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Research Article

Exploring the impact of digital gameplay on behavioral intentions in learning graphics programming courses

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ABSTRACT

The importance of gameplay extends beyond mere entertainment, playing a crucial role in shaping behavioral intentions (BIs) in various contexts. This research aims to discover how digital gameplay influences students' BIs, mainly in the context of technology adoption in education. The main objective is to investigate the impact of digital gameplay on students. This study is based on the technology acceptance model (TAM), which serves as the theoretical framework consisting of six hypotheses for research. This study aimed to assess the frequency and nature of engagement in digital gameplay while measuring students' acceptance of technology adoption. This study was conducted during the first academic semester, from October 1, 2023, until January 18, 2024. The survey was distributed among 125 participants from two departments English and information technology students. Unlike previous studies that mostly focused on the entertainment value or reasoning benefits of gameplay, this research uniquely integrates digital gameplay within the framework of technology acceptance in an educational setting. By applying TAM, this study provides empirical evidence on how gameplay engagement can influence students' readiness to adopt technology, offering new insights into the intersection of gaming, education, and technology adoption. The results highlight the potential of digital games as a leisure activity and a useful tool to promote technology acceptance were perceived usefulness (PU) R-squared (0.532) and the factors connected to PU also supported (technology integration PC = 0.402 and perceived ease of use PC = 0.446) effective integration in educational settings. This result suggests that incorporating digital gameplay into educational strategies may effectively promote more receptive attitudes toward technology among students.

Keywords: technology integration, digital gaming, behavior intention, TAM, risk-taking

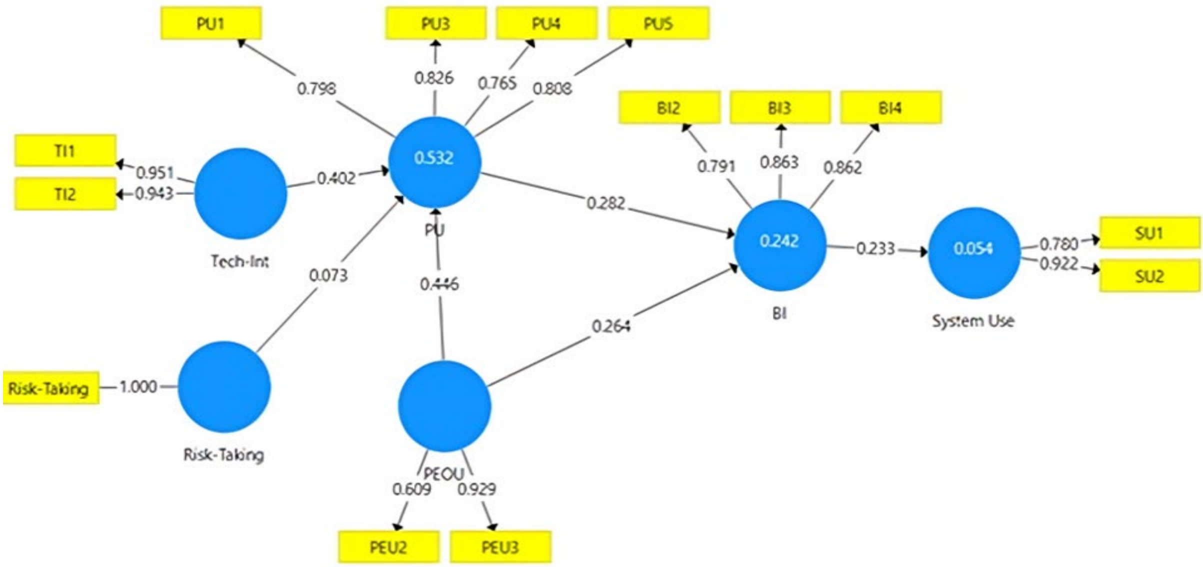

Figure 1. Conceptual research model (the authors' own work)

INTRODUCTION

In recent years, technology integration (Tech-Int) in education has drawn a lot of attention because it offers creative ways to improve student learning (Wang et al., 2023). Digital gaming is one of these technological instruments that has shown promise in promoting motivation, engagement, and better learning outcomes (Alam, 2022; Chan et al., 2022; Tawafak et al., 2019). The growing use of digital technologies in education, especially in language acquisition, is consistent with the growth of game-based learning. Digital gaming is a powerful substitute for conventional teaching techniques because it produces immersive, interactive settings that support contextualized learning (Al-Obaydi et al., 2023a; Chiang, 2020). Besides the regular use of the technology acceptance model (TAM), this active and powerful academic framework is used for evaluating the model theories and validating the factor relationships. Also, this model is used to investigate whether the behavioral intention (BI) of the learners can be influenced positively by adding graphical coding as a supported language to motivate the learners how to develop gameplay and also to upgrade the game skills (Agbo et al., 2023; Tawafak et al., 2022).

Furthermore, this study explains the essential factors used to develop the digital games and graphical programming elements to improve task taking and BI to deliver these elements for student learning journey (Al-Obaydi et al., 2023a; Chiang, 2020; Iqbal Malik et al., 2021; Mathew et al., 2019).

