Gamification in Education Management : Fulfilling Students' Intrinsic Needs and Learning Outcomes

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Abstract

Purpose : Education management is essential to utilizing technology's potential to revolutionize the educational process, which calls for more investigation into the systems that support students' learning objectives and basic needs. The research investigated the ways in which education administration might use technology to address students' basic needs and improve learning results. Based on the self-determination theory (SDT), the research examined the role of gamification elements in learning applications as a means to fulfill students' needs for competence, autonomy, and relatedness.

Methodology : The study collected data through an online survey using convenience sampling from 144 professional students (117 males and 27 females). The hypotheses were tested using partial least squares structural equation modeling with SmartPLS v3.2.9 to analyze the impact of gamification on students' needs and learning outcomes.

Findings : The study found that gamified experiences that included social presence, challenge, achievement, personalization, identification, and encouragement had a favorable and significant impact on students' basic requirements for relatedness, competence, and autonomy. The fulfillment of the needs for competence and relatedness influenced the sense of learning outcome attainment. However, the fulfillment of the need for autonomy influenced the sense of learning outcome attainment positively, yet insignificantly. Additionally, the achievement of learning outcomes influenced students' intent to use learning apps.

Practical Implications : The study provided valuable insights for educational management on effectively implementing gamification strategies to fulfill students' intrinsic needs and enhance learning outcomes.

Originality/Value : The study contributed to the academic discourse by integrating SDT with gamification in educational management, offering a novel perspective on how technology-driven strategies can meet students' intrinsic needs and improve learning outcomes.

Keywords : **education management, learning apps, competence, autonomy, relatedness, learning outcomes, intrinsic needs**

JEL Classification Codes : I20, I21, I23, M53, O33

Paper Submission Date : October 10, 2023 ; Paper sent back for Revision : August 3, 2024 ; Paper Acceptance Date : August 30, 2024 ; Paper Published Online : November 15, 2024

With technological advancements, gamified elements based on augmented reality (AR), virtual reality (VR), and 3D visualization have progressively been applied in learning apps (e.g., Duolingo, MemRise, LingualLift, TripLingo, Treehouse, AgileCRM, LevelEleven, Mint, Fitbit, Todoist, etc.), creating more immersive and engaging learning experiences (Kapp, 2012). Through the use of game-thinking and visual components, gamified learning includes interactions, conversations, and collaborations inside these applications that increase learner motivation and engagement. Gamification refers to the employment of game-

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DOI : https://doi.org/10.17010/pijom/2024/v17i11/174022

design aspects in non-gaming contexts that aren't inherently game-related. We have devoted significant attention to gamification due to the exponential rise of learning apps and their widespread adoption for enhancing learner experience (Oliveira et al., 2022).

Prior research has primarily focused on understanding the attitudes and behavioral intentions of professional students toward these apps, emphasizing factors like motivation, satisfaction, and engagement (Huang et al., 2019). Studies consistently demonstrate that gamified features enhance students' motivation, participation, and involvement (Huang et al., 2019; Koivisto & Hamari, 2019; Zou, 2020). The increasing use of gamification in learning apps involves elements related to immersion (e.g., avatars and storytelling), competence (e.g., badges and leaderboards), and relatedness (e.g., team building and cooperation), thereby further enriching the learning experience (Koivisto & Hamari, 2019).

The post-COVID-19 era has accelerated the adoption of learning tools even further (Alvi, 2021; Arora et al., 2024), bridging the rural-urban digital divide in India, particularly in terms of Internet access (Indu et al., 2022), necessitating the redesign of assessment and evaluation processes (Kumar et al., 2023). The research has also highlighted the factors driving technology adoption, such as functional, social, and epistemic values (Aaradhi & Chakraborty, 2024), alongside effort expectancy and performance expectancy (Shokeen et al., 2023), particularly in the Indian educational context.

Nevertheless, the impact of gamified elements in learning apps has yielded ambiguous and inconsistent results. However, some studies predict negative consequences if these elements are not thoughtfully designed to meet professional students' needs for gratification (Koivisto & Hamari, 2019). Additionally, there is a significant dearth of studies specifically examining the influence of gamification on learning outcomes (Gokhale & Kulkarni, 2022). The need for more studies to understand how gamified aspects affect learning outcomes and determine the circumstances in which these tools can be most effective is highlighted by this gap (Nacke & Deterding, 2017).

