A Proposed Framework of the Adoption of E-book Amongst Mathematics and Statistics Students at Universities in Libya

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Abstract—During the past two decades, many researchers study the adoption of technology as one of the important drivers in the development of education. Researchers are keen to recognize the status or factors that determine technology adoption and usage [1]. Several patterns are developed to aid in predicting technology acceptance. From these models, the Theory of Planned Behaviour, the Technology Acceptance Model and the Technology Acceptance Model are derived. These models are widely-used and most investigated. This research will be based on the Technology Acceptance Model. A number of external factors will be added to this model to examine their impact on the acceptance of e-book in Mathematics and Statistics students at universities in Libya.

Keywords - attitude; behaviour; e-book; higher education; mathematics; statistics, TAM

I. INTRODUCTION

Nowadays, new information technologies are leading most of the educational institutions to determine the technologies that can be effectively integrated into the education process. One of these technologies is electronic-book [2, 3]. Electronic sources are becoming more widespread in developed countries due to its dynamic features and nature of mobility. As of this writing, electronic publications have overtaken printed version as a source of information and news for the majority of readers in the United States [4-6]. Many studies involving the adoption of e-book in education claim that they are widely used in developed countries [7, 8]. However, most developing countries such as Brazil, Libya, Indonesia, Singapore and Turkey are still struggling to use e-book as part of enhancing their education system [7, 9, 10].

Several studies have regarded e-books in different disciplines [11, 12]. According to Letchumanan and Tarmizi [13], the rate of using e-book by the Mathematics and Statistics students in Malaysia is relatively low. Moreover, the statistics provided by some publishers such as Springer have shown that the acceptance rate of e-book among Mathematics and Statistics students is very low compared to other students in other disciplines. In 2009, the access ratio of students (at Universiti Putra Malaysia) to mathematics e-books published by Springer is only 50 mathematics titles. However, the access ratio of engineering students (also at Universiti Putra Malaysia) to engineering e-books published by Springer is 129 engineering titles [13].

This research focuses on Mathematics and Statistics students at universities in Libya. This research will determine the factors that encourage or hinder them to adopt this technology in their education process and to what extent Mathematics and Statistics students accept the idea of using the e-book. The purpose of this research is to investigate the factors that affect and then establish a framework of the adoption of e-book amongst Mathematics and Statistics students at universities in Libya.

II. THEORIES OF ACCEPTANCE OF TECHNOLOGY

A. Theory of Reasoned Action

In 1980, the Theory of reasoned action [14] was formulated by Ajzen and Fishbein to study the relationship between behaviour and attitudes. This model is derived from a learning theory and presumes that behaviour toward a specific thing is estimated by an aim to perform that behaviour. An aim signifies an individual’s conscious plan to use effort to perform a behaviour [15]. TRA was initially introduced in the field of Social Psychology, and it has been used extensively to explain the behaviour of individuals [16].

The Theory of Reasoned Action assumes that behaviour is guessed by the intention of an individual to involve in a given behaviour. In turn, the intention is anticipated by two aspects, the opinions of an individual’s social environment and by the individual’s attitude towards the result of the behaviour, known as the subjective norm. According to this theory, an individual’s intention to carry out any action is a derivative of its relationship to these actions and subjective norms associated with these actions. The theory has proved that “intention” is behaviour best predictor and intention is the cognitive illustration of an individual’s willingness to perform a given behaviour, and is considered to be the instantaneous precursor of behaviour [16].

According to Masrom [17], the two elements that are engaged in behavioural intention are guided human activity and dominance. His viewpoints are supported by the distinct results of behaviour, assessment of these results, beliefs on the perceptive expectation of others and inspiration to pursue with
this expectation (SN - Subjective Norm). As a result, the normative beliefs and behavioural beliefs can be the foundation on which to institute any further clarification for any particular action.

B. Theory of Planned Behaviour (TpB)

The Theory of Planned Behaviour (TpB) is an extension of the Theory of Reasoned Action [18]. This theory deals with the problem of incomplete control of consciousness. In 1991, Ajzen suggested TpB and it has been extensively applied by researchers throughout the past years. The main difference between TRA and TpB is the addition of a third i.e., independent ideological factors determining intent. TpB includes attitude toward the behaviour and subjective norms, but it added a component of perceived behavioural control [18].

TpB is capable of assessing a range of behaviours and intentions. An individual’s actions are discovered by behavioural intention, which consequentially are controlled by an attitude towards the subjective norms and behaviour. In addition to attitude towards the subjective norms and the behaviour in the planned behaviour theory, observed behavioural control can influence intention as well. An individual’s decision is influenced by the perceived behavioural control through the behavioural intention in the TAB. Furthermore, behavioural intention is considered as the most significant predictor of behaviour [19, 20].

