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Original Article

Determinants of University Students' Perceived Usefulness of Mobile Apps

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Abstract **-** *Technology has taken over tasks initially carried out by professionals in virtually all industries and sectors, ranging from self-checking at airports to money transfer via mobile devices. The internet has become one primary information resource for learning in the education sector. Due to the introduction of mobile devices such as smartphones, the e-learning market has evolved. E-learning applications can help students actively maintain their academic schedules irrespective of their location and time. E-learning is becoming a reality even in less developed countries like Kenya. Mobile apps have become very beneficial to users. However, mobile app developers have not paid much attention to the end-users point of view. This study aims to determine the factors influencing university students' Perceived Usefulness of mobile apps. A quantitative research design was applied. An online self-completion questionnaire collected data, and the WarpPLS – SEM (version 7.0) software for data analysis. This paper applied the Unified Theory of Acceptance and Use of Technology (UTAUT) with the Technology Acceptance Theory (TAM) to develop a model. The latent variables that were found to predict perceived usefulness were security ($\beta = 0.219$, $\rho < 0.001$), effort expectancy ($\beta = 0.247$, $\rho < 0.001$), social influence ($\beta = 0.141$, $\rho < 0.001$) and perceived ease of use ($\beta = 0.123$, $\rho < 0.012$). The findings show that effort expectancy is a more powerful predictor of perceived Usefulness than the others. This paper adds to theory and practice by providing new research directions. These are for the academic world and insights for app developers and marketers to adapt their marketing strategies to meet the customers' needs.*

UTAUT and TAM are applicable theories for understanding university students' perceived Usefulness of mobile apps. The moderating effect of gender difference should be kept in mind when designing UTAUT and TAM-based interventions to improve perceived Usefulness for mobile apps.

Keywords - *TAM, Perceived Usefulness, adoption model, mobile app quality mobile applications, UTAUT.*

I. INTRODUCTION

Mobile technology is within the field of Information Communication Technology (ICT). According to Kim & Crowston (2011), mobile technology is defined as tools or devices in Information Technology (IT) that allow or improve information and communication access for humans. Adopting such an ICT is considered people's initial acceptance of a technology (Kim & Crowston, 2011). With the increasing popularity of ICTs, it becomes important to understand humans' adoption and usage behaviour to develop and design information technologies and systems accordingly (Kim & Crowston, 2011).

Numerous studies in marketing have adapted TAM for their research, and it is in studies as a theoretical foundation (Pikkarainen et al. 2004; Yoon 2016; Ashraf et al. 2014). TAM recommends that perceived ease of use and Usefulness (PU) of technology are the important drivers of acceptance (Davis, 1989; King and He, 2006). While these factors focus on evaluating the individuals' effort of using the technology and perceived utility (Davis, 1989), they do not consider the level of innovativeness, the technological components of the innovation and social processes (Ward, 2013).

This study develops a comprehensive adoption model using key elements of the two technology adoption theories: TAM and UTAUT

Past research on technology adoption, particularly mobile apps, is primarily centred on the technical aspects of the apps, such as quality but very limited on the theoretical aspects such as social influence and perceived ease of use. By combining TAM and UTAUT theories, influencing factors can easily be captured and investigated. For example, capturing the perceived security risk and Usefulness of technology simultaneously. There is a need to combine acceptance theories in a more comprehensive framework, according to Venkatesh et al. (2003), who argue that researchers have to choose among many models and find that they must mix constructs across the models

II. LITERATURE REVIEW

The Technology Acceptance Model (TAM) is a widely used adoption theory. For example, Davis (1989) presented the TAM to explain the determinants of user acceptance of a wide range of end-user computing technologies. Davis (1989) identified two theoretical constructs in TAM, including Perceived Usefulness (PU) and Perceived Ease of Use (PEOU), which affect the intention to use a system. Various studies exist that have enhanced Technology Acceptance Model. For example, Venkatesh and Davis (2000) improved the TAM to Extended Technology Acceptance Model (TAM 2). The improved version provides a detailed explanation of the key forces underlying judgments of perceived Usefulness, hence addressing the limitations of TAM.

According to Venkatesh & Davis (2000), this means that the theory explains why users accept or reject and use technology. It suggests that when users encounter new technology, several factors influence how and when they will use it. The following two constructs explain this; Perceived Usefulness – defined as the extent an individual believes a system would improve their job performance; Perceived ease-of-use – outlined as 'the extent to a user believes that using a system be safe from physical and mental effort (Davis, 1989). Figure 1 shows the TAM Model. TAM 2 incorporated additional theoretical constructs, including social influence processes that the original TAM did not have.

