probes, the interviewees described their thinking after they had completed the questionnaire items. The objective was to identify items in which there was a misalignment between the interviewees' interpretations and the intended meanings of the items, and to identify ways to modify the items based on their responses. Moreover, this stage provided further evidence related to content validity, as the participants provided feedback on the adequacy of content coverage.

The final stage, Stage 3, involved conducting a model fit test using a large sample of educators. For the large-scale validation of the instrument in terms of internal structure, an email invitation was sent out to 469 potential participants, and 287 responded. From this group, 213 participants provided complete responses (i.e., overall response rate 45.42%). The objectives of the study were shared in the invitation email and before the start of the online questionnaire.

Among the lecturers who responded to the online questionnaire, 62.0% were males, and 38.0% were females. Most of the participants were from the age group of 41 to 50 years (39.4%), with a small group of participants from the 21-30 year age group (1.4%). For online assessment experience, 77.5% of the participants rated themselves at least "5" and above, and 0.9% of the participants responded that they did not have any experience. Participation was voluntary and anonymous. The profile of the participants is shown in Tables 3, 4 and 5.

Table 3. Profile of Participants (within Age Groups)

			Age					
			21 to 30 years old	31 to 40 years old	41 to 50 years old	51 to 60 years old	Above 60 years old	Total
Gender	Male	Count	2	25	55	31	19	132
		Percentage	66.7%	47.2%	65.5%	72.1%	63.3%	62.0%
	Female	Count	1	28	29	12	11	81
		Percentage	33.3%	52.8%	34.5%	27.9%	36.7%	38.0%
Total		Count	3	53	84	43	30	213
		Percentage	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 4. Profile of Participants (within Gender Groups)

			Age					
			21 to 30 years old	31 to 40 years old	41 to 50 years old	51 to 60 years old	Above 60 years old	Total
Gender	Male	Count	2	25	55	31	19	132
		Percentage	1.5%	18.9%	41.7%	23.5%	14.4%	100.0%
	Female	Count	1	28	29	12	11	81
		Percentage	1.2%	34.6%	35.8%	14.8%	13.6%	100.0%
Total		Count	3	53	84	43	30	213
		Percentage	1.4%	24.9%	39.4%	20.2%	14.1%	100.0%

Table 5. Participants' Online Assessment Experience

			Online Assessment Experience							
			1	2	3	4	5	6	7	Total
Gender	Male	Count	2	1	3	25	39	46	16	132
		Percentage	1.5%	0.8%	2.3%	18.9%	29.5%	34.8%	12.1%	100.0%
	Female	Count	0	2	1	14	31	19	14	81
		Percentage	0.0%	2.5%	1.2%	17.3%	38.3%	23.5%	17.3%	100.0%
Total		Count	2	3	4	39	70	65	30	213
		Percentage	0.9%	1.4%	1.9%	18.3%	32.9%	30.5%	14.1%	100.0%

Results and Discussion

A qualitative analysis was conducted for content validity and cognitive interviews, while the internal structure was assessed using quantitative education measurement analyses. During the content validity and cognitive interview stages, short notes stating the participants' general impressions and immediate reflections were taken after each session. The feedback, comments and recommendations provided by the participants were considered when the questionnaire items were reviewed. The internal structure of the instrument was then evaluated using the statistical software, IBM SPSS AMOS version 26.0.

Content Validity

As indicated previously, participants in the content validity study indicated that each of the items in the questionnaire represented its intended construct well. Some feedback was given on how to clarify the meaning of specific items, which were modified or removed in response to these comments. For example, the participants pointed out that they did not understand the

phrase, "people who influence my behaviour". The statement was thus modified in response to these comments to, "My supervisor thinks that I should use IAS", "My colleagues think that I should use IAS" and "My students think that I should use IAS". Overall, however, it was clear from this study that a 34-item questionnaire would be somewhat time-consuming to complete. As a result, a reduced, 20-item version was adopted later in the study.

Cognitive Interviews

The cognitive interviews identified several statements that were misunderstood by the interviewees. Specifically, the findings from the cognitive interview sessions resulted in the identification of four issues in the questionnaire items: (1) some statements were seen to be irrelevant in the way that they were worded; (2) some items were very similar and perceived to be repetitive; (3) some statements could be more extreme, being on the bipolar rating scale; and (4) some participants were unable to understand the words used in some statements. Based on the comments and feedback given, several items were either modified or removed.

Internal Structure

The model fit of the extended UTAUT was examined through a confirmatory factor analysis (CFA), conducted using IBM SPSS AMOS version 26.0. The CFA was conducted to estimate whether the actual factor structure and factor loadings aligned with the theorised structure, by statistically testing the fit between the observed correlations and the proposed measurement model (Albright & Park, 2009; Bollen, 1989; Hair et al., 2006; Kline, 2005). Descriptive statistics and bivariate correlations for the items in the instrument are shown in Table 6.

Five indices were used to assess the fit of the model to the data: (a) χ^2/ Degree of Freedom (χ^{22}/df), (b) Root Mean Square Error of Approximation (RMSEA; Steiger, 1990), (c) Goodness-of-Fit (GFI), (d) Comparative Fit Index (CFI; Bentler, 1990) and (e) Tucker-Lewis fit index (TLI; Bentler & Bonett, 1980). Because χ^2 is overly sensitive to the sample size (Hu & Bentler, 1999), the ratio of χ^2 to its degrees of freedom (χ^2/df) was used, and a range of not more than 3.0 was indicative of an acceptable fit (Kline 2005).

Table 6.Descriptive Statistics and Bivariate Correlations

Item	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. ASUU_1	4.878	1.151	-	.754**	.695**	.446**	.398**	.629**	.647**	.427**	.559**	.528**	.418**	.525**	.438**	.606**	.561**	.646**	.611**	.603**	.368**	.305**
2. ASUU_2	4.714	1.258			.805**	.477**	.437**	.652**	.646**	.495**	.615**	.569**	.504**	.606**	.482**	.597**	.615**	.656**	.637**	.629**	.386**	.376**
3. ASUU_3	4.850	1.215			-	.412**	.407**	.667**	.690**	.546**	.601**	.589**	.504**	.603**	.554**	.586**	.610**	.678**	.677**	.658**	.406**	.462**
4. ASUL_1	4.286	1.529				-	.670**	.450**	.415**	.446**	.446**	.437**	.447**	.337**	.364**	.482**	.437**	.396**	.405**	.396**	.388**	.343**
5. ASUL_2	4.005	1.402					-	.398**	.367**	.363**	.438**	.411**	.436**	.456**	.405**	.460**	.457**	.381**	.401**	.384**	.437**	.365**
6. BCRPE_2	4.845	1.251						-	.912**	.516**	.660**	.587**	.536**	.567**	.491**	.653**	.621**	.714**	.706**	.686**	.434**	.362**
7. BCRPE_3	4.915	1.183							-	.551**	.680**	.586**	.530**	.560**	.529**	.670**	.635**	.736**	.746**	.717**	.439**	.398**
8. BCRSI_1	5.573	1.190								-	.769**	.797**	.559**	.468**	.570**	.661**	.633**	.619**	.623**	.588**	.513**	.592**
9. BCRSI_2	5.164	1.196									--	.735**	.527**	.502**	.547**	.792**	.734**	.719**	.724**	.692**	.560**	.519**
10. BCRSI_5	5.620	1.166										-	.597**	.560**	.624**	.668**	.685**	.656**	.656**	.622**	.504**	.531**
11. BCRFC_1	5.094	1.209											-	.618**	.690**	.612**	.632**	.569**	.592**	.583**	.490**	.525**
12. BCRFC_3	4.737	1.219												-	.597**	.524**	.560**	.596**	.606**	.576**	.402**	.414**
13. BCRFC_4	5.070	1.185													-	.621**	.621**	.557**	.579**	.536**	.436**	.563**
14. CARBI_1	5.169	1.221														-	.901**	.798**	.800**	.780**	.626**	.590**
15. CARBI_3	5.117	1.213															-	.780**	.786**	.779**	.592**	.592**
16. CARA_1	5.390	1.187																-	.927**	.930**	.508**	.530**
17. CARA_2	5.300	1.179																	-	.926**	.518**	.575**
18. CARA_4	5.376	1.161																		-	.482**	.510**
19. DBRUB_1	4.502	1.481																			-	.620**
20. DBRUB_3	5.221	1.461																				-

For the RMSEA, values of less than .05 are deemed to indicate a close model fit; those between .05 and .08 a reasonable fit; those between .08 and .10 a mediocre fit; and those greater than .10 an unacceptable fit (Browne & Cudeck, 1993). According to Hair et al. (2010), the value of GFI should be more than .95. The CFI and TLI compare the hypothesised model to a 'null' or worst-fitting model, taking into account model complexity, and indicate an acceptable model fit when values are greater than .90, while a good model fit is indicated when values are greater than .95 (Hu & Bentler, 1999). Three CFAs were conducted to identify the best model in this study. Table 7 shows the fit indices for the three models tested. Model 1 was a single-factor model, with all items in the instrument loading on a single factor. Model 2 is the extended UTAUT proposed with usability, learnability, PE, FC, SI, BI, attitude and UB as separate constructs. Model 3 was an additional analysis in which the two new constructs (usability and learnability) were combined into a single factor ('adoptability'). This latter model was tested to determine whether both constructs should be retained separately, or could be considered elements of a single predictor.

Table 7. Goodness-of-fit Indices for Extended UTAUT

Measure	**Thresholds**	**Values / Fit**		
		Model 1: 1- Factor	Model 2: 8-Factor	Model 3: 7-Factor
χ^2	--	1353.042	242.998	334.875
df	--	170	142	149
χ^2/df	< 3 good; < 5 sometimes permissible	7.959	1.711	2.315
p-value	< 0.05	0.000	0.000	0.000
RMSEA	< 0.05 (good); 0.05 to 0.10 (moderate); > 0.10 (bad)	0.181	0.058	0.079
GFI	> 0.95	0.582	0.899	0.862
CFI	> 0.95 (great); > 0.90 (traditional); > 0.80 (sometimes permissible)	0.729	0.977	0.955
TLI	> 0.9	0.697	0.969	0.943

The change in χ^2 across the three models was then used to evaluate whether the fit of the three models differed significantly. From the indices, this analysis indicated that the changes in χ^2 were all significant. Specifically, the 7-factor Model 3 fit the data significantly better than the one-factor (Model 1), $\Delta\chi^2$ (21) = 1018.167; p<.01. However, the original 8-factor

model (Model 2) produced a significantly better fit than the 7-factor, in which the two new constructs were combined (Model 3), $\Delta\chi^2$ (7) = 91.877; p<.01. Given these results, the originally proposed 8-factor Model 2 was retained. The values for Model 2 fell within the recommended thresholds for acceptable model fit based on all other indices (χ^2/df = 1.711; RMSEA = .058; GFI = .899; CFI = .97, TLI = .969). Both the (χ^2 df and RMSEA were low for Model 2 and within recommended levels, while the GFI, CFI and TLI were all higher than the recommended cutoffs. Figure 18 presents the path coefficients for Model 2. An internal item consistency test was conducted for the overall model with a Cronbach's Alpha coefficient attaining .960 (Cronbach, 1951). The internal item consistency for all individual constructs is also calculated, ranging from .765 to .975 (see Table 8).

Table 8. Cronbach's Alpha Coefficients

Construct	Item	Cronbach's Alpha
Usability	ASUU_1 ASUU_2 ASUU_3	0.901
Learnability	ASUL_1 ASUL_2	0.801
PE	BCRPE_2 BCRPE_3	0.953
SI	BCRSI_1 BCRSI_2 BCRSI_5	0.908
FC	BCRFC_1 BCRFC_3 BCRFC_4	0.839
BI	CARBI_1 CARBI_3	0.948
Attitude	CARA_1 CARA_2 CARA_4	0.975
UB	DBRUB_1 DBRUB_3	0.765

Conclusion

The primary objective of this study was to validate a new instrument designed to measure users' acceptance of online assessment. The instrument was based on an extension of the

original UTAUT model. Previously, there has been a limited amount of research that has adopted the UTAUT to study online assessment adoption. The study by Tan (2013) on students' adoptions and attitudes towards computerised placement tests was the one exception identified by the authors. In other studies, the examination of responses to online assessment has always been linked to responses to online learning systems in general (Hillier et al., 2018), which can confound the acceptance of learning and assessment elements. Further studies that focus specifically on users' acceptance of online assessment systems would enable institutions to better adapt the change management practices they adopt in relation to technology-based systems, to ensure that this element of an overall online approach is received favourably.

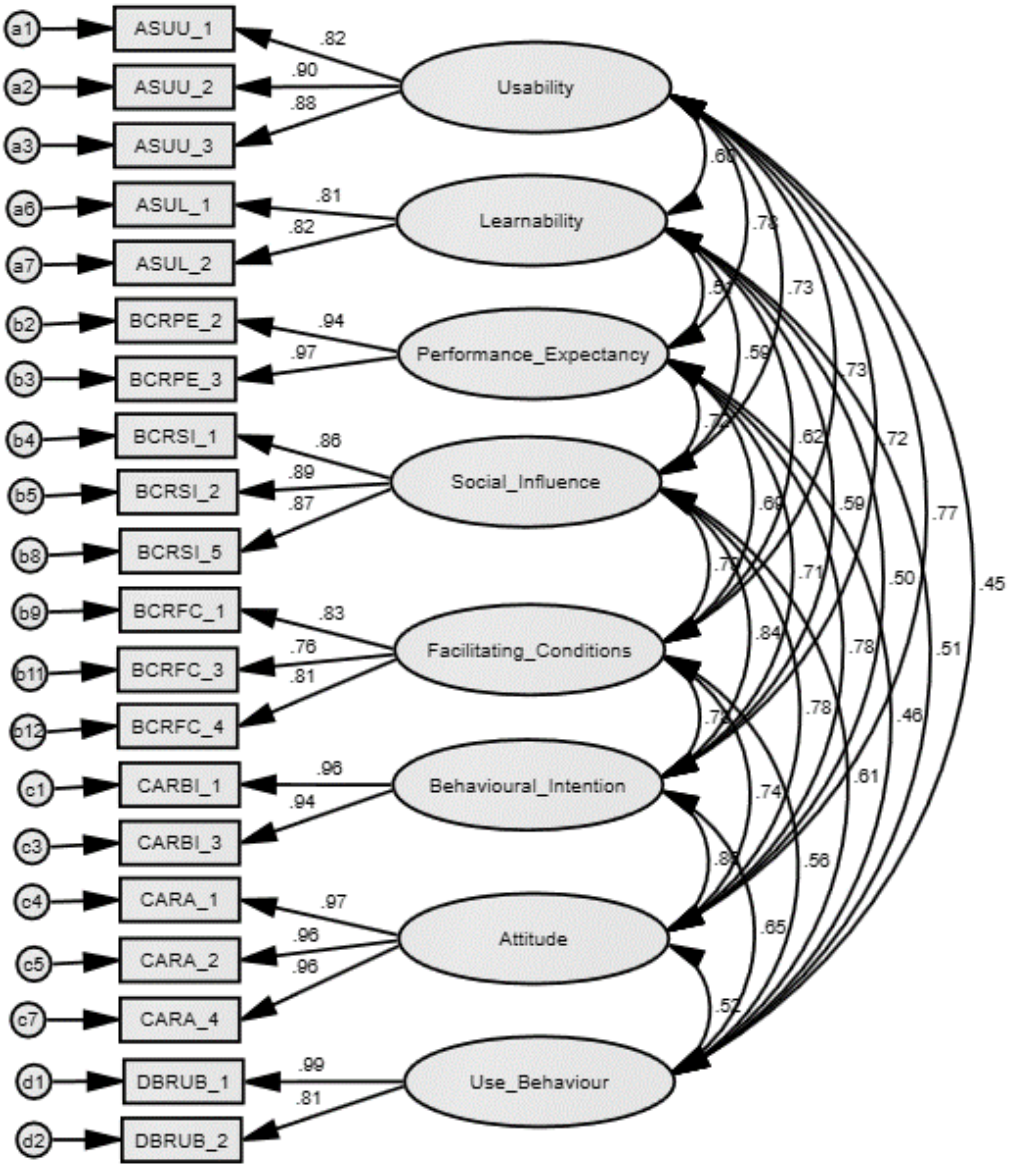

Figure 18. Confirmatory Factor Analysis of Extended Unified Theory of Acceptance and Use of Technology

The instrument developed and proposed in this study demonstrated sound psychometric properties based on evidence of content, response process, and internal structure validity. Thus, with minor revisions to the item wordings (e.g., replacing reference to the IAS with the name of the local system under study), this instrument holds significant promise for use in future studies that focus on lecturers' acceptance of online assessment approaches in higher education. Given the somewhat disparate findings reported in previous UTAUT studies, however, further research into its psychometric properties would be needed to ensure that the instrument is suitable for use across a wide range of participants and settings.

