

FACTORS LIMITING THE ADOPTION OF MOBILE BOARD GAMES AS A TOOL FOR PROMOTING GAMIFICATION: A QUANTITATIVE ANALYSIS

O. A. Randle

Digital Arts Dept

University of the Witwatersrand

Johannesburg, South Africa

<https://orcid.org/0000-0002-7948-1681>

A. A. Oni

Department of Computer and Information Sciences

Covenant University

Ota, Nigeria

<https://orcid.org/0000-0002-8625-2748>

ABSTRACT

Awale, also known as Mancala, is a popular board game, which has received most digital implementations of the game, which competes with Myriad Software's Mancala, have been studied extensively by various academics. Computer scientists and programmers have used various machine learning techniques to experiment with this ability. Literature shows that artificial intelligence has been used successfully to mimic play and compete against human strategies and techniques. However, African board games have the ability to be underutilised as a medium to support the learning abilities of young children. This has greatly reduced the ability of gamification to assist in improving the learning abilities of children in African schools. The article aims to identify the factors that prevent gamification in Public Universities. The article uses the unified theory of acceptance and use of technology as its theoretical framework. This theory focuses on the adoption of technology and the factors that limit its adoption. Furthermore, the article employs a positivist approach. The results of the research identified significant relationship between social influence, facilitating conditions, hedonic motivation, price value, habit and behavioural intention while non-significant relationship were identified between performance expectancy, effort expectancy towards behavioural intention. The importance of these results is they can guide stakeholders in understanding the key factors which influence adoption of mobile board games as tools for learning.

Keywords: Awale, digital games, child development, African board games.

INTRODUCTION TO AWALE

Awale is called Mancala in the Western world, but it has several names across African countries, including Aju, Oware, Warri, Jerin Jerin, Sideko, Morabaraba and Pogu (Donkers, Uiterwijk, and De Voogt 2002; Randle et al. 2013)

Awale has been played in rural environments of Africa since the twelfth century. The 12-pit game was developed to help understand war strategies. It was also used as a tool to teach mathematics to children in early centuries. This strategic game develops personality and arithmetic reasoning. Several groups of peoples refer to Awale as a pit and pebble game, and is possibly the most mathematical of all board games (Agbinya 2004).

Young children are initially introduced to the game as a game of change, it has subliminal educational benefits that help kids learn to count (Abayomi 2012; Randle et al. 2013). As a seed is inserted into each of a series of successive holes in the game, kids gradually grasp the idea of one-to-one mapping. With the help of this exercise, kids can learn basic arithmetic and assess several strategic possibilities while maintaining score.

Board games teach players the strategic benefit of planning, the game aids in the acquisition of gaming abilities in both adults and young children. Understanding the significance of foresight, appropriate timing, and the cause-and-effect principle are among the disciplines needed to implement long-term strategies (Abayomi, Olugbara, and Manosh 2013). It also imparts important abilities like planning, applying mathematical knowledge, and thinking strategically, ahead, and abstractly. A "game" is characterized as a particular kind of dispute in which one or more people take part (Chakraborty 2010).

Rules of Awale

The Board game Awale is a zero-sum, two-player game where seeds are sown. There are six holes on the north and south sides of the board. There are four seeds inserted to every hole at the beginning of the game, where the total number of seeds on the board are 48. Progression within the game is based on careful selection of seeds from a non-empty hole and plant it in a clockwise direction on every hole, with the exception of the starting hole. The player captures all of the next two or three seeds if the final seed is sown into a hole on the opponents section of the board and produces two or three seeds. The two-three rule, which governs this capturing principle, typically differs for various Mancala game variations.

The following basic principles determine when the Awale game ends. For a player to win the game there is a need for more 24 seeds to be obtained by the player. In the event that both

players have taken 24 seeds, a draw occurs. The game is over if neither player can catch any more seeds and there are fewer seeds—for instance, two or three seeds—that are constantly moving across the board. The victor in the game is based on the individual with the most seeds. The game is a draw if the same amount of seeds are captured by both players.

There are two additional holes that can be used as seed bags to hold the seeds that are caught. Odu is the term used to identify a hole which has between twelve and seventeen seeds. At a time, it can catch up to 15 seeds. A typical Awale game can be seen in Figure 1.



Figure 1: The Awale Board game (Abayomi, 2012)

The internet has made it possible to play board games online, including Awale (Mancala). Researchers have used various artificial intelligence techniques to develop game players (Oluwatobi, Anuoluwapo, and Kudirat 2016; Randle et al. 2013). At the master's level, there is significant research on how to evolve game players using tools such as Unity and Visual Studio. However, there is limited knowledge on using digital board games as a tool to teach young children basic mathematics. Bayeck (2018) questioned why Awale is not used as a tool for early childhood education, which becomes the problem statement of this study. This study intends to identify the elements limiting the utilisation of African board games as a tool for early childhood development.

LITERATURE STUDY

Related work/gamification

Gamification is the process of using gaming activities for non-gaming processes. Luo (2022) defined gamification as the use of games for academic or knowledge-based processes. Academic activities related to gamification have been conducted extensively in economically developed regions, such as Europe. However, there have been very few studies on the topic in Africa as a whole (Adukaite et al. 2017). While African universities, such as the University of the Witwatersrand, have developed curricula for gamification and digital arts (Geyser 2016), gamification as a concept is underutilised in Africa.

Gamification has been used in learning for the past 20 years because it engages students (Chen et al. 2015). This engagement can be seen through various tools that are used to address issues such as learning, performance evaluation, customer engagement, and crowd-sourcing activities (Caponetto, Earp, and Ott 2014). Huotari and Hamari (2012) indicated that gamification will be needed in the fields of change, behaviour, and support innovation. Domínguez et al. (2013) argued that gamification is taking place in education because it motivates and supports students, thereby improving their learning experience.

Underpinning theory

The Unified theory of acceptance and use of technology (UTAUT2) model focuses on improving the initial UTAUT1 model (Venkatesh, Thong, and Xi, 2012) by including of hedonic motivation, which is focused on the enjoyment of the utilisation of a platform.

The UTAUT 2 model for information systems usage and adoption is based on eight previously designed or developed usage models. These models include the theory of reasoned action (TRA), technology acceptance model (TAM) and theory of planned behaviour (TPB), social cognitive theory, motivational model, diffusion of innovation, and the model of PC utilisation (Hoque and Sorwar 2017; Persada, Miraja, and Nadlifatin 2019; Philippi et al. 2021; Venkatesh et al. 2003).

Venkatesh et al. 2003 investigated the decomposed Theory of planned behaviour and discovered that the model was limited because it was individual-orientated instead of being based on sophisticated or complex technologies. This restraint led to the extension of the UTAUT based on theorising four factors that play a vital role in user behaviour and adoption. Figure 2 provides a pictorial representation of the extended UTAUT2.

