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ORIGINAL RESEARCH

User Acceptance of Edutainment Mobile Applications: Advancing an Experiential Design-Engagement Model (EDEM)

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Abstract
Mobile users are increasingly engaging with edutainment gaming apps in formal and informal contexts. They are drawn to them for their educational and entertainment aspects. In this light, this study validates the Theory of Planned Behavior's key measures and integrates them with game narratives and game aesthetics constructs to better understand the extent to which psychological and gaming design factors are predicting the individuals' intentions to play with these learning technologies. The data were gathered through a survey questionnaire from one hundred eighty-six ($n=186$) respondents, who were higher education students in a Southern European university. The quantitative findings analyzed through partial least squares (PLS) revealed that the gamers appreciate the edutainment platforms' audiovisual effects as well as their storylines and narratives. The results reported that mobile users enjoyed playing with entertaining learning apps. Respondents indicated that they were willing to continue their gameplay in the future. In conclusion, this contribution raises awareness on the important synergies between gaming design elements and behavioral dimensions driving the users' engagement with edutainment apps. It puts forward a robust theoretical framework that is empirically-grounded.

Keywords Edutainment · Learning Apps · Theory of Planned Behavior · Game Narratives · Game Aesthetics · SEM-PLS

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1 Introduction

The advancements in digital technologies are transforming education as well as entertainment landscapes, as more applications (apps) are combining gaming narratives and aesthetics with serious games' learning objectives (Alexiou et al., 2022; Von Gillern & Nash, 2025). A number of app developers are creating so-called edutainment apps intended to enhance the gamers' knowledge acquisition and enjoyable experiences (Amaefule et al., 2023; Feiyue, 2022; Fiorentini et al., 2025). Very often, their platforms are characterized by compelling narratives, challenges, interactive gameplay, mechanics, appealing stories and immersive environments, to motivate and engage learners (Breien & Wasson, 2021). Digital edutainment games are usually aesthetically pleasing. Frequently, they include visual and auditory elements, that are meant to improve their gamers' experiences, as they teach or reinforce specific competencies, concepts or academic subjects, including languages, history and math, among others (Ewelt-Knauer et al., 2025; Nkosinkulu, 2024). Such games incorporate gaming aspects like rewards, levels, competition or collaboration to enhance user engagement during elearning (Jayalath et al., 2022; |Saleem et al., 2022). They provide opportunities for players to actively participate and make decisions that influence outcomes, and/or reinforce learning via digital technology innovations (Awidi & Paynter, 2024). Examples of edutainment games range from simple quiz-based apps to immersive simulations that teach problem-solving, strategy, or creativity while maintaining a high degree of user enjoyment. Edutainment games embed educational content within fun, game-like environments to make learning engaging and pleasurable activities. Their primary goal is to educate users, whilst fostering their motivations and critical thinking skills.

Arguably, the intersection of game design elements and behavioral psychology offers a rich area of inquiry that delves into the factors affecting user engagement with mobile apps (Gil-Aciron, 2024; Hsu, 2023). Several researchers have investigated the individuals' acceptance and usage of entertainment apps (Ewelt-Knauer et al., 2025), as well as the students' engagement with learning/serious games in the past (Afthinos et al., 2022; Bai et al., 2025; Romero Rodriguez, 2023). Very often, they relied on Technology Acceptance Model (TAM) and Theory of Planned Behavior (TPB), among others to investigate the users' adoption of gaming technologies (Lu et al., 2025). In many cases, they explored their content designs and/or psychological factors such as their perceptions about ease of use or perceived behavioral control, perceived usefulness as well as their attitudes towards the games' entertaining features or educational attributes (Fiş Erümit & Yılmaz, 2022).

Whilst the games' narratives and aesthetics are there to entertain their users, they also create meaningful experiences for them, as they can enhance their motivation and learning outcomes (Alexiou et al., 2022). For the time being, their influence on the users' attitudes and intentions to play with edutainment games remains largely unexamined. Given the increasing reliance on edutainment apps in both formal and informal learning settings, understanding these dynamics is crucial for the development of more effective and appealing applications (Cabellos et al., 2023).

Based on this argumentation, this study is guided by the following research questions:

RQ1. To what extent do game narratives and game aesthetics influence the users' attitudes toward edutainment mobile applications?

RQ2. How do the core constructs of the Theory of Planned Behavior, namely attitudes, subjective norms, and perceived behavioral control can affect users' behavioral intentions to use edutainment mobile applications?

RQ3. To what extent do game narratives and game aesthetics indirectly influence users' behavioral intentions through attitudinal and behavioral determinants?

RQ4. How can game design elements and behavioral factors be integrated into a unified model to explain user acceptance and continued use of edutainment mobile applications?

In this light, the research objectives of this study are threefold: (i) It explores the extent to which Edutainment platforms' narratives and aesthetics can influence their gamers' attitudes about their interactive games; (ii) It validates the Theory of Planned Behaviors' key constructs (Ajzen, 1991), as it investigates the degree to which attitudes, perceived behavioral control and subjective norms are affecting the users' behavioral intentions to use an interactive learning technology (iii) It advances a robust, structured model that integrates game design elements with behavioral determinants in the context of edutainment gaming apps.