TAM has been used in earlier research to investigate students' acceptance of instructional technology. TAM has been widely used in a variety of educational situations and assesses perceived usefulness (PU) and perceived ease of use (PEOU) as predictors of technology adoption (Davis, 1989). Digital games have been shown to promote motivation and engagement, which in turn can lead to a greater acceptance of technology (Tawafak et al., 2019). Nevertheless, previous research has mostly concentrated on the motivating elements of gaming, ignoring the ways in which these elements contribute to long-term engagement and BI in learning (Alam, 2022; Meeprom, 2020). By investigating how digital gaming affects BIs beyond motivation, especially in the context of language learning, this study expands on the use of TAM.

This research also refers to testing the theoretical model and its basic variables, which were not sufficiently specified in previous studies. However, some researchers have tried to identify these factors, but they have not tested their influence and validity.

Therefore, this study relied on referring to the components of TAM factor model and the possibility of linking it to auxiliary factors, such as the six hypotheses used in the model shown in **Figure 1**. All of these six hypotheses supported the proposed relationships and showed important results such as R^2 values.

This study is divided into several sections. The first section is an overview of the latest existing research on this topic. The second section describes the factors used in the study and their rationale. The third section describes the participant sampling method, data analysis in the study, and the data collected from the distributed survey with 21 items, followed by a conceptual explanation of the model. The fourth section describes the model configuration described above and the result tables used in the study. Finally, we provide our conclusions and future research efforts (Alam, 2022; Tawafak et al., 2023a; Zabukovsek et al., 2020).

Research Question

This study has a research question "How does computerized gameplay influence the BI of learners in obtaining graphical programming language dialect aptitudes?"

However, the extent to which digital gameplay influences BIs–such as the willingness to engage with course material, participate in class activities, and pursue further language learning–remains under-explored.

One important indicator for studying real learning behavior and its outcomes is BI. The theory of planned behavior (Ajzen, 1991) states that attitudes (ATTs), subjective norms, and perceived behavioral control can influence a person's intention to engage in a particular behavior. This study explained that it seeks to understand how these components interact to influence students' desire for daily interaction to develop the possibility of game-based learning by applying this model to digital games in language learning (Tawafak et al., 2019).

Even while digital games are being used in education more and more, little is known about how much they affect students' BIs, such as their willingness to participate in class activities, complete their schoolwork, and use technology for learning (Wire, 2023). Inquiry about it has appeared that computerized recreation can essentially improve inspiration, a key figure in effective dialect learning. Previous studies have mostly concentrated on the short-term advantages of gaming, like heightened motivation and involvement, but have not thoroughly investigated its long-term effects on BIs (Alam, 2022; Chan et al., 2022).

Significance of Study

To extend TAM use in the education sector, the model can be used in digital gaming and based on graphical programming development, this study can add this graphics to the existence knowledge. As a significance study, it can produce a comprehensive literature review by using the essential factor of BI as a key factor for technology adoption, to motivate the learner outcomes.

This study reveals how digital gameplay can positively impact students' ATTs toward language learning by focusing on BIs, including aspects such as motivation, engagement, and self-efficacy (Chiang, 2020). The research is organized, as follows: The literature on digital gaming, TAM, and its educational uses is reviewed in the following section (Wire, 2023). The research methodology, including participant sampling, data collecting, and survey instrument development, is covered in the section that follows. The survey results are analyzed in the findings section, and then the implications for instructional practice are discussed. The study ends with important conclusions, restrictions, and suggestions for further research.

LITERATURE REVIEW

The Role of Technology in Education

Resourcing is an evolving task that improves educational experiences. Software technology has radically changed the evolving landscape. It has recently become clear that it is possible to provide more interactive areas that benefit the student thanks to the transformation in educational technologies resulting from the advanced integration of digital technology elements and vocabulary (Chan et al., 2022). With the development of digital platforms, augmented reality and artificial intelligence, educational institutions are always looking for ways to increase student performance and engagement (Chan et al., 2022). However, traditional teaching methods often have difficulty maintaining student interest and motivation, resulting in suboptimal learning outcomes (Alam, 2022).

Interactive technologies have shown great promise in tackling learning challenges in the field of programming education. Because graphical programming languages are so complicated, effective training methods must be both interesting and simple.

Digital Gameplay and Learning Motivation

The potential of digital games to improve learning motivation has been approved and proven, especially in technical education and the creation of advanced programs. Digital games, unlike traditional teaching techniques, include positive vocabulary such as obstacles, rules, and feedback methods that increase students' basic motivation (Meeprom, 2020). Digital games can increase engagement by promoting a fun and competitive learning environment, according to studies (Cai et al., 2022; Kwak et al., 2011).

Conversely, if technology is difficult to use, poorly designed, or not effectively integrated into the learning process, students are less likely to find it easy to use and therefore less likely to accept it less likely to use it. When technology is integrated in a way that supports student learning and provides opportunities for participation and interaction, students are more likely to find it useful and therefore more likely to accept and use it (Cai et al., 2022; Setyaningsih et al., 2020; Wardoyo et al., 2021). Furthermore, digital games offer possibilities for experiential learning that let students use what they have learned in real-world situations with rich context (Torres, 2022). This suggests that digital gaming is a strong teaching tool that encourages participation and in-depth study in addition to being an enjoyment medium.

TAM in Learning Contexts

The opinions of students and academic bodies regarding the adoption of new technology in educational contexts were considered using TAM to examine the results and check their credibility. According to TAM, first created by Davis (1989), the key variables are expected to be useful and simplicity of use. These elements influence students' tendency to participate in game-based learning environments when implemented to digital gaming (Almajali et al., 2022). Since it enables educators to create successful learning interventions that maximize technology acceptability and educational outcomes, it is essential to comprehend how TAM relates to digital games in programming instruction (Yang et al., 2024).

