International Journal of Serious Games

ISSN: 2384-8766
https://journal.seriousgamessociety.org/

Article

Relationship Investigation between Time Investment and Language Learning Based on Digital Games

Liqaa Habeb Al-Obaydi,[1] Marcel Pikhart,[2] Ragad M Tawafak,[3,4] and Blanka Klimova[5]

[1]English Department, College of Education for Human Sciences, University of Diyala, Diyala, Iraq; [2]Centre for Basic and Applied Research, Faculty of Informatics and Management, University of Hradec Kralove, Czech Republic; [3]Department of Information Technology, AlBuraimi University, Oman; [4]College of Education, Al-Bayan University, Baghdad, Iraq; [5]Department of Applied Linguistics, Faculty of Informatics and Management, University of Hradec Kralove, Czech Republic
liqaa.en.hum@uodiyala.edu.iq; marcel.pikhart@uhk.cz; raghad@buc.edu.om; raghad.m@albayan.edu.iq; blanka.klimova@uhk.cz

Keywords:

Digital gaming
Language learning
Time factor
Technology acceptance model

Received: July 2024
Accepted: January 2025
Published: February 2025
DOI: 10.17083/ijsg.v12i1.845

Abstract

As the use of digital games in foreign language learning has increased, there is a demand for investigations that would offer a window into contemporary breakthroughs in this growingly prominent field of foreign language learning. A plethora of research papers have dealt with the effects of digital gaming on language skills, such as vocabulary and speaking. However, to date, there is a scarcity of studies that examine how the amount of time spent on digital games influences the development of a second language. Thus, the present study attempts to determine if there is any correlation between the amount of time spent on digital games (non-instructional games) and second language development. It also attempts to verify whether there is any effect of games played on their attitudes toward digital gaming as a type of informal digital language learning. The methodology used is quantitative using the Technology Acceptance Model (TAM). The sample consisted of 350 college students from Iraq and the Czech Republic who all study English as a foreign language. The findings reveal a weak correlation between the digital games played, which means there is no impact between the time of playing and TAM factors. It further reveals that the most engaging and popular game among students was PUBG and that students' attitudes are affected positively depending on the game they played. Finally, the findings clarified that TAM factors can be positively affected by language skill development through the use of digital games in learning.

1. Introduction

Learning is an integral part of the daily life of any student, including foreign language students. Through employing a technique called micro-learning, even learners with busy schedules can study for a short period each day. Micro-learning divides a challenging activity into a number of brief learning exchanges that are spaced across time. Many of these learning activities are carried out on PCs, tablets, or mobile devices as they are present everywhere in our digital societies [1]; [2]; [3]; [4]; [5]; [6]. These activities can be modified to aid in language learning through language exposure, which is any activity that reinforces what the learners have already learned but is not specifically intended to be educational. It gives the chance to practice a language in leisure time to mix learning with enjoyment [7]; [8], and to put a hand on time spent as one of the language learning predictors as mentioned by [9], (p. 127) who claims that "speed, enjoyment, and comprehension are closely linked with one another". Learners can, for example, read novels, watch movies, listen to the radio, play games, and more to gain high levels of motivation, different types of engagement, and anxiety free mood via online applications [10]; [11], in addition to work collaboratively via games [12].

This research focuses on the impact of digital gaming on second language acquisition among university students. Digital gaming on mobile devices, especially smartphones, has become increasingly popular, providing players with opportunities to play games at various times and places [8]; [13]; [14]; [15]. Non-instructional digital gaming is a favoured activity among young learners today [9], [12], with cooperative games being particularly popular [8] [16]. Players often select their games for extramural activities, enhancing enjoyment [5];[17];[18]; [19]. Investigating the relationship between gameplay duration and language acquisition is essential for two reasons. Firstly, understanding how digital gaming impacts language learning, especially among university students, is crucial for advancing knowledge in this field. Secondly, these investigations can inform educational practices and optimize the use of digital games in language acquisition.

Digital games are not permitted in school time as they are often regarded as addictive and non-educational [20]. Second language (L2) digital gaming therefore frequently occurs beyond the context of language classrooms [21]; [22], which could also promote critical pedagogy aspects [23]. Research has yet to demonstrate how players deliberately plan their L2 gaming and learning activities over time, despite the growing interest in out-of-class L2 gaming research. The web of connected, unconnected, and interconnected activities that students typically engage in represents a challenge when examining learning in outside language classrooms. Using a paradigm of Location, Formality, Pedagogy, and Locus of control to assess L2 gaming, [24] stated that L2 gaming can be seen as "naturalistic computer-assisted language learning" and they claimed that "computer-based activities that are carried out on the student's initiative, outside school, and mainly for the purpose of pursuing some interest through a foreign language, rather than for the direct purpose of learning the language" (p. 5).

In multiplayer games, strong language skills can improve teamwork and strategy, leading to better performance [8]. On the contrary, game playing can also have a certain positive impact on language skill development. For example, digital games that involve reading and comprehending text, such as adventure or role-playing games, can subsequently improve reading comprehension and vocabulary. This was, for instance, confirmed by [25], who reported that games were effective and beneficial for teaching vocabulary in reading comprehension. In addition, playing games that involve communication and negotiation, such as strategy games, can improve speaking and writing skills. However, it is important to note that playing games alone may not be sufficient for significant language skill development, and should be combined with other language learning activities and practices [26]. Therefore, it cannot be postulated that playing

games in a foreign language can be a standalone tool to develop language skills, but it can in reality be only an auxiliary tool that the users find useful and enjoyable in their everyday entertainment activities.

Based on that, the present study intends to examine the correlation between time spent by the players of digital games and their language development. The importance of the present study stems from the idea that the exaggeration of playing digital games could lead to addiction which in turn will affect students' behaviour badly and could lead to distorted learning habits. On the other hand, it tries to show whether increasing the amount of time playing digital games will affect students' language development drawing on [27] conclusion that varying the activities is much more effective than spending extra time. In addition, it intends to see whether students' attitudes are affected indirectly by the time spent and the digital games played for language development. It further asks whether (TAM) factors are affected positively by language skills development through the use of digital games in learning. Examining these two distinct contexts, Iraq and the Czech Republic indicates that the sociocultural and socio-educational environments of the two countries may influence how EFL learners engage in extracurricular activities such as gaming, which may then have an impact on how they develop their L2 English. The selection was done to create a sample that is geographically and culturally diverse, thereby enhancing the generalizability and applicability of the study findings specifically with the use of technological applications, as advised by [28], while acknowledging that these two countries cannot fully represent the entirety of their respective regions [29]. Additionally, the method of random sampling that is used guarantees a level of representativeness within each selected setting, which allows the researchers to make significant inferences about the larger population from which the participants were selected. Therefore, by including both Europe and Asia, the study seeks to offer a comprehensive picture of the phenomenon being studied in the context of the world.

1.1 Research Questions

Based on the discussion above, the following research questions have been raised:

1. Is there a relationship between the time spent by English as a Foreign Language (EFL) college student playing digital games and their language development (perceived usefulness)?
2. Are the students' attitudes toward digital gaming as a type of informal digital language learning affected indirectly by the digital games played for language development (perceived ease of use)?
3. Which is the most engaging and popular digital game that is supposed to affect the participants' language development positively?
4. Are TAM factors, perceived usefulness and perceived ease of use, affected positively by language skills development through the use of digital games in learning?

1.2 Research Hypotheses

This model proposes ten hypotheses as follows:

1. Hypothesis 1 (H1): There is a positive relationship between the amount of time invested in digital gaming and the perceived usefulness (PU) of language learning through digital games.
2. Hypothesis 2 (H2): There is a positive relationship between the amount of time invested in digital gaming and the perceived ease of use (PEOU) of language learning through digital games.

