

EXTENDING THE THEORY OF PLANNED BEHAVIOR: THE ROLE OF INTRINSIC AND EXTRINSIC MOTIVATIONS IN PREDICTING DIGITAL GAMING BEHAVIOR AMONG COLLEGE STUDENTS

WANG XIAODAN¹, AINI AZEQA MA'ROF^{1,2,*}, HASLINDA ABDULLAH^{1,2}, ZEINAB ZAREMOHZZABIEH³, YAN TANG⁴

¹Faculty of Human Ecology, Universiti Putra Malaysia, Malaysia

² Institute for Social Science Studies, Universiti Putra Malaysia, Malaysia

³ Women and Family Studies Research Center, University of Religions and Denominations, Iran

⁴ Shanghai Technical Institute of Electronics Information, China

E-mail: gs63451@student.upm.edu.my, azeqa@upm.edu.my, lynn@upm.edu.my,
zeinabzaremozhzabieh@urd.ac.ir, tangyan0935@163.com

ABSTRACT

The purpose of this study was to enhance the Theory of Planned Behavior (TPB) by integrating constructs from Self-Determination Theory (SDT), specifically intrinsic and extrinsic motivation, to better predict digital gaming intentions and behaviors among college students. A cross-sectional design was employed, and data were collected from a sample of 850 Chinese college students using a multi-stage cluster random sampling method. Structural equation modeling was used to test the extended model and assess the predictive relationships between motivational and cognitive factors influencing digital gaming behavior. The findings indicated that attitudes toward gaming, subjective norms, and perceived behavioral control significantly predicted the intention to engage in gaming, which, in turn, predicted actual behavior. Intrinsic motivation had a stronger impact on attitudes and perceived behavioral control than extrinsic motivation, and it influenced behavior indirectly through serial mediation pathways. The results also showed gender did not significantly affect gaming behavior. The findings suggest that game designers and educators should prioritize intrinsic motivational elements—such as autonomy, challenge, and relatedness—when developing game-based learning tools. Tailored interventions based on students' academic levels and geographic backgrounds are also recommended to enhance engagement. This study extends the TPB by integrating motivational dimensions from SDT, offering a more comprehensive framework for understanding technology-related behaviors. It also demonstrates the value of multilevel serial mediation in explaining digital engagement. By addressing both psychological and contextual factors, the extended model provides new insights into how youth adopt and engage with digital gaming technologies.

Keywords: *Theory of Planned Behavior, Intrinsic Motivation, Extrinsic Motivation, Digital Gaming Behavior, Self-Determination Theory*

1. INTRODUCTION

The WHO [1] defines health as “a state of complete physical, mental, and social well-being, not merely the absence of disease or infirmity.” Building on this view, the UNDP [2] stresses that mental health involves maintaining a functional balance between personal abilities and environmental demands, rather than seeking perfection. As digital technologies become deeply embedded in daily life,

concerns have grown about their impact on mental and social well-being—especially among young adults, who form a large share of global internet users.

China, as a global leader in digital innovation, has seen digital gaming become a central part of youth culture, particularly among college students. According to CNNIC [3], approximately 88% of students play digital games weekly, and over 30% spend more than two hours daily on games like

Honor of Kings, League of Legends, and Genshin Impact. These games are not only sources of entertainment but also serve as tools for socializing, coping with stress, and self-expression [4, 5]. However, excessive gaming can lead to negative outcomes, including poor academic performance, disrupted sleep, social difficulties, and increased anxiety and depression [6].

To reduce these risks, the Chinese government has introduced policies such as real-name registration and gaming time limits for minors [7]. However, these regulations have limited impact on college students, who—as adults—exercise greater control over their digital activities. This highlights the need to explore the personal and social factors influencing gaming behavior in this group.

Previous studies suggest that college students are motivated to play digital games by both intrinsic factors (e.g., enjoyment, autonomy, challenge) and extrinsic factors (e.g., peer pressure, social approval, escape from stress) [8, 9]. While intrinsic motivation often supports more balanced and healthy gaming, extrinsic motivation—especially when driven by stress or social conformity—is more closely linked to excessive or problematic use [10]. Additionally, perceived behavioral control, or the belief in one's ability to manage gaming behavior, plays a key role in translating intention into action [11].

Despite growing interest in gaming behavior in East Asia, much of the research focuses on general usage patterns or clinical issues like Internet Gaming Disorder. Less is known about the everyday motivational processes behind gaming in non-clinical settings. The Theory of Planned Behavior (TPB)[12] offers a useful framework for this purpose. It explains behavior through three main factors: attitudes, subjective norms, and perceived behavioral control. TPB can also be expanded to include additional factors such as motivation.

However, traditional uses of TPB often emphasize external influences and may not fully capture the role of internal motivation. To address this, scholars have proposed combining TPB with insights from Self-Determination Theory (SDT)[13], which differentiates between autonomous (intrinsic) and controlled (extrinsic) motivation. This integrated approach has been valuable in fields like education and digital media studies.

Building on this foundation, the current study extends the TPB by incorporating constructs from SDT to provide a more comprehensive

understanding of digital gaming behavior among Chinese college students. Specifically, it seeks to:

1. Identify the psychological and social factors—including attitudes, subjective norms, and perceived behavioral control—that influence students' intentions to engage in digital gaming;
2. Examine the indirect role of intrinsic and extrinsic motivation through TPB variables in shaping these intentions; and
3. Assess whether gender moderates the relationship between intention and actual gaming behavior.

By focusing on a population that is both digitally active and developmentally autonomous, this study offers both theoretical contributions and practical implications. The findings aim to inform educators, policymakers, and mental health professionals seeking to foster healthier and more intentional digital gaming habits among university students in China.

2. LITERATURE REVIEW

2.1 Theory of Planned Behavior

TPB is a widely used psychological model for understanding and predicting human behavior. It emphasizes the role of individual beliefs in shaping intentions, which in turn influence actual behaviors. According to TPB, behavioral intention is determined by three core constructs: attitude toward the behavior, subjective norms, and perceived behavioral control [14]. This model has been applied extensively across various domains, including health, education, and digital environments—particularly in understanding digital gaming behavior. This model is reflected in our study, where attitude, subjective norms, and perceived behavioral control significantly predicted students' digital gaming intention.

Attitude toward the behavior refers to an individual's overall evaluation of engaging in a specific action. In digital gaming contexts, attitudes are shaped by perceived enjoyment, usefulness, satisfaction, and compatibility with personal interests [15]. Research consistently demonstrates that positive attitudes toward gaming, driven by perceived enjoyment, usefulness, and satisfaction, significantly predict intentions to engage in digital gaming [16]. For instance, studies on mobile gaming show that attitudes shaped by game features, such as

compatibility and trialability, strongly influence players' intentions to continue playing [17]. Among college students, favorable attitudes toward digital gaming are expected to enhance their intention to participate. The current study, therefore, proposed the following hypothesis:

H₁. Attitude toward digital gaming is positively associated with college students' intention to engage in digital gaming.

