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Predicting Students' Intention to Use Gamified Mobile Learning in Saudi Higher Education

Completed research paper

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Abstract

While gamified mobile learning holds the promise of offering an interactive learning environment, the predictors of its adoption remain underexplored. This paper therefore examines the impact of the Unified Theory of Acceptance and Use of Technology (UTAUT) augmented with cognitive gratification and perceived enjoyment on intention to use gamified mobile learning in higher education. 271 valid responses were obtained from students from different regions of Saudi Arabia, using an online questionnaire. Structural Equation Modeling was employed to analyse the data, using AMOS. The findings reveal that perceived enjoyment and social influence had the strongest effects on intention to use gamified mobile learning, followed by performance expectancy and effort expectancy, while cognitive gratification had no influence. The proposed model explained 71% of the variance in usage intentions. The key contribution of this paper is the empirical evidence of the impact of the extended UTAUT on intention to use gamified mobile learning.

Keywords gamified mobile learning, usage intention, performance expectancy, effort expectancy, higher education

1 Introduction

Information and communication technologies (ICTs) have a strong and palpable presence in higher education (HE, adj.) due to the growing recognition of their importance as key enablers for delivering quality education (Dave 2019). ICTs have opened new opportunities for educators and students as they enable them to access and manage knowledge resources effectively, communicate, and keep pace with updates. However, despite their current status and ever-increasing use, ICTs adoption remains low when it comes to university-level teaching practices (Dahlstrom et al. 2014). In particular, while mobile devices are having a significant impact on how individuals interact and communicate today, they are still underutilised in the HE context in developed and developing countries alike (Kaliisa et al. 2019).

Mobile learning (m-learning) is a type of computer-assisted learning in which the content is delivered using mobile devices (Winters 2007); such as smartphones, phablets, tablets, and any sort of portable computer, in order to provide an interactive and visually enriched learning environment. There is a growing trend today towards enhancing its motivational affordances through gamification. Rather than a full-fledged game, gamification is a term that refers to the use of game elements and principles in non-gaming settings to improve engagement and afford enjoyment (Deterding et al. 2011). Thus, gamified m-learning refers to mobile learning applications that integrate game elements into their design.

It has been argued that gamified m-learning enables a more motivating learning experience (Hobert and Berens 2019; Pechenkina et al. 2017), which is particularly important given the increasing need in higher education to enhance students' engagement with learning activities, especially in large classrooms (Egelandsdal and Krumsvik 2019; Risko et al. 2012). Some studies have suggested that weaving suitable game elements into m-learning could maximise learning, increase motivation, and lead to improved student achievement and better overall academic performance (see, for example, Bartel and Hagel 2014; Chin 2014; Hobert and Berens 2019; Su and Cheng 2015).

However, without successful adoption, the promising benefits of the proposed technology cannot be realised, and the technology will remain underutilised. Although the significant impact of gamified m-learning has been widely researched, there has been a paucity of empirical studies exploring the attitudes of HE students, as key users, towards this technology. Gaining a better understanding of the drivers of HE students' behavioural intention helps to proactively design interventions to facilitate wider adoption and ensure successful implementation.

This study takes place in the context of Saudi higher education. It represents a rapidly developing sector that constitutes around 43 universities, 30 public and 13 private, in addition to 42 different HE institutes (MoE 2020). Improving the quality of university education and student performance is a key element in the national transformation programme to realise Saudi Vision 2030 (KSA 2017). Within such a climate of improvement, a keen interest exists in adopting innovative ways to facilitate learning for students. It can be noted that in 2019, on the global competitiveness index, Saudi Arabia was ranked 38th for its ICTs adoption and 13th with regards to internet users (Schwab 2019), a significant advancement from previous years. In the Saudi HE context, m-leaning adoption has been widely investigated (see, for example, Al-Azawei and Alowayr 2020; Alasmari and Zhang 2019; Alfarani 2014). However, there is a lack of research investigating HE students' attitudes towards gamified m-learning, given its potential to enhance students' engagement and motivation.