This study aims to address this gap by applying the self-determination theory (SDT) to explore the impact of gamification, personalization, and engagement on students' intrinsic needs and learning outcomes within the Indian educational context, thereby responding to the call from researchers (Gao, 2024).

Research Questions

- How do personalization and identification features in learning apps influence the fulfillment of professional students' autonomy needs?
- How do challenge and achievement features in learning apps affect the fulfillment of students' competence needs?
- How do social presence and encouragement features impact the fulfillment of students' relatedness needs?
- How does the fulfillment of autonomy/competence/relatedness need influence learning outcomes and students' intent to use learning apps?

Research on gamification in education is both highly relevant and increasingly in demand due to the ongoing digital transformation in education, which necessitates innovative strategies to enhance student involvement, participation, and learning outcomes. Gamification provides an interactive approach that fits with current trends toward individualized learning and the development of 21st-century skills as educators deal with the issues surrounding student disengagement, especially in digital and hybrid learning environments. Furthermore, this study may offer valuable evidence-based practices that can improve educational outcomes, making it a crucial area of focus in modern education and addressing significant gaps in the existing literature by providing practical insights for educators and policymakers.

Theoretical Framework and Hypotheses Formulation

Gamified learning has effectively incorporated SDT, which was first proposed by Ryan and Deci (2000). In terms of gamified learning, all three of STD's elements are essential. The term "autonomy" describes pupils' feeling of resourcefulness and control over their behavior. Being competent is having the ability to understand new concepts. According to Ferguson et al. (2020), relatedness is the ability to connect and experience a sense of belonging. Furthermore, the concept of intrinsic needs is a successful predictor of behavior. In the educational context, SDT offers a lens to understand learner needs and learning outcomes, aligning with the current educational landscape.

Hypotheses Development

Personalization

Professional students' needs for autonomy are fulfilled when personalized elements are incorporated into apps, as these elements offer opportunities for representation according to their preferences; such elements include those used to individualize services or products (Liao et al., 2019), such as profiles, avatars, meaningful stories, and narratives (Koivisto & Hamari, 2019). They satisfy the students' intrinsic needs (Ryan & Deci, 2000). The availability of multiple options enhances their feeling of autonomy. Therefore, learning apps increasingly incorporate customization and personalization features, such as the selection of levels, avatars, and characters, to co-create value. Personalization aids in determining the elements of the learning environment that meet the demands of professional students (Saputro et al., 2019). The freedom to personalize satisfies innate needs (Ryan & Deci, 2000); therefore, it is hypothesized that:

↳ **H1 :** The more professional students personalize their avatars in gamified learning apps, the more their need for autonomy is fulfilled.

Identification

Identification elements incorporated into learning apps allow students to enjoy personalized experiences that fulfill their need for autonomy. Identifying with characters, personas, avatars, and similar elements increases the extent to which students perceive similarity and oneness with them (Teng, 2019). Virtual characters serve as digital images or extensions of professional students (Chen, 2021), providing them with a sense of "co-presence" and belonging in the learning space. In gamified contexts, individuals emotionally identify with the characters or personas of their choice and align themselves with these avatars. This sense of identification enhances students' autonomy.

↳ **H2 :** The more professional students identify with their avatars in gamified learning apps, the more their need for autonomy is fulfilled.

Challenge

Learning apps are increasingly incorporating varied gamified elements with the hope of satisfying the students' need for competence (Xi & Hamari, 2019). The most frequently used means is the incorporation of new and novel challenges, which increase with the skills and abilities, thereby providing them a sense of achievement (Sailer et al., 2017). Prior research on challenge-based gamification for learning (Legaki et al., 2020) reveals that

points, levels, challenges, leaderboards, etc., satisfy professional students' longing for proficiency. Students' confidence in their abilities and efforts is strengthened as they take on and overcome challenges. By using stories or narratives divided into manageable, theme-based steps, students can fulfill their learning objectives. This helps them to explore their potential and satisfy their need for competence, which is favorably associated with intrinsic need fulfillment (Xi & Hamari, 2019).

↳ **H3 :** The more professional students feel a sense of being challenged when using gamified learning apps, the more their need for competence is fulfilled.