Subjective norms refer to the perceived social pressure to perform or abstain from a behavior [18]. In digital gaming, these norms include the influence of peers, family members, instructors, and online communities. Studies have shown that social approval and peer encouragement within gaming cultures can enhance individuals' intention to play, particularly in multiplayer or socially interactive gaming environments [19]. Although some research suggests the impact of subjective norms may weaken over time, their influence is particularly relevant during the early stages of gaming engagement, especially among college students seeking social connection. Therefore, a second study hypothesis was proposed:

H₂. Subjective norms are positively associated with college students' intention to engage in digital gaming.

Perceived behavioral control reflects the individual's belief in their ability to perform a given behavior. This includes both internal factors (e.g., confidence, self-efficacy) and external constraints (e.g., access to technology, time availability). In the context of digital gaming, studies demonstrate that perceived behavioral control significantly predicts gaming intentions, particularly in contexts like in-game purchases and transitions to paid game versions [20]. College students who feel confident in their gaming abilities or have easy access to gaming platforms are more likely to intend to play [21]. Therefore, a third study hypothesis was proposed:

H₃. Perceived behavioral control is positively associated with college students' intention to engage in digital gaming.

Research indicates a positive relationship between college students' intention to engage in digital gaming and their actual gaming behavior. Digital gameplay integration in education positively influences students' behavior intention, enhancing

motivation and engagement [22]. Gaming can serve as a coping mechanism against stress, with increased gaming behavior observed during stressful periods like examinations and lockdowns [6, 23]. Self-regulation plays a protective role in reducing excessive gaming [24]. The TPB, extended to include perceived enjoyment and flow experience, effectively models the determinants of actual online game usage among students [25]. These findings suggest that addressing attitudes, managing stress, and promoting responsible gaming could foster healthier gaming habits among college students. Therefore, a third study hypothesis was proposed:

H₄. College students' intention to engage in digital gaming is positively associated with their actual digital gaming behavior.

2.2 Integration of Self-Determined Motivations into the TPB Framework

While the TPB has been widely used to explain technology adoption and behavioral intentions, it predominantly emphasizes extrinsic motivations and social influences, such as perceived norms and external control factors. However, this focus has been critiqued for neglecting intrinsic motivational processes, which are critical for understanding self-initiated behaviors, particularly in learning and digital engagement contexts [12].

To address this limitation, researchers have increasingly integrated constructs from SDT into the TPB framework (Figure 1). SDT distinguishes between intrinsic and extrinsic motivation and emphasizes the importance of fulfilling basic psychological needs—autonomy, competence, and relatedness—in fostering optimal motivation and behavioral outcomes [26]. This integration provides a more holistic understanding of how both internal desires and external pressures shape behavior, particularly in the domain of digital gaming and learning technologies [27, 28]. Chan et al. [29] also used a longitudinal design to show that autonomous motivation from SDT predicts TPB constructs over time in sport injury prevention. In volunteerism, autonomous motivation positively predicted attitudes and perceived behavioral control, which in turn influenced intention to continue volunteering [30]. These studies consistently reveal that incorporating SDT's motivational constructs enhances TPB by influencing attitudes, subjective norms, and perceived behavioral control, thereby improving the model's explanatory and predictive

capacity for various behaviors, including digital gaming behaviour.

2.3 Intrinsic Motivation and Its Role in Digital Engagement

Intrinsic motivation refers to engaging in an activity for its inherent enjoyment, interest, or satisfaction, rather than for some separable external reward [26]. In the context of digital gaming, intrinsic motivation manifests as the desire to explore game narratives, overcome challenges, and master game mechanics purely for the pleasure of the activity itself [31]. For example, students may play video games for fun and excitement, not for rewards like grades or recognition [26]. This type of motivation is associated with deep learning, persistence, creativity, and long-term engagement, as it aligns with the core psychological needs identified by SDT [26]. Research shows that intrinsically motivated individuals engage more deeply in activities, driven by curiosity, challenge, and the joy of mastery [32]. In gaming, such motivation contributes to sustained participation and positive emotional experiences, including flow and euphoria [28].

In educational contexts, fostering intrinsic motivation is essential for enhancing student engagement and improving learning outcomes. Educators are encouraged to design learning environments that promote student autonomy, meaningful challenge, and interest-driven exploration. Overreliance on extrinsic rewards can undermine intrinsic motivation and diminish students' internal desire to learn [26]. Intrinsic motivation also significantly influences TPB constructs. It enhances positive attitudes toward gaming by making the activity inherently rewarding, strengthens subjective norms through the perceived value and support for gaming in one's social environment, and improves perceived behavioral control by increasing self-efficacy and autonomy [33]. Thus, the following hypothesis is proposed:

H₅. Intrinsic motivation is positively associated with college students' attitudes, subjective norms, and perceived behavioral control toward digital gaming, which in turn mediate the relationship between intrinsic motivation and their intention to continue engaging in digital gaming.

2.4 Extrinsic Motivation and Its Role in Digital Engagement

In contrast, extrinsic motivation involves engaging in a behavior due to external rewards or pressures, such as receiving recognition, avoiding punishment, or obtaining tangible incentives like money or grades [26]. In gaming, extrinsic motivation is commonly driven by rewards such as experience points (XP), badges, leaderboards, and in-game currency [34, 35]. Players may participate in games to earn these rewards, rather than for the joy of the activity itself. For example, a player might strive to complete missions not because they enjoy the gameplay but to achieve higher status or unlock new features [36, 37]. Although extrinsic motivators can effectively encourage engagement—especially in the short term—they may not always lead to sustained involvement or deep learning [38, 39].

Nonetheless, extrinsic and intrinsic motivations are not mutually exclusive. In many cases, individuals are driven by a combination of both. For example, a gamer might enjoy a challenge (intrinsic motivation) while also pursuing rewards or achievements (extrinsic motivation) [26, 35]. Well-designed games often blend these motivations to keep players engaged and invested over time [40]. Extrinsic motivators can also structure gameplay by guiding exploration, offering feedback, and creating meaningful challenges. Additionally, social comparisons and recognition—grounded in social comparison theory—can significantly impact player motivation and engagement, especially among college students [34, 39, 41].

Extrinsic motivation also influences TPB constructs. It contributes to positive attitudes by highlighting the benefits and rewards of gaming, reinforces subjective norms through peer influence and social recognition, and enhances perceived behavioral control by clarifying pathways to success and providing tangible markers of achievement [36]. However, excessive dependence on external incentives may undermine intrinsic motivation and reduce long-term engagement [39]. Accordingly, the sixth study hypothesis is proposed:

H₆. Extrinsic motivation is positively associated with college students' attitudes, subjective norms, and perceived behavioral control toward digital gaming, which in turn mediate the relationship between extrinsic motivation and their intention to continue engaging in digital gaming.