Considering the research opportunity noted above, the current study is intended to identify determinants of the intention to adopt gamified m-learning among HE students, more particularly in the Saudi HE context. It employs a quantitative approach to model HE students' intention to use gamified m-learning. The study therefore addresses the research question: What are the key predictors of higher education students' intention to use gamified m-learning?

Following, Section 2 provides an overview of the theoretical background of this study. Section 3 presents the research model and hypotheses development. Section 4 gives an outline of the study's main constructs, data collection method, and analysis techniques. Section 5 presents the results of the study. Section 6 provides a discussion of the results, in light of the relevant literature. Finally, Section 7 summarises the key findings, and presents the implications and limitations of the study, along with suggestions for future research.

2 Theoretical Background

Successful implementation of any technology, such as gamified m-learning, depends on its acceptance by its intended end-users (Davis 1993). In this sense, technology acceptance models (TAMs) seek to provide a theoretical lens to explain factors that influence user acceptance and intentions to use technology. There are several developed and widely applied TAMs for the prediction of behavioural intention and actual use. However, as Taylor and Todd (1995) highlighted, theoretical models need to be assessed on two factors, ordered by priority: (i) to what extent they are contributing to understanding a phenomenon, and; (ii) whether they contain fewer constructs. Thus, a model that offers a strong prediction while utilising few predictors is favourable. Considering this, and as is evident from the literature, the Unified Theory of Acceptance and Use of Technology (UTAUT) appears to be a powerful model with high explanatory power that provides a strong theoretical tool to assess and explain the potential success for new technology.

2.1 The UTAUT Model

Venkatesh et al. (2003) introduced the UTAUT model to explain the behaviour of individuals adopting new technology. This model is a consolidation of eight prominent models of technology adoption, including the Technology Acceptance Model, Theory of Planned Behaviour, a combined Theory of Planned Behaviour/Technology Acceptance Model, Theory of Reasoned Action, Motivational Model, Model of Personal Computer Utilisation, Diffusion of Innovations Theory, and Social Cognitive Theory. The model theorised that four constructs are the most substantial direct predictors of behavioural intention, these are, as defined by Venkatesh et al. (2003):

- Performance expectancy (PE): "the degree to which an individual believes that using the system will help him or her to attain gains in job performance."
- Effort expectancy (EE): "the degree of ease associated with the use of the system."
- Social influence (SI): "the degree to which an individual perceives that important others believe he or she should use the new system."
- Facilitating condition (FC): "the degree to which an individual believes that an organisational and technical infrastructure exists to support use of the system."

Furthermore, the UTAUT model seeks to explain the influence of individuals' differences on the adoption of technology through four moderators; gender, age, experience, and voluntariness of use. Figure 1 illustrates the main constructs of the UTAUT model.

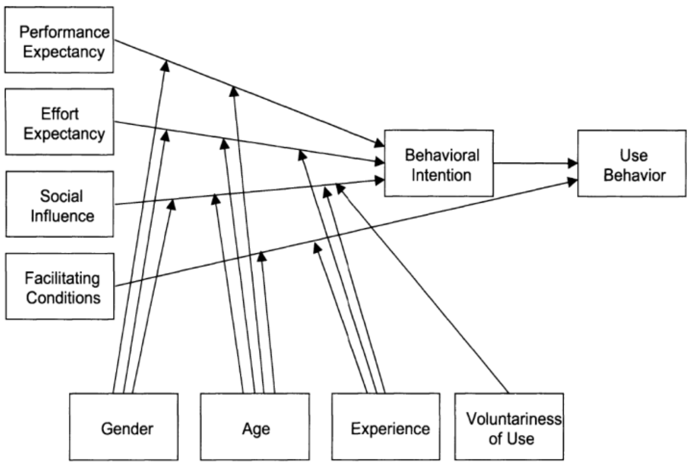

Figure 1: The UTAUT Model (Venkatesh et al. 2003)

However, this model was primarily developed to explain employees' technology adoption within the organisational context, implying that it is sometimes essential to modify and extend the model to suit different contexts and technologies, as also suggested by Venkatesh et al. (2003). Pedersen and Ling (2003) also highlighted the importance of adapting the existing technology adoption models when they are applied in mobile contexts, to best suit the topic. In the context of gamified m-learning, two dimensions are well-documented in recent m-learning and gamified systems literature but are not captured by the UTAUT model; these are the influence of cognitive needs as extrinsic motivation and enjoyment as intrinsic motivation, as discussed in the following two sections.