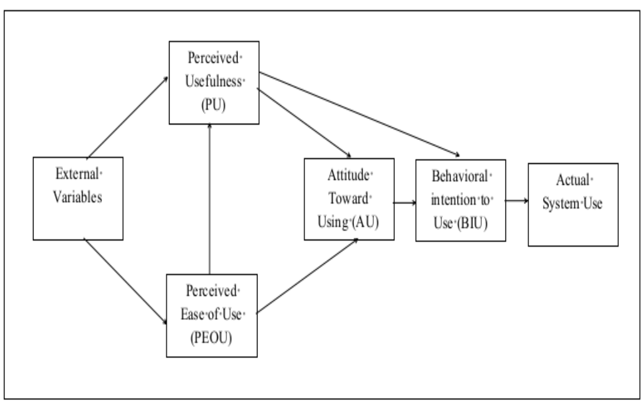

Fig. 1 Technology Acceptance Model (Source, Davis, 1989)

Another popular theory is the Unified Theory of Acceptance and Use of Technology model (UTAUT).
According to Venkatesh et al. (2003), UTAUT addresses the same limitation in TAM 2 by assuming three direct determinants of intention to use. These are (effort expectancy (EE), social influence (SI) and performance expectancy (PE) and two direct determinants of usage behaviour (intention and facilitating conditions) as posited by Venkatesh et al. (2003). Effort expectancy is the Effort Expectancy (EE) is the degree of ease associated with using the system (Venkatesh et al., 2003) or the degree of comfort in using technology (Wang and Wang, 2010). Social Influence (SI) is concerned with changing feelings, attitudes, thoughts, and behaviour, intentionally or unintentionally influenced by others (Rashotte, 2007). Performance Expectancy (PE) stands for the degree to which individuals believe that using the system will increase their performance. Facilitating Conditions (FC), which is the extent a user acknowledges that infrastructure that is technical and organizational support the use of the new technology (Jen, Lu, & Liu, 2009).

Besides the four constructs shown in Figure 2, UTAUT also covers individual differences constructs that include experience, gender, age, and voluntariness of use as moderating variables. Studies by Morris et al. (2005) found that age moderates perceived ease of use (PEOU) technology. However, some inconsistencies have been reported in this relationship.

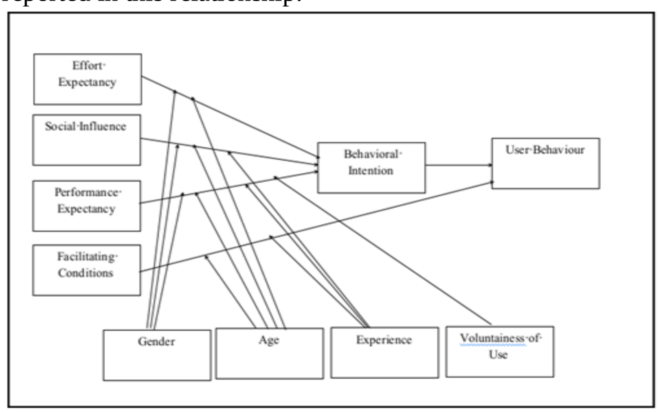

Fig. 2 UTAUT Model (Source, Venkatesh et al, 2003)

This research addresses a gap and extends the UTAUT and TAM frameworks to explore the quality factors most important to mobile applications. The TAM model is derived from social psychology and is a tool to measure an individual intention to adopt new technology. Due to its limited factors to determine adoption, the UTAUT model was developed by Venkatesh et al. (2003), which has 20 to 30% more explanatory power(Venkatesh, Morris, Davis, & Davis, 2003). The TAM model focuses only on personal factors and completely disregard the social influence on technology adoption (Lee, Kozar, & Larsen, 2003). The TAM considers two factors, Perceived Ease of Use and Perceived Usefulness, included in this study. UTAUT factors in this study were Social Influence (SI) and Effort Expectancy (EE). The TAM model was extended to take in more factors like SI missing from the TAM.