3. Hypothesis 3 (H3): Greater time investment in language learning through digital games leads to higher development of language skills, which in turn positively affects perceived usefulness (PU).
4. Hypothesis 4 (H4): Greater time investment in language learning through digital games leads to higher development of language skills, which in turn positively affects perceived ease of use (PEOU).
5. Hypothesis 5 (H5): The use of digital games for language learning positively influences perceived usefulness (PU).
6. Hypothesis 6 (H6): The use of digital games for language learning positively influences perceived ease of use (PEOU).
7. Hypothesis 7 (H7): Perceived usefulness (PU) of language learning through digital games positively influences students' attitudes towards using digital games for language learning.
8. Hypothesis 8 (H8): Perceived Ease of Use (PEOU) of language learning through digital games positively influences Perceived usefulness (PU) towards using digital games for language learning.
9. Hypothesis 9 (H9): Perceived ease of use (PEOU) of language learning through digital games positively influences students' attitudes towards using digital games for language learning.
10. Hypothesis 10 (H10): Students' positive attitudes towards using digital games for language learning positively influence their behavioural intention to continue using digital games for this purpose.
11. Hypothesis 11 (H11): Students' behavioural intention to use digital games for language learning positively influences their actual system use of digital games for language learning.

These hypotheses collectively examine the intricate relationships between time investment, perceived usefulness, perceived ease of use, language skill development, digital gaming, student attitudes, behavioural intentions, and actual system use in the context of language learning through digital games.

2. Literature review

Both positive and negative outcomes from prior research have been linked to the amount of time spent playing digital games. Numerous research studies have demonstrated a positive correlation between the amount of time spent playing digital games and the motivation and involvement of learners [30]. Playing games offers a fun and engaging learning environment that promotes frequent exposure to linguistic material. A closer look at [31] studies, however, shows that the key predictor of Korean learners' performance in productive vocabulary exams is diversity (a mix of form- and meaning-focused activities), not frequency (length of time) of extracurricular activities. [21] believe that games' immersive qualities might bolster intrinsic motivation, ultimately resulting in increased language practice and performance. According to [32], players can pick up new terminology through context-rich interactions in the game environment, leading to incidental learning chances with digital games. [25] also discovered a beneficial relationship between learners' vocabulary retention and the amount of time they spend playing English-language games. Frequent exposure to in-game language content has been linked to improved speaking, listening, and reading skills, according to previous studies [33]; [5]; [34]. Playing for longer periods of time may also have positive cognitive effects on language acquisition. Action-

oriented games may help with attention, memory, and multitasking, according to other research [35].

Even though spending time playing digital games can help with language acquisition, spending a great deal of time gaming can cause problems with time management and other downsides. Excessive gaming can take time away from formal language learning activities, which could negatively impact academic achievement, as noted by the literature [36]; [37]. [17] also focus on the negative impact of playing digital games on the well-being of young players. Since not all digital games are created with language learning objectives in mind, questions have also been raised concerning the caliber of language input offered by some of them [38].

While vocabulary acquisition, among other aspects of language development, has garnered significant attention in recent decades within the context of digital gaming [13];[17]; [19]; [31];[39]; [40];[41], the relationship between time spent on gaming and language proficiency in L2 contexts remains underexplored or explored to a limited extent. Although [17] documented the time allocation of each participant; the precise effects of gaming duration on the language learning process remain unclear. Digital games for language learners that aren't instructional (e.g. PUBG) frequently have components that make learning interesting and fun [42]. In order to promote interaction in the target language, these games usually incorporate gamification, simulation, and immersive experiences. They offer an enjoyable and inspiring setting where students may play games to hone their language skills, frequently without even realizing they are learning [42]. Furthermore, these games can facilitate social engagement by allowing students to converse with other players in the target language and contextual learning by allowing them to utilize the language in authentic situations [43].

From the above research, we can conclude that no study to date has confirmed the importance of time and whether using electronic games for specific periods may affect the learning and development of the English language. Therefore, further investigation is required to map such correlations. Consequently, this study endeavours to address this gap by examining the impact of learners' out-of-class gaming habits on their language skills.

2.1 Technology Acceptance Model

This study uses [44] and [45] Technology Adoption Model (TAM), a prominent figure in the field of information management, to conceptually support the measuring of EFL learners' adoption of informal digital language acquisition via digital games. This study aims at operationalizing college EFL learners' acceptance and adoption of digital games for informal language learning purposes.

TAM has gained recognition over the past thirty years as a significant model that explains people's adoption, rejection, and use of information technologies in the domains of digital sociology, education technology, information management, and CALL [46]; [44]; [47].

There are a lot of theories used for getting validation and acceptance but most of them are used in the business sector and purchase items. Therefore, TAM with its original version considered to be used in this study to highlight the impact of language skills development without spoiling the study objectives to the other factors that are not in the target of the study.

TAM suggests that these two factors are strong predictors of a person's intention to use technology, and ultimately, their actual use of the technology. The model has been widely tested and validated across a variety of technology contexts and has been used to understand and improve technology adoption in organizations and among consumers as well as in the field of foreign language education [48]; [49]; [50]; [51]. The two key factors that influence an individual's adoption and usage of technology include:

1. Perceived Usefulness (PU): Refers to the extent to which a person believes that using a particular technology will increase their job performance or effectiveness. This factor is

influenced by the perceived benefits of using the technology and the perceived value it provides.

2. Perceived Ease of Use (PEOU): Refers to the extent to which a person believes that using a particular technology is easy and requires minimal effort. This factor is influenced by the perceived simplicity and user-friendliness of the technology.

Altogether, PU and PEOU are strong predictors of a person's intention to use technology and their actual usage behaviour. If a person perceives the technology as useful and easy to use, they are more likely to adopt and use it, whereas if they perceive it as difficult to use or not valuable, they are less likely to adopt it [48]; [50]; [52]. Studies on TAM have explored the factors influencing individuals' acceptance and use of technology. These studies have aimed to further understand the relationships between PU, PEOU, and individuals' intentions and actual usage behaviour [48]; [51]; [53]. Overall, the literature review studies related to TAM provide a comprehensive understanding of the factors that influence technology acceptance and usage. These studies have contributed to the development of the TAM model and have helped to guide organizations and businesses seeking to implement new technologies [54].

TAM model used attitude variables and behavioural intention as internal moderators to check whether the perceived ease of use and perceived usefulness are valid and worthy enough to make the model come out with significant support according to its endeavour.

The key variables that impact the acknowledgment of innovation and advanced gameplay in EFL classrooms, agreeing to TAM, incorporating seen ease of utilisation, seen convenience, and demeanours towards innovation [21]. These components can affect the level of innovation integration in EFL classrooms and eventually influence understudy behaviour purposeful towards dialect learning. Exploring the effect of these components on the integration of innovation and computerized gameplay in EFL instruction, this consideration can give a comprehensive understanding of the relationship between EFL and innovation improvement and advise the improvement of more viable and locks in EFL instructive programs [54].

As TAM is tied up with individuals' adoption of certain digital technology/platforms, it should be necessary to make explicit the kind of digital technology this study draws attention to. It is possible to say that this study aims at operationalizing college EFL learners' acceptance and adoption of digital games for informal language learning purposes.