2.2 Cognitive Gratification

Cognitive gratification is an element of Usage and Gratification (U&G), which originally sought to explore how individuals use media to satisfy their motives, assuming that users are aware of their needs and utilise media purposefully to fulfil these needs (Rubin 1984). Later, researchers started to realise the significance of employing U&G to investigate the use of various communication technologies, as motivation and satisfaction are significant factors in understanding users' behaviours (e.g., Joo and Sang 2013; Reychav and Wu 2014).

Some recent studies found that cognitive gratification had a strong influence on the intention to adopt m-learning in the HE context (Aburub and Alnawas 2019; Thongsri et al. 2018). Cognitive gratification is a factor that concerns the acquisition of understanding, information, and knowledge about related topics, which leads an individual to believe they would gain value (Ha et al. 2015; Nambisan and Baron 2007). Thus, we can define it as:

- Cognitive gratification (CG): the degree to which an individual believes that using the system will help them to gain understanding and acquire information and knowledge.

2.3 Perceived Enjoyment

In the literature on gamification and games, perceived enjoyment has been reported as one of the most significant triggers of behavioural intention (see, for example, Ha et al. 2007; Oluwajana et al. 2019). This might imply that psychological aspects are of great importance in gamified systems. In their recent study, Köse et al. (2019) found that perceived enjoyment could positively influence the continued use of gamified systems. The significance of enjoyment in determining use behaviour towards gamified systems was also highlighted by Hamari and Koivisto (2015). Perceived enjoyment as intrinsic motivation can be defined as (adopted from Davis et al. (1992)):

- Perceived enjoyment (PEnj): the degree to which an individual believes that using the system is enjoyable in its own right, aside from any outcomes that may be expected.

3 Research Model and Hypotheses

This study aims to build a theoretical lens through which the acceptance of gamified m-learning by HE students can be better understood. It puts forth a new adaptation of UTAUT theory to suit the topic under investigation, intention to use gamified m-learning in higher education. The proposed model incorporates factors of cognitive gratification and perceived enjoyment as external variables, due to their reported significance as direct determinants of behavioural intention in recent studies of m-learning (Aburub and Alnawas 2019; Thongsri et al. 2018) and gamified systems (Köse et al. 2019; Oluwajana et al. 2019), in addition to gaming experience as a moderator. Moreover, two constructs of the original UTAUT model, facilitating conditions and use behaviour, as well as voluntariness of use as a moderator were omitted, as the current study aims to explore the factors predicting behavioural intention, and the intended participants are considered non-users at this stage. Figure 2 illustrates the research model adopted in this study.

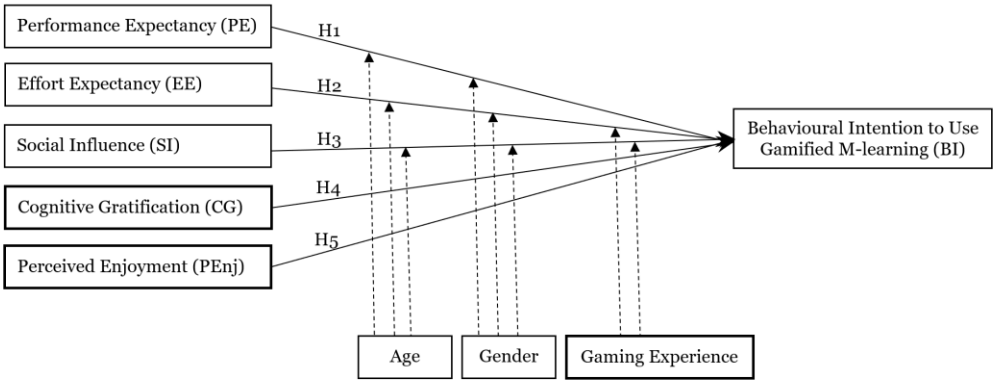

Figure 2: The Proposed Research Model

Based on the proposed research model, there are eight hypotheses in this study, as presented in Table 1. These hypotheses were adopted from the original model by Venkatesh et al. (2003), excluding H4 and H5, which were adopted from Aburub and Alnawas (2019) and Oluwajana et al. (2019), respectively.