This study advances novel contributions in the fields of digital/mobile gaming, educational technologies and user behaviors. Firstly, it examines how gaming narratives and aesthetics could influence their users' psychological factors within the context of edutainment mobile apps. Secondly, it extends the Theory of Planned Behavior as the researchers incorporate game-specific design elements relevant to edutainment apps, thereby offering an original perspective on user adoption factors in this underexplored domain. While prior studies have predominantly relied on generic acceptance models such as TAM or TPB to explain users' adoption of entertainment or learning technologies (Liew et al., 2025; Razami & Ibrahim, 2022; Rüth et al., 2022), they have largely overlooked how storytelling, audiovisual design and immersive aesthetics shape users' psychological evaluations of these platforms. By empirically examining the direct and indirect effects of narratives and aesthetics on users' attitudes and behavioral intentions, this research offers clarifies how educational and entertainment dimensions interact in mobile learning environments. Thirdly, the findings of this study present practical implications for developers of edutainment games as well as for educators, as they provide actionable insights into designing apps that are not only engaging and fun to play, but also effective in promoting learning and user adoption. Currently, there is still limited research that shed light on the key attributes of entertaining games in education (Bai et al., 2025). Moreover, the proposed integrated model represents an original contribution to the edutainment literature, as it bridges behavioral theory with game design principles to explain user acceptance in both formal and informal learning contexts. This is an area that still remains underexplored in existing academic research (Romero Rodríguez et al., 2025; von Gillern & Nash, 2025).

Therefore, this study addresses this knowledge gap in academia. It raises awareness on the synergies between gaming design and user behaviors, thereby offering a foundation for future research development focused on entertainment gaming in education.

2 Literature Review

Edutainment mobile apps represent the convergence of educational and entertainment content. Their developers are increasingly leveraging the capabilities of mobile devices to provide engaging and interactive learning experiences for their users (Aslam et al., 2025;

Urban, 2023). They are integrating elements of gamification, storytelling and multimedia to make learning enjoyable and accessible (Amaefule et al., 2023). Very often, they do so by combining traditional educational content with dynamic and immersive features (Buchner, 2025; Irminanda & Xiong, 2025). Edutainment apps can cater to diverse users' learning preferences and age groups, ranging from young children exploring foundational concepts to adults acquiring new skills (Robinson et al., 2021).

For example, Duolingo, a free language-learning program, that is available through the web and via mobile apps, incorporates various gamification techniques to enhance its users' learning experience. Its users earn points (XPs), unlock new levels and skills as they learn a language whilst playing interactive games. The game's mechanics mimic the rewards system conspicuous in video games, as users earn badges after they complete tasks and achieve streaks for consecutive days of practice. Such engagement tactics keep learners captivated as they provide them with a sense of accomplishment. Duolingo's edutainment app employs adaptive learning algorithms that adjust the difficulty of exercises based on the learner's progress and performance. It provides instant feedback on mistakes, allowing users to correct themselves and continue without feeling discouraged. This adaptive approach ensures that users are constantly challenged but not overwhelmed. For instance, when its users struggle with particular words or concepts, the app revisits that material in future lessons to reinforce learning. Hence, its gamified elements, including rewards, levels and challenges, can create a motivating environment that encourages individuals to acquire knowledge during idle times or as part of their daily routines.

Generally, edutainment apps might usually feature a traditional story with characters or plotlines. They may usually create a progression-based narrative that incorporates simple tasks as well as more complex ones as gamers proceed from one level to another (Lee, 2023). The learning platforms' narrative, their aesthetics as well as gamified elements including the provision of rewards, challenges and competitions can contribute to improve the players' experiences with edutainment apps (Jo et al., 2025; Lu, 2025; Naul & Liu, 2020). These elements combined with visual and auditory features can have a significant influence on the players' positive attitudes and intentions to continue engaging with these interactive learning technologies (Hao et al., 2025).

2.1 Intentions to Use Technologies

Several academic colleagues who have validated theoretical frameworks like the theory of planned bahavior (TPB), the theory of acceptance model (TAM) (Davis, 1989), or the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003), among others, have often included the 'behavioral intentions' construct as an endogenous factor in their studies. Generally, they indicated that behavioral intentions represent the individuals' readiness to perform certain behaviors. TPB researchers assume that a person's attitude toward behavior, subjective norms in society and perceived behavioral control can collectively influence his/her intentions and behaviors. In the context of edutainment apps, a user's intention to play the game is likely to increase if s/he has a positive attitude toward its usefulness, feels encouraged by peers or educators, and if s/he perceives the app as easy to use (Razami,& Ibrahim,2022; Rüth et al., 2022).