Achievement

The intrinsic satisfaction derived from achieving goals within gamified interactions aligns with the core principles of education management. Gamified elements assist users in setting their goals (Hamari, 2017); they help students establish their learning objectives, focus their concentration on education, enhance their perseverance in attaining the learning outcomes, and foster competence. Goals in the learning atmosphere provided by apps may be explicit, such as completing quests, or implicit, such as earning badges, ranks, coins, or marks. Achievement-related feedback influences the students' motivation as well as performance (Kapp, 2012).

↳ **H4 :** The more professional students feel a sense of achievement when using gamified learning apps, the more their need for competence is fulfilled.

Social Presence

Students' experience of social presence is grounded in the concept of interacting physically with others to enhance engagement. Additionally, the use of technology boosts social presence and sociability, which impacts identification and relatedness. When using learning apps, students interact with others and exchange views, fostering a sense of social connection. Appreciation and understanding of diverse opinions offer opportunities for social encouragement and help establish meaningful relations (Halfmann & Rieger, 2019), thus fulfilling relatedness needs (Tseng et al., 2019). Students' need for social presence is met as they build or alter their personas and avatars (Sailer et al., 2017), interact with gamification components (Mulcahy et al., 2020), and use technology to mediate these interactions (Hassanein & Head, 2007).

↳ **H5 :** The more professional students feel a social presence when using gamified learning apps, the more their need for relatedness is fulfilled.

Social Encouragement

Social encouragement, an essential factor for the satisfaction of the students' need for relatedness, refers to the capacity of learning apps to provide students with a sense of being cared for and supported throughout the learning process. Existing research emphasizes the value of belonging and social support (Hombrados-Mendieta et al., 2013). This enhances educability, defined as the apps' ability to accelerate learning by offering educational affordances, such as shared spaces and collaborative and assessment tools. Social encouragement enriches the experience of belongingness, fostering social interactions like cooperation, networking, and team building (Koivisto & Hamari, 2019). Additionally, incorporating social network capabilities into gamification systems enables users to converse, discuss, and share information with a broader audience, thereby satisfying the need for connectedness (Hassan et al., 2019).

↳ **H6 :** The more professional students feel social encouragement when using gamified learning apps, the more their need for relatedness is fulfilled.

Learning Outcomes

Learning outcomes are multifaceted, encompassing changes in cognitive, affective, or skill-based dimensions. We have developed various evaluation models, including multi-level evaluation: behavior, learning, reactions, and results. Outcomes, such as awareness, participation, and engagement (Bloom et al., 1956; Gagné, 1984), are evaluated by assessing the level to which students have attained pertinent skills. These outcomes often involve improvements in linguistic proficiency or behavioral aptitude, particularly in the context of learning (Bloom et al., 1956; Gagné, 1984). In the context of this study, which uses SDT to assess factors that enhance learning outcomes, competence, autonomy, and relatedness are considered important components for achieving these outcomes:

↳ **H7 :** The more professional students feel their needs for (A) autonomy, (B) competence, and (C) relatedness are fulfilled when using gamified learning apps, the greater their attainment of learning outcomes.