References

Ajzen, I. (1991). The theory of planned behavior. *Organisational behavior and human decision processes*, *50*(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Albright, J. J., & Park, H. M. (2009). Confirmatory factor analysis using Amos, LISREL, Mplus, SAS/STAT CALIS. https://pdfs.semanticscholar.org/887d/174122f76e2a232ba313866cb1b191bd15ad.pdf

AlDahdouh, A.A. (2019). Individual Learning Experience in Connectivist Environment: A Qualitative Sequence Analysis. *International Journal of Research in Education and Science (IJRES), 5*(2), 488-509.

Ali, R. A., & Arshad, M. R. M. (2018). Empirical Analysis on Factors Impacting on Intention to Use M-learning in Basic Education in Egypt. *The International Review of Research in Open and Distributed Learning*, 19(2). https://doi.org/10.19173/irrodl.v19i2.3510

Alshehri, A., Rutter, M. J., & Smith, S. (2019). An implementation of the UTAUT model for understanding Students' perceptions of learning management systems: A study within tertiary institutions in Saudi Arabia. *International Journal of Distance Education Technologies (IJDET), 17*(3), 1-24. https://doi.org/10.4018/IJDET.2019070101

Amante, L., Oliveira, I. R., & Gomes, M. J. (2019). E-Assessment in Portuguese Higher Education: Framework and Perceptions of Teachers and Students. *In Handbook of Research on e-Assessment in Higher Education* (pp. 312-333). IGI Global. https://www.academia.edu/download/58437616/E-Assessment-in-Portuguese-Higher-Education_-Framework-and-Perceptions-of-Teachers-and-Students._2.pdf

Barkley, A. P. (2002). An analysis of online examinations in college courses. *Journal of Agricultural and Applied Economics*, *34*(3), 445-458. https://doi.org/10.1017/S1074070800009238

Barnett, D.E. (2018). Online Adjunct Faculty: A Quantitative Examination of the Predictive Relationship between Leadership and Job Satisfaction. *International Journal of Research in Education and Science (IJRES), 4*(1), 226-236. DOI:10.21890/ijres.383159

Behrenbruch, K., Söllner, M., Leimeister, J. M., & Schmidt, L. (2013, September). Understanding diversity–the impact of personality on technology acceptance. *In IFIP Conference on Human-Computer Interaction* (pp. 306-313). Springer, Berlin, Heidelberg. https://www.irit.fr/recherches/ICS/events/conferences/interact2013/papers/8120307.pdf

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*(2), 238. https://doi.org/10.1037//0033-2909.107.2.238

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, *88*(3), 588. https://doi.org/10.1037/0033-2909.88.3.588

Bloom, T. J., Rich, W. D., Olson, S. M., & Adams, M. L. (2018). Perceptions and performance using computer-based testing: One institution's experience. *Currents in Pharmacy Teaching and Learning, 10*(2), 235-242. https://doi.org/10.1016/j.cptl.2017.10.015

Boevé, A. J., Meijer, R. R., Albers, C. J., Beetsma, Y., & Bosker, R. J. (2015). Introducing computer-based testing in high-stakes exams in higher education: Results of a field experiment. *PloS one, 10*(12), e0143616. https://doi.org/10.1371/journal.pone.0143616

Boitshwarelo, B., Reedy, A. K., & Billany, T. (2017). Envisioning the use of online tests in assessing twenty-first-century learning: a literature review. *Research and Practice in Technology Enhanced Learning*, *12*(1), 16. https://doi.org/10.1186/s41039-017-0055-7

Bollen, K. A. (1989). A new incremental fit index for general structural equation models. *Sociological Methods & Research*, *17*(3), 303-316. https://doi.org/10.1177/0049124189017003004

Botero, G. G., Questier, F., Cincinnato, S., He, T., & Zhu, C. (2018). Acceptance and usage of mobile assisted language learning by higher education students. *Journal of Computing in Higher Education*, *30*(3), 426-451. https://doi.org/10.1007/s12528-018-9177-1

Bouznif, M. M. (2018). Business students' continuance intention toward Blackboard usage: An empirical investigation of UTAUT model. *International Journal of Business and Management, 13*(1), 120. https://doi.org/10.5539/ijbm.v13n1p120

Boz, B. & Adnan, M. (2017). How do Freshman Engineering Students Reflect an Online

Calculus Course? *International Journal of Education in Mathematics, Science and Technology (IJEMST), 5*(4), 262-278. DOI:10.18404/ijemst.83046

Bradley, V. M. (2021). Learning Management System (LMS) Use with Online Instruction. *International Journal of Technology in Education (IJTE), 4*(1), 68-92. https://doi.org/10.46328/ijte.36

Brady, A. M. (2005). Assessment of learning with multiple-choice questions. *Nurse Education in Practice, 5*(4), 238-242. https://doi.org/10.1016/j.nepr.2004.12.005

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. *Sage focus editions*, *154*, 136-136. https://doi.org/10.1177/0049124192021002005

Bull, J. (1999). Computer-assisted assessment: Impact on higher education institutions. *Educational Technology & Society*, *2*(3), 123-126. http://www.jstor.org/stable/jeductechsoci.2.3.123

Bull, J., & McKenna, C. (2003). *A blueprint for computer-assisted assessment*. Routledge.

Castillo-Díaz, M., & Padilla, J. L. (2013). How cognitive interviewing can provide validity evidence of the response processes to scale items. *Social indicators research, 114*(3), 963-975. https://doi.org/10.1007/s11205-012-0184-8

Cavus, N. (2015). Distance learning and learning management systems. *Procedia-Social and Behavioral Sciences*, *191*, 872-877. https://doi.org/10.1016/j.sbspro.2015.04.611

Chalmers, D., & McAusland, W. D. M. (2002). Computer-assisted assessment. *The Handbook for Economics Lecturers*, 2-12.

Chao, C. M. (2019). Factors determining the behavioral intention to use mobile learning: An application and extension of the UTAUT model. *Frontiers in psychology, 10*, 1652. https://doi.org/10.3389/fpsyg.2019.01652

Chien, S. P., Wu, H. K., & Hsu, Y. S. (2014). An investigation of teachers' beliefs and their use of technology-based assessments. *Computers in Human Behavior*, *31*, 198-210. https://doi.org/10.1016/j.chb.2013.10.037

Chin, W. W., Johnson, N., & Schwarz, A. (2008). A fast form approach to measuring technology acceptance and other constructs. *MIS Quarterly, 32*(4). https://doi.org/10.2307/25148867

Cirit, N. C. (2015). Assessing ELT pre-service teachers via web 2.0 tools: Perceptions toward traditional, online and alternative assessment. TOJET : The Turkish Online Journal of Educational Technology, 14(3). https://search-proquest-com.ezproxy.library.uwa.edu.au/docview/1728238463?accountid=14681

Collares, C. F., & Cecilio-Fernandes, D. (2019). When I say… computerised adaptive testing. *Medical education*, *53*(2), 115-116. https://doi.org/10.1111/medu.13648

Compeau, D., Higgins, C. A., & Huff, S. (1999). Social cognitive theory and individual reactions to computing technology: A longitudinal study. *MIS quarterly*, 145-158. https://doi.org/10.2307/249749

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *psychometrika*, *16*(3), 297-334. https://doi.org/10.1007/BF02310555

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 319-340. https://doi.org/10.2307/249008

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace 1. *Journal of applied social psychology*, *22*(14), 1111-1132. https://doi-org.ezproxy.library.uwa.edu.au/10.1111/j.1559-1816.1992.tb00945.x

Deutsch, T., Herrmann, K., Frese, T., & Sandholzer, H. (2012). Implementing computer-based assessment–A web-based mock examination changes attitudes. *Computers & Education, 58*(4), 1068-1075. https://doi.org/10.1016/j.compedu.2011.11.013

Diprose, M. (2013). Learning and assessment credibility: The design of examination strategies in a changing learning environment. *Knowledge Management & E-Learning: An International Journal*, *5*(1), 104-116. https://doi.org/10.34105/j.kmel.2013.05.008

Dube, T., Zhao, Z., & Ma, M. (2009). E-assessment and Design Methodology Management. http://eprints.hud.ac.uk/id/eprint/23208

Dulle, F. W., & Minishi-Majanja, M. K. (2011). The suitability of the Unified Theory of Acceptance and Use of Technology (UTAUT) model in open access adoption studies. *Information development*, *27*(1), 32-45. https://doi.org/10.1177/0266666910385375

El-Gayar, O. F., & Moran, M. (2006). College students' acceptance of Tablet PCs: An application of the UTAUT Model. *Dakota State University*, *820*, 2845-2850. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.120.2667&rep=rep1&type=pdf

El-Gayar, O., Moran, M., & Hawkes, M. (2011). Students' acceptance of tablet PCs and implications for educational institutions. *Journal of Educational Technology & Society*, *14*(2), 58-70. https://search-proquest-com.ezproxy.library.uwa.edu.au/docview/2139143267?accountid=14681

Fageeh, A. I. (2015). EFL student and faculty perceptions of and attitudes towards online testing in the medium of Blackboard: Promises and challenges. *JALT CALL Journal, 11*(1), 41-62. https://doi.org/10.29140/jaltcall.v11n1.183

Festinger, L. (1957). A theory of cognitive dissonance: Row, Peterson. *Evanston, Il*.

Fishbein, M., & Ajzen, I. (1975). Belief, attitude, intention and behavior: An introduction to theory and research.

Fluck, A., Pullen, D., & Harper, C. (2009). Case study of a computer-based examination system. *Australasian Journal of Educational Technology*, *25*(4). https://doi.org/10.14742/ajet.1126

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research*, *18*(1), 39-50. https://doi.org/10.1177/002224378101800104

Friborg, O., Martinussen, M., & Rosenvinge, J. H. (2006). Likert-based vs. semantic differential-based scorings of positive psychological constructs: A psychometric comparison of two versions of a scale measuring resilience. *Personality and Individual Differences*, *40*(5), 873–884. https://doi.org/10.1016/j.paid.2005.08.015

Gipps, C. V. (2005). What is the role for ICT-based assessment in universities? *Studies in Higher Education*, *30*(2), 171-180. https://doi.org/10.1080/03075070500043176

Göb, R., McCollin, C., & Ramalhoto, M. F. (2007). Ordinal methodology in the analysis of Likert scales. *Quality & Quantity, 41*(5), 601-626. https://doi.org/10.1007/s11135-007-9089-z

Hair, J. F., Anderson, R. E., Babin, B. J., & Black, W. C. (2010). Multivariate data analysis: A global perspective (Vol. 7).

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). Multivariate data analysis. Uppersaddle River.

Hamsatu, P., Yusufu, G., & Mohammed, H. A. (2016). Teachers' Perceptions and Undergraduate Students' Experience in E-Exam in Higher Institution in Nigeria. *Journal of Education and Practice, 7*(23), 158-166. https://files.eric.ed.gov/fulltext/EJ1112920.pdf

Hawkins, D. I., Albaum, G., & Best, R. (1974). Stapel scale or semantic differential in marketing research? *Journal of Marketing Research*, *11*(3), 318–322. doi: 10.2307/3151152

Haynes, S. N., Richard, D., & Kubany, E. S. (1995). Content validity in psychological assessment: A functional approach to concepts and methods. *Psychological assessment, 7*(3), 238. https://doi.org/10.1037//1040-3590.7.3.238

Hillier, M., Grant, S., & Coleman, M. (2018). Towards authentic e-Exams at scale: robust networked Moodle. *Open Oceans: Learning Without Borders*, 131.

http://www.academia.edu/download/63542093/ASCILITE-2018-Proceedings20200605-17164-1rg88df.pdf#page=133

Hsu, H. S., & Kulviwat, S. (2006). An integrative framework of technology acceptance model and personalisation in mobile commerce. *International Journal of Technology Marketing, 1*(4), 393-410. https://pdfs.semanticscholar.org/9bfd/0b4da29852f2c69590394d03bd14881bb3b3.pdf

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural equation modelling: a multidisciplinary journal*, *6*(1), 1-55. https://doi.org/10.1080/10705519909540118

Huang, M. H. (2005). Web performance scale. *Information & Management, 42*(6), 841-852. https://www.inderscienceonline.com/doi/pdf/10.1504/IJTMKT.2006.010734

Huot, B. (1996). Computers and assessment: Understanding two technologies. *Computers and Composition*, *13*(2), 231-243. https://doi.org/10.1016/S8755-4615(96)90012-2

Imtiaz, M., & Maarop, N. (2014). Feasibility study of lecturers' acceptance of E-assessment. ACIS. https://core.ac.uk/download/pdf/56364754.pdf

James, R., McInnis, C., & Devlin, M. (2002). Assessing learning in Australian universities. *Melbourne: The University of Melbourne Centre for the Study of Higher Education.* http://www.ntu.edu.vn/Portals/96/Tu%20lieu%20tham%20khao/Phuong%20phap%20danh%20gia/assessing%20learning.pdf

Jamieson, S. (2004). Likert scales: How to (ab) use them?. *Medical education*, *38*(12), 1217-1218. https://doi.org/10.1111/j.1365-2929.2004.02012.x

Jamil, M., Tariq, R. H., & Shami, P. A. (2012). Computer-Based vs Paper-Based Examinations: Perceptions of University Teachers. *Turkish Online Journal of Educational Technology-TOJET, 11*(4), 371-381. https://search-proquest-com.ezproxy.library.uwa.edu.au/docview/1288340335?accountid=14681

Jawaid, M., Moosa, F. A., Jaleel, F., & Ashraf, J. (2014). Computer based assessment (CBA): Perception of residents at Dow University of Health Sciences. *Pakistan journal of medical sciences, 30*(4), 688. https://doi.org/10.12669/pjms.304.5444

Jordan, S. (2013). E-assessment: Past, present and future. *New Directions in the Teaching of Physical Sciences*, (9), 87-106. https://doi.org/10.29311/ndtps.v0i9.504

Kaleli, Y. S. (2021). The Effect of Individualized Online Instruction on TPACK Skills and Achievement in Piano Lessons. *International Journal of Technology in Education (IJTE), 4*(3), 399-412. https://doi.org/10.46328/ijte.143

Khashaba, A. S. (2020). Evaluation of the Effectiveness of Online Peer-based Formative

Assessments (PeerWise) to Enhance Student Learning in Physiology: A Systematic Review Using PRISMA Guidelines. *International Journal of Research in Education and Science (IJRES), 6*(4), 613-628.