Previous Studies on Digital Gameplay

Previously, the cognitive development of digital games in school were the main topics proven by previous studies. An (2018) emphasizes how interactive games promote engagement in solving and development of acquired skills. The function of digital games in programming grammar learning has also been highlighted by research which highlights the ability of games to provide immersive and contextually appropriate learning experiences.

Few research has explicitly addressed the influence of digital gameplay on students' BIs toward learning graphical programming languages, despite the fact that several have looked at game-based learning generally (Rahardja et al., 2019). This difference emphasizes the necessity for focused studies that investigate the ways in which digital games affect students' readiness to interact with programming ideas and stick with their studies (Agbo et al., 2023).

There are still a number of gaps that still needs adoption to clarify them according to the growing appearances on digital gaming. First off, some research has mostly considered game-based sensitivity and effectiveness, frequently ignoring the feedback influence on students' BIs. Furthermore, although TAM has been used in previous studies to improve learning through technology, its use in teaching programming through digital games has not received much attention. This study delivers fresh insights into how students view and embrace game-based learning in technical disciplines by examining the connection between digital games and behavioral intents within TAM framework.

FACTOR ATTRIBUTES

TAM Factors

A popular paradigm for comprehending the elements that affect a person's acceptance and adoption of technology is TAM (Wardoyo et al., 2021). According to TAM, there are two main essentials that influence a person's intention to utilize technology. They are thought to be user-friendly and beneficial (Davis, 1989; Liang et al., 2021).

PEOU can be defined as a student's subjective perception that technology is easy to use and understand (Torres, 2022). This increases the chances of technology acceptance and use while achieving simplicity in use (Krishnan et al., 2021; Liang et al., 2021).

The assumption that the evolutionary use of programming languages would enhance an individual's effectiveness at work is known as PU (Cai et al., 2022). People are more likely to adopt and use technology if they believe it will be useful. Along with these two crucial elements, TAM also considers outside variables including social influences, prior technological experience, and ATTs toward technology that could affect a person's intention to use it.

TAM offers a thorough framework for comprehending the elements that affect technological acceptance and adoption in various situations by taking these aspects into account.

Technology Integration Elements to Improve Students' Behavioral Intentions Improve Motivation

Tech-Int can provide instant feedback to students so they can track their progress and monitor their success. This instant feedback can increase student motivation and encourage them to work harder and achieve their goals (Alshurideh et al., 2023; Chiang, 2020). Promotes creativity. Tech-Int offers students opportunities to creatively express themselves and present their knowledge and skills in new and innovative ways (Mortazavi et al., 2021).

Tech-Int provides students with access to a wealth of resources and information, allowing them to explore and learn at their own pace (Cai et al., 2022). This approach can motivate students and inspire them to take responsibility for their learning. In instant, Tech-Int is an important factor in improving students' BIs toward technology and can play an important role in promoting student engagement and motivation in the classroom (Klimova & Kacetl, 2017; Mortazavi et al., 2021; Tawafak et al., 2023b).

Impact of Risk-Taking on Perceived Benefits

Risk-taking and PU in TAM PU

In TAM framework, PU refers to the extent to which using a particular technology improves job performance or makes task easier. It refers to the degree to which a person believes. It is a factor that determines the intention of the person using the technology. In the context of technology adoption, risk-taking (RT) is defined as a person's preparedness to accept the potential risks and uncertainties associated with the use of a new technology (Kwak et al., 2011).

The effect of risk on PU

In some cases, a certain level of risk can have a positive effect on PU of technology (Klimova & Kacetl, 2017; Tawafak et al., 2023a). When individuals take risks by trying new technologies, they may find that these technologies improve performance or make tasks easier and more efficient. This increases awareness of technology aids (Krishnan et al., 2021).

Balancing risk tolerance and perceived benefits: Optimal risk tolerance

Technology adoption often involves some degree of risk, and people who are willing to take calculated risks will (Setyaningsih et al., 2020). However, these risks must be manageable and justifiable. If individuals believe that the potential benefits (utility) outweigh the perceived risks, they are more likely to assume the technology (Wang et al., 2023). Trust and security: Building trust and ensuring the security and reliability of technology can reduce perceived risk (Alshurideh et al., 2023). Perceptions of usefulness are likely to increase if users are confident that their concerns are addressed and that using the technology will improve performance. In summary, RT can have both positive and negative effects on PU of technology in a TAM framework.

System Use

System use (SU) in TAM is a key factor that plays a key role in determining the success of technology implementation and its outcomes. SU in TAM refers to the extent to which an individual uses a particular technology or information system. Measure the frequency, depth, and reliability of usage by users (Davis, 1989). Reflects whether the user actively interacts with the system. SU is closely related to PU in TAM. PU is a user's perception of how using technology improves work performance or makes a task easier. Higher PU tends to increase SU (Mortazavi et al., 2021).

RESEARCH METHODOLOGY

The system component comprises two issues. The primary issue is the investigation of past related works to distinguish the components to be considered. The moment issue is the sending of a web-based study, which is a vital device for conducting inquiries related to the understudy behavior of utilizing game-playing to memorize graphic programming language courses (Alfadda & Mahdi, 2021). For this research, students were considered the key members to assess the components and the taking of game-playing innovation to memorize graphical programming language courses.