2.5 Moderator

Gender significantly moderates the relationships between TPB constructs, motivation, and digital gaming intentions, as males and females exhibit distinct gaming preferences [42, 43]. Males often display more positive attitudes toward competitive gaming, while females prioritize social interaction [44]. Gender influences subjective norms, with females being more sensitive to social pressures, and perceived behavioral control, as males report higher gaming competence [45, 46]. These differences affect the strength of predictors on gaming intentions among college students. Accordingly, the seventh study hypothesis was proposed:

H7. Gender moderates the relationship between college students' intention to engage in digital gaming and their actual gaming behavior, such that the strength of this relationship varies between male and female students.

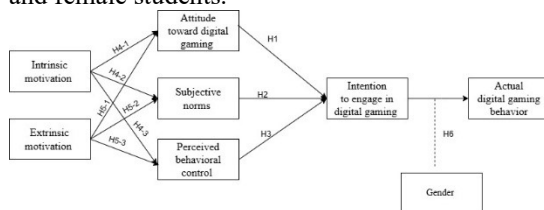


Figure 1: Research Framework.

3. METHODOLOGY

3.1 Study Design

This study employed a cross-sectional design to examine an extended TPB model by incorporating constructs from SDT, namely intrinsic and extrinsic motivation. Data were gathered from a representative sample of Chinese college students using a multi-stage cluster random sampling method [47]. In the first stage, universities were selected to represent geographical and academic diversity. In the second stage, faculties within each selected university were randomly chosen, followed by the random selection of classes or student cohorts in the third stage. Individual participants were then invited to take part through both class-based distribution and online platforms such as WeChat and QQ, enhancing inclusivity and minimizing potential sampling bias. Eligible participants were full-time undergraduate or postgraduate students aged 18 years or older. This design addressed key limitations in prior research by

focusing on everyday digital gaming behavior rather than clinical gaming addiction, incorporating validated TPB and SDT scales to measure latent constructs (e.g., attitudes, perceived behavioral control, motivation types), and administering the surveys confidentially and anonymously to reduce social desirability bias.

3.2 Participants

Quantitative data were gathered through a self-administered questionnaire survey targeting university students in Beijing, China. The research aimed to investigate digitally engaged youth behavior, particularly focusing on online gaming participation. Data collection occurred between November 2023 and March 2024. The sample was drawn from several leading universities in Beijing—the national capital and a central educational hub that attracts students from all provinces. This diverse student population, in terms of socio-economic background, digital literacy, and technology usage, offers a representative view of Chinese urban youth. Thus, findings from this study may contribute to understanding broader behavioral trends among digitally active young adults across China as recommended by previous studies [48].

A total of 850 questionnaires were distributed to college students from nine universities in Beijing. After eliminating 41 incomplete or invalid questionnaires, 798 valid questionnaires were retained for analysis, with a final response rate of 98.7%. Trained student research assistants introduced the purpose of the study, obtained informed consent, and emphasized the confidentiality and anonymity of all responses. For participants who had difficulty reading or understanding, the assistants provided neutral explanations without affecting their responses. The authors gave each participant ample time to ensure that they completed the questionnaire carefully and accurately.

As shown in Table 1, the demographic characteristics of the final sample showed that 60.5% of the respondents were male and 39.5% were female. Most of the participants were between 21 and 23 years old and were sophomores. Most of the participants majored in science and engineering and lived in urban areas (85.6%). Most of the respondents came from families of three, and more than 75% of the respondents had a monthly family income between 5,000 and 7,000 yuan. In addition,

more than half of the participants were only child in family. These characteristics indicate that the sample can widely represent the contemporary urban college student population in China.

Table 1. Demographics of the sample (n=798).

Variable	Frequency	Percent
Gender		
Male	483	60.5
Female	315	39.5
Only child		
Yes	405	50.8
No	393	49.2
Age		
18-20	150	18.8
21-23	231	28.9
24-26	150	18.8
27-29	156	19.5
Over 29	111	13.9
Grade		
Freshmen	147	18.4
Sophomore	231	28.9
Junior	152	19.0
Senior	157	19.7
Graduate	111	13.9
Major		
Science and Engineering	461	57.8
Literature and History	337	42.2
Home locality		
Countryside	22	2.8
Town	93	11.7
City	683	85.6
Family structure		
Less than two	86	10.8
Family of three	340	42.6
Family of four	310	38.8
Family of five	52	6.5
More than five	10	1.3
Household income		
Under 2000RMB	21	2.6
2000-4000RMB	89	11.2
5000-7000RMB	599	75.1
Over 8000RMB	89	11.2
Financial situation		
Poor	22	2.8
Average	93	11.7
Rich	683	85.6

3.3 Measurement

The questionnaire contained seven main concepts: attitude, subjective norm, perceived behavioral control, self-determined motivation, behavioral intention, gaming behavior, and demographic variables. The items of TPB-related concepts were adapted from the TPB questionnaire, which assesses individuals' cognitive evaluation of gaming behavior (attitude), perceived social desirability (subjective norm), and the difficulty of participating in gaming (perceived behavioral

control) [25]. The items of self-determined motivation were from the scale developed by Ryan and Deci [26] and validated by Przybylski and Weinstein [49], which distinguishes between intrinsic and extrinsic motivation in digital contexts. Each construct contains 6 to 10 items and is scored using a 5-point Likert scale ranging from 1 (completely disagree) to 5 (completely agree). The internal consistency of each subscale was tested using Cronbach's α coefficient, and its values ranged from 0.943 to 0.787, indicating high reliability. The digital game intention and behavior subscales were measured using 6 items, which were adapted from previous digital behavior research [25]. The content validity, conceptual clarity, and structural consistency of the scale with the theoretical framework have been confirmed by three university scholars in the fields of psychology and digital media research. The scale is able to systematically quantify the key psychological predictors of digital game behavior among Chinese college students.

3.4 Data Analysis

Data were analyzed using SPSS 28.0 and AMOS 28.0. First, Pearson correlation analysis was conducted to evaluate the degree of association between the key psychological constructs. Independent samples t-tests were then applied to explore the influence of specific demographic variables on individuals' online gaming intentions and behaviors. Confirmatory factor analysis (CFA) was conducted using AMOS 28.0 to assess the measurement model's reliability and validity. As shown in Table 2, all standardized factor loadings exceeded 0.6 and were statistically significant ($p < 0.001$), indicating strong item convergence. The construct reliability (CR) values for all latent variables exceeded the 0.70 threshold, and average variance extracted (AVE) values were all above 0.50, thereby confirming the model's convergent validity [50]. In addition, discriminant validity was demonstrated, as the square roots of AVE for each construct exceeded the correlations between constructs, satisfying Fornell and Larcker's [50] criterion.

Table 2: Consistency and Reliability.