Khechine, H., & Augier, M. (2019, January). Adoption of a Social Learning Platform in Higher Education: An Extended UTAUT Model Implementation. *In Proceedings of the 52nd Hawaii International Conference on System Sciences*. https://scholarspace.manoa.hawaii.edu/bitstream/10125/59446/1/0006.pdf

Kibici, V. B. & Sarıkaya, M. (2021). Readiness Levels of Music Teachers for Online Learning during the COVID 19 Pandemic. *International Journal of Technology in Education (IJTE), 4*(3), 501-515. https://doi.org/10.46328/ijte.192

Kissi, P. S., Nat, M., & Armah, R. B. (2018). The effects of learning–family conflict, perceived control over time and task-fit technology factors on urban-rural high school students' acceptance of video-based instruction in flipped learning approach. *Educational Technology Research and Development*, *66*(6), 1547-1569. https://doi.org/10.1007/s11423-018-9623-9

Kline, R. B. (2005). Methodology in the social sciences.

Kumar, L. R., Bedra, A., & Karkera, R. (2013). Perception of medical students on e-assessment conducted through Yengage portal. *Archives of Medicine and Health Sciences, 1*(1), 61. https://doi.org/10.4103/2321-4848.113577

Lakhal, S., Khechine, H., & Pascot, D. (2013). Student behavioural intentions to use desktop video conferencing in a distance course: integration of autonomy to the UTAUT model. *Journal of Computing in Higher Education*, *25*(2), 93-121. https://doi.org/10.1007/s12528-013-9069-3

Lawshe, C. H. (1975). A quantitative approach to content validity 1. Personnel psychology, *28*(4), 563-575. https://doi.org/10.1111/j.1744-6570.1975.tb01393.x

Leem, J., & Sung, E. (2019). Teachers' beliefs and technology acceptance concerning smart mobile devices for SMART education in South Korea. *British Journal of Educational Technology*, *50*(2), 601-613. https://doi.org/10.1111/bjet.12612

Lei, S. A., & Gupta, R. K. (2010). College Distance Education Courses: Evaluating Benefits and Costs from Institutional, Faculty and Students' Perspectives. *Education, 130*(4). https://web-a-ebscohost-com.ezproxy.library.uwa.edu.au/ehost/pdfviewer/pdfviewer?vid=2&sid=9c8a3b69-e185-45d3-8d5d-45349ce6eb38%40sdc-v-sessmgr03

Lin, J. W., & Lin, H. C. K. (2019). User acceptance in a computer-supported collaborative learning (CSCL) environment with social network awareness (SNA) support. *Australasian Journal of Educational Technology*, *35*(1), 100-115. https://doi.org/10.14742/ajet.3395

Llamas-Nistal, M., Fernández-Iglesias, M. J., González-Tato, J., & Mikic-Fonte, F. A. (2013). Blended e-assessment: Migrating classical exams to the digital world. *Computers & Education, 62*, 72-87. https://doi.org/10.1016/j.compedu.2012.10.021

McLeod, A., Pippin, S., & Wong, J. A. (2011). Revisiting the Likert scale: can the fast form approach improve survey research? *International Journal of Behavioural Accounting and Finance,* *2*(3-4), 310-327. https://www.researchgate.net/profile/Alexander_Mcleod2/publication/264813609_Revisiting_the_Likert_scale_can_the_fast_form_approach_improve_survey_research/links/559d4ce008ae04e36508e625/Revisiting-the-Likert-scale-can-the-fast-form-approach-improve-survey-research.pdf

Messick, S. (1987). Validity. *ETS Research Report Series, 1987*(2), i-208. https://doi.org/10.1002/j.2330-8516.1987.tb00244.x

Messick, S. (1988). Meaning and Values in Test Validation: The Science and Ethics of Assessment. *ETS Research Report Series*, *1988*(2), i-28. https://doi.org/10.3102/0013189x018002005

Messick, S. (1989). Meaning and values in test validation: The science and ethics of assessment. *Educational researcher*, *18*(2), 5-11. https://doi.org/10.2307/1175249

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information systems research*, *2*(3), 192-222. https://doi.org/10.1287/isre.2.3.192

Moran, M., Hawkes, M., & Gayar, O. E. (2010). Tablet personal computer integration in higher education: Applying the unified theory of acceptance and use technology model to understand supporting factors. *Journal of Educational Computing Research*, *42*(1), 79-101. https://doi.org/10.2190/ec.42.1.d

Müller-Seitz, G., Dautzenberg, K., Creusen, U., & Stromereder, C. (2009). Customer acceptance of RFID technology: Evidence from the German electronic retail sector. *Journal of retailing and consumer services,* *16*(1), 31-39. https://doi.org/10.1016/j.jretconser.2008.08.002

Nassuora, A. B. (2012). Students acceptance of mobile learning for higher education in Saudi Arabia. *American Academic & Scholarly Research Journal*, *4*(2), 24-30.

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.402.6814&rep=rep1&type=pdf

Norman, G. (2010). Likert scales, levels of measurement and the "laws" of statistics. *Advances in health sciences education*, *15*(5), 625-632. https://10.1007/s10459-010-9222-y

Or, C. C. P. & Chapman, E. (2021). Determinants of Online Assessment Adoption in a Technical College. *International Journal of Technology in Education and Science (IJTES), 5*(4), 601-619. https://doi.org/10.46328/ijtes.291

Osgood, C. E. (1952). The nature and measurement of meaning. *Psychological Bulletin, 49*(3), 197. https://doi.org/10.1037/h0055737

Pedersen, P. E., & Nysveen, H. (2003, June). Usefulness and self-expressiveness: extending TAM to explain the adoption of a mobile parking service. *In Proceedings of the 16th Electronic Commerce Conference, Bled, Slovenia.* https://domino.fov.uni-mb.si/proceedings.nsf/0/2e6a4fdaccbe501fc1256ea2002e0617/$FILE/50Peders.pdf

Presser, S., Couper, M. P., Lessler, J. T., Martin, E., Martin, J., Rothgeb, J. M., & Singer, E. (2004). Methods for testing and evaluating survey questions. *Public opinion quarterly, 68*(1), 109-130. https://doi.org/10.1093/poq/nfh008

Raman, A., Don, Y., Khalid, R., Hussin, F., Fauzee, O., Sofian, M., & Ghani, M. (2014). Technology acceptance on smart board among teachers in Terengganu using UTAUT model. *Asian Social Science*, *10*(11), 84-91. https://doi.org/10.5539/ass.v10n11p84

Ridgway, J., McCusker, S., & Pead, D. (2004). Literature review of e-assessment. https://telearn.archives-ouvertes.fr/file/index/docid/190440/filename/ridgway-j-2004-r10.pdf

Riera Guasp, J., Ardid Ramírez, M., Gómez-Tejedor, J. A., Vidaurre, A., & Meseguer Dueñas, J. M. (2018). Students perception of auto-scored online exams in blended assessment: feedback for improvement. *Educacion XXI, 21*(2), 79-103. https://doi.org/10.5944/educxx1.19559

Rogers, E. M. (2010). *Diffusion of innovations*. Simon and Schuster. Festinger, 1957

Rogers, E. M., & Shoemaker, F. F. (1971). Communication of Innovations; a cross-cultural approach.

Salloum, S. A., & Shaalan, K. (2018, September). Factors Affecting Students' Acceptance of E-Learning System in Higher Education Using UTAUT and Structural Equation Modeling Approaches. *In International Conference on Advanced Intelligent Systems*

and Informatics (pp. 469-480). Springer, Cham. https://doi.org/10.1007/978-3-319-99010-1_43

Samaradiwakara, G. D. M. N., & Gunawardena, C. G. (2014). Comparison of existing technology acceptance theories and models to suggest a well-improved theory/model. *International Technical Sciences Journal*, *1*(1), 21-36. https://enos.itcollege.ee/~edmund/inf-hw/seminaritoo/itsj-spec-1-1-3.pdf

Schneberger, S., Amoroso, D. L., & Durfee, A. (2008). Factors that influence the performance of computer-based assessments: an extension of the technology acceptance model. *Journal of Computer Information Systems, 48*(2), 74-90.

Schoonenboom, J. (2014). Using an adapted, task-level technology acceptance model to explain why instructors in higher education intend to use some learning management system tools more than others. *Computers & Education, 71*, 247-256. https://doi.org/10.1016/j.compedu.2013.09.016

Shuhaiber, A. H. (2015). Students' Willingness to Accept Virtual Lecturing Systems: An Empirical Study by Extending the UTAUT Model. *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, *9*(4), 11531157. https://pdfs.semanticscholar.org/7869/ae3f1c2378bac6b1c1501de1c5f0df409a6c.pdf

Sim, G., Holifield, P., & Brown, M. (2004). Implementation of computer assisted assessment: lessons from the literature. *ALT-J*, *12*(3), 215-229. https://doi.org/10.3402/rlt.v12i3.11255

Spivey, M. F., & McMillan, J. J. (2014). Classroom versus online assessment. *Journal of Education for Business, 89*(8), 450-456. https://doi.org/10.1080/08832323.2014.937676

Steiger, J. H. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate behavioral research*, *25*(2), 173-180. http://www.statpower.net/Steiger%20Biblio/Steiger90b.pdf

Stone, D. E., & Zheng, G. (2014). Learning management systems in a changing environment. *In Handbook of research on education and technology in a changing society* (pp. 756-767). IGI Global. Retrieved from https://pdfs.semanticscholar.org/5d2a/52f4d07de909bc8fbd640ebd2dba6235fa07.pdf

Šumak, B., Polancic, G., & Hericko, M. (2010, February). An empirical study of virtual learning environment adoption using UTAUT. *In Mobile, Hybrid, and On-Line Learning, 2010. ELML'10. Second International Conference on* (pp. 17-22). IEEE. https://doi.org/10.1109/eLmL.2010.11

Suryaratri, R. D., Komalasari, G., & Medellu, G. I. (2022). The Role of Academic Self-Efficacy and Social Support in Achieving Academic Flow in Online Learning. *International Journal of Technology in Education and Science (IJTES), 6*(1), 164-177. https://doi.org/10.46328/ijtes.345

Tan, P. J. B. (2013). Students' adoptions and attitudes towards electronic placement tests: A UTAUT analysis. *American Journal of Computer Technology and Application*, *1*(1), 14-23. http://www.ajcta.com/Vol.%201,%20No.%201,%20February%202013/This%20is%20my%20final%20revision(A)t_2013_2_22.pdf

Taylor, S., & Todd, P. (1995). Assessing IT usage: The role of prior experience. *MIS quarterly*, 561-570.

Taylor, S., & Todd, P. A. (1995). Understanding information technology usage: A test of competing models. *Information systems research*, *6*(2), 144-176. https://doi.org/10.1287/isre.6.2.144

Terzis, V., & Economides, A. A. (2011). Computer based assessment: Gender differences in perceptions and acceptance. *Computers in human behavior, 27*(6), 2108-2122. https://doi.org/10.1016/j.chb.2011.06.005

Terzis, V., Moridis, C. N., & Economides, A. A. (2013a). Continuance acceptance of computer based assessment through the integration of user's expectations and perceptions. *Computers & Education, 62*, 50-61. https://doi.org/10.1016/j.compedu.2012.10.018

Terzis, V., Moridis, C. N., Economides, A. A., & Mendez, G. R. (2013b). Computer based assessment acceptance: A cross-cultural study in Greece and Mexico. *Journal of Educational Technology & Society, 16*(3), 411-424. https://www.jstor.org/stable/jeductechsoci.16.3.411

Thomas, T., Singh, L., & Gaffar, K. (2013). The utility of the UTAUT model in explaining mobile learning adoption in higher education in Guyana. *International Journal of Education and Development using ICT*, *9*(3). https://search-proquest-com.ezproxy.library.uwa.edu.au/docview/1491114969?accountid=14681

Thompson, R. L., Higgins, C. A., & Howell, J. M. (1991). Personal computing: toward a conceptual model of utilisation. *MIS quarterly*, 125-143. https://doi.org/10.2307/249443

Thompson, V. L. & McDowell, Y. L. (2019). A case study comparing student experiences and success in an undergraduate course offered through online, blended, and face-to-

face instruction. *International Journal of Education in Mathematics, Science and Technology (IJEMST), 7*(2), 116-136.

