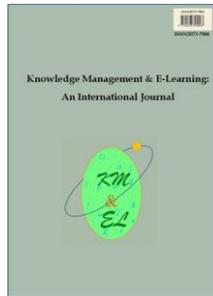


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**Measuring the moderating influence of gender on the acceptance of e-book amongst mathematics and statistics students at universities in Libya**

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## **Measuring the moderating influence of gender on the acceptance of e-book amongst mathematics and statistics students at universities in Libya**

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**Abstract:** The success of using any types of technology in education depends on a large extent of the acceptance of information technology (IT) by students. Therefore, understanding the factors influencing the acceptance of electronic book (e-book) is essential for decision-makers and those interested in the e-book industry. Based on an extended technology acceptance model (TAM), this paper examines the impact of some factors on the students' behavioural intention (BI) toward adoption of the e-book in mathematics and statistics. This paper also investigates the effect of gender differences on the relationship between the factors affecting the acceptance of e-book. A self-administered survey was used to collect data from 392 mathematics and statistics undergraduate students. The research model has shown that the factors related to the social factor and users' characteristics are the critical factors that affect the acceptance of the e-book. The results also indicated that perceived usefulness (PU), perceived ease of use (PEOU) and students' attitude (AU) have strongly affected students' BI. Self-efficacy (SE) has a significant impact on PEOU while social influence (SI) has a significant influence on students' AU. Moreover, the results confirmed that most of the TAM constructs were significant in both models (males and females), where there are no differences between males and females; however, only PEOU has been affected by the gender moderator. The results showed that the impact of the factor of SI on females was more than males. On the other hand, female students were more confident in the use of the e-book than males. In general, the female students' model was more powerful in explaining the variance than males' model.

**Keywords:** E-book; Gender; Self-efficacy; Social influence; TAM

**Biographical notes:** Mrs Asma Mohmead Smeda is currently a PhD candidate in the School of Engineering and information Technology at Murdoch University in Western Australia where she is currently undertaking a research entitled "Investigation of the Perception and Adoption of e-book amongst Mathematics and Statistics Students at Universities in Libya". She holds a Master's degree in Mathematics and Statistics Sciences from the Academy of Graduate Studies, Tripoli, Libya; and a Bachelor's degree in Data Analysis and Computer Science from Al-Jabal Al-Gharbi University, Libya. Prior to her PhD studies, she was a full-time lecturer at Al-Jabal Al-Gharbi University.

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## 1. Introduction

E-book is defined as a digital representation of printed material presented via electronic devices or mediums such as e-book readers, personal computers, smartphones, netbooks, PDAs and tablets (Poon, 2014; Letchumanan & Tarmizi, 2011). The content of e-book could comprise of an electronic copy of the printed materials such as paper books (i.e. textbooks), journals, research, reports and magazines (Embong, Noor, Hashim, Ali, & Shaari, 2012b). Most e-books have features such as notetaking, highlighting, bookmarking, searching, and annotating (Khanh & Gim, 2014; Park & Kim, 2014). The e-book is becoming more widespread in developed countries due to its dynamic features and mobility (Smeda, Shiratuddin, & Wong, 2015a; Kelley, 2011; Rosenstiel & Mitchell, 2011). 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 (Kelley, 2011; Rosenstiel & Mitchell, 2011). Some research involving the adoption of the e-book in education also claim that e-books are also widely used in developed countries

(Embong, Noor, Ali, Bakar, & Amin, 2012a; Kropman, Schoch, & Teoh, 2004). However, most developing countries such as Brazil, Libya, Sultanate Oman, South Africa and Turkey are still struggling to use the e-book as a part of enhancing their education system (Roesnita & Zainab, 2005; Embong et al., 2012a; Noorhidawati & Gibb, 2008). Numerous research has been done to look into the factors that can affect the adoption of the e-book in developing countries (Ngafeeson & Sun, 2015b; Letchumanan & Tarmizi, 2010). The studies in the field of the acceptance and effectiveness of the e-book among higher education students and teachers in developing states are still scarce (Ebied & Rahman, 2015; Smeda, Shiratuddin, & Wong, 2015a, 2015b; Al-Suqri, 2014; Smeda, Shiratuddin, & Wong, 2014; Roesnita & Zainab, 2005; Embong et al., 2012b; Mohammed Aly & Gabal, 2010; Alzaq, 2008; Noorhidawati & Gibb, 2008).

Many factors that could encourage students to use e-book; and there are also factors that hinder its use (Williams, 2011; Spring, 2010). For example, factors related to user characteristics such as self-efficacy and resistance to change; factors related to social factor i.e. social influence; factors related to the characteristic of technology i.e. cost of technology, technology acceptance and technical support; and other factors related to the infrastructure provided by the educational institutions i.e. library service and technical service. According to Pituch & Lee (2006), factors related to user characteristics appear to have a significant impact on students' acceptance of electronic education, and according to Heinich (1996) factors related to users' characteristics can be used to improve students' adoption of instructional technology. Moreover, the social factor is one of the most important factors that have a substantial impact on technology adoption. According to Ahmad (2015), intention or tendency to use technology can be influenced by the SI factor such as the influence of peers, colleagues or teachers. Lin, Tzeng, Chin, and Chang (2010) also confirmed the impact of the recommendations of peers, colleagues and experts on the students' BI to use the e-book for academic purposes. This paper addresses some of the factors related to social factor and user characteristics by studying the impact of SI and SE on the acceptance of e-book.