H1	PE positively influences BI to use gamified m-learning.
H1a	The impact of PE on BI will be moderated by age and gender.
H2	EE positively influences BI to use gamified m-learning.
H2a	The impact of EE on BI will be moderated by age, gender, and gaming experience.
H3	SI positively influences BI to use gamified m-learning.
H3a	The impact of SI on BI will be moderated by age, gender, and gaming experience.
H4	CG positively influences BI to use gamified m-learning.
H5	PEnj positively influences BI to use gamified m-learning.

Table 1. Research Hypotheses

4 Research Method

4.1 Study Constructs

The present study empirically models the adoption of gamified m-learning through incorporating cognitive gratification and perceived enjoyment factors into the UTAUT model. The model involves six constructs; namely, performance expectancy, effort expectancy, social influence, cognitive gratification, perceived enjoyment, and behavioural intention to use gamified m-learning. These constructs were mainly measured employing validated items taken from existing literature, with minor modifications to suit the topic under study. More specifically, the items of the UTAUT constructs were adopted from Venkatesh et al. (2003), cognitive gratification from Ha et al. (2015) and Nambisan and Baron (2007), and perceived enjoyment from Giannakos et al. (2012) and Jang and Park (2019). All the items were measured by a five-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (5). See Appendix 1 for the measurement items of each construct.

4.2 Data Collection and Analysis

This research used a cohort of university students in Saudi Arabia, both undergraduate and graduate, in order to address the research question: “What are the key predictors of HE students’ intention to use gamified m-learning?”. A survey questionnaire was designed using the Qualtrics online survey tool, in both Arabic (since Arabic is the mother tongue of the majority of participants) and English languages. Ethics approval was obtained from the Engineering Human Ethics Advisory Group at The University of Melbourne. Data collection was undertaken between January and March 2020, using a cross-sectional approach. The questionnaire was used to collect data concerning HE students’ perceptions based on the constructs of the research model. To test the reliability of scale constructs, a pilot study was conducted with 36 participants before commencing the full-scale data collection.

A nonprobability sampling technique was adopted as it allowed the researchers to access a large cohort of HE students utilising available students’ online communities (i.e., student clubs), and thereafter distributing the survey invitation further through their private student networks. An online invitation with a link to the survey was distributed through a variety of social networks, involving Telegram, Twitter, and WhatsApp student communities. This method of data collection enabled the researchers to reach a large sample of students, regardless of their region of residence. The questionnaire started with an introduction covering gamified m-learning, its definition and potential uses in the learning environment, to ensure that participants were aware of the topic under investigation. The questionnaire also included a section for demographic information and gaming experience. It ended with an open-ended question to provide participants with the chance for further comments.

The Statistical Package for the Social Sciences (SPSS 27) was employed to analyse the quantitative data; along with Amos 27, its complement modeling software. First, data screening, descriptive analysis, and internal reliability tests were conducted to explore data features and demonstrate the participants’ profiles using SPSS 27. Second, Amos 27 was utilised to conduct Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM).

5 Results

5.1 Descriptive Statistics

We collected 440 responses from HE students from different regions of Saudi Arabia. Data screening was conducted using SPSS 27 software to verify data quality, to ensure the trustworthiness of results, and to avoid the risk of drawing incorrect conclusions. The collected dataset was screened for missing values, unengaged responses, outliers, normality, and multicollinearity: 41 observations were deemed incomplete cases; 121 were detected as unengaged responses (Std Dev < .5); and 7 cases were found to be influential univariate outliers. As a result, the sample size fell to 271 (61.59%) valid responses that were included in the final analyses. This number satisfies the rule of 10 respondents:1 parameter of sample size to conduct SEM (Kline 2015). Table 2 presents the demographic data for the participants.