3. Methods and Material

3.1 Instrument

The main instrument of the present study was a survey of five Likert score points. The first part of it was related to the demographic information including age, gender, country, time spent, and the game played. It intends to collect basic information about the participants. The age groups were divided into four categories (18-22, 23-26, 27-30, and above 30), where the highest number of participants belonged to the first category (18-22) with (80.2%), see Table 1. The second part was related to language skills and development which consisted of eleven items, constructed by the researchers depending on the previous literature and the researchers' experience, that intended to measure students' language development as it was perceived and determined by the students themselves. The third part of the survey suggested eight common different games (non-instructional games) that most students like to play, and the highest interesting game was PUBG with 22.9% of participants considering it as their favourite and it was also primarily mentioned as the highest score of a game that helped students to enhance their language skill development

(20.8%). The fourth part was related to students' attitudes and was supposed to measure students' perceptions of using digital games in their daily classes.

After confirming its face validity (exposing the survey to a group of experts from different countries), and reliability (using the test-retest method), the survey was distributed among university undergraduate students in two countries (Iraq and the Czech Republic) by Google Forms, and the link was shared among the participants via social media applications. The researchers in the two countries discussed the idea of the research with the students before applying the survey to them. The researchers listened to the students' suggestions and gained their consent. The process of data collection continued for two weeks.

3.2 Participants

The participants of this study were selected using cluster random sampling, which is a non-probability sampling technique, participants are chosen for the sample based on their ease of availability for the researcher. This may be because they are willing to engage in the study, are available at a certain time, or are geographically close. Accidental sampling is another term for it.

The researchers approach participants based on their accessibility and availability [55]. The total number of respondents who participated and filled out the survey was 350. A sample of (50) random students was used for our pilot study, where the model tested the reliability of Cronbach's Alpha = 0.893. and the survey was validated by sending to experts in English department to check the language and an expert from IT to validate the item used for survey constructions. A total of 234 participants were from Iraq, University of Diyala, while 116 participants were from the Czech Republic, University of Hradec Kralove. They were all EFL college students. Gender distribution was 186 males and 164 females who participated from both countries. The geographical and cultural variety of Iraq and the Czech Republic were carefully taken into account while choosing the study's geographical contexts, with the goal of ensuring a thorough worldwide coverage of the topics being studied. The study encompasses a wide range of socio-cultural backgrounds by focusing on these two unique regions: Europe and Asia. This allows for an understanding of how different cultural and geographical elements may affect the phenomena under investigation. According to the usual time used for play, the maximum number of participants indicated 0-2 hours (67.7%) and it is significantly higher compared to the other mentioned time scales for play. Table 1 below shows the demographic analysis of participants´ information.

Table 1. Demographic information

	Items	Percentage 100%	Which digital games affect your language development?
Total Participants	350	100%	
Age	18-22	80.2%	
	23-26	16.7%	
	27-30	1.0%	
	Above 30	2.1%	
Country	Iraq	66.7% (234)	
	Czech Republic	33.3% (116)	
Gender	Male	53.1% (186)	
	Female	46.9% (164)	
Digital Game Played	Free Fire	9.4%	10.4%
	Minecraft	21.9%	15.6%
	Among Us	12.5%	10.4%
	PUBG	22.9%	20.8%
	Clash Royal	3.1%	3.1%
	Clash of Clans	9.4%	4.2%
	Ludo	12.5%	10.4%
	Fortnite	8.3%	4.2%

	No one of the above games affects my language development	0.0%	20.8%
Time spent per day	0-2 Hours	67.7%	
	3-5 Hours	24%	
	More than 5 Hours	8.3%	

3.3 Research model

The research model was designed by testing the three important factors suggested in this study and derived from the literature review; Game played (GP), Time of play (TP), and Language skills development (LSD). These three factors were tested in a common TAM [51]; [50]. The TAM consists of five major factors Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Student Attitude (STA), Behavioral Intention (BI), and System Use (SU) [49].

All the results used in this study are designed and generated from the distributed survey among 350 undergraduate students. The analysis of the survey values is tested by the PLS-SEM program designed for survey data collection and the program conducts many tests including but not limited to Cranach's Alpha, Reliability, Composite Reliability, Average of Variance Rollability, R-square, and discriminant values. All of these testing points were used to validate the three research questions and the hypotheses used in the research model [46]; [50].

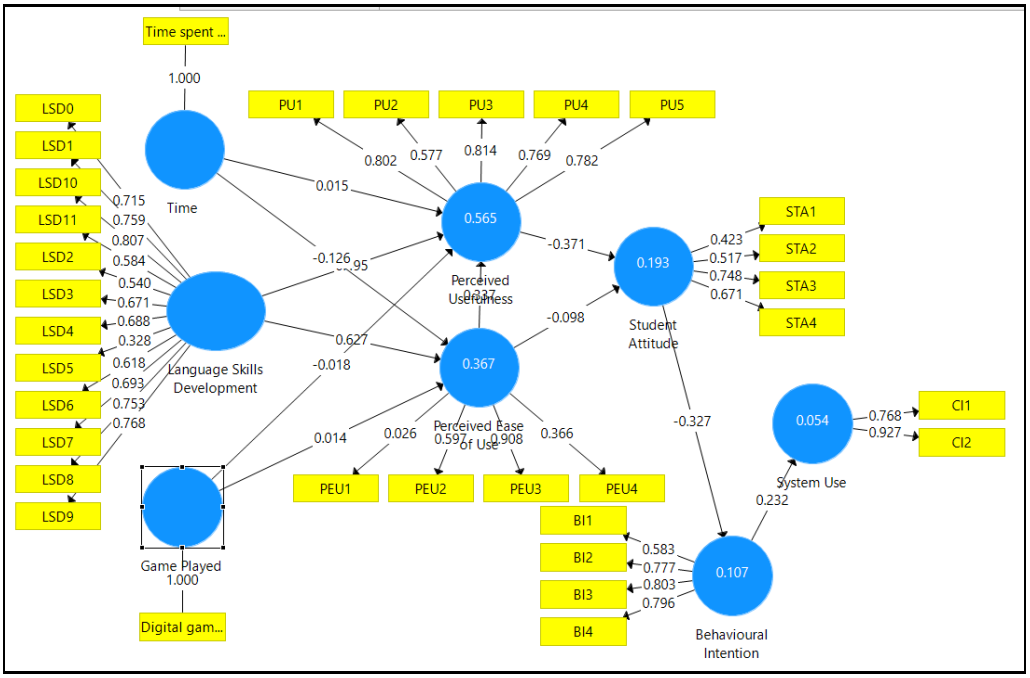

Figure 1. Research Model

The three suggested factors connected to PEOU and PU to check whether this model can approve the research question of student language skill development (according to the operational use of this term in the present study, it means language learning and the development of language skills) when they used game played and its skills development based on the time of plays those students use during the academic year [56].

Table 2 Path Coefficients

	Behavioral Intention	Game Played	Language Skills Develop	Perceived Ease of Use	Perceived Usefulness	Student Attitude	System Use	Time of Play
Behavioral Intention							0.232	
Game Played				0.014	0.018			
Language Skills Development				0.627	0.595			
Perceived Ease of Use			0.627		0.337	0.098		
Perceived Usefulness			0.595			0.371		
Student Attitude	0.327							
System Use								
Time of Play				0.126	0.015			

3.4 Data analysis

PLS-SEM (Partial Least Squares Structural Equation Modeling) is a statistical method used to analyze the relationships between variables in complex systems [57]; [58]. It is a type of structural equation modeling (SEM) that uses partial least squares (PLS) regression instead of the traditional maximum likelihood estimation (MLE) approach used in SEM [57]; [58]. PLS-SEM is commonly used in marketing, management, and information systems to test theories and assess the relationships between multiple dependent and independent variables. It is particularly useful in situations where there is a large number of variables, multicollinearity, or where the relationships between variables are non-linear [57]; [58].