According to Adam, Howcroft, and Richardson (2004), if the objective of a study is to develop the use of Information Technology (IT), the effect of gender must be taken into consideration. Gender has become a source of concern for many researchers in the acceptance of technology (Teo & Lee, 2010), where there is research arguing that gender in IT applications is still under-theorized (Adam et al., 2004). For example, Sun and Zhang (2006) emphasises that male students are more influenced by the Perceived Usefulness (PU) than females. However, (Ong & Lai, 2006) confirms that the impact of Perceived Ease of Use (PEOU) in female students is more than males. Other studies have argued that there was no considerable association between the total use or non-use of IT applications and gender (Ong & Lai, 2006; Venkatesh & Morris, 2000; Gefen & Straub, 1997; Igbaria & Baroudi, 1995). On the other hand, some researchers have agreed that the results of the impact of gender on some external variables i.e. SI and computer SE were conflicting (Kesici, Sahin, & Akturk, 2009; Wang, Wu, & Wang, 2009). Therefore, gender is one of the important issues that affect the understanding of user acceptance of IT (Padilla-Meléndez, del Aguila-Obra, & Garrido-Moreno, 2013; Terzis & Economides, 2011). Venkatesh and Bala (2008) have also proved that the gender has the impact on users' acceptance of IT.

Numerical models have been developed to assist in the acceptance of technology. The most widely used models are the Theory of Reasoned Action (TRA), the Theory of Planned Behaviours (TPB), and the Technology Acceptance Mode (TAM) (Al-Aulamie, 2013). The acceptance of technology is constantly evolving due to the rapid advances in IT. Usage and acceptance are two of the most important elements that contribute to the

improvement of these theories and models dealing with the acceptance of the technology (Al-Adwan & Smedley, 2013).

In 1986, Fred Davis and Richard Bagozzi devised a model of Technology Acceptance that was based on the TRA (Davis 1989; Davis, Bagozzi, & Warshaw, 1992). TAM is a very useful model which can be used to explain and understand the BI of users in different applications of IT (Al-Adwan & Smedley, 2013; Al-Aulamie, 2013). TAM also allows for the evaluation of the possibility and compatibility of the use of any Information System (IS) (Masrom, 2007; Fishbein & Ajzen, 1975). The model performs the assessment of the behaviour of individuals that is likely to be affected by the use of IS (Park, 2009). It allows system designers to make changes in the IT applications to improve their suitability for users to enhance its usability. Therefore, TAM is a significant body of research, and it is widely accepted in the field of IS. It is also proven to be an accurate indicator of the user's intention and the actual use of the system (Al-Aulamie, 2013).

To understand the aforementioned issues, two factors that called SI and SE have been added to TAM. This paper also investigates the moderating impact of gender on the relationships among the factors affecting on the acceptance of e-book among Mathematics and Statistics students. This paper provides a more understanding of e-book acceptance between male and female students taking Mathematics and Statistics at universities in Libya.

## 2. Literature review

### 2.1. Technology acceptance theory

Fred Davis was the first to shed light on the technology acceptance model to empirically test new end-user information systems (Ngafeeson, 2011). In his doctoral thesis, he provided a quote scarce model and introduced two beliefs which were PEOU and PU. PEOU is defined as “the degree to which a person believes that using a particular system would be free of effort” (Davis, 1989, p. 320). Whereas PU is defined as “the degree to which a person believes that using a particular system would enhance his or her job performance” (Davis, 1989, p. 320). Based on previous research that has embraced PEOU and PU in various environments, PEOU and PU are the two fundamental constructs that affect individual’s decision to adopt any applications of IT such as e-book (Davis, Bagozzi, & Warshaw, 1989).

Since then, several studies have been conducted using various technologies in many countries. There is a constant flow of research to study the possibility of the development of the original structures of TAM (Lee, Hsiao, & Purnomo, 2014; Duan, He, Feng, Li, & Fu, 2010; Venkatesh & Davis, 2000; Venkatesh & Morris, 2000), and many studies have added external variables or moderating variables to extend TAM (Marston, Thrasher, & Ciampa, 2014; Poon, 2014; Al-Aulamie, 2013; Alkharang & Ghinea, 2013; Lee, 2013; Letchumanan & Muniandy, 2013; Othman, Pislaru, & Impes, 2013; Sharma & Chandel, 2013; Letchumanan & Tarmizi, 2011; Ngafeeson, 2011; Phan & Daim, 2011; Abbad, Morris, Al-Ayyoub, & Abbad, 2009a; Abbad, Morris, & De Nahlik, 2009b; Shelburne, 2009; Martínez-Torres et al., 2008; Tao, 2008; Ngai, Poon, & Chan, 2007; Kurnia, Smith, & Lee, 2006).

TAM has established wide attention from researchers of IT for three particular reasons. Firstly, it has a strong base in speculation where Dwivedi, Wade, and

Schneberger (2011, p. 167) assert that “Substantial empirical and theoretical support has accumulated in support of TAM”. Secondly, it could be utilised as a guideline to improve effective IT applications. Within ten years, the model has become well recognised as a strong, powerful and economical model for predicting user recognition (Venkatesh & Davis, 2000). Finally, according to Venkatesh and Davis (2000) and, Hashim (2011), for the past 10 years many research supported the strength of TAM in a number of populations, settings and an extensive range of IT applications such as: (1) e-book acceptance (Letchumanan & Tarmizi, 2011; Ngafeeson, 2011); (2) e-learning framework (Pituch & Lee, 2006; Lee & Lee, 2008); (3) Microcomputer/desktop computer (Igbaria, Guimaraes, & Davis, 1995; Igbaria & Iivari, 1995); (4) Email (Davis, 1993; Venkatesh & Davis, 1996); Internet (Shih, 2004) and (5) Database management system (Venkatesh & Morris, 2000; Hasan & Ali, 2004).