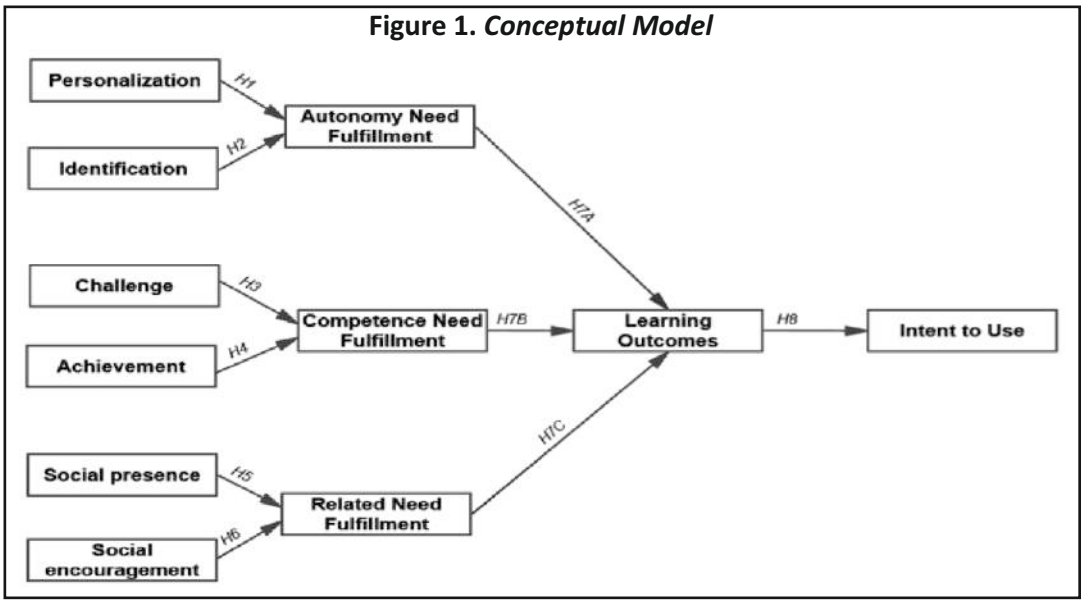
Intent to Use Learning Apps

Education management shapes the learning environment in which apps are used for educational purposes and achieving learning outcomes. However, extant studies have often overlooked measuring the students' actual experiences with gamified learning, assuming instead that exposure to gamification (Berger et al., 2018) would naturally lead to a higher likelihood of app usage. Therefore, the relationship between learning outcomes and intent to use learning apps requires further exploration:

↳ **H8 :** The more professional students feel their learning outcomes have been achieved, the higher their intent to use gamified learning apps.

The conceptual model based on self-determination theory (SDT) was developed to validate the hypotheses formulated, as demonstrated in Figure 1.

Figure 1. ***Conceptual Model***



Method

This study employs a quantitative, empirical approach utilizing a survey and applying partial least squares structural equation modeling (PLS-SEM) with SmartPLS software v3.2.9 to analyze and assess the relationships between gamification elements, student engagement, and learning outcomes.

Research Context

The study was conducted in 2023 in Kota, Rajasthan, known as India's educational hub. The participants were professional students who had been using learning apps Duolingo, MemRise, LingualLift, TripLingo, Treehouse, AgileCRM, LevelEleven, Mint, Fitbit, and Todoist for at least two months. A comprehensive approach was adopted to enhance the learning experience, integrating gamified learning with targeted support to foster an enriching learning environment for the students. Learning outcomes were identified and aligned with the gamified elements. The objectives and guidelines were explained to the students clearly. They were exposed to various gamification elements, including progress indicators (e.g., daily goal and practice points, cracking levels), time-dependent rewards (e.g., streaks), feedback (e.g., incorrect/correct responses), reward schedules (e.g., practice points), and customizations (e.g., avatars and personas). Student progress was monitored regularly, and timely feedback was provided. Data were collected following the two-month intervention.

Data Collection and Participants

The sample framework effectively targeted professional students, aligning with the study's focus on gamification in learning apps. Convenience sampling was used to ensure practical and timely data collection, warranting the data were relevant and statistically valid for examining the hypotheses formulated. The sample comprised 144 professional students recruited through various online platforms and educational networks. The unit of analysis was individual professional students who responded to the online questionnaire. Of the 144 respondents, 117 (81.3%) were male and 27 (18.8%) were female. The average age of the respondents was 19.20 years, with a standard deviation of 0.98. Regarding usage patterns, 62 (43.1%) had used learning apps for 1 hour per week, 24 (16.7%) for 2 hours, 22 (15.3%) for 3 hours, 8 (5.6%) for 4 hours, 10 (6.9%) for 5 hours, and 18 (12.5%) for more than 5 hours per week for at least two months.

Instrument

Data were collected via an online survey employing scales adapted from prior research, as detailed in the Appendix. While the identification items were based on Moon et al. (2013) and Teng (2019), the personalization items were modified from Teng (2010). Fu et al. (2009) provided the challenge's construct, Li et al. (2015) provided the base for the achievement items, Mäntymäki and Salo (2010) provided the adopted and modified items for social presence, and Ki et al. (2020) provided the items for quantifying social encouragement and support work. Autonomy needs were evaluated using questions based on Standage et al. (2005) and La Guardia et al. (2000) ; whereas, competence and relatedness needs were tested using questions from Xi and Hamari (2019). Merhi (2016) used three items to measure intent to utilize. All items were rated on a Likert scale (1 = *strongly disagree*; 5 = *strongly agree*). These measures were selected to ensure the validity and reliability of the survey instrument, with the scales grounded in established research. A pilot test with 20 students confirmed that the survey was clear and understandable, with no reported difficulties in interpreting or responding to the items.