In a similar vein, the proponents of TAM claim that a person's perceptions on the usefulness of technology and his/her beliefs about its ease of use would directly influence his/her attitudes towards it, as well as his/her intentions to continue using it. Evidently, while TPB incorporates broader psychological, social and control-related factors (Ajzen, 1991), TAM is more specific to technology-related contexts (Davis, 1989). The latter emphasizes that the users' perceptions of functionality and effort can have an impact on their willingness to adopt technologies. In any case, both frameworks can be used to better understand what influences the users' intentions to engage with edutainment apps.

2.2 Attitudes Toward Technologies

The rise of edutainment apps has revolutionized the way individuals approach learning and leisure. Such apps are usually designed to provide enjoyable and immersive experiences to their users (Kong & Feng, 2024). Various edutainment apps offer a wide range of topics, that may appeal to different demographics. Therefore, consumers may hold distinct 'attitudes' towards learning technologies (Camilleri & Camilleri, 2022a; Camilleri & Camilleri, 2022b). Many colleagues reported that individuals may be motivated to adopt technologies if they consider them as entertaining tools that can enhance their knowledge in idle times (Matthes et al., 2023). It is very likely that their intentions to engage with such pleasurable activities would increase, as they view their learning experience as worthwhile and satisfying.

The individuals who hold favorable attitudes towards these mobile gaming technologies are more likely to integrate them into their routines, as they associate them with leisure as well as with their personal development. If this is the case, gamers would probably be intrinsically motivated to engage with edutainment apps, as they offer enjoyable learning experiences (Amaefule et al., 2023; Phan et al., 2016). This reasoning leads to the following hypothesis.

H1 *The individuals' attitudes towards edutainment apps positively affect their intentions to play with them.*

2.3 Perceived Behavioral Control of Technologies

In the context of this research, the 'perceived behavioral control' reflects the users' beliefs in their abilities to use edutainment apps, in an effective manner. This construct represents factors related to the individuals' perceptions about the ease of use of technologies, in terms of their degree of understanding of how to navigate through their features (Ajzen, 1991; Davis, 1989; Huang et al., 2025). Therefore, when and if users perceive that they require minimal efforts to engage with the information systems of edutainment apps, in a reliable manner, they will probably have sufficient control over them. Hence, they would feel confident when they utilize such learning apps. As a result, their sense of control over technology can positively impact their intentions to continue availing themselves of the app (Pham et al., 2025).

Thus, the individuals' perceptions about their behavioral control can reduce potential barriers that could impede their engagement with edutainment technologies. At the same

time, it could enhance their dispositions to explore its content. In other words, the users' perceived behavioral control may be considered as a precursor that fosters their intentions to use the learning technology. This leads to the following hypotheses:

H2 The individuals' perceived behavioral control in relation to edutainment apps positively affects their intentions to play with them.

In addition, the individuals' attitudes can serve as a mediator in the relationship between perceived behavioral control and behavioral intentions. Such a relationship is particularly evidenced in the first version of TAM, where the users' attitudes mediate their perceptions about ease of use of technologies and their intentions to engage with them (Camilleri & Camilleri, 2022; Davis, 1989). The same argumentation applies for edutainment apps. When and if individuals feel confident in their abilities to interact with these learning games, they are more likely to develop positive attitudes toward them, particularly if they offer seamless and enjoyable experiences.

Such favorable attitudes could, in turn, strengthen their intentions to engage with the app. The users' attitudes construct could indirectly influence the link between perceived behavioral control and intentions to use edutainment apps. This leads to the following hypotheses:

H2a *Attitudes mediates the perceived behavioral control – intentions link.*

H3 *The individuals' perceived behavioral control in relation to edutainment apps positively affects their attitudes towards them.*

2.4 Subjective Norms of Society

The subjective norms construct refers to the social influences of family, friends and educators, among other persons, as they can have an impact on individuals' behaviors, including on their intentions to use certain technologies (Ajzen, 1991; Liu, 2025; Rahman et al., 2025). Such norms could pressurize the users of edutainment apps, particularly if they are sensitive to the opinions of their peers. If this is the case, individuals may feel that by using edutainment apps, they are conforming to the opinions of people they value (Lai et al., 2022).

Therefore, external influences can strongly affect the users' intentions to adopt learning games, especially in certain cultures where individuals seek social approval and group alignment. Arguably, the impact of subjective norms on the users' intentions to play edutainment apps could be amplified by integrating them into educational contexts. For instance, students may be coerced or motivated by their course instructors to use gaming technologies, to improve their learning outcomes (Camilleri & Camilleri, 2022). Alternatively, they could be encouraged and persuaded by their peers to engage with these apps if they communicate about their progress and achievements (Ho et al., 2022)., and/or if they come across independent reviews and testimonials that feature the users' personal experiences with games (Yu et al., 2023). Hence, social facilitation may be driven from offline as well as from online sources. As a result, the subjective norms in society can have an impact on the users' adoption of edutainment technologies (Li et al., 2022). This study presumes that subjective norms could also have a significant effect on the users' attitudes toward games,

particularly if they are young individuals and adolescents who may easily be influenced by peer pressures. This reasoning leads to the following hypothesis:

H4 *The subjective norms positively affect their intentions to play with edutainment apps.*

H4a *Attitudes mediates the subjective norms – intentions link.*

H5 *The subjective norm in society positively affects their attitudes to play with edutainment apps.*

2.5 Game Narratives

The games' narratives, including their structured stories and thematic elements can play a critical role in shaping users' attitudes toward edutainment apps (Gutierrez et al., 2025; Phan et al., 2016). A compelling narrative that combines learning with entertainment could possibly engage users by providing context, meaning and an emotional connection to the game (Naul & Liu, 2020). A well-crafted story could blend knowledge acquisition with immersive gameplay mechanics (Toh, 2023). Therefore, the narratives of edutainment apps can serve as a bridge between the cognitive and affective aspects of learning. They are meant to simplify complex topics in a way that are easier to understand by embedding them within relatable or adventurous scenarios, in order to create a sense of purpose and excitement.

For example, an edutainment app with a narrative about solving mysteries in a fictional world can transform abstract concepts into engaging challenges. Their inherent emotional connections can foster positive attitudes, as users can easily associate the app with enjoyment, curiosity, and achievement. Hence, the gamers' sense of progression within the learning app's narrative further reinforces their satisfaction levels as well as their willingness to habitually engage with the app (Gutierrez et al., 2025; Toh, 2023).

Edutainment games feature narratives that are both relatable and enjoyable for their users (Phan et al., 2016). They do so to improve user experiences to encourage app usage. Generally, the developers of such apps tend to align the users' preferences and cultural contexts, to create diverse, inclusive and interactive stories that resonate with different demographics. In addition, customizable narratives that allow users to make choices or influence outcomes can enhance personal engagement and ownership of the learning process (Lee., 2023). Hence, the games' narrative depth and relevance are a strategic tool that can significantly influence their users' attitudes toward edutainment technologies. This leads to this hypothesis:

H6 *Game narratives positively affect the individuals' attitudes toward edutainment apps.*

2.6 Game Aesthetics

The games' aesthetic features, including their artistic appeal, visual designs and sound effects can capture the users' attention and create positive first impressions (Phan et al., 2016). The edutainment apps' high-quality graphics, color schemes and immersive audio can enhance the gamers' overall experience, thereby making them more enjoyable and engaging (Alexiou et al., 2022). These elements contribute to creating favorable attitudes toward entertaining learning games, by aligning their designs with the expectations of their

users. They add value to gamers' emotional engagement by fostering a sense of immersion and enjoyment (Khaldi et al., 2023; Pasqualotto et al., 2023).

For example, the use of expressive characters, visually rich environments and dynamic animations can entice the users' curiosity, while soothing soundscapes or lively background music could enhance their mood. Such sensory stimulations are meant to elevate the app's appeal among users and motivate them to explore its features (Pasqualotto et al., 2023). The gamers' pleasurable sensory experiences as well as their emotional responses to their content could lead to increased engagement with the learning app (Squire, 2023).

Therefore, developers ought to create user-centric designs with appealing visual and auditory elements that are intended to increase interactions with their apps. Their edutainment games should present aesthetic features that are clearly appreciated by their target audience. For instance, whilst bright and playful designs may be suitable for children, minimalist visuals may attract adult learners. Additionally, developers are expected to maintain consistency in their game designs if they want to reinforce their users' sense of familiarity and satisfaction. Their high-quality, thoughtful aesthetics can influence the users' positive attitudes towards their app. This leads to the following hypothesis:

H7 *Game aesthetics positively affect the individuals' attitudes toward edutainment apps.*

Figure 1 illustrates the set hypotheses of the proposed Experiential Design Engagement in Gaming (EDEG). In sum, it indicates that game narratives, game aesthetics, subjective norms and perceived behavioral control are significant antecedents of the players' attitudes toward the game. In addition, it presumes that the latter, as well as subjective norms and