Thongsri, N., Shen, L., Bao, Y., & Alharbi, I. M. (2018). Integrating UTAUT and UGT to explain behavioural intention to use M-learning. *Journal of Systems and Information Technology*. https://doi.org/10.1108/JSIT-11-2017-0107

Toft, M. B., Schuitema, G., & Thøgersen, J. (2014). Responsible technology acceptance: Model development and application to consumer acceptance of Smart Grid technology. *Applied Energy, 134*, 392-400. https://doi.org/10.1016/j.apenergy.2014.08.048

Tojib, D. R., & Sugianto, L. (2006). Content validity of instruments in is research. *JITTA : Journal of Information Technology Theory and Application, 8*(3), 31-56. https://search-proquest-com.ezproxy.library.uwa.edu.au/docview/199992436?accountid=14681

Van Auken, S., & Barry, T. E. (1995). An assessment of the trait validity of cognitive age measures. *Journal of Consumer Psychology*, *4*(2), 107–132. https://doi.org/10.1207/s15327663jcp040202

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, *46*(2), 186-204. https://doi.org/10.1287/mnsc.46.2.186.11926

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS quarterly*, 425-478. https://doi.org/10.2307/30036540

Verhagen, T., van Den Hooff, B., & Meents, S. (2015). Toward a better use of the semantic differential in IS research: An integrative framework of suggested action. *Journal of the Association for Information Systems*, *16*(2), 108–143. https://doi.org/10.17705/1jais.00388

Wang, W., & Kingston, N. (2019). Adaptive Testing with a Hierarchical Item Response Theory Model. *Applied psychological measurement*, *43*(1), 51-67. https://doi.org/10.1177/0146621618765714

Webb, M., Gibson, D., & Forkosh-Baruch, A. (2013). Challenges for information technology supporting educational assessment. *Journal of Computer Assisted Learning, 29*(5), 451-462. https://doi.org/10.1111/jcal.12033

Wiggins, H. & van der Hoff, Q. (2021). Using an Online Homework System for Fostering Self-directed Learning. *International Journal of Technology in Education and Science (IJTES), 5*(3), 323-335. https://doi.org/10.46328/ijtes.199

Wirtz, J., & Lee, M. C. (2003). An examination of the quality and context-specific applicability of commonly used customer satisfaction measures. *Journal of Service Research*, *5*(4), 345–355. https//doi.org/10.1177/1094670503005004006

Wrycza, S., Marcinkowski, B., & Gajda, D. (2017). The enriched UTAUT model for the acceptance of software engineering tools in academic education. *Information Systems Management*, *34*(1), 38-49. https://doi.org/10.1080/10580530.2017.1254446

Yueh, H. P., Huang, J. Y., & Chang, C. (2015). Exploring factors affecting students' continued Wiki use for individual and collaborative learning: An extended UTAUT perspective. *Australasian Journal of Educational Technology*, *31*(1). https://doi.org/10.14742/ajet.170

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CHAPTER 5: DETERMINANTS OF ONLINE ASSESSMENT ADOPTION IN A SINGAPORE TECHNICAL COLLEGE

Pen-and-paper examinations have remained the traditional approach to student assessment in education institutions over the last few decades. Despite these enduring habits, the widespread availability of learning management systems and technology has increased the popularity of online assessment approaches in more recent years (Amasha et al., 2018; Choi & McClenen, 2020; Gamage et al., 2019; Krusche & Seitz, 2018; Liu et al., 2019; Xu & Mahenthiran, 2016; Way et al., 2020). Online assessment has the potential to enhance the process of evaluating student learning in myriad ways. For example, this approach can: increase testing reliability with machine marking; improve impartiality in assessment; permit the use of diverse question styles that incorporate interactivity and multimedia (Boyle & Hutchison, 2009; James et al., 2002); and increase lecturers' ability to test a wide variety of topics within a single test, in a short time period (Brady, 2005).

With features like automated marking and feedback, online assessment is viewed as efficient, fast and reliable, making it useful where large numbers of students are being tested. Online assessment may not only reduce the instructional and administrative costs of teaching a large class, but indirectly, affect the amount of student learning that takes place in courses by lowering the costs associated with administering more frequent assessments. Online assessment has the potential to support and even improve student learning with properly designed assessment tasks. Moreover, higher-order assessment tasks can also be assessed through online approaches.

Studies have shown that in general, students respond well to online assessment approaches, particularly if the assessment results are counted towards their final marks (Appiah & Van Tonder, 2018). However, it is the lecturers who must first prepare and then deliver these online assessment tasks. This group, therefore, will have a key influence on how successfully an online assessment system is used within an institution. While numerous studies on

lecturers' acceptance of online *learning* systems have appeared within the literature, studies that have focused on their acceptance of online *assessment* systems are relatively scarce. The present study focused on exploring the factors that predict lecturers' acceptance of one specific online assessment system used within an institute of technical education in Singapore. The central model used to explore lecturers' acceptance of this system was an extended version of the Unified Theory of Acceptance and Use of Technology proposed by Venkatesh et al. (2003).

Venkatesh et al. (2003) consolidated various previous Technology Acceptance Model (TAM) theories (Davis, 1989; Taylor & Todd, 1995) and models (Ajzen, 1991; Compeau et al., 1999; Fishbein & Ajzen, 1975; Moore & Benbasat, 1991; Thompson et al., 1991) in developing the Unified Theory of Acceptance and Use of Technology (UTAUT). In the UTAUT, four constructs play a significant role as direct determinants of behavioural intentions (BI) and use behaviours (UB) with respect to any technology-based system: (1) performance expectancy (PE), (2) effort expectancy (EE), (3) social influence (SI); and (4) facilitating conditions (FC) (see Figure 19).

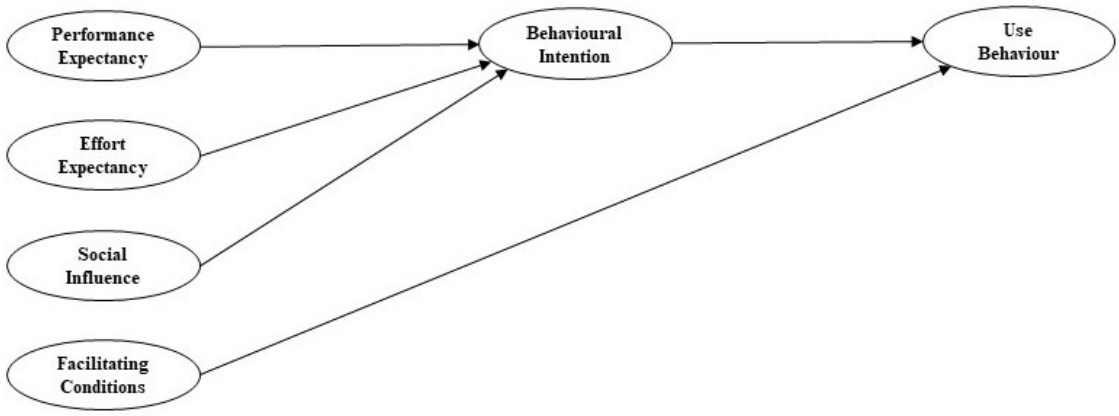

Figure 19. Unified Theory of Acceptance and Use of Technology Model [Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS quarterly, 425-478.]

PE is the degree to which a user believes that using the system will help him or her to attain gains in his or her job performance, and has been found to be a determinant of behavioural intentions in most situations. EE is the degree of ease with which the system can be used. SI is the extent to which a user perceives that 'important others' think that he or she should use

the system. FC is the extent to which a user believes that there are existing organisational and technical structures to support their system usage. Finally, BI is defined as the individual's intention to use the technology, while UB is their actual usage behaviour.

While the UTAUT has been found to have a high level of predictive power in explaining users' acceptance of various information systems (Venkatesh, et al., 2003), the original developers acknowledged that the model could be extended for use in specific contexts. As a result, an extended UTAUT model has been proposed by the first author as depicted in Figure 20.

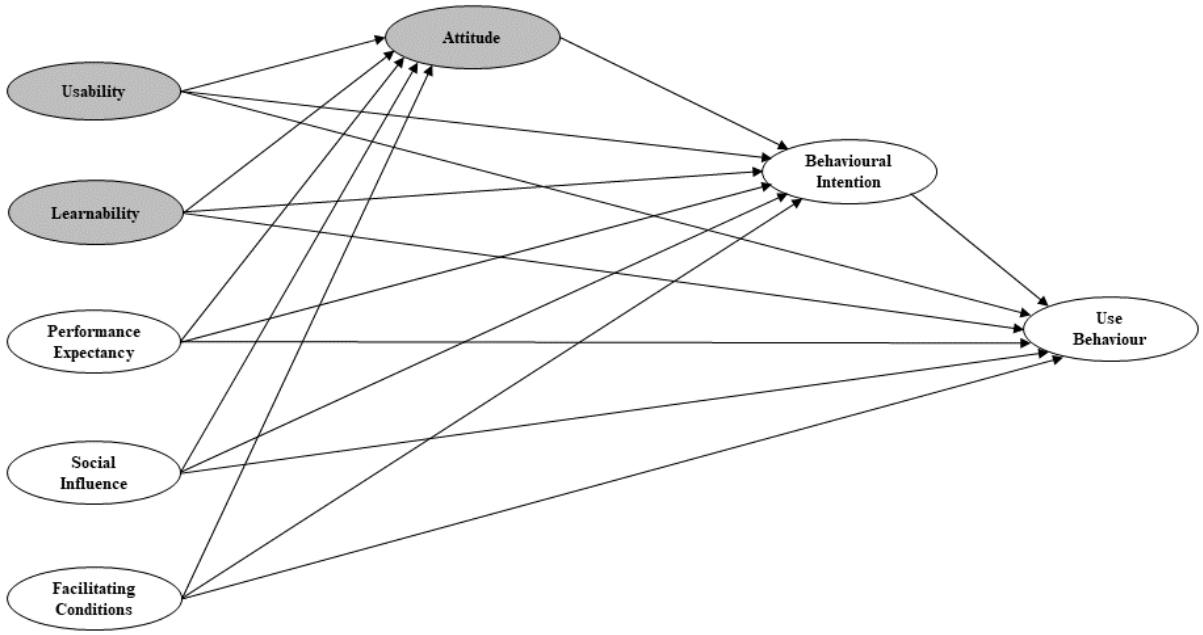

Figure 20. Extended Unified Theory of Acceptance and Use of Technology Model [Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS quarterly, 425-478.]

As indicated, in the extended model, PE, SI and FC have all been retained, because these have been shown to be powerful predictors of technology acceptance in previous research (Venkatesh, et al., 2003). However, two additional constructs (usability and learnability) have been added as potential influences on BI, given that these factors have been identified as important predictors in studies outside the UTAUT literature (Burney et al., 2017; Chiou et al., 2009; Holden & Rada, 2011; Jeng, 2005; Juarez Collazo et al., 2014; Lah et al., 2020; Lin, 2013; Tsakonas & Papatheodorou, 2008; Zbick et al., 2015). The construct of attitude

has also been added, as this factor has been found in various previous studies, including UTAUT extension studies, to be a significant predictor of both BI and UB (Botero et al., 2018; El-Gayar and Moran, 2006; El-Gayar et al., 2011; Jairak et al., 2009; Khechine, & Augier, 2019; Moran et al., 2010; Nassuora, 2012; Shuhaiber, 2015; Thomas et al., 2013).

In the extended model, *usability* is defined as the ease with which a system can be adopted to achieve given objectives with effectiveness and efficiency (Bevan et al., 2015; Jokela et al., 2003; Shackel, 2009). *Learnability* refers to the speed with which users can become familiar with the features and capabilities of a system, and will depend heavily on the quality of the system interfaces (Jeng, 2005; Nielsen, 1994). Both usability and learnability have yet to be evaluated as constructs in a UTAUT study, though these variables have been explored in past technology acceptance research. For example, Lin (2003) found that learnability (as an element of usability) was a significant predictor of intentions to use an eCampus learning system with a personal digital assistant (PDA), while Zbick et al. (2015) found that learnability was a significant predictor of intentions to use a mobile learning system in a university-level setting.

Attitudes (i.e., users' overall subjective thoughts or feelings about an object), which first appeared in the earlier TAM model but was not incorporated as a construct in the final UTAUT model, been re-introduced in the extended version proposed. According to the Theory of Reason Action, individuals' attitudes towards a given object or situation combine with subjective norms to shape their behavioural intentions, which also influence their actual behaviours (Ajzen & Fishbein, 1980). In the UTAUT extension studies on tablet PC adoption by El-Gayar and Moran (2006), Moran et al. (2010) and El-Gayar et al. (2011), attitudes toward using technology were found to significantly influence BI. Attitudes have also been found to influence BI in studies of mobile learning adoption (Nassuora, 2012; Thomas et al., 2013), virtual lecturing systems, mobile-assisted language learning systems and social learning platforms (Botero et al., 2018; Khechine & Augier, 2019; Shuhaiber, 2015).

In the exended UTAUT model, user acceptance is still operationalised by two of the constructs from the original UTAUT (BI and UB). Both of these have been incorporated in the model, though many later UTAUT researchers only considered BI as an outcome variable in technology acceptance studies. For example, Wong et al. (2013) did not include UB when studying student teachers' acceptance of interactive whiteboards using the original UTAUT

model. In another extended UTAUT study, Bouznif (2017) excluded UB in the exploring business students' continued intentions to use a learning management system. Although Dwivedi et al. (2019) argued, based on various UTAUT studies, that the influence of BI on UB might not be particularly strong or predictable, users' actual behaviours (whether assessed directly from records such as computer logs, or through a self-report survey) are an important indicator of overall acceptance levels. UB is, therefore, included as an endogenous variable in the extended UTAUT model.

While we recognised that in the original UTAUT model, the influence of the four primary factors (i.e. PE, EE, SI and FC) on BI and UB might be moderated by factors such as gender, age, experience and voluntariness, these factors are not typically included in empirical studies on the UTAUT. As a result, the extended model evaluated here does not include reference to these potential moderating variables. Further empirical studies that adopt the extended model could, however, include these as additional factors.

The goal of the present study was to explore lecturers' acceptance of one online assessment system (the *Integrated Assessment System*, or IAS) in the context of an institute of technical education (ITE) in Singapore. In the study, 213 lecturers compeleted an online survey based on the extended UTAUT model. A path analysis was then conducted to examine relationships between the constructs in the extended model. The following hypotheses regarding relationships between the constructs in the extended UTAUT model were tested in the study:

- Usability has a significant positive effect on attitude, BI and UB
- Learnability has a significant positive effect on attitude, BI and UB
- PE has a significant positive effect on attitude, BI and UB
- SI has a significant positive effect on attitude, BI and UB
- FC has a significant positive effect on attitude, BI and UB
- Attitude has a significant positive effect on BI
- BI has a significant positive effect on UB

The research model and its hypotheses are also shown in Figure 21. It should be noted here that there were no explicit hypotheses formed for indirect effects within the model, because previous studies have not focused upon these. As a result, there was no basis on which to form such predictions. However, these also were tested and interpreted in the study.

Furthermore, it should be noted that as effort expectancy was not included in the instrument, it was not possible to do a direct comparison of the strength of prediction from the extended model and the original UTAUT. As a result, this difference was not tested in the research.