Factor	Items	Standardized loading	α	CR	AVE
ATT	Cognitive Level	0.849	0.787	0.911	0.671
		0.835			
		0.814			
		0.789			
		0.807			
	Behavioral Beliefs	0.809		0.930	0.727
		0.827			
		0.858			
		0.884			
		0.882			
SN	Close Others	0.901	0.943	0.954	0.805
		0.948			
		0.848			
		0.886			
		0.899			
	Public Morals	0.912		0.968	0.857
		0.901			
		0.915			
		0.946			
		0.954			
PBC	Self-Efficacy	0.803	0.927	0.874	0.635
		0.809			
		0.789			
		0.785			
		0.811			
	Self-Control	0.827		0.899	0.689
		0.836			
		0.846			
		0.825			
		0.892			
SD M	Intrinsic Motivation	0.851	0.866	0.918	0.737
		0.865			
		0.847			
		0.863			
		0.892			
	Extrinsic Motivation	0.885		0.927	0.760
		0.865			
		0.847			
		0.863			
		0.892			
DGI	Positive Intention	0.865	0.841	0.879	0.707
		0.809			
		0.848			
		0.866			
		0.904			
	Negative Intention	0.863		0.910	0.771
		0.795			
		0.774			
		0.814			
		0.856			
DGB	Maintenance Time	0.901	0.805	0.837	0.631
		0.805			
		0.856			
		0.901			
		0.805			
	Preference Degree	0.856		0.891	0.731
		0.901			
		0.805			
		0.856			
		0.901			

Note. Attitude = ATT, Subjective Norm = SN, Perceived Behavioral Control = PBC, Self Determination Motivation = SDM, Digital Gaming Intention = DGI, Digital Gaming Behavior = DGB. Composite Reliability = CR (≥ 0.70 indicates good reliability), Average Variance Extracted = AVE (≥ 0.50 suggests good convergent validity), Cronbach's Alpha = α (≥ 0.70 is generally considered acceptable).

Pearson correlation coefficients were computed to examine the relationships among the core constructs of the extended TPB model. As shown in Table 3, digital gaming intention was significantly and positively correlated with all independent variables, including attitude ($r = 0.641$, $p < 0.01$), subjective norm ($r = 0.387$, $p < 0.01$), perceived behavioral control ($r = 0.641$, $p < 0.01$), intrinsic motivation ($r = 0.629$, $p < 0.01$), and extrinsic motivation ($r = 0.635$, $p < 0.01$). This suggests that positive attitudes, social influence, self-perceived control, and both intrinsic and extrinsic motivations are associated with stronger intentions to engage in digital gaming.

Digital gaming behavior was also significantly and positively correlated with all variables: attitude ($r = 0.457$, $p < 0.01$), subjective norm ($r = 0.359$, $p < 0.01$), perceived behavioral control ($r = 0.652$, $p < 0.01$), intrinsic motivation ($r = 0.442$, $p < 0.01$), extrinsic motivation ($r = 0.455$, $p < 0.01$), and intention ($r = 0.667$, $p < 0.01$). Notably, perceived behavioral control showed the strongest association with actual behavior ($r = 0.652$), followed closely by intention ($r = 0.667$), highlighting their critical roles in predicting digital gaming engagement.

In addition, intrinsic and extrinsic motivation were highly correlated with each other ($r = 0.820$, $p < 0.01$), suggesting a strong overlap between these motivational constructs in the context of digital gaming. Overall, the correlation results provide initial empirical support for the extended TPB model, confirming that both motivational and TPB constructs are significantly interrelated and relevant in explaining digital gaming intention and behavior.

Pearson correlation coefficients were computed to examine the relationships among the core constructs of the extended TPB model. As shown in Table 3, digital gaming intention was significantly and positively correlated with all independent variables, including attitude ($r = 0.641$, $p < 0.01$), subjective norm ($r = 0.387$, $p < 0.01$), perceived behavioral control ($r = 0.641$, $p < 0.01$), intrinsic motivation ($r = 0.629$, $p < 0.01$), and extrinsic motivation ($r = 0.635$, $p < 0.01$). This suggests that positive attitudes, social influence, self-perceived control, and both intrinsic and extrinsic motivations are associated with stronger intentions to engage in digital gaming.

Digital gaming behavior was also significantly and positively correlated with all variables: attitude ($r = 0.457$, $p < 0.01$), subjective norm ($r = 0.359$, $p < 0.01$), perceived behavioral control ($r = 0.652$, $p < 0.01$), intrinsic motivation ($r = 0.442$, $p < 0.01$), extrinsic motivation ($r = 0.455$, $p < 0.01$), and intention ($r = 0.667$, $p < 0.01$). Notably, perceived behavioral control showed the strongest association with actual behavior ($r = 0.652$), followed closely by intention ($r = 0.667$), highlighting their critical roles in predicting digital gaming engagement.

In addition, intrinsic and extrinsic motivation were highly correlated with each other ($r = 0.820$, $p < 0.01$), suggesting a strong overlap

between these motivational constructs in the context of digital gaming. Overall, the correlation results provide initial empirical support for the extended TPB model, confirming that both motivational and TPB constructs are significantly interrelated and relevant in explaining digital gaming intention and behavior.

Table 3: Variable correlations of the TPB extended model.

Constructs	SD	Mean	1	2	3	4	5	6	7
ATT	4.456	0.545	1						
SN	4.072	0.541	0.138**	1					
PBC	4.259	0.538	0.544**	0.517**	1				
IM	3.504	0.589	0.379**	0.368**	0.371**	1			
EM	2.638	0.511	0.349**	0.417**	0.391**	0.820**	1		
DGI	3.850	0.529	0.641**	0.387**	0.641**	0.629**	0.635**	1	
DGB	2.812	0.454	0.457**	0.359**	0.652**	0.442**	0.455**	0.667**	1

Note. Attitude = ATT, Subjective Norm = SN, Perceived Behavioral Control = PBC, Intrinsic motivation = IM, Extrinsic motivation = EM, Self Determination Motivation = SDM, Digital Gaming Intention = DGI, Digital Gaming Behavior = DGB, *p < 0.05, **p < 0.01, Correlation is significant at the 0.01 level (2-tailed).

4. RESULTS

The comparison between the original TPB model and the extended TPB model revealed a significant improvement in model fit. As shown in Table 4, the chi-square to degrees of freedom ratio (χ^2/df) decreased from 4.932 to 3.829, while fit indices such as GFI, AGFI, NFI, IFI, and CFI all improved substantially. For example, GFI increased from 0.819 to 0.978 and AGFI from 0.689 to 0.959, both exceeding the recommended 0.90 threshold. Similarly, NFI, IFI, and CFI rose to 0.988, 0.991, and 0.991 respectively. Additionally, the RMSEA declined from 0.070 to 0.060, further supporting the improved fit. These results suggest that the extended TPB model, which includes intrinsic and extrinsic motivation, provides a more accurate and parsimonious explanation of college students' digital gaming behavior.

Table 4: The fit indices of TPB model and extended TPB model.