PLS-SEM allows researchers to examine both the direct and indirect effects of variables, as well as the mediating effect of other variables in the model. It also provides information about the goodness of fit of the model, the reliability and validity of the measurement model, and the overall predictive ability of the model. PLS-SEM software, such as SmartPLS, WarpPLS, and AMOS, are widely used by researchers to perform PLS-SEM analyses [26].

An item construct in PLS-SEM (Partial Least Squares Structural Equation Modelling) refers to related items or questions measuring a single underlying concept or construct. In the context of PLS-SEM, constructs are used to represent the variables of interest in the study, such as perceived usefulness (PU) or perceived ease of use (PEOU) in the Technology Acceptance Model (TAM) [46].

The item construct is created by combining multiple items or questions into a single composite score through statistical methods such as factor analysis or principal component analysis. This composite score is then used as a single representative variable in the PLS-SEM analysis [50]. The quality of the item construct is dependent on the quality of the items or questions that make up the construct. The items should be valid, reliable, and have high levels of internal consistency. In PLS-SEM, the item construct is also assessed for measurement equivalence, which refers to the degree to which the items or questions measure the same construct across different groups or populations. Overall, the item construct is an important aspect of PLS-SEM, as it helps to ensure that the variables used in the analysis are valid and reliable measures of the underlying constructs of interest.

4. Results

According to the path coefficient table (see Table 2), the results show a high impact of language skills development on both TAM factors, (PEOU), and perceived usefulness (PU) with 0.627 and 0.595 respectively. However, the time of the played game (TP) had a weak or negative impact on

the two factors of PEOU and PU as 0.126 and -0.015 respectively. Furthermore, the findings reveal a weak correlation between the digital game played (GP) and the same factors of PEOU and PU, which means there is no impact between the time of play and TAM factors at all [26]. Table 3 shows the item loading value for each question used in the survey. The item loading can be accepted if it is more than 0.5, and its significant result and impact when item loading is above 0.7 [57]; [58].

Table 3. Item loadings

	GP	LSD	BI	CI	PEOU	PU	STA	TP
BI1			0.583					
BI2			0.777					
BI3			0.803					
BI4			0.796					
CI				0.768				
CI				0.927				
GP	1.000							
LSD0		0.715						
LSD1		0.759						
LSD2		0.540						
LSD3		0.671						
LSD4		0.688						
LSD5		0.628						
LSD6		0.618						
LSD7		0.693						
LSD8		0.753						
LSD9		0.768						
LSD10		0.807						
LSD11		0.584						
PEOU1					0.026			
PEOU2					0.597			
PEOU3					0.908			
PEOU4					0.366			
PU1						0.802		
PU2						0.577		
PU3						0.814		
PU4						0.769		
PU5						0.782		
STA1							0.423	
STA2							0.517	
STA3							0.748	
STA4							0.671	
TP								1.000

Table 3 shows the item load value of each item question in the survey. The values can be accepted if the item loading is greater than 0.7, while values of less than 0.7 could be considered as not affect the given questions [57]; [58].

Table 4. Discriminant Validity

	BI	GP	LSD	PEOU	PU	STA	SU	TP
BI	0.745							
GP	0.024	1.000						
LSD	0.422	-0.208	0.772					
PEOU	0.446	-0.098	0.593	0.573				
PU	0.530	-0.156	0.402	0.432	0.754			
STA	-0.327	-0.129	-0.295	-0.332	-0.433	0.703		
SU	0.232	-0.142	0.384	0.364	0.266	-0.191	0.851	
TP	0.247	-0.146	0.245	0.025	0.147	-0.200	0.109	1.000

Table 4 shows the discriminant validity of the items used in the model and the strength of the item contrast used in each field. The validity is accepted if the diagonal line of the factor values is equal or greater than 0.7 and all the other values in the lower triangle are less than 0.7 [57]; [58].

The results of Table 4 show a significant result among all the factors and their item of contrasts included in each factor.

Table 5. Construct Reliability and Validity

	Cronbach's Alpha	rho-A	Composite Reliability (CR)	Average Variance Rollability (AVR)
BI	0.726	0.727	0.831	0.555
GP	1.000	1.000	1.000	1.000
LSD	0.884	0.897	0.905	0.552
PEOU	0.495	0.491	0.573	0.329
PU	0.806	0.823	0.866	0.568
STA	0.403	0.420	0.686	0.364
SU	0.741	0.768	0.839	0.725
TP	1.000	1.000	1.000	1.000

Table 5 shows the reliability and validity results for each factor. According to Cronbach's Alpha, the reliability is accepted if the value is equal to or greater than 0.7 [57]; [58]. All the factors are accepted except PEOU and STA where Cronbach's Alpha had fewer values (0.495 and 0.403) respectively. The Composite Reliability (CR) value is accepted if the value is greater than 0.7 for all the factors given in the model [57]; [58]. It is clear that PEOU and STA have values less than the required standard of the test using the PLS-SEM program [46]. The Average Variance Rollability (AVR) is accepted if the value is greater than 0.5 for all the tested factors. According to the research model factors, still, PEOU and STA still not accepted with VAR values because both factor values are less than 0.5 as 0.329 and 0.364 respectively.

Table 6. Hypotheses Remarks**,** Bootstrapping mean, Stdev, T-test, P-values, bias, supporting

Hs.	Relationship	Sample Mean (M)	Standard Deviation (STDEV)	Path Coefficient	P Value	Bias	Remarks
H1	Time→ Perceived Usefulness	0.432	0.135	0.015	0.000	0.003	Supported
H2	Time→ Perceived Ease of Use	0.325	0.247	0.126	0.001	0.005	Supported
H3	Language Skill Development→ Perceived Usefulness	0.432	0.188	0.595	0.003	0.003	Supported
H4	Language Skill Development→ Perceived Ease of Use	0.328	0.093	0.627	0.000	0.004	Supported
H5	Digital Gaming→ Perceived Usefulness	0.250	0.295	0.018	0.067	0.032	Not Supported
H6	Digital Gaming→ Perceived Ease of Use	0.269	0.085	0.014	0.050	0.018	Not Support
H7	Perceived Ease of Use→ Perceived Usefulness	0.288	0.631	0.337	0.000	0.002	Supported
H8	Perceived Usefulness→ Students' Attitude	0.341	0.042	0.371	0.000	0.001	Supported
H9	Perceived Ease of Use→ Students' Attitude	0.341	0.053	0.098	0.102	-0.001	Not Supported
H10	Students' Attitude→ Behavioral Intention	0.451	0.058	0.327	0.000	0.001	Supported
H11	Behavioural Intention→ System Use	0.321	0.066	0.232	0.000	0.003	Supported

5. Discussion

The results of this study reveal that being proficient in various language skills can positively impact gameplay by improving communication, comprehension of game instructions, and understanding of in-game narratives and texts. With 0.627 and 0.595 for perceived ease of use (PEOU) and perceived usefulness (PU), respectively, the path coefficient table (see Table 2) indicates that language skill development (i.e. language learning and skill development based on how this term is used operationally in the current study) has a significant impact on both TAM

components. At 0.126 and -0.015, respectively, the time of the played game (TP) had a negligible or adverse effect on the two components of PEOU and PU. It also shows that there is no correlation at all between the period of play and TAM parameters, with the digital game played (GP) having a negligible impact on the same PEOU and PU components. This result is in line with [27], [59], and [38] who concluded that no correlation between time invested and language learning, and that working on the diversity of activities is much better than spending extra time on them. This result is unlike [32], [25], [33], and [35] who reached positive results towards the effects of time spent on digital games. One potential reason for the mixed findings in the literature could be the players' experience and the amount of time they have spent playing games [2]; [8].