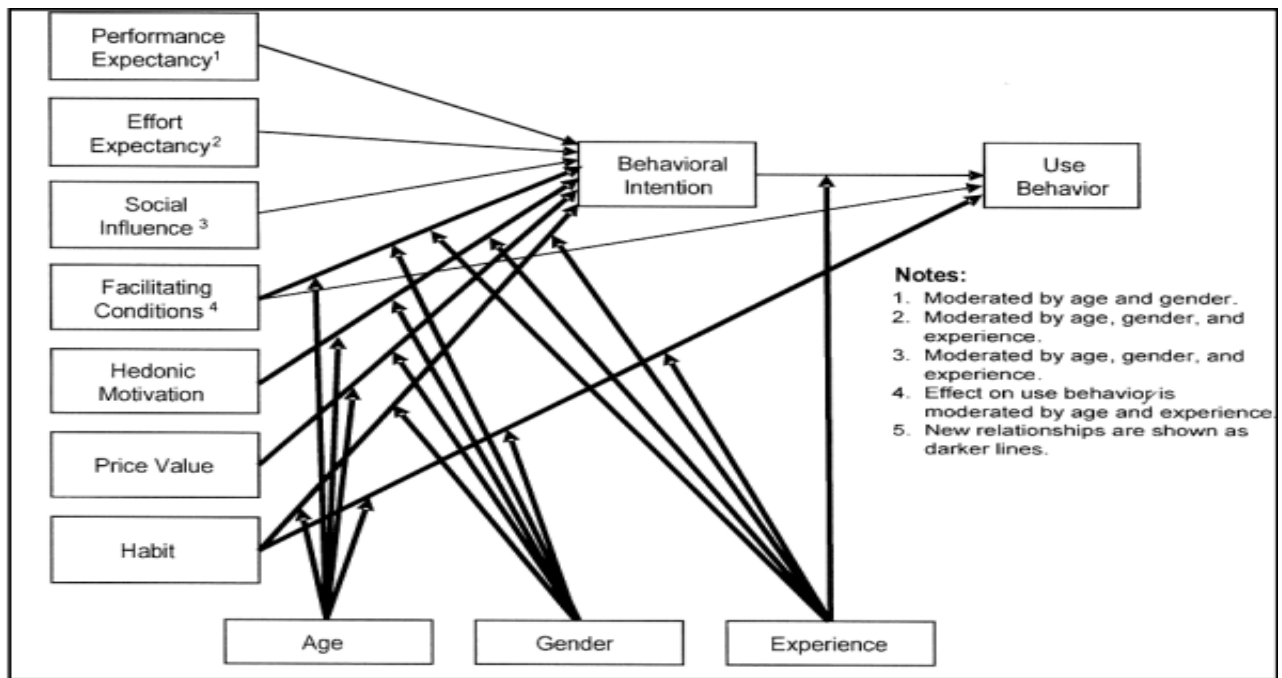


Figure 2: Extended UTAUT model (Venkatesh, Thong, and Zu 2012)

The UTAUT2 model includes the following factors: performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, and habit.

Performance expectancy refers to the degree to which using a system can help an individual or group of individuals attain benefits from their jobs. It includes extrinsic motivation, relative advantage, and outcome expectancy (Ramirez-Correa and Rondan_Cataluna 2019; Almaiah and Nasereddin 2020; Bhatnagr and Rajesh 2023; Mujalli, Khan, and Almgrashi 2022). Age and gender are moderating factors for performance expectancy, which can be seen in behavioural intention. These moderating factors are salient to males, especially male youths (Venkatesh et al. 2003; Yein and Pal, 2021). The model was validated for six months, with outcomes which indicated that men's behavioural intention were more significantly affected by performance expectancy than women's (Venkatesh et al. 2003).

Venkatesh et al. (2003) defines effort expectancy as the amount of effort an individual or group of individuals needs to use a system. Research has indicated that the acceptance of information systems is highly dependent on reduced effort to use the system (Abbad 2021; Edo et al. 2023). Age, gender, and experience are moderating factors for the relationship between behavioural intention and effort expectancy, while effort expectancy is more salient in young women (Venkatesh et al. 2003).

Social influence refers to the perceived importance of using systems that other users in the community or workplace use (Randle, Coleman, and Kekwaletswe 2017; Venkatash et al.

2003). While some studies have indicated that social influence can significantly affect behavioural intention to use a system, other studies have shown no significant influence (Cao et al. 2022; Joa and Magsamen-Conrad 2022; Khechine, Raymond, and Augier 2020). Moderating factors include age, gender, voluntariness, and experience with system usage. Research has indicated that social influence on behavioural intention is particularly significant for women, especially older women (Venkatesh et al. 2003).

Facilitating conditions refer to the degree to which an individual or group of individuals believes that there are technical and organisational infrastructure that supports their use of the system (Kijasanayotin 2009; Venkatesh et al. 2003).

Studies such as Dong et al. (2024), Nordhoff et al. (2020), and Palos-Sanchez, Saura, and Velicia-Martín (2024) indicate that there may be a relationship between effort expectancy, performance, facilitating conditions, and hedonic motivation. This leads to the discussion that conditions that facilitate the use of conditionally automated games are more likely to use digital games such as Awale as tools for learning.

The price value of a system or environment is an individual's evaluation of the net gain that could be achieved by using it (Anwar et al. 2024; Joshi 2024; Venkatesh et al. 2012; Vidal-Silva et al. 2024). If gamers feel that the cost of mobile games is affordable, the number of users will increase.

The role of habit can be understood in two ways. Firstly, through the lens of prior behaviour (Du and Liang 2024; Muchran et al. 2024; Muna, Sukresna, and Muna 2024). Secondly, as an individual belief where behaviour can become automatic (Muchran et al. 2024). The idea that habit has both an indirect and direct effect through behavioural intention was developed by Venkatesh et al. (2012).

According to the UTAUT 2 model, performance expectancy, effort expectancy, and social influence are predictors of behavioural intention, while facilitating conditions have a direct and positive effect and influence on user behaviour (see Figure 3).

Based on this model, the article proposes the following hypotheses:

- H 1: Significant influence of Performance expectancy on behavioural intention.
- H 2: Significant influence Effort expectancy on behavioural intention.
- H 3: Significant influence of Social influence on behavioural intention.
- H 4: Significant influence of Facilitating conditions behavioural intention.
- H 5: Significant influence of Hedonic motivation on behavioural intention.
- H 6: Significant influence of Price value on behavioural intention.

- H 7: Significant influence of Habit on behavioural intention.
- H 8: Significant influence of Facilitating conditions on use behaviour.
- H 9: Significant influence of Price on use behaviour.
- H 10: Significant influence of Habit on use behaviour.
- H 11: Significant influence of Behavioural intention on use behaviour.