Characteristics	Items	No. & (%)
Gender	Male	124 (45.8)
	Female	147 (54.2)
Age	From 18 to less than 25	209 (77.1)
	From 25 to less than 30	29 (10.7)
	From 30 to less than 35	23 (8.5)
	35 or more	10 (3.7)
Current course enrolment	Bachelor	200 (73.8)
	Post-graduate Diploma	8 (3.0)
	Masters	34 (12.5)
	PhD	14 (5.2)
	Prefer not to answer	15 (5.5)
Region of residence	West region	97 (35.8)
	East region	67 (24.7)
	Central region	61 (22.5)
	South region	21 (7.7)
	North region	18 (6.6)
	Prefer not to answer	7 (2.6)

Table 2. Participants' Profiles

We next asked participants several questions to identify their level of gaming experience, as shown in Table 3. Most participants (96.3%) had previous gaming experience. Results also show that mobile devices (i.e., Smartphone, tablet, and laptop) were most popular for playing games (75.9%), with smartphones having the greatest portion (69.7%). (Note: the percentages were rounded to one decimal place).

Characteristics	Items	No. & (%)
Previous electronic game experience	Yes	261 (96.3)
	No	10 (3.7)
Gaming experience rating	Very poor	4 (1.5)
	Poor	5 (1.9)
	Moderate	76 (29.1)
	Good	103 (39.5)
	Very Good	73 (28.0)
Gaming knowledge rating	Very poor	12 (4.6)
	Poor	41 (15.7)
	Moderate	108 (41.4)
	Good	62 (23.8)
	Very Good	38 (14.6)
Years spent gaming	Less than 1 year	47 (18.0)
	From 1 year to less than 3 years	65 (24.9)
	From 3 years to less than 10 years	83 (31.8)
	10 years or more	66 (25.3)
Frequency of gaming	Always	23 (8.8)
	Usually	58 (22.2)
	Sometimes	112 (42.9)
	Rarely	68 (26.1)
Often-used device for gaming	Smartphone	182 (69.7)
	Tablet (e.g. iPad)	14 (5.4)
	Laptop	2 (.8)
	Desktop computer	12 (4.6)
	PlayStation	50 (19.2)
	Xbox	1 (.4)

Table 3. Participants' Distribution based on Gaming Experience

5.2 Reliability and Validity of Measurements

First, the internal reliability of the construct was examined by calculating the value of Cronbach's Alpha, using SPSS 27. The results of Cronbach's Alpha demonstrate a high level of reliability, with all scores above the benchmark 0.75 (Hinton et al. 2014). Second, using Amos 27, the measurement model was assessed for composite reliability, validity, and the overall model fit. The results show high composite reliability (CR) with all values above the acceptable threshold of 0.7. For validity, indices of convergent and discriminant validity present no validity concerns; all constructs have a value of average variance extracted (AVE) above the acceptable threshold of .5, and a value of maximum shared variance (MSV) that is lower than AVE. Table 4 presents the reliability and validity results of the measurement model.

Cnst.*	Cron. α **	CR	AVE	MSV	PE	EE	SI	CG	PEnj	BI
PE	0.807	0.810	0.515	0.341	0.718					
EE	0.800	0.801	0.502	0.285	0.429	0.708				
SI	0.773	0.776	0.538	0.354	0.334	0.488	0.733			
CG	0.853	0.857	0.666	0.343	0.499	0.405	0.478	0.816		
PEnj	0.799	0.802	0.576	0.572	0.529	0.395	0.426	0.586	0.759	
BI	0.876	0.878	0.707	0.572	0.584	0.534	0.595	0.547	0.756	0.841

*Cnst.: Research Model Construct
**Cron. α: Cronbach's Alpha

Table 4. Results of Construct Reliability and Validity

Furthermore, the fit indices presented in Table 5 indicate that the measurement model achieved a good fit (Hair et al. 2006).