Some studies have combined the two models (Cecile van de Kamp, n.d.). Hong & Tam (2006) found that social influence affects perceived Usefulness and Perceived Ease of Use. On the contrary, later research found that social influence was inconsistent with the continuance intention. For example, Hong et al. (2008) found significant relationships, whereas Chiu & Wang (2008) found the relationships insignificant.

In the TAM model, Perceived Usefulness (PU) has been validated in different researches as a key determinant of behaviour and adoption of information systems (Calisir & Calisir, 2004), (Nirwanto, 2019).

No research has considered Perceived Usefulness as the dependent variable with independent variables drawn from variables extracted from the combined theories of TAM and UTAUT. Also, past research has not tested the moderating influence of Gender on Perceived Ease of Use and Social Influence on Perceived Usefulness.

Mobile applications for general use are downloaded from the mobile app stores. These have quality standards that must be met to be accepted in the app store. It is important to consider the quality demands of these stores. The quality factors focused on by app stores are usability that both adoption models easily cover. Perceived Ease of Use (PEOU) in TAM is influenced by usability factors (Lin, 2013). The quality factors used in this study derived from the app stores were Security, Maintenance, Data consumption and Storage Space. As defined by ISO 25010, security is the extent a system protects information and data. And appropriate levels of authorization. This security includes non-repudiation, integrity, confidentiality, accountability and authenticity. Maintainability is the extent of effectiveness and efficiency. A product or system is changed to increase performance, correct bags, or adapt to environmental changes and requirements. Data consumption is the internet consumption of the application; while storage space is the space an app occupies in memory and memory used when using the application

Perceived Usefulness is a variable best used in cases where use is non-mandatory (Nirwanto, 2019). This finding matches Seddon's (1997) and Livery (2005) research. They stated that the quality of a system or the quality of information does not affect use if the use is mandatory. Perceived Usefulness is the independent variable is for this study since the apps discussed herein are neither required nor specific.

Eight constructs for the design of this study are Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) - adopted from TAM; Social Influence (SI), Effort Expectancy (EE) - adopted from UTAUT; Security, Maintenance (MT), Data Consumption (DC), and Storage Spaces - adapted from App stores. Figure 2.3 shows the Conceptual Framework of this study with PU as the independent variable.

The hypotheses are:

H_1: Storage Space (SS) positively Influences Perceived Usefulness (PU.)

H_2: Security (SEC) has a direct positive influence on Perceived Usefulness (PU.)

H_3: Effort Expectancy (EE) directly Influences Perceived Usefulness (PU.)

H_4: Social Influence (SI) positively Influences Perceived Usefulness (PU.)

H_5: Perceived Ease of Use (PEOU) positively Influences Perceived Usefulness (PU.)

H_6: Maintenance (MT) positively Influences Perceived Usefulness (PU.)

H_7: Data Consumption (DC) positively Influences Perceived Usefulness (PU.)

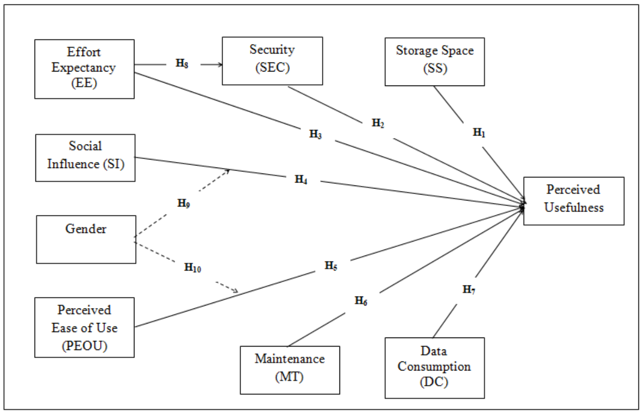

Fig. 3 Research model

III. METHODOLOGY

The researcher engaged a descriptive survey research design. According to Mugenda and Mugenda (2008), Descriptive survey research designs are preliminary and exploratory studies. This study used the quantitative approach to collect analysis and subsequent discussion data. It used primary and secondary data; the primary data used a Google Form. The secondary data were from four app stores, Google Playstore, Apple Store, Microsoft Store, and Amazon store, accounting for over 95% of the market share apps. Three hundred twenty-eight (328) students of a public university in Kenya responded and returned the filled up questionnaire for collation and data analysis. The students were selected from technical and non-technical courses to reduce bias. Pre-testing and piloting were to improve the final quality of the questionnaire. The purpose of the pre-testing was also to identify whether the questionnaire accomplishes the study objective. The modification of the questionnaire was completed after taking input of pre-testing. The researcher minimized bias and ambiguity to obtain valid and reliable data. After discussions with peers, the research tool was revised several times to ensure reliability and validity. Internal consistency reliability measurement is through different measures, including the Cronbach's alpha coefficient as recommended by Cronbach (1951) and composite reliability as Werts et al. (1974). The latter is similar since both indicate reliability as running from 0 to 1. Data were analyzed using the WarpPLS-SEM version 7.0.