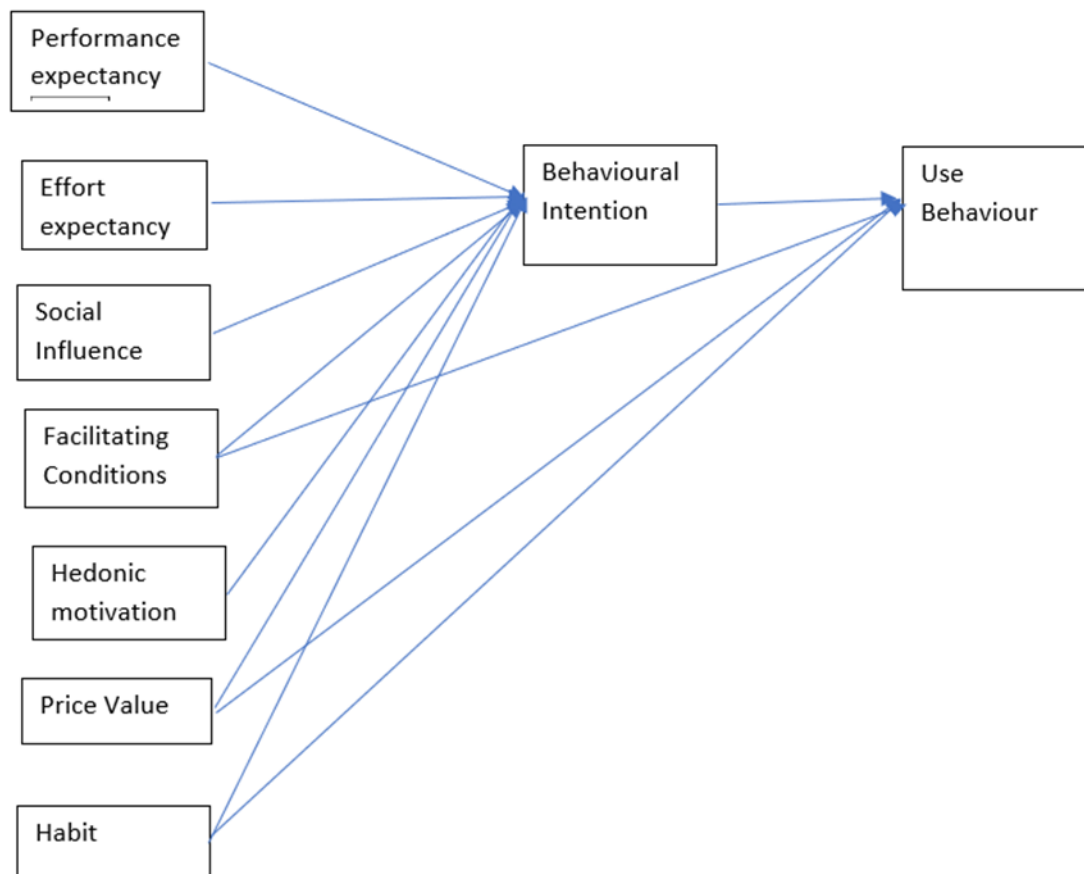


Figure 3: Proposed research model

METHODOLOGY AND RESULTS

UTAUT2 as the underpinning theory is appropriate for this research because of its extensive usage with respect to technology adoption in various fields and technology use. Furthermore, it has been extended to include hedonic motivation, which can be described as fun. Games such as Awale are enjoyable and can be included in gamification to enhance students' learning experiences. This study aims to examine the validity of the constructs in the structural equation modelling of variance-based structural equation modelling.

A survey method was utilized to test the proposed model. The survey instrument included a demographic profile, level of experience with various mobile technologies, and constructs to

be studied. The survey questions that measured each of the model's constructs were developed from Baabdullah (2018) and Goto and Munyai (2022). The questionnaire is presented as an appendix to this article.

The survey instrument was distributed randomly to undergraduate students in a public University, with a preference for individuals with prior knowledge of the Awale mobile game.

Demographic profile of respondents

A total of 350 participants completed the paper-based questionnaire, and 310 valid responses while 40 were invalid due to incomplete information. The 310 valid responses resulted in an 86 per cent response rate. 61 per cent were male and 39 per cent female. The largest age group was 21 to 25 years, which accounted for 43.9 per cent of the respondents. The second largest age group was 17 to 18 years, which constituted 31.6 per cent of the respondents. The third largest age group was 19 to 20 years, which constituted 24.5 per cent of the respondents.

All respondents were undergraduate students studying either computer science or management information systems and had access to a digital device and had played the board game. Computer science accounted for 70 per cent (217) of respondents, while management information systems accounted for 30 per cent (93) of respondents. In total, 102 respondents, or 32.9 per cent, were in their first year. The third- and fourth-year students made up 39.4 per cent and 27.7 per cent of respondents, respectively.

Responders to the questionnaires were asked to describe their level of experience with various technologies. The majority of respondents were competent or expert users of various technologies. However, almost a quarter of the respondents indicated being novice users of shared economy and global positioning systems (GPS), as shown in Table 1.

Table 1: Level of experience with technologies

Technology	Novice (%)	Competent (%)	Expert (%)
Mobile cell phone	2.6	23.2	74.2
Tablet computer (e.g. iPad)	3.5	34.5	62.0
Google Maps	12.9	45.5	41.6
Shared economy (e.g. Uber, Taxify)	24.8	46.5	28.7
GPS	21.9	50.3	27.8
SMS	3.9	39.0	57.1
Electronic mail (E-mail)	3.2	40.6	56.2
Phone calls	3.9	25.8	70.3

Assessment of the measurement model

Confirmatory factor analysis was used to assess the unidimensionality of the measurement model. This helped to confirm that the measurement items of each latent variable relate to it better than to any other latent variable in the model. A reflective model, as used in this study, requires an indicator to have a loading of not less than 0.707 on its construct (Roldán and Sánchez-Franco 2012).

As shown in Table 2, all construct indicators exceeded the acceptable factor loading of 0.707, suggesting good indicator reliability. Therefore, all items in the research instrument were retained for further analysis.

Table 2: Confirmatory factor analysis

Item	BI	EE	FC	H	HM	PE	PV	SI	UB
1	0.883	0.950	0.802	0.895	0.946	0.906	0.929	0.894	0.964
2	0.913	0.969	0.800	0.893	0.973	0.954	0.900	0.961	0.948
3	0.928	0.959	0.881	0.889	0.941	0.917		0.935	
4			0.827	0.821					

Indicators: BI = Behavioural Intention; EE = Effort Expectancy; FC = Facilitating Conditions; H = Habit; HM = Hedonic Motivation; PE = Performance Expectancy; PV = Price Value; SI = Social Influence; and UB = Behavioural Use.

Reliability and validity measures of the constructs

To assess the construct reliability and internal consistency of our reflective measurement model, two crucial types of reliability are required: composite reliability and Cronbach's alpha coefficient (α). Assessing how well construct items measure the latent notion is known as internal consistency reliability. Both omega-a (ρ_a) and omega-c (ρ_c), two suggested composite reliability metrics, were assessed in this study. According to Hair et al. (2022), the minimum acceptable level for the several SmartPLS 4 internal consistency tests is 0.70.

Table 3 displays the reliability analysis of the model constructs. All the constructs hypothesised in the research model had acceptable values for both composite reliability and Cronbach's alpha coefficient.

Table 3: Construct reliability and validity

Factor	Cronbach's alpha	Composite reliability (rho a)	Composite reliability (rho c)	Average variance extracted
BI	0.894	0.897	0.934	0.825
EE	0.957	0.958	0.972	0.920
FC	0.848	0.855	0.897	0.686
H	0.898	0.903	0.929	0.766
HM	0.950	0.952	0.968	0.909
PE	0.917	0.918	0.947	0.857
PV	0.805	0.820	0.911	0.836
SI	0.922	0.927	0.951	0.866
UB	0.906	0.926	0.955	0.913

Evaluations of both convergent and discriminant validity are required for the reflective model. Convergent validity refers to the extent to which one indicator is positively correlated with other indicators of the same construct (Hair et al., 2014). AVE values are employed to assess convergent validity. AVE, as defined by Hair et al. (2014), is the average value obtained by squaring the loadings of the indicators associated with a certain construct and then taking the mean of these squared values. The calculation involves dividing the sum of squared loadings by the entire count of indicators. AVE is also known as build communality. The constructs in the study showed Average Variance Extracted (AVE) values ranging from 0.686 to 0.920, which surpass the minimum threshold of 0.5, as stated by Hair et al. (2014). This illustrates the strong level of convergent validity for each of the constructs examined in the study. Table 3 displays the Average Variance Extracted (AVE) values for each of the model constructs.