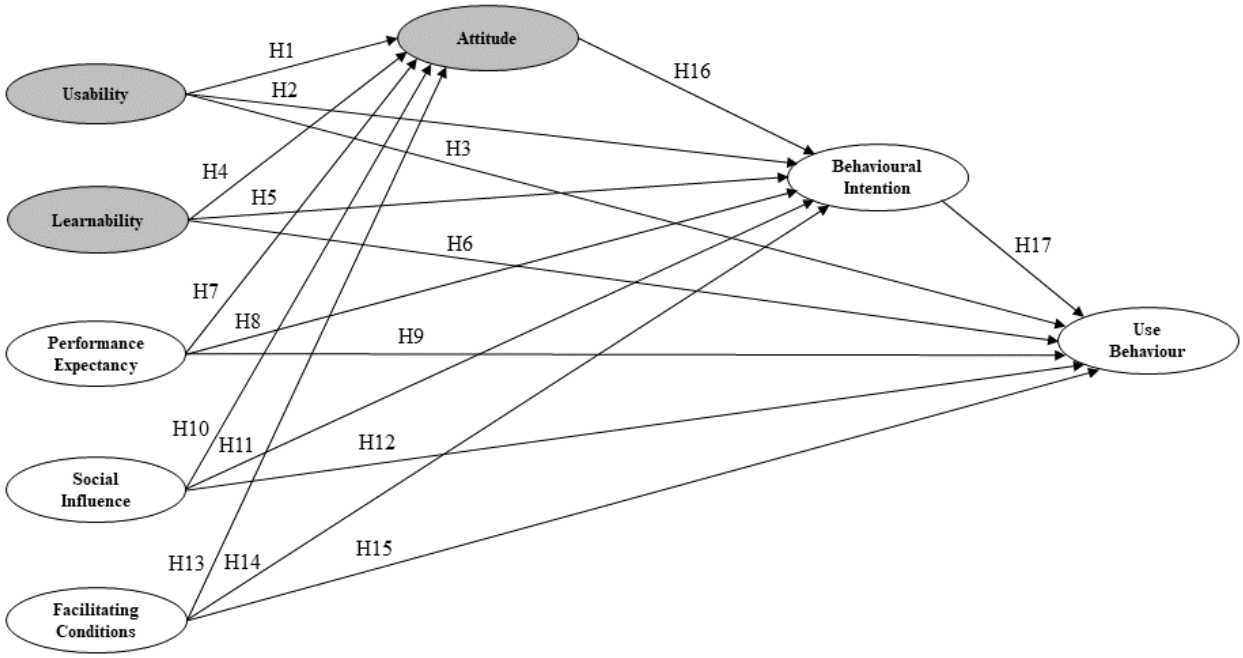

Figure 21. Hypotheses of Extended UTAUT Research Model

Method

Participants

An online questionnaire was used to obtain information from participants who had used the IAS at least on one occasion. From the email invitations sent out to 469 potential participants, 213 participants completed the online questionnaire. The online questionnaire response rate was 45.42%. Among the participants who responded to the online questionnaire, 62.0% were males, and 38.0% were females. Most of the participants were from the age group of 41 to 50 years (39.4%), with a small group of participants from the age group of 21-30 years (1.4%). In terms of online assessment experience, 77.5% of the participants rated themselves at least "5" and above, and 0.9% of the participants responded that they did not have any experience.

Instrument

The instrument used in the study included 20 items and utilized a 7-point bipolar rating scale (see Table 9). Bipolar rating scales have been found to reduce bias and produce better model

fits in instrument analyses (Friborg et al., 2006). In the instrument, each bipolar item contains two full statements to ensure meaningful responses and avoid ambiguity. As indicated, in this study, it was not possible to study actual usage behaviours, because permission to access these data could not be obtained. As a result, the measure of UB relied upon participants' self-reports of of the frequency with which they used the IAS.

Table 9. Extended UTAUT Questionnaire (20 Items)

Construct	Statement		
Performance Expectancy (PE) (Venkatesh et al., 2003)	Using IAS slows me down in accomplishing tasks	↔	Using IAS enables me to accomplish tasks quickly
	Using IAS decreases my productivity terribly	↔	Using IAS increases my productivity greatly
Social Influence (SI) (Venkatesh et al., 2003)	My supervisor thinks that I should not use IAS	↔	My superior thinks that I should use IAS
	My colleagues think that I should not use IAS	↔	My colleagues think that I should use IAS
	In general, the organisation has been unsupportive in the use of IAS	↔	In general, the organisation has been supportive in the use of IAS
Facilitating Conditions (FC) (Venkatesh et al., 2003)	I do not have any resource available to use IAS	↔	I have all the resources available to use IAS
	IAS is incompatible with systems I use	↔	IAS is compatible with all other systems I use
	No specific person (or group) is available for assistance with IAS difficulties	↔	A specific person (or group) is easily and readily available for assistance with IAS difficulties
Usability (Brooke, 1996)	I think IAS is extremely difficult to use	↔	I think IAS is extremely easy to use
	I think the various functions in IAS are not integrated	↔	I think the various functions in IAS are well-integrated
	I think there are too many inconsistencies in IAS	↔	I think there is overall consistency in IAS
Learnability	I need the support of a	↔	I am able to use IAS on my

Construct	Statement		
(Brooke, 1996)	technical person to be able to use IAS		own without any help
	I need to learn a lot of things before I could get going with IAS	↔	I need not learn new things before I could get going with IAS
Behaviourial Intention (BI) (Venkatesh et al., 2003)	Given a choice, in the next 6 months:		
	I do not intend to use IAS	↔	I intend to always use IAS
	I do not plan to use IAS	↔	I plan to always use IAS
Attitude (Davis, 1989)	All things considered, using IAS is:		
	Bad	↔	Good
	Unfavourable	↔	Favourable
	Negative	↔	Positive
Use Behaviour (UB) (Venkatesh et al., 2003)	I seldom use IAS	↔	I always use IAS
	I spend little time on IAS	↔	I spend great amount of time on IAS

Procedures

Following the receipt of approval both from the participating institution and the University of Western Australia Human Research Ethics Committee, the questionnaire was completed online, hosted on the Qualtrics platform. Given the busy schedules of the lecturers, it was left open for three months to ensure that all participants had the opportunity to complete the survey. The objectives of the study were shared in an invitation email, and on the landing page of the online questionnaire. Participation was voluntary and anonymous.

Results

Descriptive statistics and bivariate correlations for the path analysis are shown in Table 10. All initial screening analyses performed suggested that the use of path analysis was tenable, indicating no significant violations of assumptions in terms of non-normality, non-linearity, or extreme scores.

Table 10. Descriptive Statistics and Bivariate Correlations

Construct	M	SD	1	2	3	4	5	6	7	8
1. Usability	4.814	1.104	--	.515**	.733**	.653**	.650**	.669**	.723**	.468**
2. Learnability	4.146	1.340		--	.458**	.505**	.511**	.515**	.442**	.465**
3. Performance Expactancy	4.880	1.190			--	.664**	.630**	.676**	.752**	.464**
4. Facilitating Conditions	5.452	1.088				--	.688**	.777**	.731**	.649**
5. Social Influence	4.967	1.048					--	.701**	.680**	.602**
6. Attitude	5.143	1.186						--	.828**	.684**
7. Behavioural Intentions	5.355	1.147							--	.593**
8. Usage Behaviours	4.862	1.324								--

* Significant at .05 level; ** Significant at .01 level

The path analysis using IBM SPSS AMOS version 26.0 indicated that usability had a highly significant positive effect on attitude ($\beta = .294;\ p < .001$) (see Figure 22), while Learnability had a significant positive effect on BI ($\beta = .138;\ p < .05$) and UB ($\beta = .163;\ p < .05$).

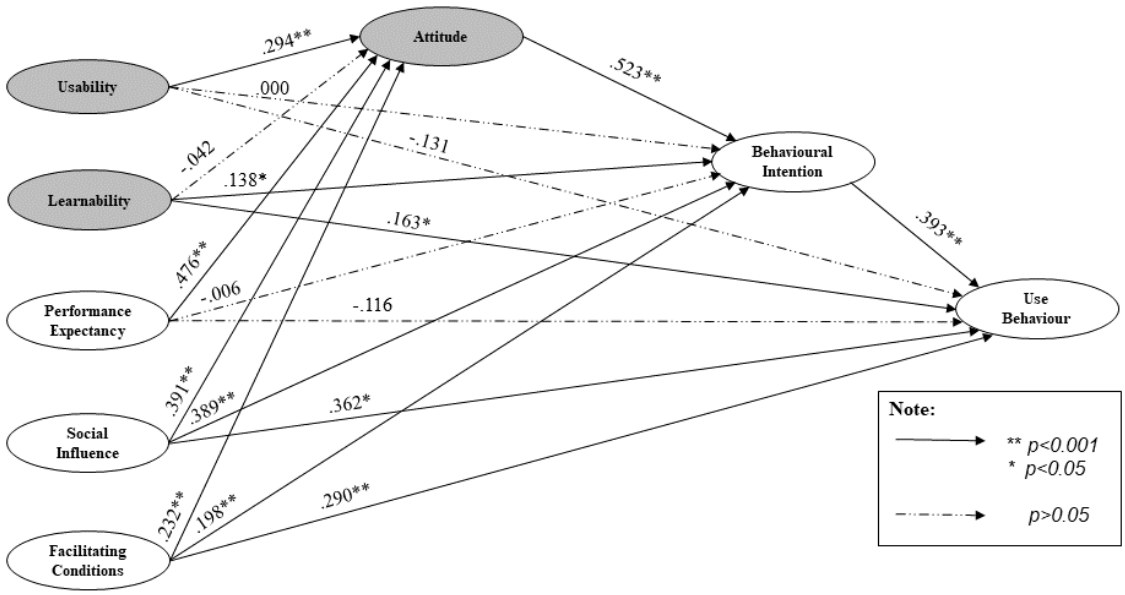

Figure 22. Extended Unified Theory of Acceptance and Use of Technology Structural Model

PE had a significant positive effect on attitude ($\beta = .476;\ p < .001$) but did not have a significant effect on BI, a departure from common UTAUT findings that have suggested that

PE is the strongest predictor of BI. SI was found to have positive effect on attitude (*β= .391; p< .001*); BI (*β= .389; p< .001*) and UB (*β= .362; p< .001*). FC was found to have a significant positive effect on attitude (*β= .232; p< .001*), BI (*β= .198; p< .001*) and UB (*β= .290; p< .001*). Attitude emerged as the strongest predictor of BI (*β= .523; p< .001*). Similar to the original UTAUT findings, BI had a significant effect on UB (*β= .393; p< .001*). The test results for the variables are summarized in Table 11.

Table 11. Path Coefficients of extended UTAUT Model

Hypothesis	Path	Unstand. Estimate	Stand. Estimate	S.E.	C.R.	*P*	Result
H1	Usability→Attitude	.268	.294	.051	5.263	***	Significant
H2	Usability→BI	.000	.000	.049	.004	.997	Not Significant
H3	Usability→UB	-.139	-.131	.072	-1.933	.053	Not Significant
H4	Learnability→Attitude	-.031	-.042	.042	-.741	.459	Not Significant
H5	Learnability→BI	.104	.138	.039	2.653	.008	Significant
H6	Learnability→UB	.141	.163	.061	2.297	.022	Significant
H7	PE→Attitude	.348	.476	.040	8.705	***	Significant
H8	PE→BI	-.005	-.006	.044	-.109	.913	Not Significant
H9	PE→UB	-.099	-.116	.058	-1.691	.091	Not Significant
H10	SI→Attitude	.311	.391	.044	6.984	***	Significant
H11	SI→BI	.314	.389	.048	6.544	***	Significant
H12	SI→UB	.334	.362	.090	3.703	***	Significant
H13	FC→Attitude	.192	.232	.047	4.062	***	Significant
H14	FC→BI	.166	.198	.046	3.612	***	Significant
H15	FC→UB	.279	.290	.078	3.587	***	Significant
H16	Attitude→BI	.531	.523	.076	7.005	***	Significant
H17	BI→UB	.450	.393	.127	3.546	***	Significant

In assessing the extent to which each independent variable has an impact on the dependent variables, the standardised direct effects, indirect effects, total indirect effects and total

effects associated with each of the five variables were examined. A coefficient linking one construct to another in the UTAUT model represents the direct effect of a determinant on a dependant variable. An indirect effect indicates the impact which a determinant has on a target variable through its effect on other intervening variables in the model. A total indirect effect on a given variable is the product of the indirect effects, while a total effect is the sum of the respective direct and indirect effects. According to Cohen (1988), effect sizes of 0.2 are considered small, those with 0.5 are medium, and values with 0.8 and above are considered large. These effects are summarized in Table 12. As indicated, Usability, PE, SI and FC all had significant indirect effects on BI, while SI and FC also had significant indirect effects on UB. These results indicate that, in addition to attitude having a significant direct effect on BI, it also acted as a significant mediator in the indirect effects of Usability, PE, SI and FC on BI (e.g., Usability → Attitude → BI). Attitude was also a significant mediator in the indirect effects of SI and FC on UB, via BI (e.g., Usability → Attitude → BI → UB).

Table 12. Direct, Indirect and Total Effects Implied in Path Model (standardized coefficients)

	Direct Effects			Indirect Effect			Total Effect		
	Attitude	BI	UB	Attitude	BI	UB	Attitude	BI	UB
Usability	.294*	.00	-.131	-	.154*	.061	.294*	.154*	-.071
Learnability	-.042	.138*	.163*	-	-.022	.046	-.042	.116*	.209*
PE	.476*	-.006	-.116	-	.249*	.095	.476*	.242*	-.021
SI	.391*	.389*	.362*	-	.204*	.233*	.391*	.593*	.595*
FC	.232*	.198*	.290*	-	.121*	.125*	.232*	.319*	.416*

Discussion

There Attitude has appeared inconsistently in tested UTAUT models within the literature, more recently, being excluded by most UTAUT researchers in line with the original UTAUT model (Venkatesh et al., 2003). However, results of the present study suggest that lecturers' attitude towards online assessment is an important predictor of both lecturers' BI and UB, and in fact, was emerged as the strongest predictor of lecturers' BI amongst all of the UTAUT predictors. This result is consistent with the findings of most of the previous studies in which attitude has been included (i.e., in a TAM or UTAUT extension study) (Bervell et al., 2020; Botero et al., 2018; Dulle & Minishi-Majanja, 2011; El-Gayar & Moran, 2006; El-

Gayar et al., 2011; Khechine & Augier, 2019; Moran et al., 2010; Nassuora, 2012; Shuhaiber, 2015; Šumak et al., 2010; Thomas et al., 2013).

The path analysis also showed that there were significant indirect effects of the online assessment system usability, the lecturers' PE and SI, and the organisation's FC on lecturers' BI through lecturers' attitude. Such mediation analysis has only been a focus of one prior UTAUT study thus far. In this study, Bervell et al. (2020) explored the intended use of blended learning in an LMS application among 267 distance tutors in Africa and found significant indirect effects of PE and FC on BI, via attitude. Such a result is also consistent with the TAM model by Davis (1989). The former study cited also found that when attitude was added to the model, the direct effect of FC on BI was not significant, and that only an indirect of FC (via attitude) was significant. These previous results, coupled with those from the present study, underscore the important role that attitude can play in predicting both users' intentions and their self-reported usage behaviours in relation to technology-based systems.

The new construct, online assessment system usability, was theorised to have a significant positive direct effect on lecturers' attitude, BI and UB. This prediction was not upheld, with results indicating no direct effects of this construct on either lecturers' BI or UB. The fact that usability had no direct effects on users' intentions was somewhat surprising but is consistent with results reported by Chiou et al. (2009) and Lew et al. (2019). Despite this, the results affirmed the importance of usability as a predictor of BI, because this construct had a significant positive *indirect* effect on BI, via attitude. Therefore, these results suggest that usability will first affect the lecturers' attitudes towards online assessment, and through lecturers' attitude, will have a significant impact on lecturers' BI. The notion of attitude being an important mediator for behavioural intentions is not new (Bervell et al., 2020), but these constructs have not previously been incorporated in the context of the UTAUT model.