IV. DATA ANALYSIS AND FINDINGS

According to Dimaunahan & Amora (2016), structural equation modelling employs partial least squares (PLS-SEM). It is analyzed and interpreted sequentially in two stages: The outer model specifies the relationships among the latent variables and their observed indicators. The inner model shows the relationships between the dependent and independent latent variables. A variable is either exogenous or endogenous. In SEM, An exogenous variable has path arrows pointing outwards and none leading to it.

On the other hand, an endogenous variable has at least one path leading to it and represents the effects of other variables. Hence independent variables are exogenous while dependent variables are endogenous. The measurement (outer) model was analyzed by assessing convergent validity, discriminant validity, and reliability as Kock (2014) recommended.

A. Descriptive Statistics

Gender moderated Social Influence and Perceived Ease of Use (PEOU) to measure. The distribution of the respondents by gender is in Table 1.

Table 1. Distribution of respondents by Gender

Demographic Information	Frequency N = 328	Percentage (%)
Gender		
Female	111	33.8
Male	217	66.2

Table 1 shows that male respondents were higher than their female counterparts.
This data shows that majority of students in this university are male. The participants were predominantly male (86.7%) and 13.3% female. This data also aligns with the Kenya Cyber security 2017 Report findings.

B. Measurement Model Evaluation

The measurement (outer) model was analyzed by assessing convergent validity, discriminant validity, and reliability as Kock (2014) recommended.

The reflective Measurement (Outer) Model assessment of convergent validity involves analyzing the links between question statements (manifest variables) and latent variables based on loadings and cross-loadings. Factor loadings or loadings constitute the question statements with the primary latent variable. At the same time, cross-loadings are the coefficients of the question statements with the other latent variables.

The constructs are Data Consumption (DC), Storage Space (SS), Maintenance (MT), Effort Expectancy (EE), Security, Social Influence (SI), Perceived Ease of Use (PEOU) and Perceived Usefulness (PU).

Ovals represent constructs, and hypotheses are represented by single-headed arrows, as shown in Figure 4.1. The measurement model is represented as rectangles by observed variables (items/indicators). Likert scale was used to measure items (1 = strongly agree, 2 = agree,3 = neutral, 4 = disagree and 5 = strongly disagree. Figure 4 contains only the items included in the study after the pilot analysis. For example, Storage space contained four SS1, SS2, SS3, SS3, SS4 and SS5. Only SS2, SS3 and SS4 were included in the analysis.

Fig. 4. shows the outer measurement model, while Table 4.2 shows the constructs used in the measurement model.

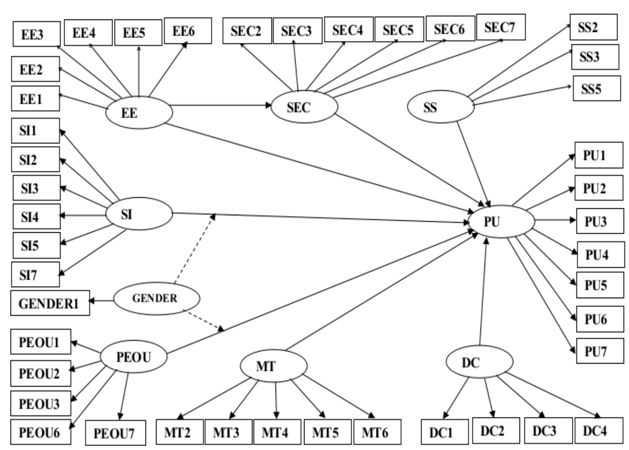

Fig. 4 The Outer Measurement Model

Internal consistency reliability is a type of reliability used to evaluate results' consistency across items. The aim is to discover if the correlation between things is high enough, suggesting similarities between the items of the same latent variable.