Common Method Bias (CMB)

Analysis and methodological techniques were used to overcome common method bias (CMB). In order to maintain the integrity of the data, participation in the survey was entirely optional, and answers were kept private. Additionally, the factors (dependent/independent) were separated into separate sections in the survey form, minimizing the risk of respondents making causal connections between the constructs. We assessed the estimations of the variance inflation factor (VIF). According to the findings (Hair et al., 2011), all of the VIF values fell between 1.382 and 3.795, which is well below the threshold of 5. This suggests that there were no collinearity issues in the study (Table 1).

Analysis and Results

The study employed Ringle et al.'s (2015) PLS-SEM method with SmartPLS v3.2.9 to analyze responses from 144 participants to examine the structural relationships within the proposed model. PLS-SEM was chosen for this study because it effectively handles the complexity of the proposed model and is suitable for small sample sizes.

Measurement Assessment

The measurement model was evaluated and the model's reliability and validity were assessed. Important aspects included item reliability, composite reliability (CR), average variance extracted (AVE), and overall validity. In accordance with Henseler et al. (2015), the model's validity and reliability were confirmed. Reliability results exceeded 0.7, indicating strong internal consistency among the constructs. Construct reliability was tested using Cronbach's alpha (CA), and Table 1 shows that CA values were higher than 0.6. The AVE values for all constructs are above 0.50, confirming adequate convergent validity. CR estimates were all higher than 0.7, indicating that the constructs are reliably measured. All variables demonstrated satisfactory convergent validity (Hair et al., 2014), with item loadings exceeding 0.60, falling within the acceptable range. The measurement model demonstrates robust reliability and validity, with all key metrics meeting or exceeding the recommended thresholds. This indicates that the model's constructs are well-defined and measured effectively, supporting the robustness of the subsequent analysis.

Table 1. ***Measurement Model***

Constructs	Items	VIF	Loadings	CA	rho_A	CR	AVE
Achievement *(ACH)*	*ACH1*	1.555	0.885	0.798	0.818	0.796	0.571
	ACH2	1.753	0.611				
	ACH3	1.951	0.745				
Autonomy Need Fulfillment *(ANF)*	*ANF1*	1.687	0.852	0.856	0.858	0.854	0.594
	ANF2	1.966	0.743				
	ANF3	2.237	0.717				
	ANF4	2.408	0.765				
Challenge *(CH)*	*CH1*	1.499	0.784	0.732	0.734	0.733	0.578
	CH2	1.499	0.736				
Competence Need Fulfillment *(CNF)*	*CNF1*	2.891	0.805	0.933	0.935	0.934	0.738
	CNF2	3.795	0.889				
	CNF3	3.615	0.902				

	CNF4	3.040	0.836				
	CNF5	2.871	0.860				
Personalization *(PER)*	*PER1*	1.779	0.699	0.824	0.826	0.824	0.539
	PER2	2.306	0.703				
	PER3	2.152	0.793				
	PER4	1.382	0.738				
Identification *(ID)*	*ID1*	1.489	0.719	0.831	0.838	0.831	0.553
	ID2	1.937	0.652				
	ID3	2.070	0.842				
	ID4	1.901	0.749				
Intent to Use *(IU)*	*IU1*	1.927	0.773	0.819	0.832	0.824	0.701
	IU2	1.927	0.897				
Learning Outcomes *(LO)*	*LO1*	2.999	0.824	0.912	0.918	0.913	0.778
	LO2	3.485	0.956				
	LO3	2.956	0.861				
Relatedness Need Fulfillment *(RNF)*	*RNF1*	1.944	0.758	0.893	0.902	0.893	0.678
	RNF2	2.766	0.719				
	RNF3	3.308	0.883				
	RNF4	2.409	0.918				
Social Presence *(SP)*	*SP1*	1.694	0.766	0.818	0.820	0.819	0.601
	SP2	1.852	0.744				
	SP3	1.983	0.814				
Social Engagement *(SEN)*	*SEN1*	1.823	0.739	0.878	0.891	0.880	0.649
	SEN2	2.747	0.848				
	SEN3	2.103	0.693				
	SEN4	2.582	0.922				