This study demonstrates the influence of distinct key components on students' perception of gaming behavior in understanding a graphical programming language. Otherwise, this investigation should evaluate the relationship between contributing variables and meaningful playing behavior for learning a graphical programming course (Liang et al., 2021). The problem is the belief that the limited recognition of gamification systems by students is due to the behavior of less use of gamification technology in learning (Agbo et al., 2023).

In this consideration, the proposed show is created based on the halfway slightest squares-structural condition show partial least squares-structural equation modeling (PLS-SEM) application which was utilized to draw out vital developments based on the structural relationship investigation between measured factors and inactive developments (Wire, 2023). This imperative development of game-play frameworks was combined into the models of TAM, and RT variables to legitimize learning objectives, learning exercises, criticism and assessment (Wang et al., 2023).

A cross-sectional study captures data at a single point in time, which limits the ability to infer causality. A longitudinal approach, though more hearty, may not have been feasible due to time and resource constraints. The advanced examination is required to get it on the off chance that the researcher's presumptions are genuine and what can be done to move forward the distinctive aspects of instructional method and quality recognition in game-play frameworks.

PLS-SEM was chosen over other regression methods due to its ability to handle complex models with multiple dependent and independent variables, especially when the research involves latent hypotheses that are measured through multiple indicators. Unlike traditional regression methods such as ordinary least squares, PLS-SEM is well-suited for exploratory research, theory development, and small to medium sample sizes. Additionally, PLS-SEM does not require strict assumptions about data distribution and can effectively model both formative and reflective constructs, making it ideal for investigating the relationships in the study.

Since the data is collected through a survey, there is a possibility of self-reporting bias, where respondents may provide socially desirable answers or may not accurately recall their experiences. This could affect the reliability and validity of the findings. Anonymity and confidentiality assure participants that their responses will remain anonymous and private to encourage honest answers. Validated measurement scales use well-established and validated scales to minimize measurement errors.

Table 1. Path coefficients

	BI	PU	SU
BI			0.233
PEOU	0.264	0.448	
PU	0.282		
RT		0.073	
Tech Int		0.402	

Participants

The survey was distributed to 125 participants at AlBuraimi University College, Oman. The participants were from two different departments, the English and linguistics department and the information technology department students. The link to the survey consists of 21 different items divided into six factors that were shared among the researchers' students through social networks. The survey used the Likert scale (1–5) from strongly disagree to strongly agree to test and validate the participant responses.

One of the limitations is the homogeneity of the sample. A lack of diversity in the sample in terms of age, gender, prior gaming skill, and graphical programming course proficiency levels can limit the applicability of the results to diverse learner populations.

Total valid participants for all respondents is 96%. The information technology department was 52% while the graphical programming course department was 48%, the age group is divided into three categories (18-21 years old, 22-26 years old, 26+ years old), and the highest number of participants (42.7%) belong to the first category (18-22 years old). Student qualifications were diploma (32.2%), university degree (14.3%), and bachelor's degree (53.4%). Of the financial scholarships, 66.1% were state scholarships and 33.9% were private scholarships. Regarding gender, 43.6% were male and 56.4% female. In particular, students' ability to use computers as technology or through gameplay applications. However, 47.4% had very high ability, 43.4% had high competency, and 9.2% had low competency.

Model Concepts

This section explains the conceptual research model, as shown in **Figure 1**. In the proposed model, PU, PEOU, ATT, BI, and original TAM factors such as SU were used. Additionally, three other elements are used in this conceptual model: Tech-Int, and RT (Tawafak et al., 2022). The model uses six hypotheses and the results are described later.

RESULTS

We describe the results and their positive impact on the proposed model. Once Cronbach's alpha value is calculated, which is only accepted if it is greater than 0.7, composite reliability (CR) also checks if it is greater than 0.7 to be accepted. The average variance extracted (AVE) value must be greater than or equal to 0.5 to be accepted. **Table 1** shows the path coefficients of all factors as the influence of each factor on the other factors. Manipulative way coefficients and approving them ordinarily includes utilizing auxiliary condition modelling (SEM). The calculation begins with indicate the show: May you characterize the hypothetical demonstration with hypothesized connections between factors? This incorporates recognizing the idle and watched factors.

Draw the way chart: Make a visual representation of the show showing the directional ways between factors. Displaying (Lorenz & Buhtz, 2017). Collect information: Assemble information for all the factors within the demonstration. Guarantee that the test estimate is satisfactory for the complexity of the protest (Alfadda & Mahdi, 2021). The calculated and approved way coefficients in an auxiliary condition show guarantee that your discoveries are vigorous and dependable.

Table 2 shows the validity of discrimination. Evaluating discriminant validity ensures that a construct is truly distinct from other constructs in the model. Fornell-Larcker criterion, this strategy compares the square root of AVE for each build with the relationships between that develop and others develop. Discriminant validity is set up in case the square root of the AVE of each expansion is more prominent than the relationships with other developments.