## *2.2. The external factors*

### *2.2.1. Social influence*

The Social Influence (SI) is the subjective norm (Yau & Ho, 2015). The term SI was introduced in social psychology research in the mid-20th century (Yau & Ho, 2015). According to Eckhardt (2009), this term was used to refer to the influence of communication that takes place between individuals, which leads to a change of emotion or mood or view of a person or an individual associated with a particular behaviour (Eckhardt, 2009). Hashim (2011) view that SI can significantly influence BI of individuals to comply with the views presented to them. Furthermore, it was suggested that individuals act or exhibit a particular behaviour despite their non-acceptance of the positive outcome of the behaviour enforced through the influence of another person or an individual. The individual behaviour is motivated by the views presented by one or more references, and his or her behaviour is simply to comply with their views. According to Lu, Yu, Liu, and Yao (2003), SI is defined as an individual’s belief that it is significant for other individuals to engage in an activity. SI is studied in both TRA and TPB as the important determinant to explain the adoption of a system (Rao & Troshani, 2007). Numerous research has supported the influence of SI on students’ AU and BI (Elkaseh, Wong, & Fung, 2015; Tarhini, Hone, & Liu, 2013; Jong & Wang, 2009; Park, 2009; Yang, 2007; Yang & Chen, 2006). The consequence, the Social Influence factor has been subjected to the test in this study.

### *2.2.2. Self-efficacy*

Self-Efficacy (SE) is a significant concept in the theory of social learning (Bandura, 1977). SE is the belief of an individual in his/her ability to carry out particular behaviours or one’s individual beliefs regarding his/her capability to carry out particular tasks successfully (Abbad et al., 2009b; Al-Ammari & Hamad, 2008; Compeau, Higgins, & Huff, 1999; Compeau & Higgins, 1995). It is also described as the personal judgment that is apprehensive, not with the skills that one possesses, but with judgments of what one can perform with whatever skills one possesses (Bandura, 1986). Therefore, the factor of SE is described as the perception of an individual regarding his or her capability to make use of e-book device such as computers in the completion of a task (Compeau & Higgins, 1995). Similarly, SE of e-book readers is interpreted by a student’s self-confidence in his/her capability to make use of e-reader software and devices, such as personal computers, tablets and smartphones (Waheed, Kaur, Ain, & Sanni, 2015; Letchumanan &

Muniandy, 2013). A student who possesses a strong sense of his ability in dealing with e-reader devices might have a more optimistic PU and PEOU, and it is possible to be more willing to use and accept e-book.

Literature shows that the relationship between SE and the adoption of technology in education is statistically significant (Waheed et al., 2015; Hayashi, Chen, Ryan, & Wu, 2004; Burkhardt & Brass, 1990). In the case of e-book, SE also emerged as a significant factor (Waheed et al., 2015). Hsiao and Chen (2015) reported that SE has the most important influence on intention to study through using e-book readers. Therefore, it has been examined to determine his influence on students' acceptance of e-book among Mathematics and Statistics students at universities in Libya.

### *2.3. Gender difference and acceptance of e-book*

In the acceptance of technology field, a few research that has explored gender difference in the area of e-learning, especially e-book (Yoo, Huang, & Kwon, 2015; Marston et al., 2014; Letchumanan & Tarmizi, 2011; Ngafeeson, 2011). In several countries, some studies have focused on researching the effect of gender on the user acceptance of e-book in higher education. They have examined the decisions made by students and teachers regarding the use of e-book. Consequently, their decisions have been influenced by numerous factors incorporating demographic factors (Roesnita & Zainab, 2005; Letchumanan & Tarmizi, 2010; Woody, Daniel, & Baker, 2010; Shepperd, Grace, & Koch, 2008).

Letchumanan and Tarmizi (2011) explored the motivation of using e-book as a learning medium among undergraduates in an engineering division by employing TAM and gender as its external determinant. The findings of their investigation demonstrated how PEOU relates positively with PU. PEOU has a substantial impact on attitude and intention to use e-book, and Attitude (AU) has a substantial impact on the motive to use. Nevertheless, PEOU does not have a substantial impact on AU towards using e-books. Letchumanan and Tarmizi (2011) suggested that gender did not have a significant impact to use e-book.