In contrast to the findings for usability, learnability of the online assessment system did not have a significant direct effect on the lecturers' attitude but did have significant positive direct effects on both lecturers' BI and UB. This result aligns with past studies that have shown learnability to be an important factor in system usability assessments (Alshehri et al., 2019; Thowfeek & Salam 2014). Learnability has previously been studied in the context of UTAUT extension studies, but only as an attribute within an overall usability construct (Lin

2003; Zbick et al., 2015). The findings of the present study, therefore, affirm the influence of learnability in technology acceptance. Furthermore, the disparate effects observed for usability and learnability in the study underscore the importance of decoupling these constructs in future UTAUT extension studies.

The study findings also indicated that lecturers' PE had a significant positive direct effect on the lecturers' attitude towards online assessment, but not on BI and UB. The findings are similar to those of past studies that have examined the relationship between PE and attitude (Bervell et al., 2020; Botero et al., 2018; El-Gayar et al., 2011; Shuhaiber, 2015; Šumak et al., 2010), but are inconsistent with the predictions of the original UTAUT model. Traditionally, PE has always been proposed and found to be the strongest predictor of BI (Liao et al., 2004; Prasad et al., 2018; Salloum & Shaalan, 2018; Venkatesh et al., 2003), with a few notable exceptions (Mtebe & Raisamo, 2014; Yueh et al., 2015). It is possible that the findings of the present study were influenced by the fact that the use of the online assessment system was non-voluntary. As such, most of the lecturers were likely to deem that the system would help them to improve their job performance, because, in effect, they could not perform their functions fully without making use of it.

From the findings, lecturers' SI also had a significant positive direct effect on lecturers' attitude, which aligns with results of past studies that have incorporated attitude as a construct (Botero et al., 2018; Nassuora, 2012; Shuhaiber, 2015; Šumak et al., 2010). SI among the lecturers had a significant positive direct effect on their intentions to use the online assessment system, which is also consistent with the findings of many previous UTAUT studies (e.g., Al-Adwan & Al-Adwan, 2018; Alasmari & Zhang, 2019; Ali & Arshad, 2018; Kim & Lee, 2020; Radovan & Kristl, 2017; Salloum & Shaalan, 2018; Shah et al., 2020; Wan et al., 2020; Zhang et al., 2020). In the present study, however, a new relationship between SI and UB was also identified, where SI had a significant positive direct effect on UB. The latter effect suggests a particularly strong influence of social influences in this context. Thus, within the participating ITE, the views of others (i.e., peers, supervisors, and students) are likely to have a significant impact in lecturers' overall acceptance of any new online assessment system.

The relationship between FC and attitude has seldom been explored in past UTAUT studies. In the only two studies identified in which this relationship has been explored, Nassuora

(2012) and Bervell et al. (2020) both found that FC had a positive influence on attitude. A similar result was obtained in the present study. The mediation analysis also revealed that there were significant indirect effects of SI and FC on UB, via BI. This result is consistent with the findings of one previous study, which focused on teachers' acceptance of communication technology by Shah et al. (2020). In this former study, it was also found that PE, SI and FC had significant indirect effects on UB through BI as a mediator.

As has been reported in various prior UTAUT studies, FC in the present study had a significant positive direct effect on UB (Alshehri et al., 2019; Liao et al., 2004; Mahande & Malago, 2019; Oh & Yoon, 2014; Prasad et al., 2018; Salloum & Shaalan, 2018; Shah et al., 2020). Typically, however, the relationship between FC and BI is not tested. In the present study, FC within participating ITE was also found to have a significant positive direct effect on the lecturers' BI. In the two studies that have also tested this relationship to date, Mtebe and Raisamo (2014) found that FC had a positive effect on BI in a study of students' behavioural intentions to adopt and use mobile learning, while Mahande and Malago (2019) reported a similar effect in their study of e-learning acceptance in a postgraduate degree program. Therefore, the results of the present study have highlighted new relationships among the original and new constructs in the extended UTAUT model, which could provide useful directions for future research in which this model is adopted.

Conclusion, Limitations and Future Directions

Since its introduction, the UTAUT has been highly regarded as a robust model with a high level of predictive power in technology acceptance studies. Venkatesh et al. (2003), however, acknowledged that across different contexts, extensions to the original UTAUT could be considered. The present study added usability, learnability and attitude to the UTAUT model, and examined their relationships in predicting acceptance of a form of technology that has thus far been under-researched in the UTAUT literature (online assessment systems).

The study results suggest that the new constructs introduced could enrich and expand explanations of the factors that influence users' intentions and usage in such settings. The new relationships amongst traditional elements of the UTAUT model also suggest a promising line for future studies to explore. The results suggested in particular that the introduction of attitude in extended models could enhance the efficacy with which user's intentions to engage

with online assessment systems can be predicted. This result also underscores the need for institutions to take steps to improve lecturers' attitudes towards the use of relevant technology systems in efforts to enhance their intentions and actual usage behaviours.

While the results from this study confirmed many predictions that were a part of the original UTAUT model, and identified new relationships amongst the UTAUT constructs, it was not possible to incorporate potential moderators in the study. Such a study would require a very large and diverse sample. The examination of moderators could, therefore, be explored in future studies with respect to the new constructs introduced in this study. It was also, as noted, not possible within the study to obtain direct evidence of usage behaviours, which could be explored in future studies. These studies could also test the relevance of the extended UTAUT model in other contexts, for instance, examining its predictive power with respect to other types of technology.

One other possible direction for future UTAUT research within education contexts is the study of links between organisational culture and technology acceptance, and how this factor contributes to influence lecturers' intentions and use behaviours. The prominent role played by SI in this study suggests that this line could prove fruitful for enhancing overall acceptance levels. Furthermore, past studies have shown that there is a strong relationship between organisational culture and technological innovation (Huang & Teo, 2019; Zhu, 2015). The addition of new variables like organisational culture to the existing UTAUT model could further enrich our understandings of how users respond to the introduction of new technological innovations within institutions of higher education.

References

Abu-Al-Aish, A., and Love, S. (2013). Factors influencing students' acceptance of m-learning: an investigation in higher education. *The International Review of Research in Open and Distributed Learning*, *14*(5). https://doi.org/10.19173/irrodl.v14i5.1631

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Ajzen, I., and Fishbein, M. (1980). Understanding attitudes and predicting social behaviour.

Alasmari, T., and Zhang, K. (2019). Mobile learning technology acceptance in Saudi Arabian higher education: an extended framework and A mixed-method study. *Education and Information Technologies*, 1-18. https://doi.org/10.1007/s10639-019-09865-8

Albright, J. J., and Park, H. M. (2009). Confirmatory factor analysis using Amos, LISREL, Mplus, SAS/STAT CALIS. https://pdfs.semanticscholar.org/887d/174122f76e2a232ba313866cb1b191bd15ad.pdf

Ali, R. A., and Arshad, M. R. M. (2018). Empirical Analysis on Factors Impacting on Intention to Use M-learning in Basic Education in Egypt. *The International Review of Research in Open and Distributed Learning*, *19*(2). https://doi.org/10.19173/irrodl.v19i2.3510

Al-Adwan, A. S., Al-Adwan, A., and Berger, H. (2018). Solving the mystery of mobile learning adoption in higher education. *International Journal of Mobile Communications*, *16*(1), 24-49. http://www.academia.edu/download/57080624/IJMC_161_Paper2.pdf

Alshehri, A., Rutter, M., and Smith, S. (2019). Assessing the Relative Importance of an E-Learning System's Usability Design Characteristics Based on Students' Preferences. *European Journal of Educational Research,* *8*(3), 839-855. https://doi.org/10.4018/IJDET.2019070101

Amasha, M. A., Abougalala, R. A., Reeves, A. J., & Alkhalaf, S. (2018). Combining Online Learning & Assessment in synchronization form. *Education and Information Technologies*, *23*(6), 2517-2529. https://10.1007/s10639-018-9728-0

Appiah, M., & Van Tonder, F. (2018). E-Assessment in Higher Education: A Review. *International Journal of Business Management & Economic Research,* *9*(6). https://www.ijbmer.com/docs/volumes/vol9issue6/ijbmer2018090601.pdf

Bervell, B., and Umar, I. N. (2017). Validation of the UTAUT Model: Re-Considering Non-Linear Relationships of Exogeneous Variables in Higher Education Technology Acceptance Research. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(10), 6471-6490.

Bervell, B., Nyagorme, P., and Arkorful, V. (2020). LMS-Enabled Blended Learning Use Intentions among Distance Education Tutors: Examining the Mediation Role of Attitude Based on Technology-Related Stimulus-Response Theoretical Framework. *Contemporary Educational Technology,* *12*(2), ep273. https://www.ejmste.com/download/validation-of-the-utaut-model-re-considering-non-linear-relationships-of-exogeneous-variables-in-5041.pdf

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*(2), 238. https://doi.org/10.1037//0033-2909.107.2.238

Bentler, P. M., and Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, *88*(3), 588. https://doi.org/10.1037/0033-2909.88.3.588

Bevan, N., Carter, J., & Harker, S. (2015, August). ISO 9241-11 revised: What have we learnt about usability since 1998?. *In International Conference on Human-Computer Interaction* (pp. 143-151). Springer, Cham. https://doi.org/10.1007/978-3-319-20901-2_13

Bervell, B., Nyagorme, P., and Arkorful, V. (2020). LMS-Enabled Blended Learning Use Intentions among Distance Education Tutors: Examining the Mediation Role of Attitude Based on Technology-Related Stimulus-Response Theoretical Framework. *Contemporary Educational Technology, 12*(2), ep273. https://www.ejmste.com/download/validation-of-the-utaut-model-re-considering-non-linear-relationships-of-exogeneous-variables-in-5041.pdf

Bervell, B., and Umar, I. N. (2017). Validation of the UTAUT Model: Re-Considering Non-Linear Relationships of Exogeneous Variables in Higher Education Technology Acceptance Research. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(10), 6471-6490. https://www.ejmste.com/download/validation-of-the-utaut-model-re-considering-non-linear-relationships-of-exogeneous-variables-in-5041.pdf

Bollen, K. A. (1989). A new incremental fit index for general structural equation models. *Sociological Methods and Research*, *17*(3), 303-316. https://doi.org/10.1177/0049124189017003004

Botero, G. G., Questier, F., Cincinnato, S., He, T., and Zhu, C. (2018). Acceptance and usage of mobile assisted language learning by higher education students. *Journal of Computing in Higher Education*, *30*(3), 426-451. https://doi.org/10.1007/s12528-018-9177-1

Bouznif, M. M. (2018). Business students' continuance intention toward Blackboard usage: An empirical investigation of UTAUT model. *International Journal of Business and Management*, *13*(1), 120. https://doi.org/10.5539/ijbm.v13n1p120

Boyle, A., & Hutchison, D. (2009). Sophisticated tasks in e-assessment: what are they and what are their benefits?. *Assessment & Evaluation in Higher Education, 34*(3), 305-319. https://doi.org/10.1080/02602930801956034

Brady, A. M. (2005). Assessment of learning with multiple-choice questions. *Nurse Education in Practice, 5*(4), 238-242. https://doi.org/10.1016/j.nepr.2004.12.005

Bukie, O. F. (2014). Understanding technologies for e-assessment: A systematic review approach. *Journal of Emerging Trends in Computing and Information Sciences*, *5*(12), 936-947.

Chiou, W. C., Perng, C., and Lin, C. C. (2009, July). The relationship between technology acceptance model and usability test-case of performing E-learning task with PDA. *In 2009 WASE International Conference on Information Engineering* (Vol. 1, pp. 579-582). IEEE. https://doi.org/10.1109/ICIE.2009.207

Choi, Y., & McClenen, C. (2020). Development of Adaptive Formative Assessment System Using Computerized Adaptive Testing and Dynamic Bayesian Networks. *Applied Sciences*, *10*(22), 8196. https://10.3390/app10228196

Cohen, J. (1988). *Statistical power analysis for the behavioural sciences*, *2nd Edition*. Hillsdale, NJ: L. Erlbaum Associates.

Compeau, D., Higgins, C. A., and Huff, S. (1999). Social cognitive theory and individual reactions to computing technology: A longitudinal study. *MIS quarterly*, 145-158. https://doi.org/10.2307/249749

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*(3), 297-334. https://doi.org/10.1007/BF02310555

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 319-340. https://doi.org/10.2307/249008

Dulle, F. W., and Minishi-Majanja, M. K. (2011). The suitability of the Unified Theory of Acceptance and Use of Technology (UTAUT) model in open access adoption studies. *Information development*, *27*(1), 32-45. https://doi.org/10.1177/0266666910385375

Dwivedi, Y. K., Rana, N. P., Jeyaraj, A., Clement, M., & Williams, M. D. (2019). Re-examining the unified theory of acceptance and use of technology (UTAUT): Towards a revised theoretical model. *Information Systems Frontiers*, *21*(3), 719-734. https://doi.org/10.1007/s10796-017-9774-y

El-Gayar, O., Moran, M., and Hawkes, M. (2011). Students' acceptance of tablet PCs and implications for educational institutions. *Journal of Educational Technology and Society*, *14*(2). https://search-proquest-com.ezproxy.library.uwa.edu.au/docview/2139143267?accountid=14681

El-Gayar, O. F., and Moran, M. (2006). College students' acceptance of Tablet PCs: An application of the UTAUT Model. *Dakota State University*, *820*, 2845-2850.

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.120.2667&rep=rep1&type=pdf

Fishbein, M., and Ajzen, I. (1975). Belief, attitude, intention and behavior: An introduction to theory and research.

Fornell, C., and Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research*, *18*(1), 39-50. https://doi.org/10.1177/002224378101800104

Friborg, O., Martinussen, M., & Rosenvinge, J. (2006). Likert-based vs semantic differential-based scorings of positive psychological constructs: A psychometric comparison of two versions of a scale measuring resilience. *Personality and Individual Differences, 40*(5), 873 - 884. https://doi.org/10.1016/j.paid.2005.08.015.

Gamage, S. H., Ayres, J. R., Behrend, M. B., & Smith, E. J. (2019). Optimising Moodle quizzes for online assessments. *International Journal of STEM Education*, *6*(1), 27. https://doi.org/ 10.1186/s40594-019-0181-4

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., and Tatham, R. L. (2006). Multivariate data analysis. Uppersaddle River.

Hair, J. F., Anderson, R. E., Babin, B. J., and Black, W. C. (2010). Multivariate data analysis: A global perspective (Vol. 7).

Holden, H., and Rada, R. (2011). Understanding the influence of perceived usability and technology self-efficacy on teachers' technology acceptance. *Journal of Research on Technology in Education, 43*(4), 343-367. https://doi.org/10.1080/15391523.2011.10782576

Huang, F., and Teo, T. (2019). Influence of teacher-perceived organisational culture and school policy on Chinese teachers' intention to use technology: an extension of technology acceptance model. *Educational Technology Research and Development*, 1-21. https://doi.org/10.1007/s11423-019-09722-y

James, R., McInnis, C., & Devlin, M. (2002). Assessing learning in Australian universities. *Melbourne: The University of Melbournjenge Centre for the Study of Higher Education.* http://www.ntu.edu.vn/Portals/96/Tu%20lieu%20tham%20khao/Phuong%20phap%20danh%20gia/assessing%20learning.pdf

Jeng, J. (2005). Usability assessment of academic digital libraries: effectiveness, efficiency, satisfaction, and learnability. *Libri*, *55*(2-3), 96-121.