C. Technology Acceptance Model

Based on the Theory of Reasoned Action, the Technology Acceptance Model [21] [21] was developed by Davis which deals more particularly with the calculation of the suitability of an information system [16, 17]. The focus of TAM is on the end users acceptance behaviour of a number of different IT applications. The intention of this model is to forecast the suitability of a tool to identify the adaptations which must be brought to the system to make it satisfactory and acceptable to users.

TAM is utilized to provide an elucidation of the determinants of computer recognition that is general, able of clarifying user behaviour, i.e. use across user populations and an extensive range of user’s computing technologies, while at the same time being both theoretically justified and economical [22]. This model recommends that the suitability of an IS (information system) is determined by two major factors: perceived ease of use and perceived convenience. During the procedure following the proper corrective steps, practitioners and researchers use a model that is not only useful and practical for estimation and forecasting, but also for elucidation of why a specific framework might be unacceptable [22]. TAM has established wide attention from researchers of Information Technology for three particular reasons. Firstly, it has a strong base in speculation, Venkatesh and Davis [23] asserts that “Substantial empirical and theoretical support has accumulated in support of TAM”. Secondly, it could be utilized as a guideline to improve effective IT applications. In the duration of ten years, the model has become well recognized as a strong, powerful and economical model for predicting user recognition [23]. Finally, per Venkatesh and Davis [23] and Hashim and Adviser-Eisner [2] for the past 10 years, a research stream supported the strength of TAM in a number of populations, settings and an extensive range of IT applications such as e-learning framework WebCT [24, 25], Internet [26] and spreadsheet [27, 28].

Based on the discussed facts, this research will use the Technology Acceptance Model [21] as the foundation. A number of other factors will be added to examine their impact on the acceptance of e-book in Mathematics and Statistics students at universities in Libya.

III. RESEARCH METHODOLOGY

This research will explore the factors that may impact the adoption of e-book among Mathematics and Statistics students at universities in Libya. The proposed theoretical framework of this research is developed from the TAM [21] which is based on the beliefs, i.e. perceived ease to use e-book, perceived usefulness, attitudes and behaviour intentions adoption framework. The TAM will expand to include ten external factors related to the beliefs and intentions constructs. Thus, the model for this research will focus on fifteen constructs: (1) Perceived usefulness, (2) Perceived ease of use, (3) Attitude, (4) Behavioural intention, (5) Demographic, (6) Cost, (7) Mobility, (8) Accessibility, (9) Contents quality, (10) Language, (11) Technical support, (12) Computer self-efficacy, (13) Resistance to change, (14) Social Influence, and (15) Library service.

This research will use both qualitative and quantitative data collection instruments, but is fundamentally based on a quantitative survey process that recognizes the significance of locating the project within a particular cultural, social, and historical context [29]. The qualitative approach would be minimal though essential in assessing the relevancy of the quantitative findings. It is essential that the data are reliable and credible, thus employment of both methodologies is very essential.

A quantitative evaluation will be utilized in this research, leveraging subjective methods, such as survey through closed question questionnaires to collect substantive and relevant data [30]. Information from the students will be collected by use of a structured questionnaire include closed ended type of questions aiming at gathering information relevant to the following aspects students’ perception and experience of using e-book in education. The questionnaire will consist of six portions: (A) Demographics, (B) Current use of e-book, (C) The Acceptance of e-book, (D) The factors related to users or potential users, (E) The factors related to infrastructure of universities and (F) The factors related with e-book characteristics. Apart from observation, multiple interviews would be carried to get the appropriate and right data from teachers in Mathematics and Statistics Departments at selected universities to support the quantitative survey results.

IV. DETERMINANTS OF TECHNOLOGY ACCEPTANCE MODEL

A. Perceived usefulness (PU)

Perceived usefulness is described as “the level to which the individual thinks that utilizing a system will improve his/her job performance” [31]. PU is assumed to have direct impact on behavioural intention. It is also projected that end users would
accept a specific IT framework, if they assumed that this framework would help them to achieve a desirable result and improve their job performance [22, 32].

B. Perceived ease of use (PEOU)

In TAM, PEOU is described as “the level to which an individual believes that utilizing a system will be free of endeavour” [2]. In accordance with Davis and Venkatesh [31], PEOU is the perception of the end-user related to the volume of mental and physical effort required to use the system. TAM suggests that PEOU optimistically influence PU [22]. Davis [33] contends the significance of PEOU in applying influence on PU and eventually on approach toward utilizing a new technology. Davis, Bagozzi [22] asserts that “the simple a particular system is in using and learning, the most helpful and useful it will be perceived; the explanation is that “effort saved because of improved ease of use might be reorganized, enabling an individual to carry out more work for the similar attempt”.