Fit Index	Recommended Threshold	Research Model
χ2/d*f*	<5.0	1.311
GFI	>0.90	0.933
CFI	>0.90	0.98
IFI	>0.90	0.98
TLI	>0.90	0.976
RMSEA	<0.08	0.034

Table 5. Goodness-of-fit Results

5.3 Assessment of Structural Model

The structural model also achieved a good fit to the empirical data ($\chi 2/df$ = 1.311, GFI = 0.933, TLI = 0.976, CFI = 0.96, IFI = 0.98, and RMSEA = 0.034). To test the research hypotheses, the standardised path coefficients were examined between the research model upstream constructs (i.e., PE, EE, SI, CG, PEnj) and the downstream construct (BI).

As shown in Table 6, the results of the path analysis indicate that perceived enjoyment (PEnj) had the highest significant positive influence on the behavioural intention (BI) to use gamified m-learning (β= .507, $p < .001$), supporting H5. Social influence (SI) had the second-highest positive impact on BI (β= .261, $p < .001$), supporting H3. Furthermore, significant positive relationships were also found between performance expectancy (PE) and BI (β= .179, p= .008), supporting H1, and between effort expectancy (EE) and BI (β= .138, p= .034), supporting H2. However, the relationship between cognitive gratification (CG) and BI was found to be nonsignificant (β= -.020, p= .770). Therefore, CG was not found as a predictor of the behavioural intention to use gamified m-learning, rejecting H4. Overall, the proposed model explained 71% of the variance in the behavioural intention (R^2= .71), see Figure 3.

Hypothesis	Structural path	Proposed Effect	Estimates			Result
			SRW	t-value	*p*-value	
H1	PE → BI	+	.179	2.657	.008	Supported
H2	EE → BI	+	.138	2.125	.034	Supported
H3	SI → BI	+	.261	3.780	***	Supported
H4	CG → BI	+	-.020	-.292	.770	Not Supported
H5	PEnj → BI	+	.507	6.096	***	Supported

SRW: Standardised Regression Weight
***: $p < .001$

Table 6. Results of Structural Relationships

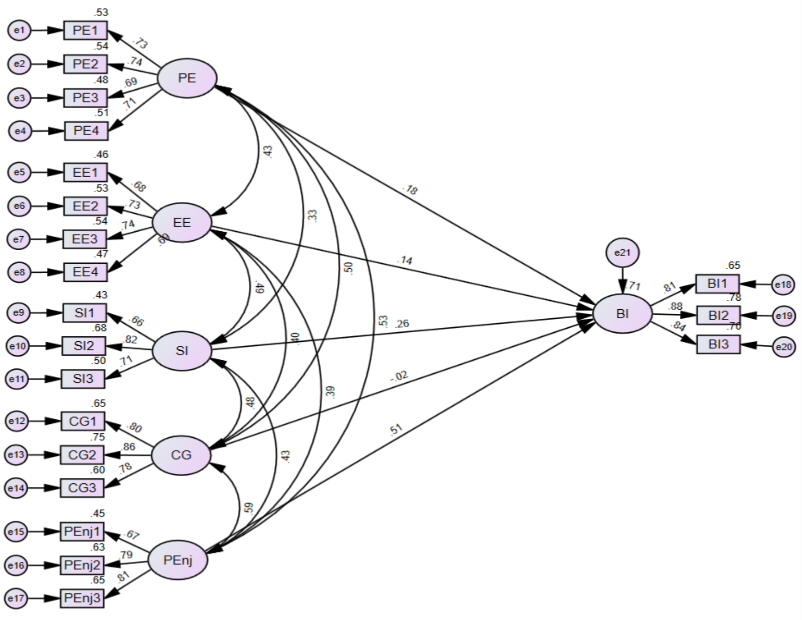

Figure 3: Results of Structural Model

Furthermore, the model-level assessment of the moderating impact of gender and gaming experience revealed no significant chi-square difference between the two sets of groups; males and females, and participants with high gaming experience and participants with low gaming experience. Therefore, neither gender nor gaming experience was found to be moderators within this study. Table 7 demonstrates the model analysis of gender and gaming experience. Age could not be reliably examined as a moderator since most participants were within the age range, 18 to 25. Thus, H1a, H2a, and H3a were not supported.