Table 2. Discriminant validity

	BI	PEOU	PU	RT	SU	TI
BI	0.839					
PEOU	0.235	0.886				
PU	0.346	0.623	0.850			
RT	0.029	0.043	0.240	1.000		
SU	0.200	0.320	0.268	0.182	0.854	
TI	0.276	0.441	0.305	0.139	0.291	0.947

Table 3. Construct reliability and validity

	Cronbach's alpha	CR	Average variance rollability
BI	0.789	0.877	0.705
PEOU	0.429	0.755	0.617
PU	0.813	0.876	0.640
RT	1.000	1.000	1.000
SU	0.645	0.842	0.729
Tech Int	0.884	0.945	0.896

Table 4. R^2 values

	R^2	Remarks
BI	0.242	Weak accepted
PU	0.532	Highly accepted
SU	0.054	Weak accepted

Calculate the AVE: The AVE is the normal sum of fluctuation captured by the development in connection to the sum of fluctuation due to an estimation blunder. Compare AVE with inter-construct correlations: The square root of the AVE ought to be higher than the most elevated relationship with any other building (Davarpanah, 2021).

Discriminant validity is evaluated by analyzing whether the pointer loads higher on its particular build than on other constructs. Check cross-loadings: Guarantee that each pointer loads more emphatically on its related build than on any other development. Heterotrait-Monotrait ratio (HTMT), HTMT could be a more rigid basis that equivalences the proportion of the between-trait relationships to the within-trait relationships. Values underneath 0.90 (or 0.85 for stricter criteria) demonstrate discriminant validity.

In case the corner-to-corner components (square roots of AVEs) are higher than the off-diagonal components (relationships), discriminant validity is built up (Lorenz & Buhtz, 2017).

Table 3 shows the reliability and validity of all factors.

Reliability and validity are principal concepts in investigating and estimating hypotheses, basic for guaranteeing that rebellious estimations deliver exact and steady results. Reliability refers to the consistency or hardness of an estimation instrument. A solid instrument yields the same comes about beneath reliable conditions. Measures the consistency of comes about over things inside a test. Commonly evaluated utilizing Cronbach's alpha, with values extending from 1. The next esteem shows way better inner consistency (more often than not over 0.70 is considered worthy).

Validity alludes to the degree to which an estimation instrument measures what it is assumed to degree. A substantial instrument precisely reproduces the concept or development it is expecting to measure.

Reliability could be a prerequisite for validity: An instrument must be dependable (reliable) to be substantial (exact). In any case, a dependable instrument isn't fundamentally substantial. For occasion, a scale that reliably measures weight erroneously is solid but not substantial. Validity envelops reliability: For an estimation to be substantial, it must too be solid. In any case, validity goes past reliability by guaranteeing that the estimation reflects the planning build precisely.

Table 4 shows that the R-squared (R^2) results show high tolerance for some factors but low tolerance for others. R^2 is a statistical measure that characterizes the proportion of the variance for a dependent variable that's explained by an independent variable or variables in a regression model (Jang & Byon, 2020; Tawafak et al., 2022). In other words, it tells us how well independent variables explain the variability of the dependent variable. $R^2 = 0$: The free factors don't clarify any of the changeability of the subordinate variable. $R^2 = 1$: The

Table 5. Bootstrapping path coefficient, SD, supporting

H	Relationship	PC	SD	Support
H1	Tech Int → PU	0.402	0.055	Supported
H2	RT → PU	0.073	0.084	Not supported
H3	PEOU → PU	0.446	0.064	Supported
H4	PEOU → BI	0.264	0.071	Supported
H5	PU → BI	0.282	0.073	Supported
H6	BI → SU	0.233	0.066	Supported

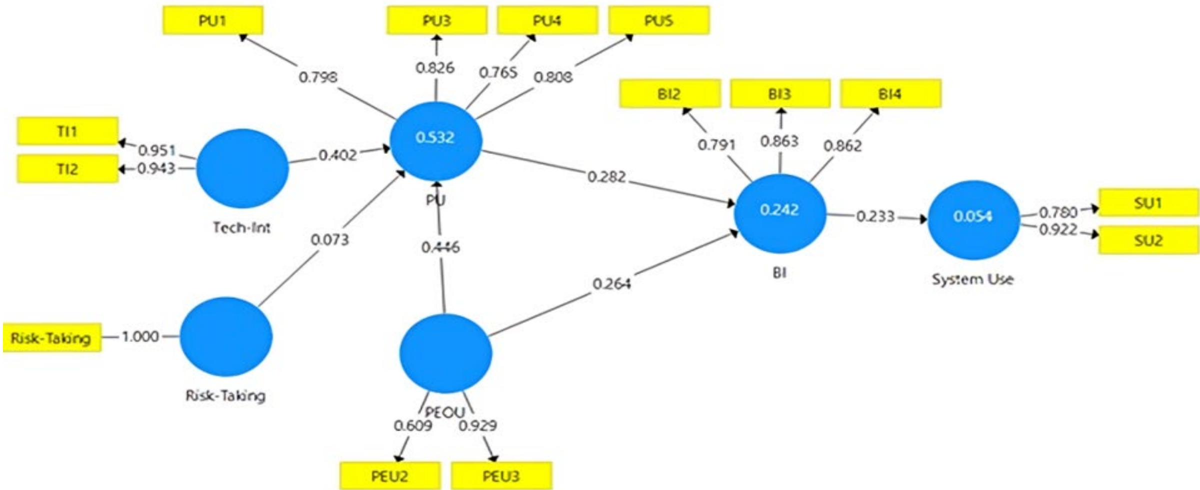

Figure 2. Path coefficient histogram (the authors' own work)

autonomous factors clarify all the inconstancy of the subordinate variable. $0 < R^2 < 1$: Indicates the extent of the fluctuation within the subordinate variable that's predictable from the free factors. For this case, an R^2 of 0.70 implies that 70% of the change within the subordinate variable is explained by the autonomous factors. R^2 measures the extent of the change within the subordinate variable clarified by the free factors (Hamari et al., 2014; Lorenz & Buhtz, 2017).