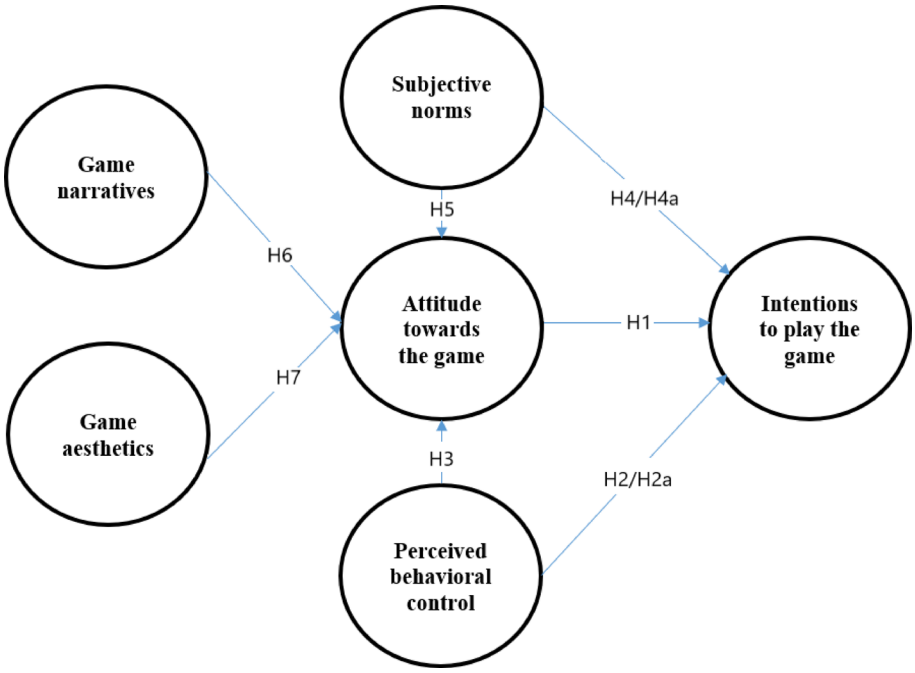

Fig. 1 An Experiential Design-Engagement Model (EDEM)

perceived behavioral control are significant precursors of the individuals' intentions to play the game.

3 Methodology

Primary data were captured through a questionnaire disseminated among students who attended a higher education institution in a Southern European country. A link to the survey was distributed via the university registrar. The cover letter clearly explained that edutainment apps combine education and entertainment to enhance the students' engagement and learning outcomes. It clarified that there are different types of entertaining learning games including: literacy and language learning apps (e.g. Duolingo); quizzes and trivia-based apps (e.g. Kahoot); STEM-based apps involving problem-solving games, coding puzzles, virtual experiments; as well as creative and artistic learning apps, among others.

The data collection process complied with the research ethic policy of the institution, as well as with the national legislation and with the European Union Commission's General Data Protection Regulation (GDPR) (EU Regulation 2016/679). The questionnaire clearly specified that the gathered data shall be used for research purposes. They were informed that there was no way that the respondents' identities could be revealed, as only aggregate data were required for this study.

The research participants could complete the survey in less than ten minutes. They were expected to answer twenty (20) questions by indicating their level of agreement (through a five-point Likert scale) with items drawn from the Theory of Planned Behavior including "intentions to play the game" (2), "perceived behavioral control" (4), "attitudes" (4) and "subjective norms" (2) (Ajzen, 1991). The other items were related to "game narratives" (4) and "game aesthetics" (4) (Phan et al., 2016), as shown in Table 1. The participants were expected to respond to the demographic questions in the last part of the survey. They were required to indicate their gender, age and education.

4 Data analysis

After a week there were one hundred eighty-six responses (n = 186) to the survey. The research participants indicated, through a filter question, that they played edutainment games in the past. The sample of respondents comprised 93 males, 78 females, 9 non-binary persons and 6 participants who did not indicate their gender. The research participants were categorized into 6 age groups. The majority of them were between 18 and 28 years (n = 155). This group was followed by those who were between 29 and 39 years of age (n = 13). Most respondents were pursuing a bachelor's degree (n = 132), as featured in Table 2.

The results confirmed that the survey participants indicated that they agreed with the statements featured in the questionnaire. Most of the mean (M) scores were well above 3.000. While AEST4 (M = 4.500) and ATT1 (M = 4.435) reported the highest mean values; SN1 (M = 2.290) and SN2 (M = 2.065) were found to be the lowest mean figures. The standard deviation (SD) values were quite low as the highest variance was 1.169 (for SN1).

A collinearity assessment indicated that the variance inflation factors (VIFs) were lower than 3.300. This result confirmed that the proposed model is not influenced by common

Table 1 The survey questionnaire's measures and their corresponding items

Perceived behavioral control	
PBC1	I feel it is easy to play edutainment games
PBC2	I find the controls of edutainment games to be simple and straightforward
PBC3	I do not need to go through a lengthy tutorial or a manual to play edutainment games
PBC4	I find the edutainment games' menus to be user friendly
Attitudes	
ATT1	I enjoy playing edutainment games
ATT2	I feel excited playing edutainment games
ATT3	I feel connected to edutainment games
ATT4	I feel frustrated by the challenges in edutainment games
Subjective norms	
SN1	People who influence my behavior think I should play edutainment games
SN2	People whose opinions I value encourage me to play edutainment games
Game narratives	
NARR1	I think the characters in the game are well developed
NARR2	I am captivated by the game's story from the beginning
NARR3	I can identify with the characters in the game
NARR4	I am very interested in seeing how the events in the game will progress
Game aesthetics	
AEST1	I like the edutainment games' graphics
AEST2	I think the visual aesthetics of most edutainment games are appropriate
AEST3	I like the sound effects in edutainment games
AEST4	I believe the audio of edutainment games, including sound effects and music, significantly enriches the gameplay experience
Intentions to play the game	
INT1	My intention is to play edutainment games in the future
INT2	I will probably continue making in-app purchase transactions to access premium features in edutainment games