Next, all constructs showed AVE values above the optional threshold of 0.5, representing satisfactory discriminant validity. The cross-loadings were reviewed and found to be satisfactory, confirming that items load higher on their corresponding constructs than on others. Table 2 presents the results following Fornell and Larcker's (1981) criteria. The bold values represent the square roots of the AVE, affirming discriminant validity by demonstrating that each construct shares greater variance with its own indicators than with other constructs. The diagonal values, which correspond to the square roots of the AVE for each construct, exceeded the correlations between constructs (listed below the diagonal), confirming a stronger association of each construct with its own measures than with those of other constructs.

All HTMT values were evaluated in accordance with the guidelines provided by Henseler et al. (2015) and were discovered to be below the 0.90 level (Table 3).

Next, the value of R^2 is assessed. All loading values deliberated as significant relations are above 0.6, moderate above 0.33, and weak above 0.19. The R^2 estimates are shown in Table 4 and are strong for all constructs, with the exception of intent to use (0.287), which is moderate. The f^2 value of 0.35 is construed as a large effect, 0.02 as a trivial effect, and 0.15 as a reasonable effect on the dependent variable. Table 1 shows the effect size for autonomy need fulfillment on learning outcomes is small (0.009), while the effect size personalization on autonomy need fulfillment is the largest among all variables (0.794). The Q^2 value is above 0, demonstrating sufficient

Table 2. ***Fornell and Larcker (1981) Criteria***

	ACH	ANF	CH	CNF	PER	ID	IU	LO	RNF	SP	SEN
ACH	**0.755**										
ANF	0.719	**0.771**									
CH	0.557	0.667	**0.760**								
CNF	0.715	0.788	0.656	**0.859**							
PER	0.708	0.773	0.735	0.768	**0.774**						
ID	0.481	0.653	0.627	0.531	0.528	**0.745**					
IU	0.503	0.624	0.592	0.447	0.450	0.686	**0.837**				
LO	0.748	0.723	0.546	0.713	0.816	0.579	0.536	**0.882**			
RNF	0.698	0.724	0.526	0.565	0.549	0.398	0.552	0.725	**0.824**		
SP	0.698	0.758	0.758	0.725	0.604	0.744	0.709	0.724	0.705	**0.775**	
SEN	0.553	0.660	0.484	0.558	0.443	0.540	0.567	0.548	0.693	0.706	**0.806**

Table 3. ***HTMT Ratio***

	ACH	ANF	CH	CNF	PER	ID	IU	LO	RNF	SP	SEN
ACH											
ANF	**0.732**										
CH	0.553	**0.669**									
CNF	0.709	0.785	**0.655**								
PER	0.712	0.769	0.738	**0.768**							
ID	0.501	0.647	0.629	0.536	**0.528**						
IU	0.524	0.625	0.599	0.445	0.450	**0.696**					
LO	0.755	0.719	0.547	0.714	0.818	0.584	**0.537**				
RNF	0.708	0.725	0.526	0.559	0.542	0.403	0.560	**0.72**			
SP	0.698	0.756	0.761	0.726	0.605	0.754	0.713	0.722	**0.702**		
SEN	0.562	0.662	0.488	0.559	0.443	0.556	0.579	0.542	0.692	**0.714**	

Table 4. ***Model Summary***

	R^2	R^2 Adjusted	Q^2	Model Indices	Saturated Model	Estimated Model
Autonomy Need Fulfillment	0.680	0.676	0.344	**SRMR**	0.062	0.106
Competence Need Fulfillment	0.607	0.602	0.375	**Chi–Square**	1150.254	1301.878
Relatedness Need Fulfillment	0.573	0.567	0.345	**NFI**	0.754	0.721
Intent to Use	0.287	0.282	0.181			
Learning Outcomes	0.664	0.657	0.483			

extrapolative significance. This result suggests that the model has predictive relevance and that the constructs can effectively forecast outcomes beyond the sample data. The SRMR standardized root means square residual, as the results show, is 0.062; NFI is 0.754 for the saturated model. Overall, these results confirm that the model is well-suited for further analysis.

Path Assessment

Using 2,000 re-samples and the bootstrapping procedure, the standardized routes were measured. The results of the statistical test are shown in Table 5.