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.106.1655&rep=rep1&type=pdf

Jokela, T., Iivari, N., Matero, J., & Karukka, M. (2003, August). The standard of user-centered design and the standard definition of usability: analyzing ISO 13407 against ISO 9241-11. *In Proceedings of the Latin American conference on Human-computer interaction* (pp. 53-60). https://doi.org/10.1145/944519.944525

Khechine, H., & Augier, M. (2019, January). Adoption of a social learning platform in higher education: an extended UTAUT model implementation. In *Proceedings of the 52nd Hawaii International Conference on System Sciences*. https://scholarspace.manoa.hawaii.edu/bitstream/10125/59446/1/0006.pdf

Kim, J., and Lee, K. S. S. (2020). Conceptual model to predict Filipino teachers' adoption of ICT-based instruction in class: using the UTAUT model. *Asia Pacific Journal of Education*, 1-15. https://doi.org/10.1080/02188791.2020.1776213

Kline, R. B. (2005). Methodology in the social sciences.

Krusche, S., & Seitz, A. (2018, February). ArTEMiS: An automatic assessment management system for interactive learning. In *Proceedings of the 49th ACM Technical Symposium on Computer Science Education* (pp. 284-289). https://10.1145/3159450.3159602

Lew, S. L., Lau, S. H., and Leow, M. C. (2019). Usability factors predicting continuance of intention to use cloud e-learning application. *Heliyon, 5*(6), e01788. https://doi.org/10.1016/j.heliyon.2019.e01788

Liao, Q., Shim, J. P., and Luo, X. (2004). Student acceptance of web-based learning environment: An empirical investigation of an undergraduate IS course. *AMCIS 2004 Proceedings*, 377. https://pdfs.semanticscholar.org/08a6/61f75a828e418911ecc5e7bb5a28455cc58a.pdf

Lin, C. C. (2013). Exploring the relationship between technology acceptance model and usability test. *Information Technology and Management, 14*(3), 243-255. https://doi.org/10.1007/s10799-013-0162-0

Liu, J., Guo, X., Gao, R., Fram, P., Ling, Y., Zhang, H., & Wang, J. (2019). Students' learning outcomes and peer rating accuracy in compulsory and voluntary online peer assessment. *Assessment & Evaluation in Higher Education*, *44*(6), 835-847. https://10.1080/02602938.2018.1542659

Mahande, R. D., and Malago, J. D. (2019). An E-Learning Acceptance Evaluation through UTAUT Model in a Postgraduate Program. *Journal of educators online, 16*(2), n2. https://files.eric.ed.gov/fulltext/EJ1223779.pdf

McDonald, R. P., and Ho, M. H. R. (2002). Principles and practice in reporting structural equation analyses. *Psychological Methods*, *7*(1), 64. https://doi.org/10.1037/1082-989X.7.1.64

Moore, G. C., and Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information systems research*, *2*(3), 192-222. https://doi.org/10.1287/isre.2.3.192

Moran, M., Hawkes, M., and Gayar, O. E. (2010). Tablet personal computer integration in higher education: Applying the unified theory of acceptance and use technology model to understand supporting factors. *Journal of Educational Computing Research*, *42*(1), 79-101. https://doi.org/10.2190/ec.42.1.d

Mtebe, J., and Raisamo, R. (2014). Investigating students' behavioural intention to adopt and use mobile learning in higher education in East Africa. *International Journal of Education and Development using ICT*, *10*(3). https://search-proquest-com.ezproxy.library.uwa.edu.au/docview/1561442025?accountid=14681

Nassuora, A. B. (2012). Students acceptance of mobile learning for higher education in Saudi Arabia. *American Academic and Scholarly Research Journal*, *4*(2), 24-30. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.402.6814&rep=rep1&type=pdf

Nielsen, J. (1994). *Usability engineering*. Morgan Kaufmann.

Oh, J. C., and Yoon, S. J. (2014). Predicting the use of online information services based on a modified UTAUT model. *Behaviour and Information Technology*, *33*(7), 716-729. https://doi.org/10.1080/0144929x.2013.872187

Prasad, P. W. C., Maag, A., Redestowicz, M., and Hoe, L. S. (2018). Unfamiliar technology: Reaction of international students to blended learning. *Computers and Education*, 122, 92-103. https://doi.org/10.1016/j.compedu.2018.03.016

Radovan, M., & Kristl, N. (2017). Acceptance of Technology and Its Impact on Teachers' Activities in Virtual Classroom: Integrating UTAUT and CoI into a Combined Model. *Turkish Online Journal of Educational Technology-TOJET*, *16*(3), 11-22. https://search-proquest-com.ezproxy.library.uwa.edu.au/docview/1953141374?accountid=14681

Salloum, S. A., and Shaalan, K. (2018, September). Factors Affecting Students' Acceptance of E-Learning System in Higher Education Using UTAUT and Structural Equation Modeling Approaches. *In International Conference on Advanced Intelligent Systems*

and Informatics (pp. 469-480). Springer, Cham. https://doi.org/10.1007/978-3-319-99010-1_43

Shah, S. N. A., Khan, A. U., Khan, B. U., Khan, T., & Xuehe, Z. Framework for teachers' acceptance of information and communication technology in Pakistan: Application of the extended UTAUT model. *Journal of Public Affairs*, e2090. https://doi.org/10.1002/pa.2090

Shackel, B. (2009). Usability–Context, framework, definition, design and evaluation. *Interacting with computers*, *21*(5-6), 339-346. https://doi.org/10.1016/j.intcom.2009.04.007

Shuhaiber, A. H. (2015). Students' Willingness to Accept Virtual Lecturing Systems: An Empirical Study by Extending the UTAUT Model. *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, *9*(4), 11531157. https://pdfs.semanticscholar.org/7869/ae3f1c2378bac6b1c1501de1c5f0df409a6c.pdf

Šumak, B., Polancic, G., & Hericko, M. (2010, February). An empirical study of virtual learning environment adoption using UTAUT. In *2010 Second international conference on mobile, hybrid, and on-line learning* (pp. 17-22). IEEE. https://doi.org/10.1109/eLmL.2010.11

Steiger, J. H. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate behavioral research, 25*(2), 173-180. http://www.statpower.net/Steiger%20Biblio/Steiger90b.pdf

Tan, P. J. B. (2013). Students' adoptions and attitudes towards electronic placement tests: A UTAUT analysis. *American Journal of Computer Technology and Application*, *1*(1), 14-23. http://www.ajcta.com/Vol.%201,%20No.%201,%20February%202013/This%20is%20my%20final%20revision(A)t_2013_2_22.pdf

Thomas, T., Singh, L., and Gaffar, K. (2013). The utility of the UTAUT model in explaining mobile learning adoption in higher education in Guyana. *International Journal of Education and Development using ICT*, *9*(3). https://search-proquest-com.ezproxy.library.uwa.edu.au/docview/1491114969?accountid=14681

Taylor, S., and Todd, P. A. (1995). Understanding information technology usage: A test of competing models. *Information systems research*, *6*(2), 144-176. https://doi.org/10.1287/isre.6.2.144

Thompson, R. L., Higgins, C. A., and Howell, J. M. (1991). Personal computing: toward a conceptual model of utilization. *MIS quarterly*, 125-143. https://doi.org/10.2307/249443

Thowfeek, M. H., and Salam, M. N. A. (2014). Students' assessment on the usability of E-learning websites. *Procedia-Social and Behavioral Sciences, 141*, 916-922. https://doi.org/10.1016/j.sbspro.2014.05.160

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS quarterly*, 425-478. https://doi.org/10.2307/30036540

Wan, L., Xie, S., & Shu, A. (2020). Toward an Understanding of University Students' Continued Intention to Use MOOCs: When UTAUT Model Meets TTF Model. *SAGE Open, 10*(3), 2158244020941858. https://doi.org/10.1177/2158244020941858

Wang, Y. S., Wu, M. C., and Wang, H. Y. (2009). Investigating the determinants and age and gender differences in the acceptance of mobile learning. *British journal of educational technology*, *40*(1), 92-118. https://doi.org/10.1111/j.1467-8535.2007.00809.x

Way, K. A., Burrell, L., D'Allura, L., & Ashford-Rowe, K. (2020). Empirical investigation of authentic assessment theory: An application in online courses using mimetic simulation created in university learning management ecosystems. *Assessment & Evaluation in Higher Education*, 1-19. https://10.1080/02602938.2020.1740647

Wong, K. T., Teo, T., and Russo, S. (2013). Interactive whiteboard acceptance: Applicability of the UTAUT model to student teachers. *The Asia-Pacific Education Researcher*, *22*(1), 1-10. https://doi.org/10.1007/s40299-012-0001-9

Xu, H., & Mahenthiran, S. (2016). Factors that influence online learning assessment and satisfaction: Using Moodle as a Learning Management System. *International Business Research*, *9*(2), 1-18. https://doi.org/10.5539/ibr.v9n2p1

Yakubu, M. N., & Dasuki, S. I. (2019). Factors affecting the adoption of e-learning technologies among higher education students in Nigeria: A structural equation modelling approach. *Information Development*, *35*(3), 492-502. https://doi.org/10.1177/0266666918765907

Yueh, H. P., Huang, J. Y., and Chang, C. (2015). Exploring factors affecting students' continued Wiki use for individual and collaborative learning: An extended UTAUT perspective. *Australasian Journal of Educational Technology*, *31*(1). https://doi.org/10.14742/ajet.170

Zbick, J., Nake, I., Milrad, M., & Jansen, M. (2015, July). A web-based framework to design and deploy mobile learning activities: Evaluating its usability, learnability and acceptance. In *2015 IEEE 15th International Conference on Advanced Learning Technologies* (pp. 88-92). IEEE. https://core.ac.uk/download/pdf/192383918.pdf

Zhang, Z., Cao, T., Shu, J., & Liu, H. (2020). Identifying key factors affecting college students' adoption of the e-learning system in mandatory blended learning environments. *Interactive Learning Environments*, 1-14. https://doi.org/10.1080/10494820.2020.1723113

Zhu, C. (2015). Organisational culture and technology-enhanced innovation in higher education. *Technology, Pedagogy and Education, 24*(1), 65-79. https://doi.org/10.1080/1475939x.2013.822414

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CHAPTER 6: GENERAL CONCLUSIONS: DETERMINANTS OF ONLINE ASSESSMENT ADOPTION

From the deployment of the first electronics assisted assessment in the 1960s to the online assessment systems that are currently available, interest in the use of online assessment processes has grown, particularly since the emergence of learning management systems (Baig et al. 2020; Gamage et al., 2019; Shdaifat & Obeidallah, 2019; Xu & Mahenthiran, 2016). For large-scale assessment implementations, online approaches are often coupled with commercial systems like Blackboard and Moodle (Jordan, 2013).

The development of online assessment approaches is likely to continue to grow at increased rates as students become increasingly technology-savvy, and expect to take examinations and tests on computers and mobile devices. Online assessment systems are also becoming essential as the accountability demands upon universities increase, because these have the ability to amass useful learning data for analysis. The COVID-19 pandemic, which forced educational institutions around the world to continue teaching and learning in digital forms, again pushed the implementation of online assessment to the forefront (UNESCO, 2020).

Despite its potential, for the benefits of online assessment to be realized within higher education insititutions, it must be accepted by the educators who set and oversee these assessments (i.e., the lecturers). The overarching goal of the research presented in this work was to contribute to addressing this issue in the context of one Singapore-based Institute of Technical Education. Previous research on lecturers' acceptance of online assessment has appeared within the literature, but this research has not typically been based on a systematic and standardised theoretical model. The resulting lack of standardisation across studies makes comparisons across contexts, which can serve to highlight important moderating factors, difficult to make.

In the present research, a well-established theoretical model on users' acceptance of

technology was applied to examine the factors that predicted lecturers' acceptance of the online assessment system used within the participating institution. This final chapter summarizes findings obtained in the research, and discusses implications for research and practice based on these findings. The limitations of the research reported, and directions for possible future studies based on the UTAUT model, are also discussed.

Summary

The overarching objective of this research was to identify the factors that predicted lecturers' adoption of online assessment in one Singapore-based Institute of Technical Education. The factors investigated were system usability and learnability; lecturers' performance expectancy, social influences and attitudes towards online assessment; and lecturers' perceptions of the facilitating conditions that support online assessment. Among these factors, usability, learnability and attitude were introduced to the UTAUT model as additional variables. The adoption of online assessment was measured in terms of lecturers' behavioural intentions to use the online assessment system and their self-reported system usage behaviour. The relationships between these factors were also examined.

Four papers are presented in the book. The first reviewed previous literature on the Unified Theory of Acceptance and Use of Technology (UTAUT) model, and proposed an extended UTAUT model to examine the factors that influence online assessment adoption. The second reviewed studies in the area of online assessment methods published from 2007 to 2019. In the third paper, an instrument to assess constructs in the extended UTAUT model proposed was developed and validated. In the final paper, the instrument developed in the third study was used to explore relationships among the constructs in the extended UTAUT model. Specifically, path analysis was conducted to examine the various factors that influence lecturers' acceptance of online assessment within the institution.

Previous studies on online assessment have often been tied to studies on learning management systems (Hillier et al., 2018). Thus, questions of online assessment acceptance have typically been overshadowed by a focus on the acceptance of learning management systems in general (Schoonenboom, 2014). The focus of the present research on the online assessment aspect of such systems, therefore, is relatively rare amongst UTAUT studies. Furthermore, in many education-based UTAUT studies, the participants have often been

students. The present research also departed from this previous work by focusing specifically on lecturers, who will inevitably be key stakeholders in the introduction of any new technology-based system.

The primary empirical contributions of this research were discussed in Paper 4, in which the constructs within the new extended UTAUT model were explored. This new model incorporated three constructs that were not included in the original UTAUT model: attitude, usability, and learnability. As discussed previously, the UTUAT model is an evolution from the TAM, which included attitudes as a predictor variable (Davis, 1986). During the development of UTAUT, however, the attitude construct was discarded because it was deemed to be redundant after taking into account the effects of the other model variables. Despite this, researchers have reintroduced attitude in as a construct in UTAUT extension studies, and it was likewise re-introduced in the extended model tested in the present research. The empirical results reported in Paper 4 make clear that attitude is an important predictor of users' intentions and use behaviours. Thus, these results confirm that researchers should consider including attitude as a construct in future UTAUT extension models.