Internal consistency reliability is different measures, including the Cronbach's alpha coefficient as recommended by Cronbach (1951) and composite reliability as recommended by Werts et al. (1974). The latter is similar since both indicate reliability as running from 0 to 1. However, the composite reliability approach is less

conservative. To address the weaknesses of Cronbach's alpha introduced the consistent reliability coefficient to measure internal consistency (rho*A*). For all criteria, values between 0.60 and 0.70 are acceptable in exploratory research. However, according to Hair et al. (2019), values between 0.70–0.90 reflect satisfactory to good results.
Hair et al. (2019) further observed that values 0.95 may indicate that items are measuring the same phenomenon, coefficient approach, Dijkstra and Henseler (2015) decreasing construct validity typically, which implies that the items are semantically redundant.

Table 2. shows the findings of internal consistency and reliability.

Table 2. Validity and reliability analysis

Construct /Variable)	Item	Cronbach's Alpha (α) Coefficients	Factor Loading	Composite Reliability Coefficients	Average Variance Extracted AVE)
Perceived ease of use	PEOU1		0.605		
	PEOU2		0.736		
	PEOU3	0.828	0.719	0.740	0.492
	PEOU6		0.696		
	PEOU7		0.743		
Social Influence	SI1		0.632		
	SI2		0 674		
	SI3		0.698		
	SI4	0.845	0.664	0.779	0.476
	SI5		0.738		
	SI7		0.720		
Security	SEC2		0.647		
	SEC3		0.079		
	SEC4		0.726		
	SEC5	0.866	0.750	0.813	0.511
	SEC6		0.756		
	SEC7		0.686		
Data Consumption	DC1		0.723		
	DC2	0.806	0.637	0.678	0.806
	DC3		0.773		
	DC4		0.719		
Storage Space	SS2		0.707		
	SS3	0.745	0.727	0.488	0.494
	SS5		0.674		
Perceived Usefulness	PU1		0.712		
	PU2		0.739		
	PU3		0.776		
	PU4	0.899	0.783	0.869	0.560
	PU5		0.760		
	PU6		0.772		
	PU7		0.693		
Maintenance	MT2		0.737		
	MT3		0.735		
	MT4	0.852	0.753	0.783	0.536
	MT5		0.747		
	MT6		0.686		
Effort Expectancy	EE1		0.657		
	EE2		0.728		
	EE3	0.889	0.782	0.849	0.573
	EE4		0.821		
	EE5		0.803		
	EE6		0.737		

Table 2 shows the Cronbach's alpha and Composite reliability coefficients. All constructs, except the "Storage Space" (0.488) and "Data consumption" (0.678), had values that were satisfactory to well based on the Composite reliability coefficients. Cronbach's alpha reliability coefficient normally ranges between 0 and 1. All the values met surpassed the minimum value of Cronbach's alpha coefficient (0.700

Table 2 shows the findings of the study: Perceived ease of use (0.492 app. 0.500), Social influence (0.476 app. 0.500), Security (0.511), Data consumption (0.806), Storage space (0.494 app. 0.500), and Perceived usefulness (0.560), Maintenance (0.536) and Effort Expectancy (0.573). These values show that all the latent variables met the criterion.

According to Fornell and Larcker (1981), the AVE's desired values are above 0.50 because this would suggest that the construct represents more than 50% of the variance of its items. Table 4.2 shows AVEs.

A good convergent validity implies that the respondents understand the question-statements associated with the corresponding latent variables in the same way intended by the designers of the question statements.

Table 2 shows the findings of discriminant validity for the items used in the survey. The findings were: Perceived ease of use (0.701), Social influence (0.690), Security (0.720), Data Consumption (0.715), Storage space (0.703), Perceived usefulness (0.748), Maintenance (732) and Effort expectancy (0.757).

A construct has passed the discriminant validity test to capture a unique phenomenon not represented by any other construct in the model (Sarstedt, 2018).

The average variance extracted (AVE) square root for each latent variable should be higher than any correlations involving that latent variable (Fornell & Larcher 1981). This result implies that values on diagonal should be higher than those above or below in the same column. Alternatively, diagonal values should be higher than any of the values to their left or right. Based on Table 4.5, each construct passed the discriminant validity test.