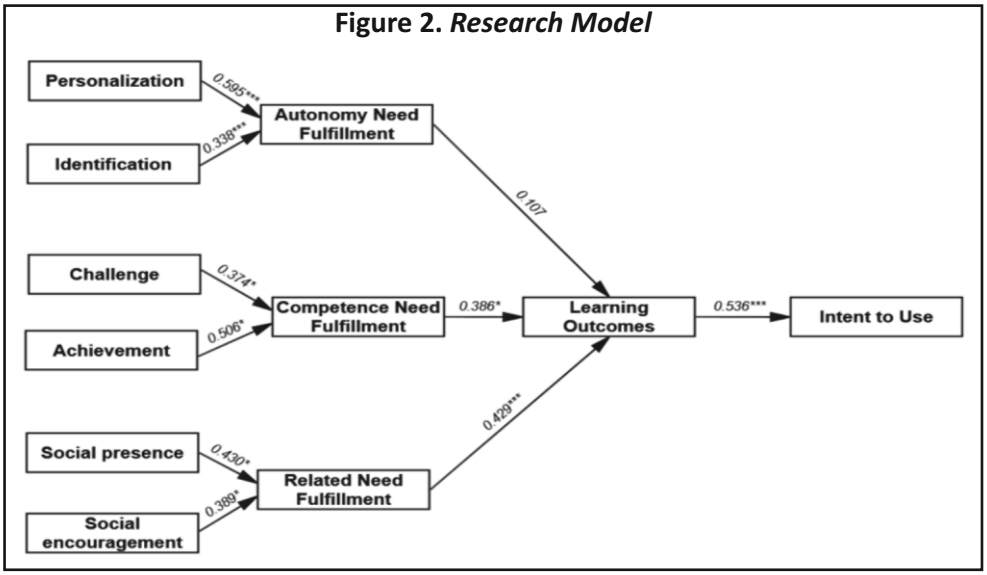
All hypotheses, except H7A, are supported. Hypotheses H1 and H2 are validated as character personalization (β = 0.595***) and identification (β = 0.338***) affected autonomy need fulfillment considerably and affirmatively; challenge (0.374*) and achievement (β = 0.506*) affected competence need fulfillment considerably and affirmatively at the $p < 0.05$ level, thereby supporting hypotheses H3 and H4; social presence (β = 0.430*) and social encouragement (β = 0.389*) affected relatedness need fulfillment considerably and affirmatively at $p < 0.05$ level, thereby supporting hypotheses H5 and H6. While competence need fulfillment (β = 0.387*) and related need fulfillment (β = 0.429***) have a significant influence on learning outcomes at $p < 0.05$ and $p < 0.000$ level, respectively, supporting hypotheses H7B and H7C, the impact of the need for autonomy (β = 0.107, $p > 0.05$) on learning outcomes is positive but insignificant. Finally, hypothesis H8, Learning outcomes –> Intent to use, is validated (β = 0.536***) at the $p = 0.000$ level, as indicated in Figure 2.

Table 5. ***Hypotheses Testing***

Hypotheses		β	*STD*	*T*	*P*	CI LL	CI HL	Results
H1	Personalization –> Autonomy Need Fulfillment	0.595***	0.082	7.222	0.000	0.426	0.746	Accepted
H2	Identification –> Autonomy Need Fulfillment	0.338***	0.093	3.649	0.000	0.147	0.511	Accepted
H3	Challenge –> Competence Need Fulfillment	0.374*	0.196	1.905	0.050	0.093	0.791	Accepted
H4	Achievement –> Competence Need Fulfillment	0.506*	0.203	2.497	0.013	0.043	0.793	Accepted
H5	Social Presence –> Relatedness Need Fulfillment	0.430*	0.190	2.260	0.024	0.050	0.820	Accepted
H6	Social Encouragement –> Relatedness Need Fulfillment	0.389*	0.171	2.273	0.023	0.001	0.675	Accepted
H7A	Autonomy Need Fulfillment –> Learning Outcomes	0.107	0.189	0.570	0.569	–0.267	0.480	Rejected
H7B	Competence Need Fulfillment –> Learning Outcomes	0.386*	0.167	2.309	0.021	0.061	0.720	Accepted
H7C	Relatedness Need Fulfillment –> Learning Outcomes	0.429***	0.122	3.526	0.000	0.196	0.678	Accepted
H8	Learning Outcomes –> Intent to Use	0.536***	0.099	5.413	0.000	0.326	0.713	Accepted

Note. $p < 0.05$ = *, $p < 0.01$ = **, $p < 0.001$ = ***.