The two other new constructs in the extended UTAUT model were also found significantly to predict, either directly or indirectly, users' intentions and behaviours. While usability was not found to have a direct effect on intentions or reported behaviours, it did have a significant direct effect on attitudes, and a significant positive indirect effect on users' intentions, via the attitude construct. Therefore, these results suggest that while usability does not directly affect users' intentions and behaviours, it will ultimately affect these through its relationship with attitude. The notion of attitude being an important mediator for behavioural intentions is not new (Bervell et al., 2020). These constructs have not, however, previously been incorporated in the context of the UTAUT model.

The other new construct included in the extended UTAUT model, learnability, behaved quite differently from usability in the study. Learnability did not have a significant direct effect on attitude, but instead, had significant positive direct effects on both intentions and reported use behaviours. This aligns with the results of past studies that have shown that learnability is an important factor in system usability assessments (Alshehri et al., 2019; Thowfeek & Salam 2014). Collectively, therefore, the results reported in Paper 4 affirm the potential importance of both usability and learnability in predicting user acceptance levels. Their importance

within the present study suggests that these factors would be worthy of consideration in subsequent UTAUT studies.

The results reported in Paper 4 also confirmed those from previous studies, which have indicated that social influence factors have a significant direct effect on intentions, while both facilitating conditions and intentions have significant direct effects on actual use behaviours. However, in the present research, it was also found that social influences had a significant direct effect on usage behaviours, and that facilitating conditions had a significant direct effect on intentions. These relationships within the UTAUT have typically not been explored in previous studies. Thus, the findings of the present research identified new relationships that were not theorised in the original UTAUT model, and suggest, in line with the findings of Bervell and Umar (2017), that future researchers should explore a broader range of possible interconnections amongst the UTAUT constructs in their analyses.

Implications for Practice

From the research results, attitude played a key role in lecturer's intentions to use the online assessment system within the institution. Specifically, attitude had the strongest direct effect on BI. Given this, within the participating institution and others, shaping the attitudes of lecturers towards new technology-based systems is important to ensure that these are used to their full potential. Several factors within the extended UTAUT model were shown, in turn, to be important in predicting lecturers' attitudes towards the online assessment system. These were the perceived usability of the system, lecturers' expecations that the system would enhance their performance, the social influences upon system use, and perceptions of the infrastructure available within the institute to support the use of the system. All of these are potentially alterable factors that could be manipulated to enhance lecturers' attitudes and, in doing so, their intentions towards and actual usage of the system. For example, to enhance both PE and usability perceptions, institutions must ensure that the systems they adopt are 'fit for purpose' given the nature of the tasks for which they will be used within that institution. It implies that user needs analysis for such system must occur at the beginning of the development cycle, coupled with early significant user involvement, when it is being decided what the system will be like and how it is going to support and benefit the users.

The research results showed that contextual factors like SI and FC, in addition to having a

direct effect on attitudes, also had positive and significant direct effects on both BI and UB. Learnability also had a direct effect on these two variables. Turning first to the findings for learnability and facilitating conditions, institutions must ensure that suitable support mechanisms such as helpdesks and training programs are available to staff when introducing such systems. Effective professional development should be provided to assist lecturers in the adoption of online assessment, which would not only enhance the conditions within which the system is used, but also, the perceived 'learnability' of the systems in the eyes of staff. Studies have shown that the most effective professional development programmes that improve teaching practices are those with activities that are ongoing and sustained over time (Tournaki et al., 2011). Besides providing professional development programmes, an ongoing institutional support structure is essential. Buchan and Swann (2007) suggested a three-level support approach, including real-time training and professional development, helpdesk troubleshooting and self-help resources. Educational institutions implementing online assessment systems should, therefore, considering a multi-faceted approach to professional development of staff, which incorporates varied training approaches and high-quality technical support structures for different faculty groups. These must be readily available and accessible throughout the assessment periods. The recommendations for the comprehensive training and support structure are also in line with the findings from earlier literature review on teachers' acceptance where it was found that efforts to learn were required to use online assessment systems effectively (Amante et al., 2019; Rolim & Isaias; 2018).

The relationship indicated between SI and UB was a new finding in this research. The influence of fellow lecturers, supervisors and students was significant, and this implies that maintaining a positive organisational culture in educational institutions is vital to technology adoption and usage. Educational institutions should strive to manage changes well and encourage 'buy-ins' from the lecturers to ensure that technological innovations can be accepted more readily and successfully. It is important also for all supervisors within institutions, who will no doubt be amongst the 'important others' whose expectations drive the intentions and behaviours of other staff members, to be openly supportive of any new systems adopted. Supervisors should play the role of sharing good practices and championing the use of online assessment systems within educational institutions. To further promote the use of online assessment, however, lecturers who have greater social and peer influence can also step up as "change agents" to lead the system adoptions and enhance the acceptance of these systems by others.

Directions for Future Research

Based on the findings in this research, one of the critical directions for future UTAUT research is the study of the link between organisational culture and technology acceptance, and how it plays a part in influencing BI and UB. Studies have shown that there is a strong relationship between organisational culture features and technological innovation (Huang & Teo, 2019; Zhu, 2015). The addition of new variables like organisational culture to the existing model can further enrich current UTAUT extension studies and provide a more in-depth understanding of how educational institutions adopt and implement technological innovations.

The extended UTAUT model and its associated instrument could be introduced in other institutes of higher learning in Singapore to compare the findings. In fact, there was only one previous UTAUT study that the author could locate which was conducted in the Singapore education context. This study focused on the adoption of wikis in a Singapore secondary school in 2013 (Toh, 2013). Further studies based on the UTAUT model could, for example, be applied to study Singapore students' acceptance of online assessment approaches, which may identify different factors that promote acceptance to those identified for lecturers.

This study collected and analyzed self-reported data to measure the lecturers' UB, rather than analyzing user log files from the online assessment system. Self-reported data were used as it was not possible to obtain the actual system logs in this case (the institution in which the study was conducted was cautious about this point, owing to data privacy and security issues, particularly given that the system in question was used to deliver high-stakes examinations for national skills certifications). However, a future study could access the data analytics features of software systems to obtain a direct measure of users' behaviour. This feature is currently undergoing development within the participating institution's online assessment system.

Like many prior UTAUT studies, this research also did not consider moderating variables to explain online assessment acceptance by the lecturers. It was not possible to look at moderating variables due to restrictions in the sample characteristics of this study. The examination of such moderators, such as in the study by Lin and Lai (2019), could be pursued in future studies, and in particular, with respect to the new constructs introduced in the

present study. For example, Venkatesh et al. (2003) argued that voluntariness had a moderating effect on users' acceptance of new technology-based systems. Thus, further studies could explore the application of the extended model in other situations, in which system users have a greater degree of freedom in their adoption and usage decisions. Such research would provide a more in-depth and nuanced view of the influence of factors such as usability on acceptance, which would in turn permit more specific practical implications to be drawn for individual institutions.

The current study took a quantitative approach to collect data from the participants, as the use of a survey instrument is the most efficient means by which a large amount of data can be collected. Despite this, future work could consider the utilization of qualitative or mixed methods designs (e.g., combining surveys, interviews and focus groups), to obtain a more in-depth understanding of the barriers to online assessment acceptance. Such an approach is likely to highlight a broader range of factors that affect users' acceptance in different contexts. Armed with such knowledge, leaders within education institutions will be better placed to anticipate problems that may arise when introducing new online assessment systems, and thus, ensure that any associated change management processes are geared to address these problems. Such steps will, in turn, help to ensure that the full benefits of online assessment systems are reaped both within individual institutions, but also, within the higher education sector at large.

References

Amante, L., Oliveira, I. R., & Gomes, M. J. (2019). E-Assessment in Portuguese Higher Education: Framework and Perceptions of Teachers and Students. *In Handbook of Research on e-Assessment in Higher Education* (pp. 312-333). IGI Global. https://www.academia.edu/download/58437616/E-Assessment-in-Portuguese-Higher-Education_-Framework-and-Perceptions-of-Teachers-and-Students._2.pdf

Baig, M., Gazzaz, Z. J., & Farouq, M. (2020). Blended Learning: The impact of blackboard formative assessment on the final marks and students' perception of its effectiveness. *Pakistan Journal of Medical Sciences*, *36*(3), 327. https://doi.org/10.12669/pjms.36.3.1925

Bervell, B., and Umar, I. N. (2017). Validation of the UTAUT Model: Re-Considering Non-Linear Relationships of Exogeneous Variables in Higher Education Technology

Acceptance Research. *Eurasia Journal of Mathematics, Science and Technology Education, 13*(10), 6471-6490. https://www.ejmste.com/download/validation-of-the-utaut-model-re-considering-non-linear-relationships-of-exogeneous-variables-in-5041.pdf

Buchan, J. F., & Swann, M. (2007). A Bridge too Far or a Bridge to the Future? A case study in online assessment at Charles Sturt University. *Australasian Journal of Educational Technology, 23*(3). https://doi.org/10.14742/ajet.1260

Davis, F. D. (1986). A technology acceptance model for testing new end-user information systems: Theory and results. Sloan School of Management, 291. https://dspace.mit.edu/bitstream/handle/1721.1/15192/14927137-MIT.pdf

Gamage, S. H., Ayres, J. R., Behrend, M. B., & Smith, E. J. (2019). Optimising Moodle quizzes for online assessments. *International Journal of STEM Education*, *6*(1), 27. https://10.1186/s40594-019-0181-4

Hillier, M., Grant, S., & Coleman, M. (2018). Towards authentic e-Exams at scale: robust networked Moodle. *Open Oceans: Learning Without Borders*, 131. http://www.academia.edu/download/63542093/ASCILITE-2018-Proceedings20200605-17164-1rg88df.pdf#page=133

Huang, F., Teo, T., Sánchez-Prieto, J. C., García-Peñalvo, F. J., & Olmos-Migueláñez, S. (2019). Cultural values and technology adoption: A model comparison with university teachers from China and Spain. *Computers & Education, 133*, 69-81. https://doi.org/10.1007/s11423-019-09722-y

Jordan, S. (2013). E-assessment: Past, present and future. *New Directions in the Teaching of Physical Sciences*, (9), 87-106. https://doi.org/10.29311/ndtps.v0i9.504

Lin, J. W., & Lai, Y. C. (2019). User acceptance model of computer-based assessment: moderating effect and intention-behavior effect. Australasian Journal of Educational Technology, 35(1).

Schneberger, S., Amoroso, D. L., & Durfee, A. (2008). Factors that influence the performance of computer-based assessments: an extension of the technology acceptance model. *Journal of Computer Information Systems, 48*(2), 74-90. https://search-proquest-com.ezproxy.library.uwa.edu.au/docview/232573986?accountid=14681

Rolim, C., & Isaias, P. (2018). Examining the use of e-assessment in higher education: teachers and students' viewpoints. *British Journal of Educational Technology*. *50*(4), 1785-1800. https://doi.org/10.1111/bjet.12669

Schoonenboom, J. (2014). Using an adapted, task-level technology acceptance model to explain why instructors in higher education intend to use some learning management system tools more than others. *Computers & Education, 71*, 247-256. https://doi.org/10.1016/j.compedu.2013.09.016

Shdaifat, A., & Obeidallah, R. (2019). Quiz Tool Within Moodle and Blackboard Mobile Applications. https://10.3991/ijim.v13i08.10552

Terzis, V., & Economides, A. A. (2011). Computer based assessment: Gender differences in perceptions and acceptance. *Computers in human behavior, 27*(6), 2108-2122. https://doi.org/10.1016/j.chb.2011.06.005

Terzis, V., Moridis, C. N., & Economides, A. A. (2013a). Continuance acceptance of computer based assessment through the integration of user's expectations and perceptions. *Computers & Education, 62*, 50-61. https://doi.org/10.1016/j.compedu.2012.10.018

Terzis, V., Moridis, C. N., Economides, A. A., & Mendez, G. R. (2013b). Computer based assessment acceptance: A cross-cultural study in Greece and Mexico. *Journal of Educational Technology & Society, 16*(3), 411-424. https://www.jstor.org/stable/jeductechsoci.16.3.411

Toh, C. H. (2013, October). Assessing adoption of wikis in a Singapore secondary school: Using the UTAUT model. In *2013 IEEE 63rd Annual Conference International Council for Education Media (ICEM)* (pp. 1-9). IEEE. https://doi.org/10.1109/CICEM.2013.6820158

Tournaki, E., Lyublinskaya, I., & Carolan, B. (2011). An ongoing professional development program and its impact on teacher effectiveness. *The Teacher Educator, 46*(4), 299-315. https://doi.org/10.1080/08878730.2011.604711

UNESCO. *UNESCO's support: Educational response to COVID-19.* (2020, May 28). https://en.unesco.org/covid19/educationresponse/support

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS quarterly*, 425-478. https://doi.org/10.2307/30036540

Xu, H., & Mahenthiran, S. (2016). Factors that influence online learning assessment and satisfaction: Using Moodle as a Learning Management System. *International Business Research*, *9*(2), 1-18. https://doi.org/10.5539/ibr.v9n2p1

Zhu, C. (2015). Organisational culture and technology-enhanced innovation in higher education. *Technology, Pedagogy and Education, 24*(1), 65-79. https://doi.org/10.1080/1475939x.2013.822414

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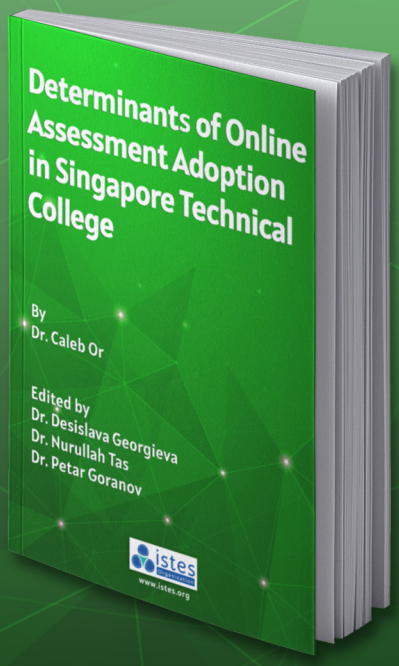
The overarching objective of this research was to identify the factors that predicted lecturers' adoption of online assessment in one Singapore-based Institute of Technical Education. The factors investigated were system usability and learnability; lecturers' performance expectancy, social influences and attitudes towards online assessment; and lecturers' perceptions of the facilitating conditions that support online assessment. Among these factors, usability, learnability and attitude were introduced to the UTAUT model as additional variables. The adoption of online assessment was measured in terms of lecturers' behavioural intentions to use the online assessment system and their self-reported system usage behaviour. The relationships between these factors were also examined. Four papers are presented in the book. The first reviewed previous literature on the Unified Theory of Acceptance and Use of Technology (UTAUT) model, and proposed an extended UTAUT model to examine the factors that influence online assessment adoption. The second reviewed studies in the area of online assessment methods published from 2007 to 2019. In the third paper, an instrument to assess constructs in the extended UTAUT model proposed was developed and validated. In the final paper, the instrument developed in the third study was used to explore relationships among the constructs in the extended UTAUT model. Specifically, path analysis was conducted to examine the various factors that influence lecturers' acceptance of online assessment within the institution.



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