C. Results

Figure 2 shows that the results of the inner model indicate that storage space (SS) has a positive but insignificant influence ($\beta = 0.04$, $p = 0.21$) on the Perceived Usefulness (PU) of a mobile app. Security (SEC) has a positive and significant influence ($\beta = 0.22$, $p < 0.001$) on the perceived usability of a mobile app. Effort Expectancy (EE) has a significantly and positively influence ($\beta = 0.25$, $p < 0.01$) on the Perceived Usefulness (PU) of a mobile app. Social influence (SI) has a positive influence that is also significant ($\beta = 0.14$, $p < 0.01$) on the Perceived Usefulness (PU) of a mobile app. Perceived ease of use (PEOU) has a positive and significant influence ($\beta = 0.12$, $p = 0.01$) on the perceived usability of a mobile app. Maintenance has a positive but insignificant influence ($\beta = 0.08$, $p = 0.07$) on a mobile app's perceived Usefulness (PU). Lastly, Data consumption has a positive but insignificant influence ($\beta = 0.08$, $p = 0.06$) on a mobile app's perceived Usefulness (PU). Table 4.6 summarizes the hypotheses testing findings based on the direct effects.

Table 3. Correlations among latent Variables

	GENDER	PEOU	SI	SEC	DC	SS	PU	MT	EE	GENDER*	GENDER*
PEOU	0.008	**0.701**									
SI	-0.051	0. 537	**0.690**								
SEC	-0.022	0.434	0.455	**0.720**							
DC	-0.092	0.348	0.462	0.520	**0.715**						
SS	-0.021	0.161	0.259	0.268	0.391	**0.703**					
PU	-0.028	0.476	0.493	0.558	0.457	0.276	**0.748**				
MT	-0.099	0.421	0.479	0.453	0.458	0.304	0.486	**0.732**			
EE	-0.057	0.453	0.427	0.493	0.491	0.292	0.545	0.579	**0.757**		

Note: on diagonal shows the Square roots of average variances extracted (AVEs)

We used the partial least squares regression approach to test the direct effects of storage space (SS), security (SEC), effort expectancy (EE), social influence (SI), perceived ease of use (PEOU), maintenance (MT) and data consumption (DC)on perceived Usefulness (PU). We also tested the mediation effect of SEC on EE toward PU and the moderating effect of GENDER on PEOU and SI, as shown in Figure 5

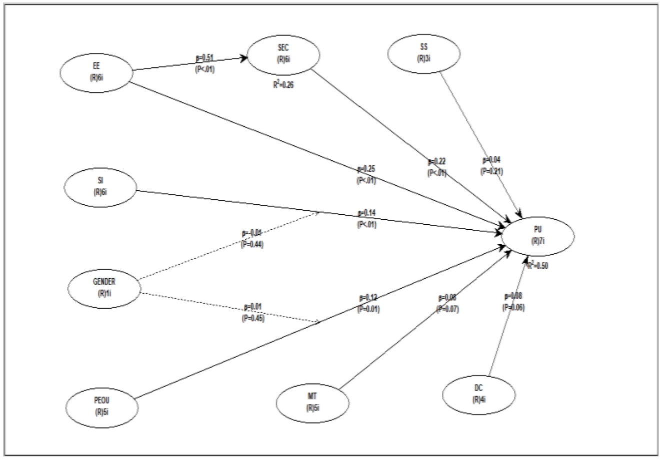

Fig. 5 Path coefficient estimates

What factors influence university students' perceived Usefulness of mobile apps? The innermost model to determine the path coefficient sizes (β values) and significance (p-values) as depicted in Figure 5. This model is to answer the hypotheses stated in the introduction.

Table 4. Hypothesis Testing based on Direct Effects.

Hypothesis	Path	p value (p)	Path coef. (β)	Significance of path coef. ($p < 0.05$)
H_1:	SS -> PU	0.212	0.044	Unsupported
H_2:	SEC -> PU	<0.001	0.219	Supported
H_3:	EE -> PU	<0.001	0.247	Supported
H_4:	SI -> PU	< 0.005	0.141	Supported
H_5:	PEOU -> PU	0.012	0.123	Supported
H_6:	MT -> PU	0.073	0.079	Unsupported
H_7:	DC -> PU	0.063	0.084	Unsupported

Table 4 shows path coefficients and p values of latent variables with Perceived Usefulness as the dependent variable extracted from Figure 2. A hypothesis is supported if $p < 0.05$), otherwise it is unsupported. The research model shown in Figure 6 shows the hypothesis supported and included in the final model.