The measure of discriminant validity in this research was the degree to which a construct differs from other constructs in the model, as determined by the Fornell-Larcker criterion. It is based on the idea that a construct and its associated indicators have a higher degree of shared variation compared to other constructs (Hair et al. 2014). The approach compares the correlations of the latent variables with the square root of the average variance extracted (AVE) values. It is expected that the square root of the average variance extracted (AVE) for each construct will exceed the strongest correlation it has with any other construct. The results of discriminant validity are presented in Table 4. The square root of the average variance extracted (AVE) for each construct exceeded the correlation between each pair of components.

Table 4: Discriminant validity

Construct	BI	EE	FC	H	HM	PE	PV	SI	UB
BI	0.908								
EE	0.548	0.959							
FC	0.569	0.620	0.828						
H	0.594	0.493	0.365	0.875					
HM	0.608	0.789	0.682	0.436	0.954				
PE	0.539	0.566	0.429	0.724	0.470	0.926			
PV	0.452	0.467	0.636	0.203	0.557	0.243	0.914		
SI	0.583	0.477	0.417	0.665	0.445	0.674	0.242	0.930	
UB	0.020	0.025	0.078	-0.058	0.048	-0.017	0.231	0.020	0.956

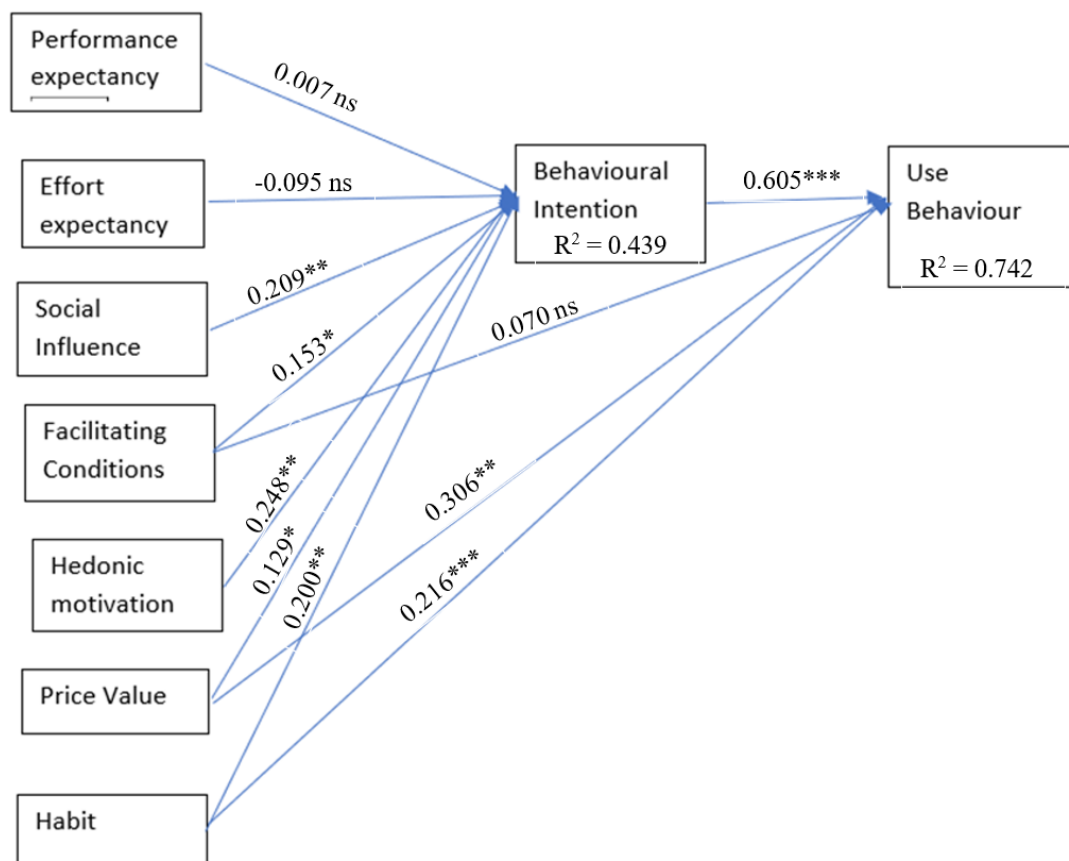
Indicators: BI = Behavioural Intention; EE = Effort Expectancy; FC = Facilitating Conditions; H = Habit; HM = Hedonic Motivation; PE = Performance Expectancy; PV = Price Value; SI = Social Influence; and UB = Behavioural Use.

Structural model

The initial test on the structural (inner) model to forecast the relationships in the research model that were hypothesized was the route coefficient. It shows how closely the exogenous latent variables are related to one another. To determine the path coefficients' significance, we bootstrapped with 5,000 resamples after generating them using the partial least squares algorithm. The path coefficients for each of the proposed paths are displayed in Table 5. To evaluate the path coefficients' importance, we employed T-statistics. The T-statistics and significant values (p-values) for each of the hypothesized pathways are displayed in Table 5. Eight of the eleven hypotheses in the research model had support, as shown in Figures 4 and 5.

Table 5: Structural model results

Hypothesis	Path coefficients (β)	T-statistics	p-value	Decision
EE $\geq$ BI	-0.095	0.516	0.606	Not supported
FC $\geq$ BI	0.153	1.666	0.096	Supported
H $\geq$ BI	0.200	2.396	0.017	Supported
HM $\geq$ BI	0.248	2.458	0.014	Supported
PE $\geq$ BI	0.007	0.106	0.916	Not supported
PV $\geq$ BI	0.129	1.874	0.061	Supported
SI $\geq$ BI	0.207	3.119	0.002	Supported
FC $\geq$ UB	0.070	0.826	0.409	Not supported
H $\geq$ UB	0.216	4.547	0.000	Supported
PV $\geq$ UB	0.306	3.345	0.001	Supported
BI $\geq$ UB	0.605	10.925	0.000	Supported

**Figure 4:** Model of Awale mobile game adoption and use with coefficient of paths

Five factors significantly influence behavioral intention to use: price value, habit, harmonic incentive, facilitating conditions, and social influence. The results of the analysis showed that intention to use is not significantly predicted by effort expectancy or performance expectancy. Furthermore, it was discovered that whilst facilitating condition is a non-significant predictor of use behavior, price value, habit, and desire to use are significant predictors of use behavior.

The second test on the structural model was the coefficient of determination (R^2). It calculates the prediction accuracy of the model, or the percentage of variation in the construct that the model explains. As shown in Table 6 (Hair et al. 2014; Dijkstra et al., 2015), habit, price value, facilitating conditions, and behavioural intention explained 74.2 per cent of the use behaviour of the Awale mobile game, while all exogenous factors in the model explained 43.9 per cent of the variation in behavioural intention to use. The reason why habit, price value, enabling conditions, and behavioral intention considerably explained use behavior was properly described by all of the predictive components of intention to use. As per the findings of Urbach and Ahlemann (2010), weak variance is defined as R^2 values less than 0.190.