On the contrary, a lack of language skills can hinder understanding and enjoyment of the game, as well as high interactivity may hinder learning. Therefore, when the users realize they need to have a better understanding of the second language to play the game, it can be an impetus for their foreign language learning, even in their formal education classes at school. In addition, not all games are useful for language learning, or there is a lack of knowledge about digital games among language teachers and institutions may hinder their proper use [60]; [61]; [8]. Generally speaking, today's youth prefer non-instructional digital gaming [8]; [5], with cooperative-style games seeing the most popularity [8]; [16]. According to [17], [62]; [5], and [19], players frequently choose their games for extracurricular activities, which increases their satisfaction and motivation.

To answer the research questions of this study, the following responses have been provided and discussed within the context of other research studies on this topic: *What is the nature of the relationship between the time spent by EFL college students playing digital games and their language development?*

The relationship between the time spent playing digital games by EFL college students and their language development is complex and dependent on various factors, such as the type of game, the language used in the game, and the level of language proficiency of the students. The results gave a negative remark for two hypotheses H5 and H6, where the path coefficient was weak (0.018 and 0.014). Also, the p-value for these two relationships (0.067, and 0.050) respectively.

However, the results of this study indicate that in general, playing digital games in English can provide exposure to the language and increase motivation for language learning. This was also confirmed by [59] whose study conducted among 42 university EFL students in Jordan showed that there existed a strong impact of exposure to the English language on language acquisition Similarly, [8] found that the attitudes and according the effectiveness of digital games can be different among EFL students based on their different level of language proficiency, age, gender, and experience of playing digital games. However, the impact on language development depends on the level of challenge and complexity of the language used in the game [21].

Moreover, it seems that the time variable does not play any role in it as our study showed. Table 6, shows that hypothesis H7 positively remarks in this model between the perceived ease of use and perceived usefulness, the path coefficient (0.337) and the p-value (0.000). Nevertheless, playing digital games can lead to positive effects on vocabulary acquisition and grammar development. For example, in a recent systematic review exploring the potential of digital game-based vocabulary learning by [63] showed that digital games were effective for learning vocabulary. In fact, they appear to have a higher effect on vocabulary learning than using conventional teaching methods. The authors also maintain that teachers should pay attention to the right choice of the game since it should match the language proficiency of the target group, as the text coverage of the games may sometimes prove too difficult [5].

The second question of this study was: *Are the students' attitudes affected indirectly by the digital games played for language development?*

The result of this study confirmed that the digital games played for language development can indirectly affect the students' attitudes. Students with positive experiences with digital games tend to have more positive attitudes toward the language and the learning process. The current values derived from the model gave positive remarks for hypothesis H8, where perceived usefulness is positive relationships with student attitude, and the p-value (0.000). on the other hand, hypothesis H9 (see Table 6) shows negative remarks with the relationship between perceived ease of use and the student attitude, were the p-value (0.102). Digital games can also increase motivation for language learning by providing an enjoyable and engaging context for language practice [26]; [8]. The factor of motivation is one of the pivotal incentives for learning since it can create a pleasant and positive learning environment in which learners feel safe and without any negative emotions [15]; [64]. The model tested positive and significant remarks for the two hypotheses H10 and H11 respectively, where the p-values (0.000) for both cases and the whole model impact significantly the relationship of student attitude to behavioural intention, then the next relationship from behavioural intention to the actual system use with digital gaming to enhance the EFL learning process. As already indicated above, the impact on attitudes can also depend on the type of game and the language used in the game. For example, if the game is too difficult or frustrating, it may negatively affect students' attitudes toward the language and the learning process. In summary, playing digital games for language development can have both positive and negative effects on students' attitudes, depending on various factors such as the type of game, the language used, and the individual students' prior experiences and attitudes which is consistent with the findings of the previous studies [2]; [8].

The third question of this study was: *Which digital game is supposed to affect students' language development positively?*

The findings of this study reveal that the most engaging and popular game among students was *PUBG*, followed by *Minecraft*, which has the following characteristics:

- Uses the target language (English in this case) extensively and at an appropriate level of challenge for the students.
- Provides meaningful opportunities for language use and practice, such as conversation, problem-solving, and negotiation.
- Encourages interaction, competition, and collaboration with other players, which can improve speaking and listening skills.
- Offers clear and comprehensive instructions, texts, and narratives, which can improve reading comprehension and vocabulary acquisition.

Examples of digital games that meet these criteria include adventure and role-playing games, strategy games, and simulation games. It is important to note that the impact of a particular game on language development will depend on the individual student's language proficiency level and the amount of time and effort invested in language learning outside of the game. However, these games, such as *Minecraft*, expand mainly vocabulary learning [65]; [66]. Therefore, further research should focus also on the development of other language skills and structures when using digital games for learning a foreign language.

The fourth question of this study was: *Are TAM model factors affected positively by language skills development through the use of digital games in learning?*

Yes, the Technology Acceptance Model (TAM) factors can be positively affected by language skill development through the use of digital games in learning. The TAM model proposes that two factors, perceived usefulness (PU) and perceived ease of use (PEOU), are crucial in determining an individual's intention to use and continue using technology [46]; [53]; [67]. When students experience positive language development through the use of digital games, they may perceive the technology as more useful for language learning, leading to an increase in

PU. Additionally, if the digital games are user-friendly and easy to use, students may perceive them as easy to use, leading to an increase in PEOU [26]; [54].

Overall, a positive relationship between language skill development and digital games can lead to increased PU and PEOU, which in turn can increase the students' intention to use and continue using digital games for language learning. It is also important to note that other factors, such as individual differences, prior experiences, and attitudes towards technology, can impact the relationship between language skill development and the TAM factors. However, in general, the development of language skills through the use of digital games can have a positive impact on the TAM factors, leading to increased acceptance and usage of digital games in language learning [26].

This study's findings have a number of pedagogical ramifications that can influence educational practices and policies in the Czech Republic and Iraq. We would want to emphasize that the variables that have been identified provide insightful information about how technology, language acquisition, and learner time interact. These consequences can be summed up as follows when some or all of the outcomes intersect:

- Promoting social aspects: Teachers can encourage positive student relationships that may aid in the development of collaboration and respect by utilizing group projects and student-centered learning through games [68].
- Global Perspectives in Education: By highlighting the pedagogical implications of taking into account global perspectives in educational practices in both the Czech Republic and Iraq, educators can gain valuable insights and approaches that cross-cultural boundaries and promote a more inclusive and culturally aware learning environment.
- Teacher Training: the pedagogical implications of digital gaming in language acquisition underscore the significance of continuous teacher training and professional development, particularly in light of the obstacles and issues associated with its use. In order to handle privacy issues, adjust to digital tools, and negotiate the complicated ethical and humanistic issues surrounding online learning, educators require assistance and training.
- Examining Pedagogical Strategies for Active Learning: Instructors ought to understand the value of the use of active teaching techniques in fostering extracurricular pursuits like online gaming. Subsequent research endeavours may investigate certain pedagogical approaches, such as game-based and collaborative learning, in the context of technology-enabled learning environments. Evidence-based teaching approaches would be informed by a review of these strategies' efficacy in developing language acquisition skills.
- Students' well-being comes before all: teachers should be aware that though spending much time playing digital games may lead to enhanced language learning, this will lead to increased screen time and the subsequence will harm students. So, teachers need to insert the idea of making balance and take all the safety considerations.
- Teachers who understand how digital games may turn typically passive students into active participants may be more likely to embrace them. According to the study, playing digital games can boost motivation and promote group learning, especially when there are competitive elements or multiplayer language games that promote interaction.
- By encouraging a culture of innovation and offering resources like game-based learning platforms or chances for educators to exchange best practices, educational institutions could foster a more encouraging atmosphere for promoting digital games in language learning context. Digital gaming may be made more commonplace with the help of creative educators and peer support.
- Digital games can be a very useful addition to language learning, but in order to prevent excessive screen time, it's crucial to balance them with other activities. Without becoming

overly dependent on digital games, the goal is to design a learning environment that optimizes their educational potential. The following are some tactics that educators and organizations can employ to strike this balance: Focus on active learning, set time limits for gaming, and combine gaming with other learning methods.