Fit indices	Recommended value	TPB	Extended TPB	Improvement
χ^2/DF	< 5	4.932	3.829	Improved
GFI	≥ 0.90	0.819	0.978	Improved significantly
AGFI	≥ 0.90	0.689	0.959	Improved significantly
NFI	≥ 0.90	0.859	0.988	Improved significantly
IFI	≥ 0.90	0.885	0.991	Improved slightly
CFI	≥ 0.90	0.884	0.991	Improved slightly
RMSEA	≤ 0.1	0.070	0.060	Slight improvement

Note. χ^2/DF =Chi-square/degree of freedom; GFI=Goodness-of-Fit Index;

AGFI=Adjusted Goodness-of-Fit Index; NFI=Normed Fit Index; IFI=Incremental Fit Index; CFI=Comparative Fit Index; RMSEA=Root Mean Square Error of Approximation.

Structural path analysis within the original TPB model supported H₁ to H₄. Attitude ($\beta = 0.231$, $t = 5.835$, $p < .001$), subjective norms ($\beta = 0.171$, $t = 4.331$, $p < .001$), and perceived behavioral control ($\beta = 0.166$, $t = 3.886$, $p < .001$) all had significant positive effects on students' intention to engage in digital gaming, supporting H₁ through H₃. Together, these variables explained 22.5% of the variance in digital gaming intention ($R^2 = 0.225$). Furthermore, intention significantly predicted actual gaming behavior ($\beta = 0.643$, $t = 23.706$, $p < .001$), confirming H₄. Attitude ($\beta = 0.510$), PBC ($\beta = 0.481$), and subjective norm ($\beta = 0.432$) also had direct effects on digital gaming behavior, with the full model accounting for 52.8% of the variance in actual behavior ($R^2 = 0.528$).

Mediation analyses revealed that intention partially mediated the relationships between the core TPB variables—attitude, subjective norms, and perceived behavioral control—and actual digital gaming behavior. Specifically, the indirect effect of attitude on behavior through intention was significant ($\beta = 0.2850$, 95% CI [0.2296, 0.3407]), accounting for approximately 42.3% of the total effect, highlighting intention as a substantial conduit through which personal evaluations shape behavior. Similarly, subjective norms exerted a significant indirect influence on behavior via intention ($\beta = 0.2143$, 95% CI [0.1684, 0.2621]), as did perceived behavioral control ($\beta = 0.2697$, 95% CI [0.2194, 0.3252]). These findings underscore the pivotal role of intention as a mediating mechanism, aligning with the core assumptions of the TPB.

In testing H₅ and H₆, which proposed intrinsic and extrinsic motivation as antecedents of the TPB components, results from the extended model confirmed their significant predictive value. Intrinsic motivation demonstrated stronger effects than extrinsic motivation across all three TPB constructs. Notably, intrinsic motivation exhibited its greatest influence on attitude ($\beta = 0.582$, $t = 14.980$), followed by significant effects on subjective norms and perceived behavioral control. While extrinsic motivation also significantly predicted all three TPB variables, the effects were comparatively weaker.

Further chain mediation analyses supported the extended model by demonstrating that both intrinsic and extrinsic motivation influenced digital gaming behavior indirectly via sequential pathways

involving TPB constructs. For instance, the indirect path from intrinsic motivation $\rightarrow$ attitude $\rightarrow$ intention $\rightarrow$ behavior was significant ($\beta = 0.0861$, 95% CI [0.0640, 0.1099]), highlighting the importance of internal drive in shaping favorable attitudes that translate into behavioral action. Likewise, the path from extrinsic motivation $\rightarrow$ subjective norms $\rightarrow$ intention $\rightarrow$ behavior was also significant ($\beta = 0.0385$, 95% CI [0.0259, 0.0532]), suggesting that external reinforcement can shape social pressures that ultimately affect behavior. Overall, these findings offer robust support for the partial mediating roles of TPB constructs and validate the integration of motivational dimensions within the TPB framework to better explain digital gaming behavior among Chinese college students (Table 5).

Table 5: Path Testing Results.

Path Analysis	Path	β	t	F	p	R ²	
	TPB Model						
	ATT → DGI	0.231	5.835	78.132	.000	0.225	
	SN → DGI	0.171	4.331				
	PBC → DGI	0.166	3.886				
	ATT → DGB	0.510	16.716	178.983	.000	0.528	
	SN → DGB	0.432	13.526				
	PBC → DGB	0.481	15.469				
	DGI → DGB	0.643	23.706				
	Extended TPB						
	IM → ATT	0.582	14.980	162.421	.000	0.342	
	IM → SN	0.465	11.274				
	IM → PBC	0.491	12.631				
	EM → ATT	0.398	9.387	98.532	.000	0.269	
	EM → SN	0.341	8.002				
	EM → PBC	0.376	8.975				
	Mediation Analysis	Path	Effect	SE	95% CI (LLCI, ULCI)		
		TPB Model					
		ATT → DGI → DGB					
		Total effect		0.6731	0.0403	[0.5941, 0.7522]	

Direct effect	0.3882	0.0369	[0.3157, 0.4606]
Indirect effect	0.2850	0.0285	[0.2296, 0.3407]
SN $\rightarrow$ DGI $\rightarrow$ DGB			
Total effect	0.4330	0.0320	[0.3702, 0.4959]
Direct effect	0.2187	0.0284	[0.1630, 0.2744]
Indirect effect	0.2143	0.0240	[0.1684, 0.2621]
PBC $\rightarrow$ DGI $\rightarrow$ DGB			
Total effect	0.5995	0.0388	[0.5234, 0.6756]
Direct effect	0.3297	0.0351	[0.2609, 0.3986]
Indirect effect	0.2697	0.0272	[0.2194, 0.3252]
Extended TPB			
IM $\rightarrow$ ATT $\rightarrow$ DGI $\rightarrow$ DGB	0.0861	0.0115	[0.0640, 0.1099]
IM $\rightarrow$ SN $\rightarrow$ DGI $\rightarrow$ DGB	0.0510	0.0087	[0.0346, 0.0682]
IM $\rightarrow$ PBC $\rightarrow$ DGI $\rightarrow$ DGB	0.0523	0.0092	[0.0351, 0.0705]
EM $\rightarrow$ ATT $\rightarrow$ DGI $\rightarrow$ DGB	0.0593	0.0090	[0.0421, 0.0771]
EM $\rightarrow$ SN $\rightarrow$ DGI $\rightarrow$ DGB	0.0385	0.0076	[0.0259, 0.0532]
EM $\rightarrow$ PBC $\rightarrow$ DGI $\rightarrow$ DGB	0.0410	0.0082	[0.0278, 0.0564]

Note. Attitude = ATT, Subjective Norm = SN, Perceived Behavioral Control = PBC, Intrinsic motivation = IM, Extrinsic motivation = EM, Self Determination Motivation = SDM, Digital Gaming Intention = DGI, Digital Gaming Behavior = DGB, Standard Error = SE, = Lower limit of the 95% confidence interval = LLCI, Upper limit of the 95% confidence interval = ULCI, Bootstrap mediation analyses were performed with 5,000 resamples. $p < 0.001$.