Table 2 The demographic profile of the respondents

Gender	N	Age	N	Academic cycle	N
Males	93	18—28	155	B	132
Females	78	29—39	13	M	44
Non-binary	9	40—50	8	PhD	3
		51—61	2		
		62+	0		
Preferred not to say	6		8		7
Total (N):	**186**		**186**		**186**

method bias. The outer loadings as well as the reliability values were above 0.700, except for INT. In this case, its alpha value was 0.604 and had composite reliability value of 0.691. Moreover, the average variance extracted (AVE) figures were higher than the 0.500 threshold. The Heterotrait-Monotrait ratio (HTMT) procedure reported HTMT values that were less than 0.900 (Hair et al., 2024). In addition, Fornell and Larcker's criterion reported that

the square roots of the AVE values were higher than the other correlations featured in the same columns, as presented in Table 3.

The PLS algorithm provided detailed information about the robustness of the proposed structural equations model. It revealed the factors' predictive power and shed light on the values of the adjusted R2 and f2. It clearly indicated that the exogenous constructs including perceived behavioral control (f2 = 0.196), game aesthetics (f2 = 0.191), subjective norms (f2 = 0.146) and game narratives (f2 = 0.117) affected 64.5% (r2 = 0.645) of the attitudes toward edutainment games. Moreover, attitudes with an f2 = 0.372, perceived behavioral control (0.012) and subjective norms (0.011) contributed to the r2 of 43.2% (r2 = 0.432) of the users' intentions.

The bootstrapping procedure was used to test the research hypotheses and to shed light on the robustness of the proposed structured model. H1 reported the strongest structural path in the research model. Evidently, the users' attitudes toward edutainment games highly influence their intentions to play with them, where $\beta = 0.575$, $t = 4.530$ and $p < 0.001$. Other noteworthy findings, in descending order of importance, include between game aesthetics and attitudes (H7), perceived behavioral control and attitudes (H3), game narratives and attitudes (H6) and subjective norms and attitudes (H5), as shown in Table 3. The perceived behavioral control (H2) and subjective norms (H4) were not found to be direct antecedents of user intentions to engage with these games. Interestingly, the findings confirmed that attitudes fully mediated perceived behavioral control – intentions link as well as subjective norms – intentions link, as shown in Tables 4 and 5. Moreover, Fig. 2 clearly illustrates the total (direct and indirect) effects of this research model.

Table 4 The direct effects in the research model

Path	Coefficient	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	*P* values	Outcome
H1	Attitudes toward the game—>Intentions to play the game	0.575***	0.568	0.127	4.530	0.000	Supported
H2	Perceived behavioral control—>Intentions to play the game	0.098	0.118	0.130	0.751	0.452	Not supported
H3	Perceived behavioral control—>Attitudes toward the game	0.289**	0.281	0.099	2.929	0.003	Supported
H4	Subjective norms—>Intentions to play the game	0.083	0.090	0.108	0.773	0.439	Not supported
H5	Subjective norms—>Attitudes toward the game	0.231**	0.227	0.083	2.782	0.005	Supported
H6	Game narratives—>Attitudes toward the game	0.281**	0.304	0.110	2.563	0.009	Supported
H7	Game aesthetics—>Attitudes toward the game	0.360**	0.344	0.130	2.776	0.006	Supported

Note: $P < 0.001$; $P < 0.01$.; and * $P < 0.05$

Table 3 The reliability and validity of the constructs

Construct	Item	Loading	VIF	Alpha	Rho_A	CR	AVE	1	2	3	4	5	6
Attitudes toward the game	ATT1	0.868	2.212	0.629	0.879	0.799	0.615	**0.784**	0.889	0.887	0.854	0.677	0.381
	ATT2	0.922	3.007										
	ATT3	0.901	2.615										
	ATT4	-0.214	1.032										
Game aesthetics	AEST1	0.886	3.051	0.823	0.848	0.885	0.664	0.684	**0.815**	0.841	0.715	0.479	0.170
	AEST2	0.835	2.766										
	AEST3	0.899	3.247										
	AEST4	0.604	1.836										
Game narratives	NARR1	0.796	1.857	0.739	0.751	0.837	0.564	0.651	0.675	**0.751**	0.651	0.513	0.200
	NARR2	0.645	1.334										
	NARR3	0.843	1.933										
	NARR4	0.705	1.337										
Intentions to play the game	INT1	0.914	1.230	0.604	0.691	0.827	0.707	0.649	0.529	0.433	**0.841**	0.576	0.330
	INT2	0.762	1.232										
Perceived behavioral control	PBC1	0.767	1.641	0.705	0.706	0.818	0.531	0.516	0.362	0.373	0.391	**0.728**	0.080
	PBC2	0.742	1.710										
	PBC3	0.759	1.698										
	PBC4	0.638	1.427										
Subjective norms	SN1	0.879	1.849	0.808	0.895	0.909	0.834	0.287	0.125	0.079	0.245	-0.038	**0.913**
	SN2	0.946	1.851										

Notes:

[1]ATT4 is reverse coded

[2]The bold values (i.e. the square root of AVE) is higher than the corresponding values in the same column. This confirms the constructs' discriminant validity. Fornell & Larcker's criterion has been met

[3]The items on the right-hand side of the bold values represent the results of the HTMT Matrix. Again, the findings confirm the constructs' discriminant validities as the values are less than 0.900 (Henseler et al., 2015)

5 Discussion

This study advances an integrated model that combines TPB constructs with game-specific design elements to explain user acceptance of edutainment mobile applications. The findings confirm that attitudes toward edutainment apps are the most influential determinant of behavioral intentions. This result clearly corroborates prior TPB research. The strong and significant path between attitudes and intentions suggests that the individuals' affective evaluations such as enjoyment, excitement and emotional connection (that were measured in the survey), are having an impact on their intentions to continue playing the game and/or to make in-app purchases.

The results highlight the strong explanatory power of game design features in this Experiential Design-Engagement Model. Evidently, game aesthetics and narratives significantly influence the users' attitudes, with aesthetics exerting a slightly stronger effect than the narratives. This indicates that the decorative attributes of games in terms of their audiovisual richness, graphical quality and immersive soundscapes, may be considered as strategic drivers of enhanced affective engagement and responses. This research confirms that compelling storylines and character development may reinforce favorable attitudes toward edutainment gaming apps. These findings extend TPB by demonstrating that experiential design elements influence attitudinal formation as well as intentional behaviors to engage with entertaining educational technologies.

The proposed Experiential Design–Engagement Model is robust and empirically-grounded as it explained a substantial proportion of variance in attitudes (64.5%) and intentions (43.2%). While perceived behavioral control and subjective norms did not directly predict intentions, their indirect effects through attitudes were found to be significant. The finding of full mediation indicates that social influences as well as the game's ease of use are not influencing the players' continued gameplay. The results imply that these factors are affecting the users' attitudes first. Interestingly, the results suggest that the latter would ultimately influence their intentions to keep playing with edutainment games. In plain words, gamers may not always be intrigued to engage with socially endorsed, easy-to-play games. This research postulates that they need to develop positive feelings about them. This insight reconceives existing technology adoption models. It underlines the important role of attitudes as a mediating psychological link between technical features and usage intentions, as well as between social factors and continued engagement.

6 Conclusions

6.1 Theoretical Implications

The study increases theoretical understanding by bridging behavioral theory with game design principles. It extends the Theory of Planned Behavior by integrating experiential design elements related to compelling gaming narratives and immersive aesthetics, into a unified framework that sheds light on user acceptance of edutainment mobile applications. The proposed Experiential Design–Engagement Model provides a structured and empirically validated explanation of how psychological and design-related factors interact to shape users' intentions to engage with edutainment apps.

Table 5 The mediation analysis: Illustrating direct, indirect and total effects

Path		Original Sample (O)	Original sample (O)	Original Sample (O)	Standard deviation (STDEV)	T statistics	P Values	Outcome
		Direct effect	Indirect effect	Total effects				
H2 (Direct)	Perceived behavioral control—>Intentions to play the game	0.098			0.130	0.751	0.452	Insignificant effect / Not supported
H2a (Mediation)	Perceived behavioral control—>Attitudes toward the game—>Intentions to play the game		0.166		0.070	2.362	0.018*	Significant effect / Supported
Total effects	**Perceived behavioral control—>Intentions to play the game**			**0.264**	**0.126**	**2.090**	**0.037***	**Supported with Full Mediation**
H4 (Direct)	Subjective norms—>Intentions to play the game	0.083			0.108	0.773	0.439	Insignificant effect / Not supported
H4a (Mediation)	Subjective norms—>Attitudes toward the game—>Intentions to play the game		0.133		0.052	2.561	0.010*	Significant effect / Supported
Total effects	**Subjective norms—>Intentions to play the game**			**0.216**	**0.103**	**2.093**	**0.036***	**Supported with Full Mediation**

Note: $P<0.001$; $P<0.01$.; and * $P<0.05$

The findings raise awareness on the central role of attitudes in technology adoption models. They clearly indicate that perceived behavioral control as well as subjective norms were precursors of the users' attitudes. Moreover, they show that attitudes mediate the link between perceived behavioral control – intentions as well as between subjective norms – intentions.

6.2 Practical Implications

This study provides actionable insights for game developers, policy makers and educators seeking to enhance user engagement with edutainment mobile applications. It implies that these stakeholders ought to prioritize gaming design alongside user-friendly interfaces to enhance positive attitudes and sustained engagement with edutainment applications.

While the results confirmed that ease of use remains an important factor for technology adoption, the users' emotional responses including their enjoyment, excitement and connection are ultimately fostering their sustained engagement. The findings highlight that game developers should invest in high-quality audiovisual aesthetics and compelling narratives. They suggest that use of immersive graphics, expressive characters, coherent storylines and engaging soundscapes can significantly shape users' positive attitudes, which in turn drive continued gameplay and in-app purchases. Hence, there is scope for developers to prioritize experiential design and usability.