Future studies should examine successful integration techniques that consider the preferences and learning goals of individual students when integrating digital games into language curricula. Furthermore, more research is needed to fully understand the relationship between gameplay and language development in an EFL context. It should be investigated how to improve specific language skills, such as listening, speaking, and reading, through gaming, and the findings could be implemented by game designers to intentionally enhance second language acquisition among users. Moreover, research is needed on the psycholinguistics of gaming, as it may impact communication skills in players who lack human interaction. Therefore, balanced research should be conducted to comprehensively evaluate the potential of gaming and its pitfalls.

6. Conclusions

The study's key findings demonstrate the significant impact of language skills on gameplay, revealing that proficiency in various language skills positively influences communication, comprehension of game instructions, and understanding of in-game narratives and texts. Within the Technology Acceptance Model (TAM) framework, language skill development exhibits notable effects on perceived ease of use (PEOU) and perceived usefulness (PU). Additionally, the relationship between time spent playing digital games and language development among EFL college students is complex, with factors such as game type, language complexity, and individual proficiency levels influencing the outcome. Surprisingly, the study suggests that the time variable may not significantly influence language development. Moreover, digital games played for language development indirectly affect students' attitudes, with positive gaming experiences correlating with more positive attitudes toward language learning. Games like PUBG and Minecraft emerge as particularly beneficial for language development due to factors such as extensive use of the target language, meaningful language practice opportunities, interaction with other players, clear instructions, and comprehensive narratives. Furthermore, language skill development through digital games positively impacts TAM factors, including perceived usefulness and perceived ease of use, thereby increasing students' intention to use digital games for language learning. These findings underscore the potential of digital games as effective tools for language learning, emphasizing the importance of game selection and the interplay between language skills and technology acceptance factors.

In summary, playing digital games for extended periods of time has a variety of effects on language acquisition. While prolonged gaming can improve motivation, vocabulary growth, engagement, and overall language competency, it is important to strike a balance between formal language learning methods and time spent on gaming activities. Playing digital games can be a helpful tool for language learning, but it is not a substitute for formal language instruction and practice. The nature of the relationship between gameplay and language development is complex and context-dependent. The best digital game for language development seems to be the one that provides a balance of challenge, engagement, and meaningful language practice, tailored to the students' language proficiency level and learning goals. Excessive playing of digital games could lead to addiction, which in turn will negatively affect students.

In addition to its significant findings, the study acknowledges several limitations that warrant further investigation. Specifically, there is a need for research to explore strategies

for reducing screen time among users while still maximizing the benefits of digital games for language learning. Additionally, it's essential to verify whether prolonged engagement with digital games affects users' communication skills negatively, thus highlighting the importance of balancing gaming activities with other forms of language practice and social interaction. These limitations underscore the ongoing need for comprehensive research to optimize the educational potential of digital games while mitigating potential drawbacks.

The study's key findings demonstrate the significant impact of language skills on gameplay, revealing that proficiency in various language skills positively influences communication, comprehension of game instructions, and understanding of in-game narratives and texts. Within the Technology Acceptance Model (TAM) framework, language skill development exhibits notable effects on perceived ease of use (PEOU) and perceived usefulness (PU). Additionally, the relationship between time spent playing digital games and language development among EFL college students is complex, with factors such as game type, language complexity, and individual proficiency levels influencing the outcome. Surprisingly, the study suggests that the time variable may not significantly influence language development. Moreover, digital games played for language development indirectly affect students' attitudes, with positive gaming experiences correlating with more positive attitudes toward language learning. Games like PUBG and Minecraft emerge as particularly beneficial for language development due to factors such as extensive use of the target language, meaningful language practice opportunities, interaction with other players, clear instructions, and comprehensive narratives. Furthermore, language skill development through digital games positively impacts TAM factors, including perceived usefulness and perceived ease of use, thereby increasing students' intention to use digital games for language learning. These findings underscore the potential of digital games as effective tools for language learning, emphasizing the importance of game selection and the interplay between language skills and technology acceptance factors.

Acknowledgements

This research is supported by the Excellence 2025 Project run at the Faculty of Informatics and Management at the University of Hradec Kralove, Czech Republic.

Conflicts of interest

The authors declare no conflict of interest.

References

[1] L. H. Al-Obaydi, "Humanistic learning elements in a blended learning environment: a study in an EFL teaching context," Interactive Learning Environments, vol. 31, no. 5, pp. 3098-3111, 2023. https://doi.org/10.1080/10494820.2021.1919717.

[2] C. Blume, "Games people (don't) play: An analysis of pre-service EFL teachers' behaviors and beliefs regarding digital game-based language learning," Computer Assisted Language Learning, vol. 33, no. 1-2, pp. 109-132, 2020. https://doi.org/10.1080/09588221.2018.1552599.

[3] M. Pikhart, B. Klimova, L. H. Al-Obaydi, S. Dziuba, and A. Cierniak-Emerych, "The quantitative evaluation of subjective satisfaction with digital media in L2 acquisition in younger adults: A study from Europe, Asia, and Latin America," Frontiers in Psychology, vol. 13, p. 946187, 2022. https://doi.org/10.3389/fpsyg.2022.946187.

[4] R. M. Tawafak, I. Y. Alyoussef, and W. M. Al-Rahmi, "Essential Factors to Improve Student Performance Using an E-Learning Model: Review Study," International Journal of Interactive Mobile Technologies, vol. 17, no. 3, 2023.

[5] A. Soyoof, B. L. Reynolds, B. Vazquez-Calvo, and K. McLay, "Informal digital learning of English (IDLE): A scoping review of what has been done and a look towards what is to come," Computer Assisted Language Learning, vol. 36, no. 4, pp. 608-640, 2023. https://doi.org/10.1080/09588221.2021.1936562.

[6] Y. Zhang, and G. L. Liu, "Examining the impacts of learner backgrounds, proficiency level, and the use of digital devices on informal digital learning of English: an explanatory mixed-method study," Computer Assisted Language Learning, pp. 1-28, 2023. https://doi.org/10.1080/09588221.2023.2267627.

[7] F. Liu, B. Vadivel, E. Rezvani, and E. Namaziandost, "Using games to promote English as a foreign language learners' willingness to communicate: Potential effects and teachers' attitude in focus," Frontiers in Psychology, vol. 12, p. 762447, 2021. https://doi.org/10.3389/fpsyg.2021.762447.

[8] A. Soyoof, B. L. Reynolds, K. K. Chan, W. T. Tseng, and K. McLay, "Massive online multiplayer games as an environment for English learning among Iranian EFL students," Computer Assisted Language Learning, pp. 1-44, 2023. https://doi.org/10.1080/09588221.2023.2171065.

[9] C. Nuttall, Teaching reading skills in a foreign language. Heinemann, 1996.