Cohen's f^2 was used to assess the effect size (f^2) of the hypothesised paths and the overall model.

$$f^2 = \frac{R^2}{1-R^2} \quad \text{Equation 1}$$

The effect size values and corresponding R^2 values for the two endogenous variables are displayed in Table 6. The findings show that the exogenous factors of desire to use and use behavior have a significant impact on the endogenous latent variable. The only factors that have an impact on the behavioral intention to use are enabling conditions, habit, harmonic motivation, price value, and social influence, according to an evaluation of the effect size of the individual hypothesised path. The only factors that affect the second endogenous variable, use behavior, are price value, habit, and desire to use. All of the exogenous latent variables of intention to use have a significant impact on their endogenous latent variable, according to the overall effect size. This, in turn, along with price value and habit, has a significant effect on use behaviour.

Table 6: Model coefficient of determination and effect size

	R²	R² adjusted	f²	Effect size	
EE ≥ BI			0.013	None	
FC ≥ BI			0.022	Small	
H ≥ BI			0.077	Small	
HM ≥ BI	0.439	0.426	0.043	Small	0.782
PE ≥ BI			0.000	None	
PV ≥ BI			0.025	Small	
SI ≥ BI			0.068	Small	
FC ≥ UB			0.003	None	
PV ≥ UB	0.742	0.738	0.057	Small	2.876
H ≥ UB			0.128	Medium	
BI ≥ UB			0.876	Large	

Indicators: BI = Behavioural Intention; EE = Effort Expectancy; FC = Facilitating Conditions; H = Habit; HM = Hedonic Motivation; PE = Performance Expectancy; PV = Price Value; SI = Social Influence; and UB = Behavioural Use.

DISCUSSION

This study employed the UTAUT2 model to investigate the adoption of the Awale board game among undergraduate students. The original UTAUT2 framework proposed ten hypothesised relationships. In addition to those, this study hypothesised a direct relationship between price value and use behaviour, which is important given the context in which this study was carried out. Out of the 11 hypothesised relationships, only seven hypothesised structural paths had statistically significant results.

Social influence has a direct positive influence on behavioural intention, as stated in Hypothesis 3 ($\beta = 0.207$, $t = 4.119$, $p < 0.05$). This implies that as social influence grows, individuals are more likely to feel compelled to use the Awale mobile board game. The behavioural intention of Awale games players is influenced by people who are important to them and whose opinions they value. This result deviates from Kumar, Natarajan, and Acharjya's (2017) findings on mobile game adoption. However, it is consistent with later findings that suggest social influence positively influences mobile game users' intention to use (Azizah et al. 2023; Baabdullah 2018; Baabdullah, 2020; Erdoğan 2023). The result from this study is also consistent with Ofosu-Ampong, Boateng, Anning-Dorson and Kolog (2019). Investigation of students' perceptions and readiness to use gamification in learning management

systems (LMS) in Ghana where it was found that social influence have direct and significant impact on behavioural intention to use gamification. The majority of the participants are youthful, ranging from 18 to 25 years old, and are actively working towards obtaining a bachelor's degree. The individuals in this category regularly interact with technology in their daily routines and are also influenced by their social environment.

Hypothesis 4, the hypothesised relationship between facilitating conditions and behavioural intention to use, was supported with a coefficient estimate of 0.153, *t*-value of 1.666, and *p*-value of < 0.10 . The facilitating conditions have a direct and positive influence on behavioural intention. The results of this study indicate that the population sample values having access to resources, skills, and assistance needed to engage with Awale mobile board games. They are more likely to accept and take pleasure in the Awale mobile game if they have access to enough resources, technological assistance, and knowledge. These findings corroborate those of Venkatesh et al. (2012) about the influence of enabling circumstances on technological intention. The outcomes corroborate earlier research, including that of Kumar et al. (2017), which found that behavioral intention to embrace mobile games is influenced by conducive settings. Furthermore, Baabdullah (2018) discovered that users' intentions to use mobile social network games in Saudi Arabia are positively influenced by facilitating conditions. Ultimately, Erdoğan (2023) discovered that favorable circumstances help Turkish mobile game players achieve their goals. Jiang, Peng, and Liu (2015) discovered that favorable attitudes on mobile games in China are influenced by enabling conditions. Players need to be familiar with the rules of the game in order to play the Awale mobile board game.

This study corroborates the findings of Baabdullah (2018) and Erdoğan (2023) on the importance of requisite skills, compatibility, availability of resources, and necessary assistance as measures of facilitating conditions for engaging with mobile games. The significant relationship between facilitating condition and behavioural intention in this study however deviates from the findings of Ofosu-Ampong, et al. (2019) on students' perceptions and readiness to use gamification in learning management systems (LMS) in Ghana. They found that facilitating condition has no significant effect on intention to use gamification.

Hypothesis 5, the hypothesised relationship between hedonic motivation and behavioural intention, is supported by the data ($\beta = 0.248$, $t = 4.181$, $p < 0.05$). The positive relationship between behavioural intention and hedonic motivation indicates that respondents intend to play the Awale board game for pleasure, fun, and enjoyment. According to Baabdullah (2018), mobile games are adopted to satisfy harmonic purposes rather than instrumental values. This

implies that if users find Awale interesting, entertaining, and enjoyable, they will engage more with it. This finding is consistent with reports from Baabdullah (2018) and Erdoğan (2023).

The analysis of the hypothetical relation between price value and behavioural intention produced a significant result. The coefficient estimate was 0.129, *t*-value of 1.974, and *p*-value of < 1.0 . This confirms that Hypothesis 6 is supported. It implies that price is a motivating factor for respondents to engage with the Awale board game. Offering Awale as a free download can increase motivation for gamers intending to play the game. This finding supports previous studies on the power of price value as an influencing factor of behavioural intention in mobile games (Baabdullah 2018; Erdoğan 2023).

As proposed by Venkatesh et al. (2012), this study also found support for the hypothesised relationship between price value and use behaviour with a path coefficient estimate of 0.306, *t*-value of 3.345, and *p*-value of < 0.005 . This demonstrates that price is an important factor in determining usage of the Awale mobile game app. Respondents will continue to engage with the game if it is affordable or available for free. This finding is consistent with previous research that asserts that price is inversely proportional to behavioural use, meaning that as the price value decreases, behavioural use increases (Goto and Munyai 2022; Venkatesh et al. 2012).

Hypothesis 7 states that habit has a positive influence on the behavioural intention to the play Awale mobile board game. This hypothesis was supported with a coefficient estimate of 0.200, *t*-value of 2.396, and *p*-value of < 0.05 . If individuals find that they are naturally good at playing the Awale mobile game, they are more likely to choose to play a mobile game. Habits play a significant role in enhancing one's intention to play the Awale mobile board game. Thus, when playing the Awale game has become a habit, it will result in the creation of intention. Studies that support this result include Erdoğan (2023), Ramírez-Correa et al. (2019), and Yein and Pal (2021). Habit also had a statistically significant effect on behavioural use. This finding is consistent with prior research (Ramírez-Correa et al. 2019). However, many existing studies that employed UTAUT2 did not investigate this relationship. This suggests that habit is an important factor in the adoption and use of the Awale mobile board game, although it is popular among indigenous Africans.