Balanced R^2 alters R^2 based on the number of indicators, giving a more exact degree when comparing models with distinctive numbers of indicators. Assessing R^2 includes analyzing its esteem within the setting of the field of pondering, understanding its restrictions, and considering the plausibility of overfitting and non-linearity (Davarpanah, 2021). The following elements are written in the short form for easy reference: ATT, BI, long-term.

According to the PLS-SEM program, R^2 value could be accepted if its value is above 0.3, while scrawny if it is less than 0.3, and highly accepted with a value of equal to or above 0.5, as shown in **Table 5**. The path coefficient histograms show the results in **Figure 2**.

Bootstrapping may be a resampling strategy utilized to gauge the dispersion of a measurement (such as a coefficient) by inspecting with substitution from the information set. It permits the estimation of the standard blunder, certainty interims, and the robustness of the way coefficients in basic equation modelling (SEM).

Standard deviation (SD) could be a degree of the sum of variety or scattering in a set of values. In bootstrapping, SD of the bootstrapped way coefficients gives an appraisal of the standard blunder of the way coefficient (Habes et al., 2023; Hamari et al., 2014).

Bootstrapped way coefficients: The assessed way coefficients from the bootstrapped tests.

SD: The SD of the bootstrapped way coefficients, giving an appraisal of the standard blunder. Certainty Interims: The run inside which the open way coefficient is likely to drop with a certain level of certainty (e.g., 95%).

Table 6. MV and LV prediction summary

Item	MV Q2 predict	LV Q2 predict
BI2	0.094	0.185
BI3	0.156	
BI4	0.135	
PU4	0.168	0.497
PU3	0.385	
PU1	0.291	
PU5	0.370	
SU1	0.032	0.052
SU2	0.045	

By utilizing bootstrapping in SEM, analysts can get vigorous gauges of way coefficients, evaluate their unwavering quality through standard mistakes, and back their discoveries with certainty interims, upgrading the by and large legitimacy of the show.

H1. Tech-Int → PU (PC = 0.402, SD = 0.055, supported). The results indicate a strong positive relationship between Tech-Int and PU, with a path coefficient of (0.402). This suggests that the assimilation of technology significantly enhances users' perception of its usefulness. The low SD (0.055) reflects stability in the estimated effect.

H2. RT → PU (PC = 0.073, SD = 0.084, not supported). The relationship between RT and PU is weak and statistically insignificant (PC = 0.073). The higher SD (0.084) suggests variability in responses, and the lack of support for this hypothesis implies that RT behavior does not directly influence perceptions of usefulness (Lorenz & Buhtz, 2017). The lack of support for **H2** suggests that PU is more strongly driven by practical and functional aspects of technology rather than individual RT behavior. While risk-takers may be more open to trying new technologies, their willingness to take risks does not necessarily shape their perception of how useful a system is. Future research could explore additional mediators or moderators, such as knowledge with technology or perceived trust, to better understand the relationship between personality traits and technology adoption (Su et al., 2023).

H3. PEOU → PU (PC = 0.446, SD = 0.064, supported). A strong positive relationship (PC = 0.446) is observed between PEOU and PU, indicating that when users find a system easy to use, they also perceive it as more useful. The low SD (0.064) suggests reliability in this finding.

H4. PEOU → BI (PC = 0.264, SD = 0.071, supported). The results support the hypothesis that PEOU positively affects BI (PC = 0.264). This implies that users who perceive a system as easy to use are more likely to develop an intention to use it.

H5. PU → BI (PC = 0.282, SD = 0.073, supported). A significant positive relationship (PC = 0.282) is found between PU and BI, indicating that users are more inclined to adopt a system if they perceive it as useful. The SD (0.073) confirms the robustness of this relationship.

H6. BI → SU (PC = 0.233, SD = 0.066, supported). The final hypothesis, probing the link between BI and SU, is also supported (PC = 0.233). This confirms that a strong BI translates into actual SU, reinforcing the predictive validity of the model.

The results indicate that Tech-Int and PEOU significantly influence PU, while PU and PEOU directly impact BI. Finally, BI plays a crucial role in expecting actual SU (Su et al., 2023). However, the relationship between RT and PU was not significant, suggesting that RT behavior does not strongly influence users' perceptions of usefulness. These findings align with established technology adoption models, emphasizing the importance of usability and perceived benefits in shaping user behavior.

PEOU, PU, RT, SU, and Tech-Int: **Table 5** shows the correlation between the mean, SD, p-value, and path coefficient for the final decision to accept or reject a support type. However, although there were negative path coefficients at several points in **Table 5**, the p-values achieved across the model are still highly supported. **Table 6** shows MV and LV prediction summary.

Qualitative analysis of the output results shows that the integration of digital gameplay has a positive impact on students' BIs in learning graphical programming courses. This result strongly supports **H1** and indicates that students will be more interested in learning graphical programming courses when digital gameplay is integrated into the curriculum. Tapingkae et al. (2020) and Mortazavi et al. (2021) showed enthusiasm and engagement in using digital gaming tools, suggesting a positive impact on BIs.