[10] L. H. Al-Obaydi, F. Shakki, R. M. Tawafak, M. Pikhart, and R. L. Ugla, "What I know, what I want to know, what I learned: Activating EFL college students' cognitive, behavioral, and emotional engagement through structured feedback in an online environment," Frontiers in Psychology, vol. 13, p. 1083673, 2023. https://doi.org/10.3389/fpsyg.2022.1083673.

[11] A. Tatnall, "Editorial for EAIT issue 2, 2020," Education and Information Technologies, vol. 25, pp. 647-657, 2020.

[12] H. Almås, and F. Giæver, "The emergence of collaboration in serious games: An exploratory study," International Journal of Serious Games, vol. 11, no. 3, pp. 89-108, 2024. https://doi.org/10.17083/ijsg.v11i3.739.

[13] H. Chen, W. Rong, X. Ma, Y. Qu, and Z. Xiong, "An extended technology acceptance model for mobile social gaming service popularity analysis," Mobile Information Systems, vol. 2017, no. 1, p. 3906953, 2017. https://doi.org/10.1155/2017/3906953.

[14] J. Hamari, and L. Keronen, "Why do people play games? A meta-analysis," International Journal of Information Management, vol. 37, no. 3, pp. 125-141, 2017. https://doi.org/10.1016/j.ijinfomgt.2017.01.006.

[15] M. Pikhart, L. H. Al-Obaydi, B. Klimova, and R. M. Tawafak, "The Impact of Digital Games on Motivation and Attitudes of EFL College Students," The Journal of AsiaTEFL, vol. 21, no. 1, pp. 235-243, 2024. http://dx.doi.org/10.18823/asiatefl.2024.21.1.16.235.

[16] C. L. Hsu, and H. P. Lu, "Why do people play on-line games? An extended TAM with social influences and flow experience," Information & Management, vol. 41, no. 7, pp. 853-868, 2004. https://doi.org/10.1016/j.im.2003.08.014.

[17] L. H. Habeb Al-Obaydi, M. Pikhart, and F. Shakki, "Digital gaming as a panacea for incidental L2 acquisition in an EFL context," Applied Research on English Language, vol. 12, no. 1, pp. 73-94, 2023. https://doi.org/10.22108/ARE.2022.135344.2001.

[18] G. L. Liu, and Y. Wang, "Modeling EFL teachers' intention to integrate informal digital learning of English (IDLE) into the classroom using the theory of planned behavior," System, vol. 120, p. 103193, 2024. https://doi.org/10.1016/j.system.2023.103193.

[19] L. K. Sylvén, and P. Sundqvist, "Gaming as extramural English L2 learning and L2 proficiency among young learners," ReCALL, vol. 24, no. 3, pp. 302-321, 2012. https://doi.org/10.1017/S095834401200016X.

[20] D. A. Gentile, H. Choo, A. Liau, T. Sim, D. Li, D. Fung, and A. Khoo, "Pathological video game use among youths: a two-year longitudinal study," Pediatrics, vol. 127, no. 2, pp. e319-e329, 2011. https://doi.org/10.1542/peds.2010-1353.

[21] R. M. Tawafak, L. H. Al-Obaydi, B. Klimova, and M. Pikhart, "Technology integration of using digital gameplay for enhancing EFL college students' behavior intention," Contemporary Educational Technology, vol. 15, no. 4, p. ep452, 2023. https://doi.org/1030935/cedtech/13454.

[22] S. L. Thorne, R. W. Black, and J. M. Sykes, "Second language use, socialization, and learning in Internet interest communities and online gaming," The modern language journal, vol. 93, pp. 802-821, 2009. https://doi.org/10.1111/j.1540-4781.2009.00974.x.

[23] M. Pikhart, L. H. Al-Obaydi, and R. M. Tawafak, "The implementation of critical pedagogy in digital second language acquisition in higher education: age and gender differences," Computer-Assisted Language Learning Electronic Journal, vol. 23, no. 2, pp. 56-75, 2022.

[24] P. Benson, and A. Chik, "Towards a more naturalistic CALL: Video gaming and language learning," in Explorations of language teaching and learning with computational assistance, IGI Global, 2013, pp. 75-88. https://doi.org/10.4018/ijcallt.2011070101.

[25] A. Hashemi, "The effects of using games on teaching vocabulary in reading comprehension: a case of gifted students," Journal for the Education of Gifted Young Scientists, vol. 9, no. 2, pp. 151-160, 2021. https://doi.org/10.17478/jegys.866480

[26] M. Arifianto and I. Izzudin, "Students' acceptance of discord as an alternative online learning media," International Journal of Emerging Technologies in Learning (iJET), vol. 16, no. 20, pp. 179-195, 2021. https://doi.org/10.3991/ijet.v16i20.22917.

[27] J. S. Lee, "Quantity and diversity of informal digital learning of English," 2019. [Online]. Available: https://hdl.handle.net/10125/44675.

[28] A. Tarhini, K. Hone, and X. Liu, "A cross-cultural examination of the impact of social, organisational and individual factors on educational technology acceptance between British and Lebanese university students," British Journal of Educational Technology, vol. 46, no. 4, pp. 739-755, 2015. https://doi.org/10.1111/bjet.12169.

[29] J. S. Lee and L. K. Sylvén, "The role of Informal Digital Learning of English in Korean and Swedish EFL learners' communication behaviour," British Journal of Educational Technology, vol. 52, no. 3, pp. 1279-1296, 2021. https://doi.org/10.1111/bjet.13082.

[30] D. Johnson, J. Gardner, and P. Sweetser, "Motivations for videogame play: Predictors of time spent playing," Computers in Human Behavior, vol. 63, pp. 805-812, 2016. https://doi.org/10.1016/j.chb.2016.06.028.

[31] J. S. Lee, "Informal digital learning of English and second language vocabulary outcomes: Can quantity conquer quality?," British Journal of Educational Technology, vol. 50, no. 2, pp. 767-778, 2019. https://doi.org/10.1111/bjet.12599.

[32] J. P. Gee, Why video games are good for your soul: Pleasure and learning. Common Ground, 2005.

[33] U. Ritterfeld, Serious games: mechanisms and effects. Routeledge, 2009.

[34] D. Yüksel, M. Altay, and S. Curle, "English Medium Instruction programmes in Turkey: evidence of exponential growth," in English-Medium Instruction in Higher Education in the Middle East and North Africa: Policy, Research and Practice, Bloomsbury Publishing, 2022.

[35] C. S. Green and D. Bavelier, "Exercising your brain: a review of human brain plasticity and training-induced learning," Psychology and Aging, vol. 23, no. 4, p. 692, 2008. https://doi.org/10.1037/a0014345.

[36] D. J. Kuss, J. Louws, and R. W. Wiers, "Online gaming addiction? Motives predict addictive play behavior in massively multiplayer online role-playing games," Cyberpsychology, Behavior, and Social Networking, vol. 15, no. 9, pp. 480-485, 2012. https://doi.org/10.1089/cyber.2012.0034.

[37] A. Soyoof, B. L. Reynolds, M. Neumann, J. Scull, E. Tour, and K. McLay, "The impact of parent mediation on young children's home digital literacy practices and learning: A narrative review," Journal of Computer Assisted Learning, vol. 40, no. 1, pp. 65-88, 2024. https://doi.org/10.1111/jcal.12866.

[38] H. Reinders, ed., Digital games in language learning and teaching. Basingstoke: Palgrave Macmillan, 2012.

[39] S. J. Franciosi, J. Yagi, Y. Tomoshige, and S. Ye, "The effect of a simple simulation game on long-term vocabulary retention," Calico Journal, vol. 33, no. 3, pp. 355-379, 2016. https://doi.org/10.1558/cj.v33i2.26063.