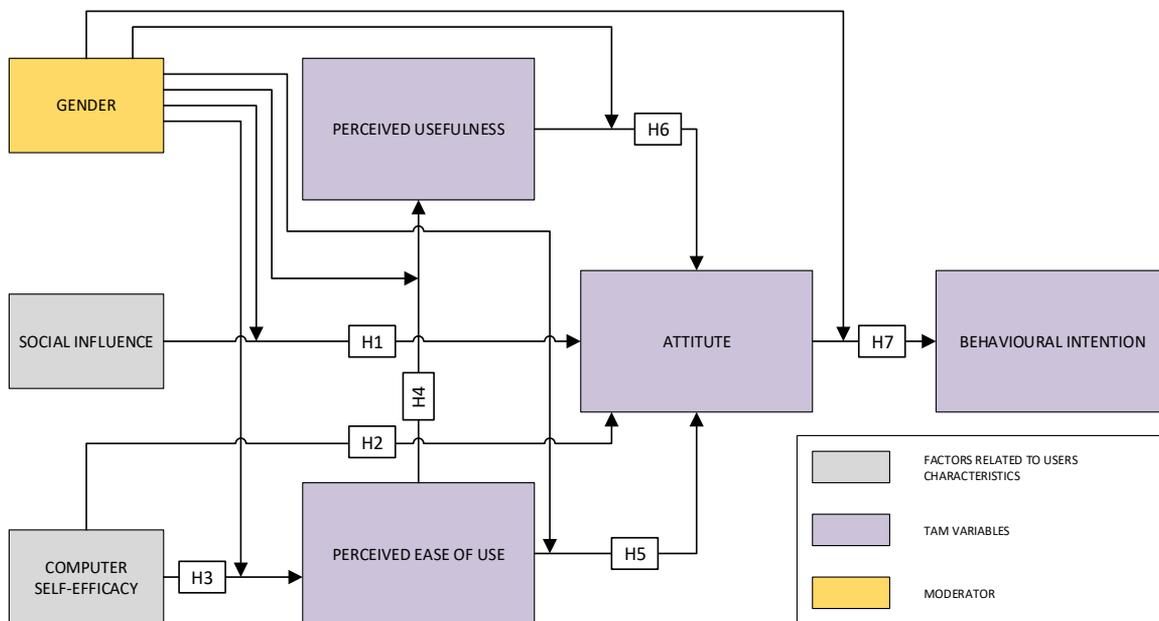
Using gender as a moderator, Ngafeeson (2011) did research on the acceptance of e-book by undergraduate students into the application of TAM. Gender difference has been tested through the investigation of the impact of moderating "gender" on the acceptance of e-book. The exploration entailed research work centred on information collected from undergraduate students (70 males, 88 females). The results confirmed the reliability and applicability of TAM when measuring the acceptance of e-book. Although the significance of gender difference moderator is general, there is no sufficient evidence on the significant of gender differences in mutual relations between the constructs. The results of this research also indicated that despite the gender differences have been theorised and tested with different levels of the experimental support; one must be aware of the generalisations when studying its effect on the use of technology.

In contrast, some research has found that male perception is significantly higher compared to female perception to use e-book (Roesnita & Zainab, 2005; Shepperd et al., 2008). These results were also supported by Marston et al. (2014) where they studied the impacts of gender difference on the level of satisfaction and student adoption of an electronic version of the textbook (e-textbook). The use of e-books as textbooks in education is a new paradigm particularly in developing countries (Embong et al., 2012b). Their study presented survey results collected from 250 male and female undergraduate students who used e-book in their study. It is looking for examining the potential

differences between male and female students with respect to satisfaction with an e-book. Their results confirmed that there is a difference between the genders in the likelihood of reusing e-book. Although the results revealed that female students were using e-books less than males, females were using it more than males because of the interactive features of e-book. However, there is no sufficient evidence of the existence of gender differences with respect to satisfaction, ease of use and usefulness.

### 3. Theory development and hypotheses

Recently, many research focused on the role that technology plays in the development of the educational process, and specifically in the factors determining technology adoption and usage (Al-Aulamie, 2013). Several models have been developed to aid in predicting technology acceptance (Marston et al., 2014; Poon, 2014; Al-Aulamie, 2013; Alkharang & Ghinea, 2013; Lee, 2013; Letchumanan & Muniandy, 2013; Othman et al., 2013; Sharma & Chandel, 2013; Letchumanan & Tarmizi, 2011; Ngafeeson, 2011; Phan & Daim, 2011; Abbad et al., 2009a; Abbad et al., 2009b; Shelburne, 2009; Martínez-Torres et al., 2008; Tao, 2008; Ngai et al., 2007; Kurnia et al., 2006).



**Fig. 1.** The research model

This paper presented a study that added several external factors to examine Mathematics and Statistics students’ acceptance of e-book at universities in Libya. The research model in this study focused on two main constructs, which are (1) Self-Efficacy (SE), and (2) Social Influence (SI) (Fig. 1); and gender was used as a moderator. The research model in this paper explores the effect of gender difference on the acceptance of e-book where it measures the relationship between the external factors and TAM constructs for male and female students. These relationships in Fig. 1 represent the research hypotheses (H1, H2, H3, H4, H5, H6, and H7). According to research in

technology acceptance, the relationships between dependent and independent variables represent the hypotheses that governing the relationships between the variables of the model (Venkatesh & Davis, 2000; Lee, Cheung, & Chen, 2005; Cho, Cheng, & Hung, 2009; Park, 2009; Liu, Liao, & Pratt, 2009; Sánchez & Hueros, 2010; Al-Harbi, 2011; Lee, Hsieh, & Chen, 2013; Udo, Bagchi, & Kirs, 2012; Padilla-Meléndez et al., 2013). The study of hypotheses allows for the exploration of each relationship between different technology adoptions variables in terms of the probability value such as the level of significance and standardised coefficient such as the expectation value. The hypotheses are specified as follows.

*H1: Social Influence has an influence on MAS students' Attitude towards using the e-book at universities in Libya.*

*H2: Computer Self-Efficacy influences MAS students' Attitudes towards using the e-book at universities in Libya.*

*H3: Computer Self-Efficacy influences the Perceived Ease of Use of the e-book among MAS students at universities in Libya.*

*H4: Perceived Ease of Use influences the Perceived Usefulness of the e-book among MAS students at universities in Libya.*

*H5: Perceived Ease of Use influences MAS students' Attitudes towards using the e-book at universities in Libya.*

*H6: Perceived Usefulness influences MAS students' Attitudes towards using the e-book at universities in Libya.*

*H7: Attitude influences MAS students' Behavioural Intention to adopt the e-book at universities in Libya.*