However, cooperative gameplay has a positive impact on group dynamics and student cooperation when learning graphical programming courses. The personalization and adaptability of digital gaming tools improve the individual learning experience when learning graphical programming courses. Students' social presence in digital gameplay positively influences learning outcomes in graphical programming course learning. Digital gameplay integration is positively associated with the long-term sustainability of technology in graphical programming course learning. Students' ATTs toward digital gameplay during graphical programming course learning are influenced by environmental aspects. The integration of digital gameplay positively contributes to the world's digital literacy and is consistent with the principles of sustainable development.

Still, some limitations are limited to the acceptance of the results. Causal inferences: Establishing causality between digital gameplay and BIs in learning is complex. The study may demonstrate correlation, but causation requires more rigorous experimental designs and control of extraneous variables (Al-Obaydi et al., 2023b).

Confounding variables: There may be other variables influencing both digital gameplay and learning intentions (e.g., intrinsic motivation, prior knowledge, teaching quality) that are not adequately controlled for in the study.

DISCUSSION

Regarding the first research question: Integrating digital gameplay into language instruction can have a significant impact on university students' BIs such as motivation, engagement, and self-efficacy. This discussion examines the implications of the findings and research questions and focuses on the transformative impact of using digital gameplay to improve college students' BIs (Dahri et al., 2023).

Motivation plays an important role in language learning, and digital gameplay has proven to be an effective tool for stimulating and sustaining student motivation. The immersive and interactive nature of the gameplay creates an engaging environment that stimulates student interest and curiosity (Su et al., 2023). Digital gameplay fosters a sense of success and progress through instant feedback, rewards, and challenges, increasing language learning motivation (Gee, 2011). This positive influence on motivation can be attributed to the intrinsic pleasure and satisfaction of playing, as well as extrinsic factors related to achievement and recognition. This study is working on the same strength of the previous study where the results were positive and aligned with the use of games in learning (Pikhart et al., 2022; Yu et al., 2021).

Additionally, integrating digital gameplay increases student engagement in language learning. Traditional teaching methods often have difficulty keeping students actively engaged throughout the learning process. However, gameplay provides an interactive platform that requires active participation from students and encourages them to apply language skills in meaningful contexts. The high acceptance of PEOU with PU (0.466) is active and strongly supported in the same way as the acceptance of (Alam, 2022; Zabukovsek et al., 2020). The practical and experiential nature of gameplay provides a deeper understanding of language concepts and encourages language practice in real-life situations. As a result, students become more engaged, invested, and engaged in their language learning journey (Lorenz & Buhtz, 2017)

Another important aspect affected by the integration of digital gameplay is students' self-efficacy. This refers to belief in one's ability to succeed in language learning tasks (Yang et al., 2024).

Regarding the second research question: Understanding college students' perceptions and experiences of using digital gameplay as a language learning tool provides valuable insight into the impact of this approach on BIs. This discussion will consider the results and implications of the research question, highlighting the student perspective and how it aligns with improving BIs (Pikhart et al., 2022; Yu et al., 2021).

University students' perceptions of using digital games for language learning play an important role in forming their BIs. Setyaningsih et al. (2020) and Pikhart et al. (2022) provide that examining student ATTs, beliefs, and opinions can provide a deeper understanding of student motivation, engagement, and self-efficacy. Student perceptions can vary widely and are influenced by factors such as previous digital gameplay experience, personal preferences, and cultural background. One outcome that may emerge from the discussion is the positive recognition that digital gameplay is a fun and engaging tool for language learning (Tawafak et al., 2022).

Furthermore, this discussion may reveal that university students consider digital gameplay as an effective means to improve their language skills. Students can emphasize opportunities to apply their language skills in practice and immediate feedback through gameplay (Ngubelanga & Duffett, 2021; Yu et al., 2021). They may express the belief that gameplay facilitates the development of language skills because it allows them to practice language skills in an authentic context and learn from their mistakes (Blume, 2020). These perceptions are consistent with increased BIs, as students recognize the value of gameplay in improving language skills and are motivated to actively participate in language learning activities (Ngubelanga & Duffett, 2021; Yu et al., 2021).

Additionally, students' digital gameplay experiences can shed light on the challenges they encounter and the strategies they use to overcome them. Some students may express concerns about potential distractions and difficulty adapting to game mechanics (Blume, 2020; Su et al., 2023; Wu et al., 2020).

But through their experiences, students can also provide insight into methods they use to stay focused, manage their time effectively, and reap the benefits of gameplay in language learning. These experiences can provide valuable guidance to educators and policymakers to optimize the integration of digital games into language classrooms (Al-Adwan et al., 2021; Graf-Vlachy & Buhtz, 2017; Jang & Byon, 2020). The match between student perceptions and BIs is an important aspect that needs to be considered. If students view digital gameplay positively and find it beneficial for language learning, this may have a positive impact on their BIs.

On the other hand, Graf-Vlachy and Buhtz (2017) finds if students have negative perceptions or perceive gameplay to be irrelevant or ineffective, this will affect their motivation, engagement, and self-efficacy, leading to decreased BIs may be connected (Rahardja et al., 2019; Tapingkae et al., 2020; Wang et al., 2021).