[40] C. I. Hitosugi, M. Schmidt, and K. Hayashi, "Digital game-based learning (DGBL) in the L2 classroom: The impact of the UN's off-the-shelf videogame, Food Force, on learner affect and vocabulary retention," Calico Journal, vol. 31, no. 1, pp. 19-39, 2014. http://www.jstor.org/stable/calicojournal.31.1.19.

[41] A. K. Maior, "An exploration of the massively multiplayer online role-playing game World of Warcraft as a tool for facilitating incidental vocabulary acquisition," Master's Thesis, University of Glasgow, Utrecht University, Netherlands, 2016.

[42] V. Juvonen, "The experienced effects of non-educational digital games on English language learning motivation," Bachelor's Thesis, 2019. [Online]. Available: https://jyx.jyu.fi/handle/123456789/66898.

[43] F. Su, D. Zou, H. Xie, and F. L. Wang, "A comparative review of mobile and non-mobile games for language learning," SAGE Open, vol. 11, no. 4, p. 21582440211067247, 2021.

[44] F. D. Davis, "A technology acceptance model for empirically testing new end-user information systems," Massachusetts Institute of Technology, Theory and Results, 1986. http://dspace.mit.edu/handle/1721.1/15192.

[45] F. D. Davis, "Perceived usefulness, perceived ease of use, and user acceptance of information technology," MIS Quarterly, pp. 319-340, 1989. https://doi.org/10.2307/249008.

[46] H. A. Alfadda and H. S. Mahdi, "Measuring students' use of zoom application in language course based on the technology acceptance model (TAM)," Journal of Psycholinguistic Research, vol. 50, no. 4, pp. 883-900, 2021. https://doi.org/10.1007/S10936-020-09752-1/TABLES/6.

[47] P. P. Sun and B. Mei, "Modeling preservice Chinese-as-a-second/foreign-language teachers' adoption of educational technology: A technology acceptance perspective," Computer Assisted Language Learning, vol. 35, no. 4, pp. 816-839, 2022. https://doi.org/10.1080/09588221.2020.1750430.

[48] G. Liu and C. Ma, "Measuring EFL learners' use of ChatGPT in informal digital learning of English based on the technology acceptance model," Innovation in Language Learning and Teaching, vol. 18, no. 2, pp. 125-138, 2024. https://doi.org/10.1080/17501229.2023.2240316.

[49] E. A. Putri and Z. Zulherman, "The Use of Wordwall Application Towards Elementary School Students Acceptance: Extension TAM Model," AL-ISHLAH: Jurnal Pendidikan, vol. 14, no. 4, pp. 5557-5572, 2022. https://doi.org/10.35445/alishlah.v14i4.2047.

[50] P. Silva, "Davis' technology acceptance model (TAM)(1989)," Information seeking behavior and technology adoption: Theories and trends, pp. 205-219, 2015. https://doi.org/10.4018/978-1-4666-8156-9.ch013.

[51] R. M. Tawafak, A. BT Romli, R. B. A. Arshah, and R. A. S. Almaroof, "Assessing the impact of technology learning and assessment method on academic performance," EURASIA Journal of Mathematics, Science and Technology Education, vol. 14, no. 6, pp. 2241-2254, 2018.

[52] K. F. Yuen, L. Cai, G. Qi, and X. Wang, "Factors influencing autonomous vehicle adoption: An application of the technology acceptance model and innovation diffusion theory," Technology Analysis & Strategic Management, vol. 33, no. 5, pp. 505-519, 2021. https://doi.org/10.1080/09537325.2020.1826423.

[53] A. Tahar, H. A. Riyadh, H. Sofyani, and W. E. Purnomo, "Perceived ease of use, perceived usefulness, perceived security and intention to use e-filing: The role of technology readiness," The Journal of Asian Finance, Economics and Business, vol. 7, no. 9, pp. 537-547, 2020. https://doi.org/10.13106/jafeb.2020.vol7.no9.537.

[54] A. Katebi, P. Homami, and M. Najmeddin, "Acceptance model of precast concrete components in building construction based on Technology Acceptance Model (TAM) and Technology, Organization, and Environment (TOE) framework," Journal of Building Engineering, vol. 45, p. 103518, 2022. https://doi.org/10.1016/j.jobe.2021.103518.

[55] Z. Dornyei, Research methods in applied linguistics. Oxford University Press, 2007.

[56] R. M. Tawafak, I. Y. Alyoussef, W. M. Alrahmi, and S. I. Malik, "Contributing factors for student perception to use e-learning systems," J. Theor. Appl. Inf. Technol, vol. 100, pp. 2040-2050, 2022.

[57] J. F. Hair, M. Sarstedt, C. M. Ringle, and J. A. Mena, "An assessment of the use of partial least squares structural equation modeling in marketing research," Journal of the Academy of Marketing Science, vol. 40, pp. 414-433, 2012. https://doi.org/10.1007/s11747-011-0261-6.

[58] M. Sarstedt, C. M. Ringle, and J. F. Hair, "Partial least squares structural equation modeling," in Handbook of market research, Cham: Springer International Publishing, 2021, pp. 587-632.

[59] S. M. Al Zoubi, "The impact of exposure to English language on language acquisition," Journal of Applied Linguistics and Language Research, vol. 5, no. 4, pp. 151-162, 2018.

[60] Y. Chen and S. Zhao, "Understanding Chinese EFL learners' acceptance of gamified vocabulary learning apps: an integration of self-determination theory and technology acceptance model," Sustainability, vol. 14, no. 18, p. 11288, 2022. https://doi.org/10.3390/su141811288.
[61] R. M. Tawafak, A. Romli, and R. A. Arshah, "E-learning prospect on improving academic performance in Omani Universities," in IOP Conference Series: Materials Science and Engineering, vol. 551, p. 012033, 2019.
[62] G. L. Liu and Y. Wang, "Modeling EFL teachers' intention to integrate informal digital learning of English (IDLE) into the classroom using the theory of planned behavior," System, vol. 120, p. 103193, 2024. https://doi.org/10.1016/j.system.2023.103193.
[63] G. Vnucko and B. Klimova, "Exploring the potential of digital game-based vocabulary learning: A systematic review," Systems, vol. 11, no. 2, p. 57, 2023. https://doi.org/10.3390/systems11020057.
[64] A. A. Rahman and A. Angraeni, "Empowering learners with role-playing game for vocabulary mastery," International Journal of Learning, Teaching and Educational Research, vol. 19, no. 1, pp. 60-73, 2020. https://doi.org/10.26803/ijlter.19.1.4.
[65] Y. Chien, "The Language of Massively Multiplayer Online Gamers: A Study of Vocabulary in Minecraft Gameplay," TESL-EJ, vol. 23, no. 3, 2019.
[66] A. Müller, J. B. Son, K. Nozawa, and R. Dashtestani, "Learning English idioms with a web-based educational game," Journal of Educational Computing Research, vol. 56, no. 6, pp. 848-865, 2018. https://doi.org/10.1177/0735633117729292.
[67] A. Seyderhelm and K. Blackmore, "Dynamic Adaptive Surveillance Training in a Virtual Environment Using Real-Time Cognitive Load and Performance," International Journal of Serious Games, vol. 11, no. 3, pp. 109-133, 2024. https://doi.org/10.17083/ij
[68] B. Klimova and J. Kacet, "Efficacy of computer games on language learning," Turkish Online Journal of Educational Technology-TOJET, vol. 16, no. 4, pp. 19-26, 2017.