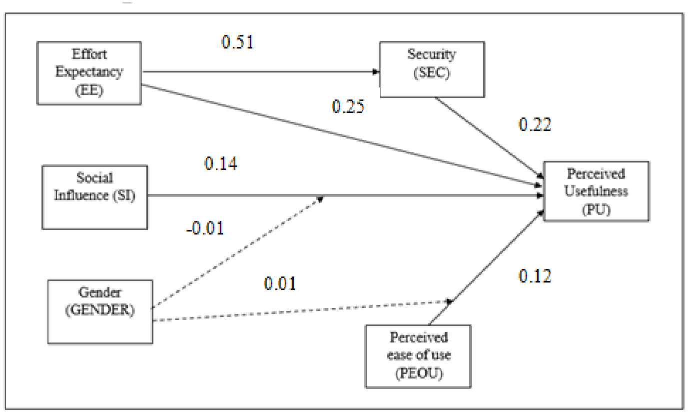

Fig. 6 Research Model

The research model shown in Figure 6 reveals that security (SEC), effort expectancy (EE), social influence (SI) and perceived ease of use (PEOU) predicted perceived Usefulness (PU) of mobile apps by university students. Hence, in this study, a positive relationship between the low Effort Expectancy and the increasing probability of use was established, supported by the literature (Rose et al., 2016; Rose & Bruce, 2018; Venkatesh et al., 2003).

The results also showed that the moderating effect of gender on social influence and perceived ease of use was insignificant. The research model explained 49.4% of the variance in PU. The most crucial factors that influenced PU were EE (β = 0.247, ρ <0.001), SEC (β = 0.219, ρ <0.001), SI (β = 0.141, ρ <0.005) and PEOU (β = 0.123, ρ = 0.012) in that order.

We found that the relationship between the social influence construct (SI) and perceived Usefulness (PU) was significant and positive. This result echoed the findings of prior studies (for example, Lu et al., 2005; Suneeta et al., 2018). We also examined whether perceived ease of using mobile apps has a significant positive influence on the PU of mobile apps among university students in Kenya and found strong support (β= 0.123, p< 0.012). This result was in line with what prior related studies found. For example, Khaled et al. (2020) found that PEOU (β= 0.250, p< 0.05) and PU (β= 0.551, p< 0.001) were significantly and positively influencing the students' attitudes toward the usage of PSAU mobile application. Ahmed et al. (2018) found that perceived ease of use with beta values β = .347, p = .058 considerably predicts the perceived Usefulness, Raza et al. (2017) found that perceived ease of use with perceived Usefulness (β = 0.202, p < 0.01). Kalayou et al. (2020) found that perceived ease of use significantly impacted perceived Usefulness (β = 0.385, t = 3.11). Considering the social influence construct, we found that it has a significant and positive influence on the Perceived Usefulness of mobile apps (β = 0.141, p < 0.005). This result was in line with the findings of prior studies. For example, Mark et al. (2015) found that social influence constructs positively affected Perceived Usefulness, while Ali et al. (2016) found that social media (β = .426, p < 0.001) predicts perceived Usefulness to e-learning.

The findings of the influence of PEOU on PU. has consisted of those findings of Qingxion Ma and Liping Liu (2017). Hence PEOU is a vital predictor of an individual's perception of the Usefulness of a mobile app.

This result will hence, help in the design of mobile apps for use by university students in Kenya, particularly in terms of online learning and examinations as necessitated by the COVID 19 pandemic.

V. CONCLUSION

This study intended to determine the factors influencing university students' Perceived Usefulness of mobile apps. We used a quantitative research design with an online self-completion questionnaire to collect data and the WarpPLS – SEM (version 7.0) software for data analysis.

Storage space, maintenance and data consumption variables do not predict the perceived Usefulness of a mobile app. The study's findings show that the latent variables security, effort expectancy, social influence, and perceived ease of use directly predict the U*sefulness* of a mobile app. These findings resulted in a research model integrating the Unified Theory of Acceptance and Use of Technology (UTAUT) and the Technology Acceptance Theory (TAM) model. Gender does not moderate social influence or perceived ease of use.

The implication to developers is key. The app market is global and competitive. Developers can use the findings to prioritize their resources when developing apps. They should make apps that are easy to use, i.e. require little effort, secure and ensure that they have good reviews and ratings to cater for social influence.

This knowledge is useful to the mobile app developers as the users' perspective is considered, and therefore user acceptance is bound to improve. Researchers and scholars could also consider constructs from behavioural theories such as the theory of planned behaviour (TPB)and the rational choice theory (RCT).

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