This research raises awareness on the need to support the development and evaluation of high-quality edutainment solutions. Policy makers ought to consider investing in these educational technologies. If they do so, they should articulate policies that promote evidence-based digital tools quality as well as guidelines for educators and students. Ideally, such guidelines will integrate pedagogical value with immersive designs, to enhance learner motivation, improve educational outcomes, and maximize returns on investments in educational technologies.

For educators, the results indicate that the adoption of edutainment apps may not necessarily translate to enhancing the students' usage intentions. Course instructors should utilize gaming platforms that are intrinsically engaging and emotionally appealing to their students. This study confirms that the integration of well-designed edutainment apps into curricula, accompanied by reflective and collaborative activities, can increase positive attitudes that lead to long-term engagement with these educational technologies.

6.3 Contribution, Limitations and Future Research Directions

This study is not without limitations. Primary data were collected from a relatively small sample (n = 186) of students who were members of social media groups focused on interactive games. The majority of respondents were young adults pursuing bachelor's degrees. Hence, the findings may not be fully generalizable to other demographic groups, such as younger learners, older adults and/or users from different cultural contexts. Future research could replicate the Experiential Design-Engagement Model with larger and more diverse samples to enhance its validity in different contexts.

The data were gathered via a cross-sectional survey design. While cross-sectional designs are usually considered as efficient and suitable for theory testing, one of their limitations is that they may not account for changes in the individuals' attitudes or behaviors over time.

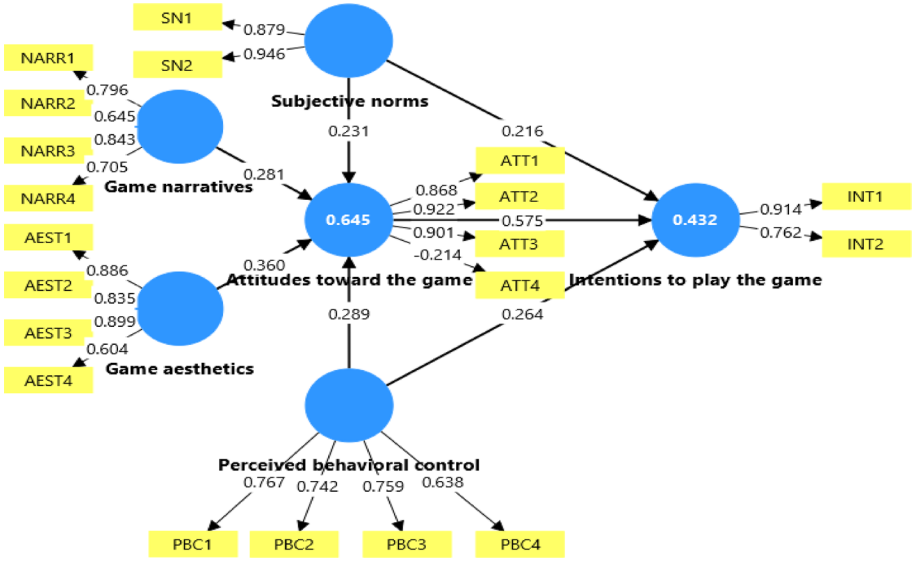

Fig. 2 A graphical illustration of total effects in this research model

Although the structural model is theoretically grounded and is statistically robust, longitudinal studies would probably confirm the stability of attitudes and intentions in the long term, particularly in relation to continued gameplay and in-app purchases.

The study relied on self-reported measures, which may be susceptible to social desirability bias, as respondents could provide socially acceptable rather than fully accurate answers. Additionally, non-response bias, common method variance and sampling limitations may have affected the representativeness and validity of the findings. For instance, the behavioral intentions construct exhibited relatively lower reliability compared to other measures. This finding suggests that future studies could refine or expand its operationalization.

In addition, while the integrated model explained a substantial proportion of variance in attitudes and intentions, other relevant factors, such as perceived learning effectiveness, competition, the gamers' personal gratifications, intrinsic motivations, emotional attachment, or even facilitating conditions, among others, were not included in this study. These constructs could have further enriched our understanding of the students' sustained commitment to engage with edutainment applications.

In conclusion, despite these limitations, this research offers a novel contribution. For the time being, few studies sought to investigate the design elements and psychological determinants that could influence the users' acceptance and usage of mobile edutainment gaming apps (Gutierrez et al., 2025; Jo et al., 2025). While prior research has largely relied on generic technology acceptance models, it has seldom included storytelling and audiovisual design as antecedents of attitudinal formation. This contribution differentiates itself from previous studies. Clearly it empirically demonstrates the direct and indirect effects of these experiential features on behavioral intentions. It reconceptualizes attitudes as the central mechanism linking design, social and control-related factors to continued engagement. The proposed Experiential Design–Engagement Model advances theory at the intersection of behavioral psychology and educational game design.

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Declarations

Conflict of interests The authors have no relevant financial or non-financial interests to disclose.

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