To examine H₇, independent samples t-tests were conducted to determine whether significant gender differences exist in digital gaming intention and behavior among college students. As shown in Table 6, the results revealed no statistically significant differences between male and female students regarding their intention to engage in digital gaming ($M = 3.14$, $SD = 0.98$ for males; $M = 3.06$, $SD = 1.04$ for females; $t = -1.015$, $p = 0.310$). Similarly, no significant difference was found in actual digital gaming behavior between male ($M = 3.01$, $SD = 1.04$) and female students ($M = 2.83$, $SD = 0.93$), with the t-test result indicating $t = 1.081$, $p = 0.280$.

These findings suggest that gender does not play a significant role in influencing either the intention to engage in digital gaming or the actual gaming behavior among the sample studied. Therefore, H₇, which proposed that individual factors such as gender would significantly influence gaming intention and behavior, was not supported. This outcome highlights that both male and female students exhibit similar patterns in their digital gaming engagement, and other factors—such as

motivational or environmental influences—may be more critical in understanding their gaming behaviors.

variables also exert direct effects on behavior, revealing a more complex behavioral process than previously assumed.

Table 6: Differences in individual factors and environmental factors.

Construct		Male (N=483)		Female (N=315)		t / F	p
		M	SD	M	SD		
Gender	DGI	3.1356	0.9763	3.0571	1.03985	1.015	0.310
	DGB	3.0087	1.03891	2.8254	0.92873	1.081	0.280

Note. Digital Gaming Intention = DGI, Digital Gaming Behavior = DGB, M = mean; SD = standard deviation; t = independent samples t-test; F = one-way analysis of variance (ANOVA); p-values are indicated by asterisks to denote levels of statistical significance: * p < 0.05, ** p < 0.01, *** p < 0.001; t-tests were conducted for gender differences.

5. DISCUSSION

This study set out to enhance the TPB by incorporating intrinsic motivation and extrinsic motivation in predicting digital gaming behavior among college students. The findings underscore the extended TPB model's superior predictive validity and theoretical depth, particularly in capturing the multifaceted nature of digital gaming intentions and behaviors in contemporary educational settings.

The present findings align with a study by Alzahrani et al. [51], who similarly found that intrinsic motivation strengthened TPB's predictive power for gaming behavior, though their focus was on adolescents rather than college students. Unlike prior studies that treated motivation as a unidimensional construct (e.g., [52]), the present differentiation of intrinsic/extrinsic pathways offers finer-grained insights into how motivation types interact with cognitive TPB constructs.

Consistent with the propositions of the TPB [12], attitude toward the behavior, subjective norms, and perceived behavioral control significantly predicted digital gaming intention, which, in turn, strongly predicted digital gaming behavior. This supports the well-documented hierarchical structure of the TPB, where intentions serve as a proximal determinant of behavior. However, the traditional TPB explained only modest variance in digital gaming intention and digital gaming behavior, which highlights the limitations of a purely rational-intentional model in capturing the nuances of digital gaming.

Importantly, the results provide evidence for the partial mediating role of intention in the relationship between the TPB constructs (attitude, subjective norms, and perceived behavioral control) and actual behavior. This suggests that while intention remains a critical determinant, TPB

The integration of motivational variables addressed this gap. Intrinsic motivation emerged as a more potent predictor than extrinsic motivation, influencing both attitude toward the behavior and perceived behavioral control, and exerting significant indirect effects on digital gaming behavior through serial mediation chains (e.g., intrinsic motivation → attitude toward the behavior → digital gaming intention → digital gaming behavior). This supports the SDT [13], which posits that intrinsic goals—those aligned with autonomy, competence, and relatedness—foster sustained engagement. In contrast, while extrinsic motivation (e.g., rewards, recognition) positively influenced intentions, its effects were comparatively weaker and less stable, potentially due to the undermining effect of extrinsic rewards on intrinsic interest when perceived as controlling [53, 54]. This aligns with meta-analytic evidence [55] showing that extrinsic motivators in gaming often yield short-term compliance but fail to sustain long-term engagement.

Gamification strategies that align with intrinsic needs, such as challenge and social interaction, were also discussed as critical levers for engagement. Recent studies (e.g., [56]) similarly highlight the efficacy of autonomy-supportive game design, though our focus on college students—a less-studied population in gamification research—adds novel contextual insights.

This was evident in the supporting literature showing that well-designed digital environments that balance autonomy and achievement features can sustain learners' motivation and enhance the perceived value of gaming in educational contexts [57, 58].

Furthermore, the findings displayed gender did not significantly influence digital gaming intention or digital gaming behavior. The implications of no significant gender differences in the intention to engage in digital gaming suggest a shift in societal norms and gaming culture. Recent studies indicate that while there are some motivational differences between genders, the overall time spent playing and engagement levels are increasingly similar. This trend reflects a narrowing gender gap in gaming, which has important consequences for game design and educational

applications [59, 60]. The findings suggest that digital games can be effective learning tools for all genders, promoting equal opportunities in educational settings [61, 62].

6. CONCLUSION

This study extended the TPB by integrating intrinsic and extrinsic motivation from SDT to better explain digital gaming intentions among Chinese college students. The results showed that both intrinsic and extrinsic motivation significantly influenced attitudes, subjective norms, and perceived behavioral control, which in turn affected students' intentions to continue digital gaming. Mediation analyses revealed that these TPB components partially mediated the effects of both types of motivation on gaming intentions, supporting the hypothesized indirect pathways. The extended model accounted for a substantially greater proportion of variance in behavioral intention compared to the original TPB, demonstrating its enhanced predictive power. Additionally, gender invariance analysis confirmed the model's stability across male and female students. These findings highlight the value of incorporating motivational constructs into cognitive-behavioral models and suggest that promoting intrinsic motivation may be particularly effective in sustaining engagement with digital gaming in both recreational and educational contexts.

7. IMPLICATIONS

This study contributes to the theoretical literature by bridging the TPB with SDT. The extended TPB model demonstrates that motivational constructs—particularly intrinsic motivation—are critical antecedents to digital gaming behavior. This integration enriches the rationalist foundation of the TPB with affective and psychological dimensions of decision-making, offering a more nuanced understanding of how digital behaviors are formed.

The dual-stage mediation paths uncovered in the results provide empirical support for the argument that motivation influences behavior not only directly but also indirectly through attitudes, perceived behavioral control, and intentions. This multilevel interaction framework can inform future behavioral models across digital domains, including e-learning, social media usage, and mobile application engagement.

For game developers and educational technologists, understanding that intrinsic motivation is a stronger predictor of sustained gaming behavior suggests that design strategies should prioritize user autonomy, relatedness, and challenge rather than relying solely on rewards or incentives. Elements such as user customization, collaborative features, and adaptive difficulty levels may significantly boost user engagement.

Marketers and digital product designers can leverage insights into subjective norms and perceived behavioral control to craft campaigns that resonate with social values and reduce perceived barriers to gaming. For example, peer influence and parental attitudes can be framed positively to increase acceptance among target audiences.