The findings from Lorenz and Buhtz (2017) and Tawafak et al. (2022) consider recommending a solid relationship between PU, PEOU, and Innovation Integration Variables in forming the behavioral eagerness of learners to utilize computerized gameplay for securing graphic programming course dialect aptitudes (Al-Obaydi et al., 2023a; Chiang, 2020). When learners see advanced diversions as valuable and simple to utilize, and when these diversions are viably coordinated into their learning environment, they are more likely to grasp these apparatuses for dialect learning (Tawafak et al., 2019). This adjusts with the broader TAM system, which sets that higher seen convenience and ease of utilization lead to more noteworthy acknowledgement and appropriation of innovation (Songkram et al., 2023).

Moreover, Setyaningsih et al. (2020) and Habes et al. (2023) proposed the integration of advanced diversions into instructive settings must be carefully arranged to guarantee that these instruments are open, adjusted with learning objectives, and bolstered by fundamental assets. This comprehensive approach not only upgrades the learners' encounter but also increases the probability of positive instructive results, as learners are more persuaded and locked in when they see the innovation as advantageous and simple to utilize (Graf-Vlachy & Buhtz, 2017).

Wu et al. (2020) and Alfadda and Mahdi (2021) show the exchange of PU, PEOU, and innovation integration variables offers a strong clarification for how computerized gameplay can impact learners' behavior eagerly in procuring graphical programming course dialect abilities. Future inquiries ought to proceed to investigate these connections, especially in assorted instructive settings, to advance approve these discoveries and upgrade the adequacy of computerized diversions as dialect learning apparatuses (Dahri et al., 2023).

Practical Implications

The findings of this study provide valuable insights for lecturers, instructional designers, and educational game developers who aim to enhance students' BIs in learning graphics programming courses through digital gameplay.

1. Focus on PU and PEOU: Since PEOU and PU significantly influence students' BIs, lecturers and developers should prioritize designing educational games that are intuitive, user-friendly, and aligned with students' learning objectives (Milutinović, 2024). Simplified user interfaces, clear instructions, and

accessible tutorials can enhance students' perception of the game's usefulness in mastering complex programming concepts.

2. RT may not directly influence PU: The lack of support for the RT → PU relationship suggests that students' willingness to take risks does not necessarily affect their judgment of an educational game's usefulness (Su et al., 2023). Instead of designing games that rely heavily on risk-oriented challenges, developers should focus on structured learning elements such as interactive problem-solving tasks, real-world applications, and scaffolded learning experiences that directly enhance PU (Songkram et al., 2023).
3. Bridging the gap between Tech-Int and student engagement: Tech-Int was found to have a strong impact on PU, indicating that the way digital tools are incorporated into coursework significantly affects student engagement. Educators should ensure that educational games are seamlessly integrated into the curriculum rather than being an optional supplement (Milutinović, 2024).

Study Limitations

While the findings provide meaningful insights, several limitations should be acknowledged:

1. Sample population limitations: The study may have been conducted within a specific educational setting (e.g., a single university or a small group of students), which limits the generalizability of the results to broader populations, including different institutions or levels of expertise. Future studies could expand the sample to include students from various universities, different educational backgrounds, and diverse geographical locations (Mellado et al., 2024).
2. Self-reporting bias: Data was collected through a self-reported questionnaire, which may introduce social desirability bias–students might have provided responses they believed were expected rather than their true opinions. To mitigate this, future research could incorporate objective behavioral data, such as game interaction logs, completion rates, and real-time feedback analytics, to validate students' self-reported perceptions.
3. Technological constraints and game design variability: The effectiveness of digital gameplay depends on game quality, technical issues, and accessibility. If students experience technical difficulties or poorly designed game mechanics, their engagement and PU might be negatively affected (Su et al., 2023). Future studies should consider multiple game designs and compare different types of digital learning environments to assess which game features contribute most to positive learning outcomes.

CONCLUSION

In conclusion, this research sheds light on the significant impact of digital gameplay on behavior intention and Tech-Int among graphical programming course college students, using TAM as a guiding framework.

Firstly, the study's quantitative results demonstrated a clear positive correlation between digital gameplay and behavior intention towards technology adoption. This suggests that engaging in interactive and immersive gameplay experiences can foster a more positive ATT towards embracing technology in educational settings. As technology continues to play an increasingly integral role in modern education, understanding how to enhance behavior intention is critical for promoting effective Tech-Int and, consequently, improving the overall learning experience. Secondly, the qualitative insights from the interviews provided valuable depth to the understanding of students' perceptions and motivations behind their engagement with digital gameplay. Participants reported enhanced motivation, increased interest in learning, and improved problem-solving skills as direct outcomes of digital gameplay experiences. However, this study also highlights the importance of a balanced approach to technological integration. While digital gameplay can positively influence behavior intention and technology acceptance, excessive and unregulated usage may lead to distractions and potential negative consequences. These findings offer valuable guidance for educators and game developers to design engaging and effective digital learning tools for graphics programming courses. By focusing on usability, PU, and BI, educators can enhance student engagement and learning outcomes. However, future research should address sample diversity, objective behavioral metrics, and additional external influences to provide deeper insights into the role of digital gameplay in education.

Recommendations and Future Work

This study suggests multi recommendation points: Professional development that effectively improve digital gameplay to help enhance student BI, this part is crucial to find good guidelines opportunity in consistent to professional development teachers.

Continuous support to encourage students for collaborating work use the open access instructions from the site designers, plus the advantage of working with technology specialists for successful implementation.

Use personalized strategies to get adaptive gameplay, give authorized students to engage with multi gameplay activities, this step can align with their skills of graphic programming language as a professional development.

Customized experiences to guide students to feel as ownership of building a gameplay and be confident to be a better BI.

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