The study found that behavioural intention had a statistically significant effect on behaviour. This supports Hypothesis 11 with a coefficient estimate of 0.605, *t*-value of 10.925, and *p*-value of 0.000. This is consistent with prior studies that have shown behavioural intention to be a significant predictor of usage behaviour (Erdoğan 2023; Ramírez-Correa et al. 2019).

Statistically non-significant paths

There was no statistically significant relationship between performance expectancy and behavioural intention. This finding contradicts popular findings in online and mobile gaming contexts mentioned in the literature review (Azizah et al. 2023; Baabdullah 2018; Erdoğan 2023; Mulhem and Almaiah 2021; Yein and Pal 2021). This finding is consistent with the findings of Ramírez-Correa et al. (2019), who found that performance expectations are not significant predictors of the behavioural intention to accept online games on mobile devices in Spain. * Goto and Munyai (2022) discovered no noteworthy correlation between behavioral intention and performance expectancy in university students enrolled in an online learning environment. Furthermore, there was no statistically significant difference between effort expectancy and behavioral intention. This result is in line with Kumar et al. (2017) and Ramírez-Correa et al. (2019), even though it conflicts with a number of previous evaluations of online and mobile game literature (Baabdullah 2018; Erdoğan 2023; Mulhem and Almaiah 2021; Yein and Pal 2021). The respondents' extensive technological familiarity explains why performance expectancy and effort expectancy have no bearing.

Within African context, previous studies such as Ofosu-Ampong et al. (2019) found support for significant relationship between performance expectancy, effort expectancy and behavioural intention to use gamification in learning management systems (LMS) using a sample of Ghanaian students. Similarly, Adukaite et al (2017) investigated the extent to which perceptions about playfulness, curriculum fit, learning opportunities, challenge, self-efficacy and computer anxiety) influenced acceptance of gamified application by South African tourism teachers. They found that perceived playfulness and perceived curriculum fit of gamified application significantly influence behavioural intention. Chinomona (2013) in an investigation on the use of mobile gaming continuance in South Africa also found that perceived ease of use and perceived enjoyment have both direct significant influence and indirect significant influence when mediated with attitude on mobile game continuance intention. These studies are however not focused on a specific mobile game application as in the case of this current study so the difference in finding is not surprising though the geographic context is similar.

Facilitating conditions did not have a statistically significant effect on behavioural use as proposed by Venkatesh et al. (2012). Few authors have investigated this relationship. The results of this study are in line with those of Ramírez-Correa et al. (2019), who discovered a statistically non-significant correlation between enabling conditions and behavioral use of mobile games. This is not unexpected considering the shaky correlation between behavioral

desire to use and conducive conditions; their hypothesised relationship was supported at $p < 0.1$, indicating a weak relationship. Skills, knowledge, and access to technical support may be motivating factors for engaging with games such as Awale, which has strict rules but does not result in continued usage. Since the respondents are digital natives and experienced with technology, other facilitating conditions, such as the use of a connected mobile device, are quite easy to obtain.

CONCLUSION AND LIMITATIONS

This research employed UTAUT2 to investigate the factors that limit the adoption of the Awale board game as a tool for promoting gamification. UTAUT2 has been used by several researchers to investigate mobile games before but not with the Awale mobile game. The findings of this study provided valuable insights into the factors that influence the intention and actual use of Awale mobile games for learning. These factors which were significant included price value, habit, social influence, facilitating conditions, hedonic motivation. The findings can assist game developers in understanding strategies to enhance users' experience, adoption, and usage of the game. The limitations of this research is data was only collected from one university, and further research will incorporate other universities, as well as investigate the utilization on non-digital board games within the learning space. The technology usage of the study participants shown in Table 1 showed that most of the participant are comfortable or expert in various mobile technology usage. Also, all the participant possesses at least a form of mobile device at the time of investigation and have access to the internet which is provided by the school. The study however, did not capture the amount of time the participant have to engage in online games and the institutional policy of engaging in such application thought the institutional network. Future study in this domain can investigate policy gaps that might impact the adoption of mobile gamification in the region.

RECOMMENDATIONS

The article suggests there is a need for partnership between game developers and universities to help provide in-depth understanding of how these factors influence the utilization of games to improve the learning experience of Students.

The article further recommends the provision of training for faculty on game-based learning, the importance of this is learning is going digital and these is a need to utilize game-based learning as a tool to keep students engaged.

REFERENCES

- Abayomi, Randle Oluwarotimi. 2012. "An efficient hybrid algorithm to evolve an Awale player." In *Proceedings of the Second International Conference on Computational Science, Engineering and Information Technology*, October 2012, 434–438. <https://doi.org/10.1145/2393216.2393289>.
- Abayomi, Randle Oluwarotimi, Oludayo O. Olugbara, and Lall Manosh. 2013. "An Overview of Supervised Machine Learning Techniques in Evolving Mancala Game Player." In *Conference of the 2nd International Conference on Computer Science and Electronics Engineering (ICCSEE 2013)*, March 2013, 978–983. Atlantis Press. <https://doi.org/10.2991/iccsee.2013.246>.
- Abbad, Muneer M.M. 2021. "Using the UTAUT Model to Understand Students' Usage of E-Learning Systems in Developing Countries." *Education and Information Technologies* 26(6): 7205–7224.
- Adukaite, Asta, Izak van Zyl, Şebnem Er, and Lorenzo Cantoni. 2017. "Teacher Perceptions on the Use of Digital Gamified Learning in Tourism Education: The Case of South African Secondary Schools." *Computers & Education* 111(August): 172–190. <https://doi.org/10.1016/j.compedu.2017.04.008>.
- Agbinya, Johnson Ihieh. 2004. *Computer Board Games of Africa: Algorithms, Strategies & Rules*. Belville: Department of Computer Science, University of the Western Cape.
- Almaiah, Mohammed Amin, and Yacoub Nasereddin. 2020. "Factors Influencing the Adoption of E-Government Services Among Jordanian Citizens." *Electronic Government* 16(3): 236–259. <https://doi.org/10.1504/EG.2020.108453>.
- Anwar, Waseem, Amir Zaib Abbasi, Mousa Albashrawi, Ghazanfar Ali Abbasi, and Umm-e-Habiba. 2024. "Asymmetric and Symmetric Approaches to the Extension of UTAUT2 in the M-Payment Adoption of Pakistani Apps." *Journal of Financial Services Marketing* 1–19. <https://doi.org/10.1057/s41264-024-00266-8>.
- Azizah, Amiril, Anninda Kintani, Rizky Septia Eka Putri, Fajrina Z. Ardli, Rif'ah Rif'ah, and Amelia Dwisafira. 2023. "Investigating the Influence of Enjoyment, Convenience, Trust, and Social Influence on Perceived Usefulness and Intention to Use Among Mobile Game Users." *Enrichment: Journal of Multidisciplinary Research and Development* 1(5): 225–232. <https://doi.org/10.55324/enrichment.V1i5.43>.
- Baabdullah, Abdullah Mohammed. 2018. "Consumer Adoption of Mobile Social Network Games (M-SNGs) in Saudi Arabia: The Role of Social Influence, Hedonic Motivation and Trust." *Technology in Society* 53: 91–102. <https://doi.org/10.1016/j.techsoc.2018.01.004>.
- Baabdullah, A. M. (2020). Factors influencing adoption of mobile social network games (M-SNGs): The role of awareness. *Information Systems Frontiers*, 22(2), 411–427.
- Bayeck, Rebecca Yvonne. 2018. "A Review of Five African Board Games: Is There Any Educational Potential?" *Cambridge Journal of Education* 48(5): 533–552. <https://doi.org/10.1080/0305764X.2017.1371671>
- Bhatnagr, Puneett, and Anupama Rajesh. 2023. "Neobanking Adoption: An integrated UTAUT-3, Perceived Risk and Recommendation Model." *South Asian Journal of Marketing* (Ahead of Print). <https://doi.org/10.1108/SAJM-06-2022-0040>.
- Cao, Jianfei, Karin Kurata, Yeongjoo Lim, Shintaro Sengoku, and Kota Kodama. 2022. "Social Acceptance of Mobile Health Among Young Adults in Japan: An Extension of the UTAUT Model." *International Journal of Environmental Research and Public Health* 19(22): article 15156. <https://doi.org/10.3390/ijerph192215156>.
- Caponetto, Ilaria, Jeffrey Earp, and Michela Ott. 2014. "Gamification and Education: A Literature Review." In *European Conference on Games Based Learning* 1, October, 50. Academic Conferences International Limited.
- Chakraborty, Rudrasis C. 2010. *Game Playing: Artificial Intelligence* (Lecture Notes, June 1, 2010).