In educational settings, the findings underscore the importance of aligning game-based learning tools with students' psychological needs and personal interests. Educators and instructional designers should consider incorporating game elements that enhance enjoyment, autonomy, and social interaction to encourage sustained engagement. Understanding the nuances of gender preferences can guide the development of more inclusive educational games, fostering a diverse learning environment.

8. LIMITATIONS AND FUTURE DIRECTIONS

Despite these contributions, the study's cross-sectional and self-reported design limits causal interpretations. Longitudinal or intervention-based research is needed to confirm the directionality and stability of the relationships identified. Additionally, while the study was conducted with a reasonably diverse sample within a national new area in China, its cultural and geographic specificity may limit generalizability. Future studies should incorporate multi-site or cross-national samples to examine cultural moderators of gaming behavior.

Finally, future research should explore additional psychological and contextual variables—such as emotional regulation, flow state, and family gaming culture—to further enrich the extended Theory of Planned Behavior model. Examining how these interact with motivational and normative factors may yield even deeper insights into digital engagement patterns among youth.

REFERENCES

- [1]. WHO. Constitution. Geneva, Switzerland: World Health Organization; 1948.
- [2]. UNDP. United Nations System Mental Health and Well-being Strategy for 2024 and beyond. United Nations; 2024.
- [3]. CNNIC. The 54th Statistical Report on China's Internet Development. China Internet Network Information Center; 2024.
- [4]. Bowditch L, Naweed A, Signal T, Chapman J. More than just a game: Understanding how internet games are used in times of stress. *Entertainment Computing*. 2024;49:100617.
- [5]. Jo H, Park S, Jeong J, Yeon J, Lee JK. Metaverse gaming: analyzing the impact of self-expression, achievement, social interaction, violence, and difficulty. *Behaviour & Information Technology*. 2025;44:749–63.
- [6]. Wang X, Zhang Y, Lin J, Wong ACW, Chan KK, Wong SY, et al. Treatments of internet gaming disorder and comorbid mental disorders: A systematic review and meta-analysis. *Computers in Human Behavior*. 2023;149:107947.
- [7]. Wu J, Zhang H. An Introduction to the Development of the Anti-Addiction System of Online Games for Minors in China. In: 2024 4th International Conference on Public Art and Human Development (ICPAHD 2024). Atlantis Press; 2025. p. 279–86.
- [8]. Lin Y-L, Wang W-T, Kuo C-C, Chen P-H. Motivational incentives in the context of online game-based formative assessment and improved student learning performance. *Education and Information Technologies*. 2025;30:4669–94.
- [9]. Lyu Y. Gamification as a Bridge Between Intrinsic and Extrinsic Motivation in Chinese Post-Secondary Education. Master's Thesis. McGill University; 2024.
- [10]. Zhang L, Han J, Liu M, Yang C, Liao Y. The prevalence and possible risk factors of gaming disorder among adolescents in China. *BMC psychiatry*. 2024;24:381.
- [11]. Wang Y-M, Wei C-L, Wang M-W. Factors influencing students' adoption intention of brain-computer interfaces in a game-learning context. *Library Hi Tech*. 2023;41:1594–620.
- [12]. Ajzen I. The Theory of planned behavior. *Organizational Behavior and Human Decision Processes*. 1991;50:179–211.
- [13]. Deci EL, Ryan RM. The general causality orientations scale: Self-determination in personality. *Journal of research in personality*. 1985;19:109–34.
- [14]. Wang GY, Simkute D, Griskova-Bulanova I. Neurobiological link between stress and gaming: A scoping review. *Journal of clinical medicine*. 2023;12:3113.
- [15]. Chen A, Lu Y, Wang B. Enhancing perceived enjoyment in social games through social and gaming factors. *Information Technology & People*. 2016;29:99–119.
- [16]. Lin C-W, Lin Y-S, Xie Y-S, Chang J-H. Understanding the Behavioural Intention to Play the Nintendo Switch: An Extension of the Technology Acceptance Model. *Applied System Innovation*. 2022;5:124.
- [17]. Arimbawa PAP, Surachman S, Hussein AS. Pengaruh Persepsi dan Sikap Pemain terhadap Niat Menggunakan Mobile Game Menggunakan Technology Acceptance Model [The Influence of Players' Perceptions and Attitudes on Intention to Use Mobile Games Using the Technology Acceptance Model]. *MIX: Jurnal Ilmiah Manajemen*. 2017;7:224242.
- [18]. Wang J, Liu R-D, Ding Y, Liu Y, Xu L, Zhen R. What influences Chinese adolescents' choice intention between playing online games and learning? Application of theory of planned behavior with subjective norm manipulated as peer support and parental monitoring. *Frontiers in Psychology*. 2017;8:589.
- [19]. Muhammad AN, Hidayanto AN. Gamers Intention Towards Purchasing Game Items in Virtual Community: Extending the Theory of Planned Behavior. *International Journal of Advanced Computer Science & Applications*. 2023;14:215–21.
- [20]. Putra HB, Pradita N, Mansyur A. Integration model TPB and perceived risk of intention of use applications and games online freemium paid version: Indonesian students context. *Inovbiz: Jurnal Inovasi Bisnis*. 2022;9:110–6.
- [21]. Lee M-C. Understanding the behavioural intention to play online games: An extension of the theory of planned behaviour. *Online information review*. 2009;33:849–72.
- [22]. Tawafak RM, Al-Obaydi LH, Klimova B, Pikhart M. Technology integration of using digital gameplay for enhancing EFL college students' behavior intention. *Contemporary Educational Technology*. 2023;15:ep452.
- [23]. Balhara YPS, Singh S, Saini R, Kattula D, Chukkali S, Bhargava R. Development and validation of gaming disorder and hazardous gaming scale (GDHGS) based on the WHO