C. Attitude toward using e-book

The TAM model described attitude as an individual’s negative or positive emotions on performing the target behaviour [34]. These thoughts are PU’s and PEOU’s role; and as a result, the greater PEOU and PU of a specific framework, the more is the possibility of an end-user to have a positive approach to using it [22]. Furthermore, TAM was modified as the attitude formation was detached based on some experimental study that points toward attitude formation was only shown to partly mediate the results two beliefs of the end-user’s intentions [22, 32]. Formulation of TAM incorporated the attitude build-up; the last model excluded the attitude build-up since attitude did not completely mediate the impact of PU and PEOU on intention. Since the formation of attitude was detached from TAM, behavioural intention to use was re-assumed to influence directly by two beliefs of end-user [23, 31, 35].

D. Behavioural intention

In relation to BI (Behaviour Intention), TAM assumes that is influenced mutually by perceived and usefulness attitude. Therefore, a greater PU and an approving attitude toward using a specific system, the more is the possibility of an end-user to use it. In addition, individuals form intentions toward using computer systems based mainly on a cognitive judgment of how it will enhance their performance [22]. It was also noted by Davis and Venkatesh [31] that on the basis of experimental research, PU is a stronger causal factor of intention to use a system as compared to PEOU; they contended that “as users get considerable hand-on experience with a system, PEOU’s direct effect on intention at times lessens to the point of non-importance leaving PU as the only determining factor of intention.

V. Extending TAM with External Variables

A. Demographic

There are a number of research studies carried out by examining the demographic influence of the knowledge and understanding of the users and developers of e-book in higher education in various nations, and they examined the decisions made by the students and teacher on the use of e-book are influenced by many factors incorporating demographic factors [36-39].

B. Social Influence

The source of the term public influence or subjective norm lies in the structure of research in social psychology back in the early fifties of the 20th century, where it was described that it communicates itself in an individual as change of feeling or thinking related to a particular behaviour due to communication with another person or an individual [40]. According to Hashim and Adviser-Eisner [2], public influence or subjective norm is assumed to have a direct effect on behaviour intention to use by compliance; the explanation is that individuals might select to perform a behaviour, even if they are not themselves positive toward the behaviour or its outcomes. If they believe that one or more significant referents think that they must and they are suitably motivated to conform to the referents.

C. Language

Language plays a significant part to take advantage of the benefits offered by e-learning since most of the documents related to e-learning are written in English language, for instance e-book [41]. Essential to the cultural challenge in web based learning is the problem of language, where it is prominent that a great number of online books are written primarily in English [42, 43].

D. Resistance to change

When something new is tried it usually produces feelings of anxiety and discomfort [44, 45], particularly when the change has been externally imposed (for example by the university) and the individual feels to have relatively little control over the event [45, 46]. In education, technological innovation involves a procedure of change, it is not only attainment of additional skills, but it results from difficult work and trial and mistake [47]. Change creates anxiety, unless identified and managed properly, can slow down the learning procedure and following the success of the innovation.

E. Self-efficacy

Self-efficacy is a significant conception in the theory of social learning [48]. Self-efficacy is the belief of an individual in his/her ability to carry out particular behaviours or one’s individual beliefs on his/her ability to carry out particular tasks successfully. It is also described as “personal judgment that is apprehensive, not with the skills that one have, but with judgments of what one can perform with whatever skills one possesses” [49]. Subsequent to these explanations, computer self-efficacy is described as the perception of an individual on his or her ability to make use of computers in the completion of a task [28]. Similarly, self-efficacy of e-reader devices are interpreted by student’s self confidence in his/her ability to make use of e-reader software and devices, such as personal computers, tablets and smart phones. A student who possesses a strong sense about his ability in dealing with e-reader devices might have a more optimistic perception of its usefulness and ease of use and is possible to be more willing to use and accept e-book.
F. Technical Support

The accessibility of technical support is one of the most significant aspects in determining the recognition and approval of technology for learning [50]. This is particularly the case in the first stage of technology acceptance in the developing countries [41]. This incorporates problems like operation, maintenance, installation, network security and administration. This is a significant part of the integration and implementation of ICT in education system. However, in most cases, there is no availability of technical support, which means that students and trainers need some basic skills of troubleshooting to overcome technical issues when using ICTs. For example, most of the developing nations have very few technical professionals to maintain and implement ICTs [51].

G. Library Services

Library services are referred to the level of service that are provided by Academic libraries for teachers and students to locate and use e-book [52]. A number of universities were early adopters of e-books and were provided with many opportunities to enhance electronic access for their users [53]. However, the lack of e-book service in some universities or weakness of the other was the main cause for not preferring e-book as learning source by many users. According to a survey conducted by Roesnita and Zainab [10] to fourteen academic library's web in Malaysian, the results confirmed that e-book services are provided by six academic libraries, with the poor of information that explain the current situation and usage of e-books service.