- Chen, E.T., 2015. The gamification as a resourceful tool to improve work performance. *Gamification in education and business*, pp.473–488.
- Chinomona, R. 2013. Mobile gaming perceived enjoyment and ease of play as predictors of student attitude and mobile gaming continuance intention. *Mediterranean Journal of Social Sciences*, 4(14), 237–247.
- Dijkstra, Theo K., and Jörg Henseler. 2015. “Consistent Partial Least Squares Path Modeling.” *MIS Quarterly* 39(2): 297–316.
- Domínguez, Adrián, Joseba Saenz-de-Navarrete, Luis de-Marcos, Luis Fernández-Sanz, Carmen Pagés, and José-Javier Martínez-Herráiz. 2013. “Gamifying Learning Experiences: Practical Implications and Outcomes.” *Computers & Education* 63(April): 380–392. <https://doi.org/10.1016/j.compedu.2012.12.020>.
- Dong, Lingfeng, Jinghui (Jove) Hou, Liqiang Huang, Yuan Liu, and Jie Zhang. 2024. “Impacts of Normative and Hedonic Motivations on Continuous Knowledge Contribution in Virtual Community: The Moderating Effect of Past Contribution Experience.” *Information Technology & People* 37(1): 502–520. <https://doi.org/10.1108/ITP-07-2022-0529>.
- Donkers, Jeroen, Jos W.H.M Uiterwijk, and Alex de Voogt. 2002. “Mancala Games: Topics in Artificial Intelligence and Mathematics.” In J. Retschitzki and R. Haddad-Zubel (Eds.), *Proceedings of the 4th Colloquium ‘Board Games in Academia’*, 1 January 2002, Fribourg, Switzerland, 133–146. Editions Universitaires.
- Du, Wenbin, and Ruo-yan Liang. 2024. “Teachers’ Continued VR Technology Usage Intention: An Application of the UTAUT2 Model.” *SAGE Open* 14(1): article 21582440231220112. <https://doi.org/10.1177/21582440231220112>.
- Edo, Onome C., David Ang, Egbe Emmanue Etu, Imokhai Theophilus Tenebe, Solomon O. Edo, and Oladapo A. Diekola. 2023. “Why do Healthcare Workers Adopt Digital Health Technologies: A Cross-Sectional Study Integrating the TAM and UTAUT Model in a Developing Economy.” *International Journal of Information Management Data Insights* 3(2): article 100186. <https://doi.org/10.1016/j.ijime.2023.100186>.
- Erdoğan, Görkem. 2023. “Determinants of Adoption of Mobile Games: Extending UTAUT2 with Trust and Reward.” *Uludağ Üniversitesi Fen-Edebiyat Fakültesi Sosyal Bilimler Dergisi* 24(45): 505–520. <https://dx.doi.org/10.21550/sosbilder.1248688>.
- Geyser, Hanli., 2016. Towards Diversity: Interventions in Curriculum and Pedagogy of an Introductory Game Design Course. Digital Games Research Conference 2016, pp1–3
- Goto, Jameson, and Anzanilufuno Munyai. 2022. “The Acceptance and Use of Online Learning by Law Students in a South African University: An Application of the UTAUT2 Model.” *The African Journal of Information System* 14(1): article 3.
- Hair Jr, Joe F., Marko Sarstedt, Lucas Hopkins, and Volker G. Kuppelwieser. 2014. “Partial Least Squares Structural Equation Modeling (PLS-SEM): An Emerging Tool in Business Research.” *European Business Review* 26(2): 106–121. <https://doi.org/10.1108/EBR-10-2013-0128>.
- Hair, Joe F., G. Tomas M. Hult, Christian M. Ringle, and Marko Sarstedt. 2022. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, 3rd ed. Thousand Oaks, CA: Sage.
- Hoque, Rakibul, and Golam Sorwar. 2017. “Understanding Factors Influencing the Adoption of mHealth by the Elderly: An Extension of the UTAUT Model.” *International Journal of Medical Informatics* 101 (May): 75–84. <https://doi.org/10.1016/j.ijmedinf.2017.02.002>.
- Huotari, Kai, and Juho Hamari. 2012. “Defining Gamification: A Service Marketing Perspective.” In *Proceedings of the 16th International Academic MindTrek Conference*, October 2012, 17–22. ACM. <https://doi.org/10.1145/2393132.2393137>.
- Jiang, Guoyin, Ling Peng, and Ruoxi Liu. 2015. “Research on the Factors Influencing Mobile Game Adoption in China.” In *LISS 2014: Proceedings of 4th International Conference on Logistics, Informatics and Service Science* 1297–1302. Berlin Heidelberg: Springer.