## 4. Methodology

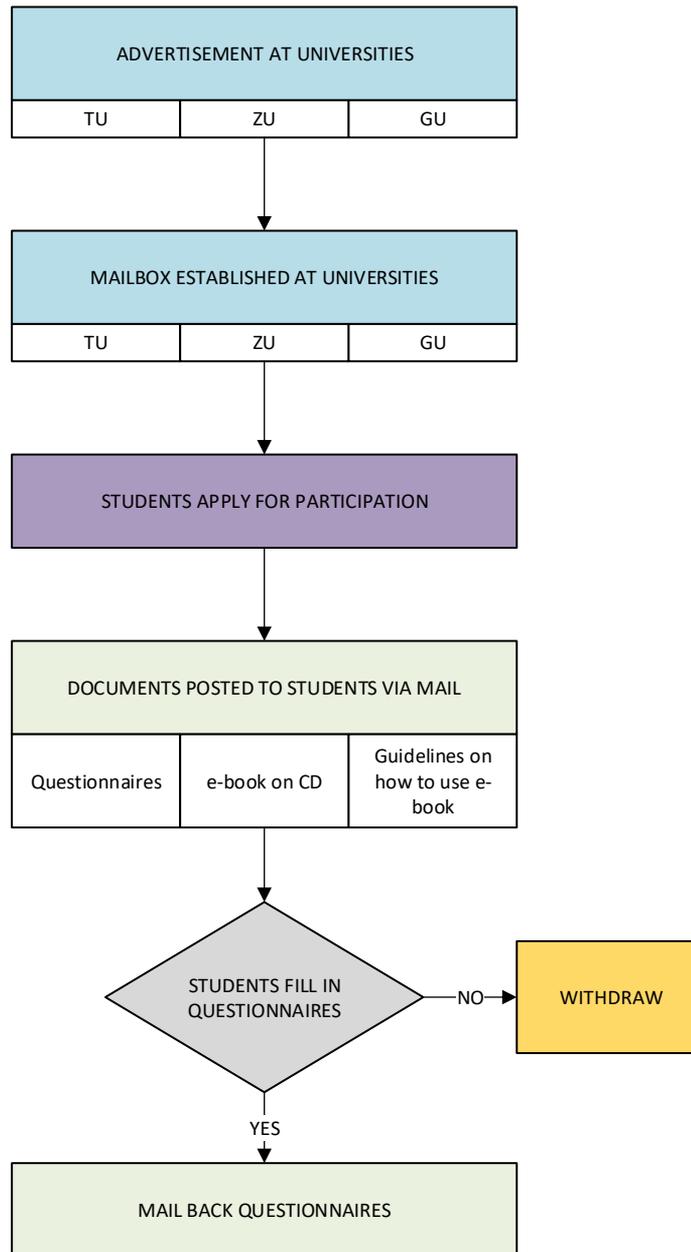
### 4.1. Sample of population

Data was collected using self-administered survey method. Mathematics and Statistics students from three different universities in Libya have participated in this survey, and they are Tripoli University (TU), Al-Zawia University (ZU) and Al-Jabal Al-Gharbi University (GU). These universities differ in terms of density of students and geographical location. The sample size required was calculated based on Yamane (1967) table with  $\alpha=0.05$ ; 391 respondents; 199 males and 192 females (Table 1). The survey was conducted between 30-35 minutes, and participation was voluntary. Undergraduate students were selected because they are the majority population at universities in Libya.

**Table 1**

Descriptive statistics of the participants' demographic information

Variable	Category		Percent
Al-Zawia University(ZU)	Male	Female	45.6
	97	84	
Tripoli University(TU)	69	73	36.2
Al-Jabal Al-Gharbi University(GU)	33	35	18.2
Total	199	192	100



**Fig. 2.** Data collection process

#### 4.2. Data collection process

In this study, the first step in data collection process was to advertise in the selected universities using printed colour flyers. The flyer contained information such as the research topic, and contact information where students wishing to participate will contact the researcher via phone or email. Then the questionnaire and all of the required

documents were posted to the participants via snail/normal mail. The documents include the questionnaire, the e-book file on CD and guidelines on how to use the e-book. A student can still withdraw at any time even though he or she may have initially agreed to participate. Students who completed the questionnaire will then mail it back to the researcher. Fig. 2 summarises the data collection process.

## 5. Data analysis and results

Structural Equation Modelling (SEM) was used as the main technique to analysis the data and examines the hypotheses in this study. In the field of the acceptance of technology, SEM has been widely used by the majority of published studies for its ability to predict the full model as well as the integration both measurements and structuring perceptions (Creswell, 2013; Abbad et al., 2009b; Selim, 2007; Venkatesh, Morris, Davis, & Davis, 2003; Venkatesh & Morris, 2000; Davis, 1993, 1989). SEM is beneficial for testing theories that participate dependency relationships i.e. ( $a \rightarrow b \rightarrow c$ ) (Khodabandelou, Jalil, Wan Ali, & Mohd Daud, 2014; Hair, 2010). Furthermore, Chin (1998) indicated that SEM was used to evaluate the reliability and validity of the model, as it is capable of simultaneous analysis of all the variables in the model rather than being analysed separately.