For gaming experience analysis, the study sample (only participants with previous gaming experience included) was divided into two groups: participants with high gaming experience and participants with low gaming experience. This was achieved by: (i) for each case we calculated the composite score of the four values related to the gaming experience section of the survey (gaming experience rating, gaming knowledge rating, years spent gaming, and frequency of gaming); (ii) based on the mean value of the composite scores, the sample was divided into two groups, lower than the mean and higher than the mean, that is, low-experienced participants (43.7%) and high-experienced participants (56.3%).

Moderator	Model	χ2	df	CFI	χ2/d*f*	χ2 Difference	*p*-value
Gender	Unconstrained model	394.216	310	0.965	1.272	25.246	.153
	Fully constrained	419.462	329	0.963	1.275		
Gaming Experience	Unconstrained model	392.457	310	0.965	1.266	19.086	.451
	Fully constrained	411.543	329	0.965	1.251		

Table 7. Model Analysis of Gender and Gaming Experience

6 Discussion

The purpose of this study was to identify determinants of the behavioural intention to adopt gamified m-learning among HE students. The proposed model in this paper theorised five constructs as having a positive impact on HE students' intention to use gamified m-learning; these are performance expectancy, effort expectancy, social influence, cognitive gratification, and perceived enjoyment. Based on our findings, as Figure 3 demonstrates, the proposed model was able to explain 71% (R^2= .71) of the data variance in behavioural intentions (BI). The quantitative data indicated that perceived enjoyment had the strongest significance as a predictor of the intention to use gamified m-learning within Saudi HE context, confirming H5. It accounts for a high degree of variance in students' intentions to use gamified m-learning (β= .507, p < .001). This finding is in line with the findings of another recent study concerning the gamified learning environment (Oluwajana et al. 2019). Thus, designing an enjoyable gamified m-learning experience is key towards its successful adoption.

Overall, the study found support for the use of the UTAUT model in the context of gamified m-learning in higher education. Specifically, social influence was found to be the second significant predictor of students' behavioural intention, which corresponds with the findings of Alasmari and Zhang (2019) in m-learning adoption. As suggested by some previous studies, social influence had more effect on individuals' intention to use m-learning in a collectivistic culture than it did in an individualistic culture (Arpaci 2015). With the Saudi context as an example of collectivistic culture, social influence is of significant effect (β= .261, p < .001). Furthermore, the results support the role of performance expectancy and effort expectancy in HE students' intention to use gamified m-learning, which is generally in line with research findings in the topic of m-learning adoption. Thus, H1, H2, H3 are all supported.

Interestingly, within this study, cognitive gratification was found to be nonsignificant in predicting HE students' intention to use gamified m-learning (β= -.020, p= .770), therefore H4 was not supported. This presents a departure from Aburub and Alnawas (2019) and Thongsri's et al. (2018) findings around m-learning adoption in Jordanian and Thailand HE contexts respectively, but is in line with the findings of a recent study done by Shukla (2020) in the Indian HE context. If this is of significance, then it may indicate that HE students in the context of Saudi perceive gamified m-learning as a supportive element of enjoyment and engagement but not as a primary avenue of gaining information, knowledge, and understanding. Thus, there is not enough evidence (p > .05) to accept the hypothesis that cognitive gratification on its own is a predictor of students' intentions to use gamified m-learning. We, therefore, suggest that the use of gamified m-learning be restricted to a supportive position, not as a replacement of traditional dialogue inside classes. The nonsignificant correlation between cognitive gratification and intention to use gamified m-learning perhaps implies that knowledge acquisition is not primarily what students expect from it, even if that is what it delivers. Even if gamified m-learning cannot be a main knowledge-delivery avenue for students, it can be used to gauge their knowledge, and deliver real-time feedback to professors during classes to assist in addressing any misconceptions as they arise.