- Joa, Claire Y., and Kate Magsamen-Conrad. 2022. "Social Influence and UTAUT in Predicting Digital Immigrants' Technology Use." *Behaviour and Information Technology* 41(8): 1620–1638. <https://doi.org/10.1080/0144929X.2021.1892192>.
- Joshi, R. 2024. "A Mixed Methods UTAUT2-Based Approach to Understanding Unified Payments Interface Adoption Among Low-Income Users." *Banks and Bank Systems* 19(1): 57–73. [http://dx.doi.org/10.21511/bbs.19\(1\).2024.06](http://dx.doi.org/10.21511/bbs.19(1).2024.06).
- Khechine, Hager, Benoit Raymond, and Marc Augier. 2020. "The Adoption of a Social Learning System: Intrinsic Value in the UTAUT Model." *British Journal of Educational Technology* 51(6): 2306–2325. <https://doi.org/10.1111/bjet.12905>.
- Kijsanayotin, B., Pannarunothai, S., and Speedie, S. M. 2009. Factors influencing health information technology adoption in Thailand's community health centers: Applying the UTAUT model. *International journal of medical informatics*, 78(6), 404–416.
- Kumar, K. Anil, Subhashree Natarajan, and Biswajit Acharjya. 2017. "Understanding Behavioural Intention for Adoption of Mobile Games." *ABSM Journal of Management* X(1): 5–18.
- Luo, Zhanni. 2022. "Gamification for Educational Purposes: What are the Factors Contributing to Varied Effectiveness?" *Education and Information Technologies* 27(1): 891–915. <https://doi.org/10.1007/s10639-021-10642-9>.
- Muchran, Muchriana, Nurul S. Khairudin, Ainun Arizah, Wa Ode Rayyani, Zalkha Soraya, and Anggriana Irwan. 2024. "Integration of the UTAUT 2 Model and Awareness of Cybercrime as the Moderating Variable of Cashless Adoption in Indonesia." *Review of Integrative Business and Economics Research* 13(3): 304–321.
- Mujalli, Abdulwahab, Tehmina Khan, and Ahmed Almgrashi. 2022. "University Accounting Students and Faculty Members using the Blackboard Platform during COVID-19; Proposed Modification of the UTAUT model and an Empirical Study." *Sustainability* 14(4): article 2360. <https://doi.org/10.3390/su14042360>.
- Mulhem, Ahmed. A., and Mohammed A. Almaiah. 2021. "A Conceptual Model to Investigate the Role of Mobile Game Applications in Education During the COVID-19 Pandemic." *Electronics* 10(17): article 2106. <https://doi.org/10.3390/electronics10172106>.
- Muna, Nalal, I. Made Sukresna, and Nilna Muna. 2024. "Post-Adoption Model of Mobile Payment in Indonesia: Integration of UTAUT2 and the Dedication-Constraint Perspective." *International Journal of Data and Network Science* 8(2): 967–976. <https://doi.org/10.5267/j.ijdns.2023.12.010>.
- Nordhoff, Sina, Tyron Louw, Satu Innamaa, Esko Lehtonen, Anja Beuster, Guilhermina Torrao, Afsaneh Bjorvatn, Tanja Kessel, Fanny Malin, Riender Happee, and Natasha Merat. 2020. "Using the UTAUT2 Model to Explain Public Acceptance of Conditionally Automated (L3) Cars: A Questionnaire Study Among 9,118 Car Drivers from Eight European Countries." *Transportation Research Part F: Traffic Psychology and Behaviour* 74: 280–297. <https://doi.org/10.1016/j.trf.2020.07.015>.
- Ofosu-Ampong, K., R. Boateng, T. Anning-Dorson, and E. A. Kolog. 2020. Are we ready for Gamification? An exploratory analysis in a developing country. *Education and Information Technologies*, 25(3), 1723–1742.
- Oluwatobi, A. Ayilara, Ajayi Anuoluwapo, and Jimoh Kudirat. 2016. "A Synthetic Player for Ayò Board Game Using Alpha-Beta Search and Learning Vector Quantization." *Computer and Information Science* 9(3). <https://doi.org/10.5539/cis.v9n3p1>.
- Palos-Sanchez, Pedro R., Jose Ramon Saura, and Félix Velicia-Martín. 2024. "A Case Study on a Hedonic-Motivation System Adoption Model in a Game-Based Student Response System." *International Journal of Human-Computer Interaction* 40(3): 701–718. <https://doi.org/10.1080/10447318.2022.2121801>.

- Persada, Satria Fadil, Bobby A. Miraja, and Reny Nadlifatin. 2019. "Understanding the Generation Z Behavior on D-Learning: A Unified Theory of Acceptance and Use of Technology (UTAUT) Approach." *International Journal of Emerging Technologies in Learning* 14(5): 20–33. <https://doi.org/10.3991/ijet.v14i05.9993>.
- Philippi, Paula, Harald Baumeister, Jennifer Apolinário-Hagen, David D. Ebert, Severin Hennemann, Leonie Kott, Jiaxi Lin, Eva-Maria Messner, and Yannik Terhorst. 2021. "Acceptance Towards Digital Health Interventions—Model Validation and Further Development of the Unified Theory of Acceptance and Use of Technology." *Internet Interventions* 26(December): article 100459. <https://doi.org/10.1016/j.invent.2021.100459>.
- Ramírez-Correa, Patricio, Francisco J. Rondán-Cataluña, Jorge Arenas-Gaitán, and Félix Martín-Velicia. 2019. "Analysing the acceptance of online games in mobile devices: An application of UTAUT2." *Journal of Retailing and Consumer Services* 50(September): 85–93. <https://doi.org/10.1016/j.jretconser.2019.04.018>.
- Ramírez-Correa, P., Rondán-Cataluña, F. J., Arenas-Gaitán, J., and Martín-Velicia, F. (2019). Analysing the acceptance of online games in mobile devices: An application of UTAUT2. *Journal of Retailing and Consumer Services*, 50, 85–93.
- Randle, Oluwarotimi A., Alfred Coleman, and Ray Kekwaletswe. 2017. "Empirical Investigation on the Influence of Organizational Systems Mechanisms (OSM) on Employees Motivation to Effectively Use Human Resource Information Systems: A Case of South African Universities." In *2017 International Conference on Advances in Computing, Communications and Informatics (ICACCI)*, 13–16 September, Udipi, India, 1745–1750. IEEE. <https://doi.org/10.1109/ICACCI.2017.8126096>.
- Randle, Oluwarotimi A., Oluwagbenga O. Ogunduyile, Tranos Zuva, and N.A. Fashola. 2013. "A Comparison of the Performance of Supervised and Unsupervised Machine Learning Techniques in Evolving Awale/Mancala/Ayo Game Player." *International Journal of Game Theory and Technology* 1(June): 9–18.
- Roldán, José L. and Manuel J. Sánchez-Franco. 2012. "Variance-Based Structural Equation Modeling: Guidelines for Using Partial Least Squares in Information Systems Research." In Manuel Mora et al. (Eds.), *Research Methodologies, Innovations and Philosophies in Software Systems Engineering and Information Systems*, 193–221. Hershey, PA: IGI Global. <https://doi.org/10.4018/978-1-4666-0179-6.ch010>.
- Urbach, N., & Ahlemann, F. (2010). Structural equation modeling in information systems research using partial least squares. *Journal of Information Technology Theory and Application (JITTA)*, 11(2), 2.
- Venkatesh, V., Morris, M. G., Davis, G. B., and Davis, F. D. 2003. User acceptance of information technology: Toward a unified view. *MIS quarterly*, 425–478.
- Venkatesh, Viswanath, Michael G. Morris, Gordon B. Davis, and Fred D. Davis. 2003 "User acceptance of information technology: Toward a unified view." *MIS quarterly* 425–478.
- Venkatesh, Viswanath, James Y. Thong, and Xin Xu. 2012. "Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology." *MIS Quarterly* 36(March): 157–178. <https://doi.org/10.2307/41410412>.
- Vidal-Silva, Cristian, Aurora Sánchez-Ortiz, Jorge Serrano-Malebrán, Vanessa Arriagada, Moisés Flores, Mónica Godoy, and Cristopher Vargas. 2024. "Social Influence, Performance Expectancy, and Price Value as Determinants of Telemedicine Services Acceptance in Chile." *Heliyon* 10(5): article e27067. <https://doi.org/10.1016/j.heliyon.2024.e27067>.
- Yein, Nilakshi and Swati Pal. 2021. "Analysis of the User Acceptance of Exergaming (Fall-Preventive Measure): Tailored for Indian Elderly Using Unified Theory of Acceptance and Use of Technology (UTAUT2) Model." *Entertainment Computing* 38(May): article 100419. <https://doi.org/10.1016/j.entcom.2021.100419>.