### 5.1. Measurement of the developed model

To measure the model and test the relationships between the constructs, Exploratory Factor Analysis (EFA) were used to test the validity of the variables proposed and compared the initial reliability of the scales. Confirmatory Factor Analysis (CFA) was then used to measure the Goodness of fit and constructs' validity. In this study, Cronbach's Alpha ( $\alpha$ ) was applied to evaluate the reliability of each factor. According to (Hair, Tatham, Anderson, & Black, 2006; Stafford, Stafford, & Schkade, 2004), the Cronbach's Alpha ( $\alpha$ ) should be more than 0.7 to be considered as the acceptable value of internal consistency. There are certain indicators that should be taken into account to evaluate the model's goodness of fit. Six measures have been chosen to evaluate the validity of the developed model, Chi-Square Test, Goodness-of-fit Index (GFI) and Adjusted Goodness of Fit Index (AGFI), Root mean square error of approximation, Standardized root mean residual, comparative fit index, and Tucker-Lewis index. These measures are commonly used in most literature. However, in this study, some measures that could be sensitive to large samples, such as Normed Chi-square (NC) were not selected (Al-Aulamie, 2013; Schumacker & Lomax, 2012; Sharma, Mukherjee, Kumar, & Dillon, 2005).

The results of the goodness of fit of the model measurement are shown in Table 2. While carrying CFA, it is very important to find out convergent, and discriminant validity and the same is true of reliability, Composite Reliability (CR), Average Variance Extracted (AVE) and Maximum Shared Variance (MSV) are among the important measures for testing the validity and reliability (Cramer & Howitt, 2004). As indicated earlier, discriminate validity helps to check the degree in which a variable is very distinctive from other variables (Hair, 2010). Dividing the total of all squared standardised factors loading on the number of measured variables gives the AVE value. In examining the measured variables discriminate validity, the AVE values will be compared to the MSV. AVE value must be at less 0.5 to confirm convergent validity. Also, the AVE value has to be higher than the MSV to ensure discriminate validity (Al-

Hadad, 2015; Kannan & Narayanan, 2015; Awang, 2012). The results obtained in this study were more than the recommended value.

**Table 2**

Goodness of fit results of the measurement and structure model

GOF	Recommended value	Measurement model	Structural model
$\chi^2$		918.59	1090.79
DF	N/A	587	642
$\chi^2/df$	>0.3	1.56	1.70
CFI	>0.9	0.96	0.95
RMSEA	<0.08	0.04	0.04
SRMR	<0.08	0.04	0.05
TLI	>0.8	0.96	0.95
GFI	>0.9	0.89	0.88
AGFI	>0.8	0.86	0.85

5.2. Structural model and testing of hypotheses

The criteria that have been used to the measurement model were used again to measure the Goodness of fit (GOF) for the structural model. The outcomes obtained of the GOF were satisfactory and emphasised the acceptance of the proposed model. The findings were within the range of the recommended value, except GFI that was close to the recommended value (0.90) (Lee et al., 2014; Arteaga Sánchez, Duarte Hueros, & García Ordaz, 2013; Ong & Lai, 2006). Table 2 shows the results of the mode fit of this study. The last step is to check the proposed model hypotheses through the use of path analysis. The results are shown in Table 3. The study hypotheses were tested by using path analysis via standardised path coefficients, the significance of the estimated coefficients (critical ratio) and probability value (p-value). The acceptance hypothesis should be ( $-0.05 \leq P\text{-value} \leq 0.05$ ) as well as the critical ratio which is more than +1.96, or less than -1.96 (two tails). All hypotheses of the developed model in this study have been successful in overcoming these conditions.

**Table 3**

Results of path tests

Hypothesis	Proposed relationship	Critical Raito	P-Value	Result
H1	SI → AU	3.36	***	Supported
H2	SE → AU	3.03	***	Supported
H3	SE → PEOU	4.84	***	Supported
H4	PEOU → PU	6.27	***	Supported
H5	PEOU → AU	4.28	***	Supported
H6	PU → AU	5.40	***	Supported
H7	AU → BI	7.65	***	Supported

Note. \*\*\*= $p\text{-value} < 0.001$ . \*\*= $p\text{-value} < 0.01$ . \*= $p\text{-value} < 0.05$

### 5.3. Moderating effect of gender

This study has utilised multi-group analysis to explore the moderating impact of gender on the relationship between the constants in the proposed model. Multi-group analysis has been used to investigate the influence of moderators. According to Lowry and Gaskin (2014), a multi-group moderation is “a special form of moderation in which a dataset is split along values of a categorical variable i.e. gender, and then a given model is tested with each set of data” using gender as an example, the model was tested for males and females separately.

The measurement and structural model test were used to examine the research model. First, the measurement model was tested for the differences between genders in terms of the measured variables. In addition, the structural model was also tested for the differences between genders in term of the hypotheses. In AMOS, multi-group analysis classified the data on the basis of the value of grouping i.e. gender, and the group analyses were performed simultaneously among male and female (Byrne, 2013).

Chi-square differences and critical ratios are two ways to measure the differences between multi-group moderation such as genders. This study used the difference in chi-square  $\Delta x^2$  to test if there are significant differences in genders on the measurement model, and the structural models level. According to Hair (2010), Chi-square represents a statistical measure of differences that commonly utilised to compare and estimate the matrices of covariance. In the measurement model, the chi-square  $x^2$  has been computed through CFA; whereas in the structural model it has been calculated through the structural equation modelling. Byrne (2013) has suggested that the difference in chi-square  $x^2$  can be calculated by finding the chi-square  $x^2$  for the proposed model twice; first time should compute it without weight constraints; then with weight constraints. If the result of the difference in chi-square  $\Delta x^2$  is significant, that means the model is not equivalent over genders.

#### 5.3.1. The measurement model test

Chi-square was computed in the measurement model before and after the process of weight constraints to the measured variables. Based on the results shown in Table 4, there is no significant difference at the model level between the two groups. It means that gender perception towards the measured variables is similar.