Overall, the results indicated that several factors are significant predictors of the intention to use gamified m-learning among HE students, most particularly in the Saudi HE context. These are perceived enjoyment, social influence, performance expectancy, and effort expectancy. The theorised relationships between the independent constructs and the behavioural intention were largely confirmed. However, the hypothesised moderating impact of gender and gaming experience was not supported within this study. The proposed model explained 71% of the variance in the behavioural intention to use gamified m-learning, leaving room for additional factors that are yet to be identified.

7 Conclusion and Future Work

A key theoretical contribution of this paper is the new validated adaptation of the UTAUT model in the context of gamified m-learning in higher education, while a key practical contribution is reducing the risk of failure when implementing gamified m-learning by identifying key areas of intervention. This study reinforces the importance of maintaining a high level of enjoyment for gamified m-learning applications to be successfully adopted, particularly in the Saudi HE context. Therefore, HE institutes should engage students in the process of designing the system in a way that satisfies their enjoyment requirements and meets their preferences. Social influence was also found to be a strong predictor of gamified m-learning adoption. That is, when one supportive student adopts gamified m-learning, this may positively affect other students' motivation for using the system. It is therefore crucial to conduct awareness-promoting activities and create that sense of social support.

However, sustaining enjoyment in longer-term use could be a challenge. One fruitful avenue for future work could be to explore what may trigger the continued use of gamified m-learning applications among HE students, as it is an important aspect that was not examined in the current study. This study also relied on cross-sectional data; future work could involve undertaking a longitudinal analysis, which may also integrate qualitative methods, to further explore the outcomes of this study. Another consideration for future studies is to investigate possible differences between undergraduate and postgraduate groups, as well as the effect of age as a moderator. Lastly, as discussed earlier, Saudi represents a collectivistic culture, which was expected to impact the findings of the investigated factor of social influence, and therefore, the outcomes of this study cannot necessarily be applied to a dissimilar cultural context.

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Appendix 1

Table 8 presents the items measuring the constructs of the research model.

Construct	Items
Performance Expectancy (**PE**) (Venkatesh et al. 2003)	**PE1:** Using a gamified mobile learning system will support critical aspects of my learning process. **PE2:** Using a gamified mobile learning system will enable me to accomplish my learning tasks better. **PE3:** Using a gamified mobile learning system will enhance my understanding of my own learning progress. **PE4:** Overall, a gamified mobile learning system will improve the quality of my learning process.
Effort Expectancy (**EE**) (Venkatesh et al. 2003)	**EE1:** Learning how to use a gamified mobile learning system would be easy for me. **EE2:** My interaction with a gamified mobile learning system would be clear and understandable. **EE3:** I would find a gamified mobile learning system easy to use. **EE4:** It would be easy for me to become skilful at using a gamified mobile learning system.
Social Influence (**SI**) (Venkatesh et al. 2003)	**SI1:** People who influence my behaviour (e.g., family members and friends) would think that I should use a gamified mobile learning system. **SI2:** People who are important to me would think that I should use a gamified mobile learning system. **SI3:** People whose opinions I value would prefer that I use a gamified mobile learning system.
Cognitive Gratification (**CG**) (Ha et al. 2015; Nambisan and Baron 2007)	**CG1:** Using a gamified mobile learning system will enhance my current information and knowledge. **CG2:** Using a gamified mobile learning system will help me to acquire new information and knowledge. **CG3:** Using a gamified mobile learning system will enhance my process of exploring information and knowledge.
Perceived Enjoyment (**PEnj**) (Giannakos et al. 2012; Jang and Park 2019)	**PEnj1:** It would be fun to use a gamified mobile learning system. **PEnj2:** I believe using a gamified mobile learning system will stimulate my curiosity. **PEnj3:** I believe using a gamified mobile learning system will fit well with the way I like to learn.
Behavioural Intention (**BI**) (Venkatesh et al. 2003)	**BI1:** Given I have access to a gamified mobile learning system, I predict that I will use it. **BI2:** I intend to use gamified mobile learning to support my learning process in the future. **BI3:** I will use gamified mobile learning whenever appropriate to support my learning process.

Table 8. Construct Items of Research Model

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