- framework (ICD-11 criteria) of disordered gaming. *Asian Journal of Psychiatry*. 2020;54:102348.
- [24]. Achab S, Rothen S, Giustiniani J, Nicolier M, Franc E, Zullino D, et al. Predictors of gaming disorder or protective from it, in a French sample: A symptomatic approach to self-regulation and pursued rewards, providing insights for clinical practice. *International Journal of Environmental Research and Public Health*. 2022;19:9476.
- [25]. Alzahrani L, Al-Karaghoul W, Weerakkody V. Analysing the critical factors influencing trust in e-government adoption from citizens' perspective: A systematic review and a conceptual framework. *International business review*. 2017;26:164–75.
- [26]. Ryan RM, Deci EL. Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary educational psychology*. 2000;25:54–67.
- [27]. Kang B, Tan SH. Interactive games: Intrinsic and extrinsic motivation, achievement, and satisfaction. *Journal of Management and Strategy*. 2014;5:110–6.
- [28]. Poeller S, Birk MV, Baumann N, Mandryk RL. Let me be implicit: Using motive disposition theory to predict and explain behaviour in digital games. In: *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. 2018. p. 1–15.
- [29]. Chan DKC, Zhang L, Lee ASY, Hagger MS. Reciprocal relations between autonomous motivation from self-determination theory and social cognition constructs from the theory of planned behavior: A cross-lagged panel design in sport injury prevention. *Psychology of Sport and Exercise*. 2020;48:101660.
- [30]. Li C, Wu Y. Understanding voluntary intentions within the theories of self-determination and planned behavior. *Journal of Nonprofit & Public Sector Marketing*. 2019;31:378–89.
- [31]. Cheah I, Shimul AS, Phau I. Motivations of playing digital games: A review and research agenda. *Psychology and Marketing*. 2022;39:937–50.
- [32]. Zheng Y, Janiszewski C, Schreier M. Exploring the Origins of intrinsic motivation. *Motivation and Emotion*. 2023;47:28–45.
- [33]. 33. Norlia N, Mastura M. Relationship between attitude, subjective norm, and perceived behavioural control of learning practices among boarding school students. *Journal of Counseling and Educational Technology*. 2020;3:23.
- [34]. 34. Birk MV, Atkins C, Bowey JT, Mandryk RL. Fostering intrinsic motivation through avatar identification in digital games. In: *Proceedings of the 2016 CHI conference on human factors in computing systems*. 2016. p. 2982–95.
- [35]. 35. Hamari J, Koivisto J, Sarsa H. Does gamification work?—a literature review of empirical studies on gamification. In: *2014 47th Hawaii international conference on system sciences*. IEEE; 2014. p. 3025–34.
- [36]. 36. Kistnasamy EJ. The power of extrinsic motivation in tertiary education. *American journal of educational research (Online)*. 2014;2:383–8.
- [37]. 37. Silva WF, Arrieta JAC, Castañeda CYQ. Extrinsic motivation and its association with the teaching quality, student attitude and academic performance in engineering students. *Contemporary engineering sciences*. 2018;11:5109–16.
- [38]. 38. Deci EL, Ryan RM, Gagné M, Leone DR, Usunov J, Kornazheva BP. Need satisfaction, motivation, and well-being in the work organizations of a former eastern bloc country: A cross-cultural study of self-determination. *Pers Soc Psychol Bull*. 2001;27:930–42.
- [39]. 39. Serin H. The use of extrinsic and intrinsic motivations to enhance student achievement in educational settings. *International Journal of Social Sciences & Educational Studies*. 2018;5:191–4.
- [40]. 40. Deterding S, Sicart M, Nacke L, O'Hara K, Dixon D. Gamification. using game-design elements in non-gaming contexts. In: *CHI '11 Extended Abstracts on Human Factors in Computing Systems*. Vancouver BC Canada: ACM; 2011. p. 2425–8.
- [41]. 41. Festinger L. A Theory of Social Comparison Processes. *Human Relations*. 1954;7:117–40.
- [42]. 42. Litster K, Lommatsch CW, Novak JR, Moyer-Packenham PS, Harmon MJ, Roxburgh AL, et al. The role of gender on the associations among children's attitudes, mathematics knowledge, digital game use, perceptions of affordances, and achievement. *International Journal of Science and Mathematics Education*. 2021;19:1463–83.
- [43]. 43. Öntürk Y, Güvendi B, Keskin B, Gelen NK. An Investigation of the Digital Gaming Attitudes of the Faculty of Sports Sciences

- Students. Education Quarterly Reviews. 2021;4.
- [44]. Bertozzi E, Lee S. Not Just Fun and Games: Digital Play, Gender and Attitudes Towards Technology. Women's Studies in Communication. 2007;30:179–204.
- [45]. Bonanno P, Kommers PAM. Exploring the influence of gender and gaming competence on attitudes towards using instructional games. Brit J Educational Tech. 2008;39:97–109.
- [46]. Wang ES-T. Perceived control and gender difference on the relationship between trialability and intent to play new online games. Computers in Human Behavior. 2014;30:315–20.
- [47]. Cochran WG. Sampling techniques. New York, NY: Wiley; 1977.
- [48]. Lin M-P, Wu JY-W, You J, Hu W-H, Yen C-F. Prevalence of internet addiction and its risk and protective factors in a representative sample of senior high school students in Taiwan. Journal of adolescence. 2018;62:38–46.
- [49]. Przybylski AK, Weinstein N. Can you connect with me now? How the presence of mobile communication technology influences face-to-face conversation quality. Journal of Social and Personal Relationships. 2013;30:237–46.
- [50]. Fornell C, Larcker DF. Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. Journal of Marketing Research. 1981;18:39–50.
- [51]. Alzahrani AI, Mahmud I, Ramayah T, Alfarraj O, Alalwan N. Extending the theory of planned behavior (TPB) to explain online game playing among Malaysian undergraduate students. Telematics and Informatics. 2017;34:239–51.
- [52]. Ji Y, Wong DFK. Effectiveness of an integrated motivational cognitive-behavioral group intervention for adolescents with gaming disorder: a randomized controlled trial. Addiction. 2023;118:2093–104.
- [53]. Mekler ED, Brühlmann F, Tuch AN, Opwis K. Towards understanding the effects of individual gamification elements on intrinsic motivation and performance. Computers in human behavior. 2017;71:525–34.
- [54]. 54. Van Roy R, Zaman B. Need-supporting gamification in education: An assessment of motivational effects over time. Computers & Education. 2018;127:283–97.
- [55]. 55. Li L, Hew KF, Du J. Gamification enhances student intrinsic motivation, perceptions of autonomy and relatedness, but minimal impact on competency: a meta-analysis and systematic review. Education Tech Research Dev. 2024;72:765–96.
- [56]. Tyack A, Mekler ED. Self-Determination Theory and HCI Games Research: Unfulfilled Promises and Unquestioned Paradigms. ACM Trans Comput-Hum Interact. 2024;31:1–74.
- [57]. Luarn P, Chen C-C, Chiu Y-P. Understanding continuance intention to play exergames during the COVID-19 pandemic: hedonic and utilitarian aspects. Managing Sport and Leisure. 2023;;1–14.
- [58]. Uysal A, Yildirim IG. Self-Determination Theory in Digital Games. In: Bostan B, editor. Gamer Psychology and Behavior. Cham: Springer International Publishing; 2016. p. 123–35.
- [59]. Liu C, Wang Z, Yang Y, Mao P, Tai RH, Cai Z, et al. Do males have more favorable attitudes towards digital game use than Females: A Meta-Analytic review. Children and Youth Services Review. 2024;160:107550.
- [60]. Rodriguez-Barcenilla E, Ortega-Mohedano F. Moving towards the end of gender differences in the habits of use and consumption of mobile video games. Information. 2022;13:380.
- [61]. Chung L-Y, Chang R-C. The effect of gender on motivation and student achievement in digital game-based learning: A case study of a contented-based classroom. Eurasia Journal of Mathematics, Science and Technology Education. 2017;13:2309–27.
- [62]. Osunde OJ. A study into the characteristics of game-based learning software that appeal to 11-14 year old girls. PhD Thesis. University of Greenwich; 2017.