**Table 4**

The Chi-Square  $\Delta x^2$  for the measurement model

Measurement model	$x^2$	Degree of freedom ( $\alpha$ )
Unconstrained Model	2607.76	1761
Constrained Model	2692.98	1873
The difference in chi-square	85.22	76

#### 5.3.2. The structural model test

Chi-square was calculated before the process of weight limitations of the research hypotheses, and the same process was also applied to after weight constraints to the hypotheses. As shown in Table 5, there is no significant difference amongst two groups at

the model level. However, they may be different at the path level. Therefore, the identification of the hypothesis has been determined by repeating the method of weight constraints on each hypothesis separately and computes the difference in chi-square  $\Delta x^2$  again.

**Table 5**  
The Chi-Square for  $\Delta x^2$  the structural model

Structural Model	$x^2$	Degree of freedom ( $\alpha$ )
Unconstrained Model	2965.65	1944
Constrained Model	3030.91	2012
The difference in chi-square	65.26	68

The model hypotheses were then tested by comparing the path coefficients between both groups by using the critical ratio (t-value > 1.96) and p-value > 0.05 (Table 5). SE factor was the main variable that hypothesised to impact students' AU, where the hypothesis for SE toward students' AU has been accepted in the case of females and rejected in the males' case. Based on the result that showed in the test of the structural model, the  $R^2$  (explained variance) of PU, PEOU, AU and BI, was totally different between males and females (Table 6).

**Table 6**  
The explained variance for the dependent variables for each group

Gender	Perceived Usefulness	Perceived Ease of Use	Attitude	Behaviours Intention
Male	0.18	0.33	0.63	0.34
Female	0.55	0.25	0.56	0.40

## 6. Discussion and conclusion

The main purpose of this study was to investigate the impact of personal characteristics factor including SE and the social factor including SI on the acceptance of e-book among the mathematics and statistics students at Universities in Libya by extending the TAM. This study also determines the effect of the gender moderator on the acceptance of e-book among the students.

### 6.1. Determining the acceptance of e-book

The findings of this study regarding the impact of PU upon AU were strongly and directly affected. Conversely, PU has an indirect influence on BI via AU. Numerous studies have confirmed that PEOU has a strong influence on AU and BI (Elkaseh, Wong, & Fung, 2016; Al-Adwan & Smedley, 2013; Arteaga Sánchez et al., 2013). Students who benefit from e-book will have a positive AU toward using e-book. The importance of PEOU was through its direct and indirect effects via PU on students' AU toward using e-book. This logical consequence of the participants who were not from the area of IT, and they have poor knowledge about the use of e-books. It also has an indirect influence on students' BI. This explains the choice of the majority of the participants to use the e-book

for easy handling. The results of this study also agree with (Elkaseh et al., 2016). Moreover, students' AU seems to have a powerful effect on students' BI. The positive feelings of the students towards the use of the e-book will be positively reflected on their behaviour.

In this study, based on the results related to the social factor, it can be emphasised the importance of SI. Numerous research has supported the influence of SI on AU and BI (Elkaseh et al., 2015; Tarhini et al., 2013). This could be due to the social culture that is often active in Libya. According to the results related to the characteristics of the users, SE was the strongest factor that impacted PEOU. The findings of this study also confirmed that SE has a positive impact on students' AU regarding the use of e-book. SE also has a strong positive indirect effect on BI through PEOU and AU. It can be explained by the user's confidence in their abilities to use e-book associated with their judgment on the ease of use of the devices that was used to download and read e-book; as supported by (Abbad et al., 2009b; Al-Ammari & Hamad, 2008; Venkatesh & Davis, 1996). Thus, developing students' skills in the use of computers or other devices that can be used to read e-book, as well as encouraging them to use e-book by officials, faculty members and librarians at universities will have a positive impact in attracting more students towards the utilisation of the e-book.

## 6.2. Determining the effect of moderate

Seven hypotheses were tested in this study. Five hypotheses were similar in terms of impact, whereas just one hypothesis has a significantly difference between men and women, which are SE (Table 7). The findings in Table 7 mentioned that gender did not moderate the relationship between PU, PEOU, AU and BI in most of the hypotheses. Perhaps this is due to the convergence rate of the use of e-book among males and females, which reduces the expected differences between them (Wong, Teo, & Russo, 2012).

**Table 7**

The summary of the moderating effect on research hypotheses

Hypothesis	Path	Male			Female		
		Standardised Coefficient	Critical ratio	p-value	Standardised Coefficient	Critical ratio	p-value
H1	SI → AU	0.15	2.20	*	0.24	2.95	***
H2	SE → AU	0.02	0.30	0.77	0.30	3.38	***
H3	SE → PEOU	0.38	4.07	***	0.24	2.15	**
H4	PEOU → PU	0.44	3.89	***	0.65	5.58	***
H5	PEOU → AU	0.45	3.99	***	0.16	1.15	0.25
H6	PU → AU	0.48	4.87	***	0.43	2.91	***
H7	AU → BI	0.48	5.16	***	0.59	5.55	***

Note. \*\*\*=  $P$ -value  $\leq 0.001$ . \*\*= $p$ -value  $\leq 0.01$ . \* =  $P$ -value  $\leq 0.05$ . broad line= hypotheses that are significantly different between gender

TAM constructs were found to be positive and significant for most parts. Although the results confirmed that PEOU has a strong influence on PU in female students, it insignificantly impacted their AU toward the acceptance of e-book. However, it has a strong indirect influence on female students AU through PU factor. Tarhini, Hone,

and Liu (2014) have explained that “*females tend to place more emphasis on ease of use of the system when deciding to whether or not adopt a system*”. Therefore, they may be selecting e-book because they think it will reduce the effort required in the study, research and find solutions to their questions. It can also help them to understand their subjects since most of them did not use e-book before and had no experience in dealing with it. Similarly, Ong and Lai (2006) confirmed that the impact of PEOU on female students is more than males.