Although several academic libraries have a web page and enter points within the library’s online catalogue to allow users to access and find e-books, many catalogues, users could not specifically search about e-books [54]. Dinkelman and Stacy-Bates [54] discuss that the terms used to identify e-books in the catalogue were non-standard and confusing, which hindered students’ ability to identify, access, and use e-books. In essence, students might want to use an e-book, but academic libraries were doing a poor job enabling students to find them.

H. Accessibility

Accessibility can be observed at the facility to access and benefit from the service of libraries. The facility to gain access to e-books anywhere and anytime is very attractive to students [53]. According to Letchumanan and Tarmizi [36] the point of access to e-books could be a strong motivation for potential users to adopt books. Detailed that accessibility attracts a number of students to adopt e-books as a source of learning. Therefore, it is confirmed that students from the West of England typically have a preference of e-books, and the facility to access 24×7 was the most attractive attraction of e-books [55].

I. Cost

The cost is the amount of money paid by the student to buy e-publishers. This cost incorporates electronic reading devices such as handheld devices, software used and electronic publications. Educational professionals consider that technology, mainly e-book technology, presents the chance to concurrently lower educational expenses and enhance student accomplishment [56]. For example, according to Vedder et al. [57], a number of textbook publishers now present their products in an electronic format, often at a greatly reduced price of their printed adaptations.

This comparatively new format provides students yet an additional choice to find their course materials, supporting the extra competition for sales in the market of textbooks. At times, electronic textbooks are of an inferior cost substitute, as the electronic system facilitates publishers to lower their cost of production. Few costs, such as writer charges, copy-editing authorizing and proofreading, are possible to stay stable regardless of system. The cost savings related to the e-book production can be conceded to students in the appearance of low-priced books. Also, Cavanaugh [58] confirms that the cost is the important reason to adopt and use an e-book by students.

J. Mobility

E-book readers are devices that facilitate individuals to read e-books. E-book readers are referred to by a number of names. These incorporate mobile reading devices, e-readers, e-book readers, and devices for reading on the go etc. [59, 60]. Where it can be defined as the ability to enter and search any place and anytime without restrictions [53].

Mobile devices that could be used to read e-book usually are a small and portable device, having a display screen by touch input and/or a small keyboard, such as smart phones, tablets and other mobile devices. Mobile technology increasingly infused a number of aspects of modern living, including education.

Simon [61] proofs that the students in the area of biology enjoyed using e-book; where advantages of electronic reading devices, such as mobility was a strong motivation for students to use e-book, because they enabled the access to digital resources by providing search-ability, portability, and content tagging [62, 63]. Whereas, other studies have attributed not to use e-book in issues with slow loading times, battery life, difficulties in browsing and navigating, and uneasiness when reading from the small screen of a laptop, personal computer or any other tablets [39, 64, 65].

K. Content quality

Quality of content is the use of the contents of the e-book (tools and content that help to clarify the information) in the study of mathematics and statistics. De Diana [66] assumes that annotation and demarcation are key components in making e-books an attractive alternative to printed books [67]. According to Chong et al. [68], students liked the facility to highlight, bookmark, link between pages, draw notes, linking from the table of contents, annotate the e-book, and linking from the index.

Additionally, students prefer e-books consisting of pages mixed together with figures that contained a clean, consistent, tidy layout design and strong navigational tools. Furthermore, an e-book provides interactive dictionaries that facilitate users to choose any word within the e-book and get a description instantly, look up an immediate translation to another language or have the definition read aloud [69, 70]. Moreover, e-book allows for updates on monthly, weekly or daily basis, which can be helpful for courses based on technology or for those related to current affairs. These can be improved with an
extensive range of types of media (audio, video, animated materials, etc.) to help the learning process [71].

VI. CONCLUSION

After the emergence and spread of technology in the 21st century, there was a need to integrate technology in education, particularly in teaching and learning. The evolution of technology has supported the change in education methods at the tertiary level, such as using e-books. Many models are developed to help in predicting technology acceptance in different fields like education. Theory of Planned Behaviours, the Theory of Reasoned Action and Technology Acceptance Model are more comment models that have been examined in many experimental researches and proved their worth and credibility. TAM is a very helpful model that utilized to explain and understand behaviour in IS applications. The framework suggested above to determine the factors that may affect the adoption e-book amongst Mathematics and Statistics students at universities in Libya. Moreover, it identifies the TAM factors (Perceived usefulness, Perceived ease of use, Attitude and Behavioural intention) and other external factors, such as Cost, Mobility, Accessibility, Content quality, Language, Technical support, Computer self-efficacy, Resistance to change and Social Influence. To examine this framework, data collection will be the next step.

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