In regard to PU, the construct was slightly stronger for male students than females. The results of this study are supported by numerous literature such as by Al-Aulamie (2013); Ong and Lai (2006); Morris and Venkatesh (2000). Venkatesh et al. (2003); Hoffman (1972) explained that male students tend to concentrate more on the benefits that accrue from the use of technology, and they are driven by the achievement needs more than females. Sun and Zhang (2006) also emphasises that males are more influenced than females by the PU.

The students' BI was used to predict the extent of acceptance of technology such as e-book (Davis, 1989). According to the results shown in Table 7, AU is a strong predictor of students' BI in both males and females participants. Similarly, Fishbein and Ajzen (1975) have indicated that BI was predicted by using users' AU. It is logical to expect that the positive AUs will produce positive behaviour whether in the case of male or female students. However, the females' AU is always courageous, especially when it comes to technology which in turn could contribute to their excellence.

Unexpectedly in this study, SE has been found to be stronger for female students' than males. These results were consistent with the results obtained from some other research (Ngafeeson & Sun, 2015a; Madigan, Goodfellow, & Stone, 2007; Ong & Lai, 2006; Morris & Venkatesh, 2000). The factor of SE has a strong influence on female students' AU while it has an insignificant impact on the AU of male students towards the use of e-book. However, SE has a significant impact on PEOU in the case of males. Female students seem more confident than males when using the e-book. Tarhini et al. (2014) and Morris and Venkatesh (2000) have interpreted that an increased level of SE will lead to the decline in the importance of ease of use. In fact, the number of female students in higher education in Libya exceeds the number of male students; this could explain the superiority of females in the use of technology (Al-Hadad, 2015; Abdulatif, 2011). These results are in contrast with the results recorded in other research which confirmed that men are more confident when it comes to using technology from women (Ngafeeson & Sun, 2015a; Madigan et al., 2007; Ong & Lai, 2006; Morris & Venkatesh, 2000). Moreover, although both hypotheses that represent the relationship between SI and students' AU were accepted, the results confirmed that female students are more influenced by social factors than males. These results were consistent with the results obtained from other research (Tarhini et al., 2014; He & Freeman, 2009; Wang et al., 2009; Venkatesh & Morris, 2000).

Therefore, the only difference observed is their ability to explain the variance in students' BI. The results showed that the explained variance of female students' BI was largest than males (Table 6) and these results were expected due to the high level of higher education enjoyed by women in Libya compared with other developing countries (Rhema, 2013; Tamtam, Gallagher, Olabi, & Naher, 2011). The moderating impact of males and female students on the acceptance of e-book has received great attention, but some of the results were inconsistent (Marston et al., 2014; Al-Aulamie, 2013; Ngafeeson, 2011).

### 6.3. Implications

The results of this study include a number of important implications that can be summed up in the following points:

1. The results of this study have important implications for academics, decision makers, as well as supervisors and stakeholders to adopt the e-book in the field of education in Libya, where this study represents a good source of information about the factors that effect on the acceptance of e-book among Mathematics and Statistics at universities in Libya. Understanding of the impact of these factors is often a prerequisite crucial to develop effective strategies aimed at increasing the level of use of e-books in higher education institutions in Libya. For example, the factor of SI has a significant influence on students' BI towards the use of the e-book; therefore, decision-makers can take advantage of social influence to enhance the acceptance of e-books through the granting of incentives for existing real users to convince their colleagues to adopt e-book.
2. The importance of this study can be traced back to the possibility of obtaining a better understanding of e-book acceptance among university students as well. Through knowledge of the intentions of the participants, the officials can decide on how to encourage non-users for the use of e-book in future.
3. The results of this study could also help the Faculties of Mathematics and Statistics in Libya to understand the current state of e-book, which can improve their AUs towards the use of e-book as a new method of teaching and learning. Faculty members could also acquire knowledge from the results of this research to help them understand the student tendencies through knowledge of the barriers and incentives facing the use of e-book by students.
4. Studying the effect of gender on the acceptance of e-book can help researchers interested in studying the impact of demographic factors on the use of technology; where the impact of gender is still a subject of controversy among many researchers, especially in Arab countries.
5. Results from this study also can be used primarily as a critical nucleus that will assist other future researchers on the subject matter in Libya because there are no previous researches that have been conducted before in Libya.

### 6.4 Limitations

Some of the results obtained were inconsistent with other studies; they could be due to the long war that broke out in Libya since 2011. The war has had negative effects especially on the men which led to the absence of many males in education for a long time (Rhema & Miliszewska, 2012), and this may have affected the participants' responses especially in the male students.

### 6.5. Conclusion

In summary, students' AU was only the factor that has a strong direct effect on students' BI. PU had the strongest direct impact on students' AU, followed by PEOU. Regarding the external factors, SE has a significant impact on PEOU whereas SI has a significant influence on students' AU. In addition, PEOU, PU, SE and SI factors have a significant indirect impact on students' BI toward the adoption of the e-book. The results also confirmed that most of the TAM constructs were significant in both models (males and females), where there are no differences between males and females; however, only

PEOU has been affected by the gender difference moderator. The results showed that there are the important differences in male and female students' perceptions in just one hypothesis. The hypothesis of SE toward AU was supported in females' case, nevertheless; it was rejected in the case of male students. The results of gender differences confirmed that females were more confident to use e-book than males. The females' model has the greatest ability to interpret variation than males.

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