Figure 2. ***Research Model***



Discussion

The present findings shed light on the significance of aligning educational practices with students' intrinsic needs for autonomy, competence, and relatedness by demonstrating how gamified elements boost learning by offering an experience of accomplishment. In contrast to prior studies that focused on engagement contributing to behavioral changes (Hursen & Bas, 2019), the present study investigates the impact of interaction with gamified elements in learning apps on learning outcomes. The results indicate that interaction with personalization and identification features has a positive and significant effect on autonomy need fulfillment; interaction with challenge and achievement features has a positive and significant effect on competence need fulfillment; interaction with social presence and encouragement features has a positive and significant effect on relatedness need fulfillment.

Professional students were given the impression that they were physically present in the virtual environment they shared with their lecturers and classmates because of gamification. The findings reveal that when the students' innate demands for competence, autonomy, and relatedness were met, it had a significant impact on their sense of learning outcome achievement and, consequently, their intent to use learning apps. As a result, developing in-app features that meet the students' intrinsic needs for competence, autonomy, and relatedness is central to maximizing learning outcomes. The findings highlight the elements that influence learning outcomes and app usage by addressing students' needs.

Although the findings demonstrate that meeting students' need for autonomy is positively associated with learning outcome gratification, the effect is found to be statistically insignificant. Nonetheless, the more students are allowed to personalize their digital character/ persona in learning apps, the more they will experience a sense of identification, thereby satisfying their need for autonomy. As indicated by the present results, the more the students felt a sense of challenge and achievement while using the learning apps, the more their need for competence was fulfilled. These findings suggest that students might benefit even more if the apps' game components linked to challenge and achievement are improved, further satisfying their natural desire for competence, thereby confirming prior findings (Lampropoulos & Kinshuk, 2024).

On the other hand, students experienced social presence and encouragement when utilizing learning apps, which satisfied the need for relatedness. The more the students experience connectedness while using apps, the more their demands for relatedness are fulfilled. Additionally, the more they experience interconnectedness and the ability to discuss and communicate with each other, the more their need for interconnectedness is fulfilled. These findings affirm that enhancing social presence among students can play a central role in encouraging an engaging educational experience, motivating them, and assisting them in realizing their goals.

The findings show that learning outcomes are significantly impacted by attending to pupils' innate wants. Students feel that learning objectives are met to a greater extent when their experiences of competence and relatedness are richer. Students' need for autonomy, on the other hand, has a positive but minimal influence on perceived learning outcome achievement. This means that the student's interaction with gamification, personalization, and customization features in apps more significantly influences learning outcome achievement. This could be because human–computer interaction can satisfy autonomy needs, but relatedness could be more relevant and important in the context of L2 learning, supporting the findings of prior studies (Kaur et al., 2021). Finally, the fulfillment of learning outcomes is found to be a key antecedent of gamified learning app usage intention.

The current study successfully confirms the existence of substantial positive associations between the students' interactions with gamification, customization, and engagement features in apps, their inherent needs (competence, autonomy, and relatedness), and learning outcome achievement (Huang et al., 2019; Legaki et al., 2020). As a result, the study endorses the use of gamified elements for learning, which should be carefully

chosen and meticulously applied to ensure effective communication and learning outcome achievement, thereby affirming previous research need for the use of effective strategies for implementing educational innovations (Alvi, 2022). The study also affirms the significance of embracing new technologies and techniques that surpass traditional methods in improving students' learning experiences (Dahalan et al., 2024). The present investigation further highlights the need for continual discourse on best policies and practices for enhancing learning experiences. Top management's leadership, research strategy, and adequate research infrastructure (Kanojia et al., 2022) can provide strategic support in integrating innovative educational tools like gamification in India.

The findings of the study have various theoretical and practical implications for education management, learning app design, and the broader landscape of education. It adds to the existing literature by highlighting the significance of educating management strategies and the fulfillment of professional students' needs (competence, autonomy, and relatedness) as critical precursors that impact learning outcomes, affirming the role of gamification. Unlike most previous studies, which saw SDT as a one-dimensional construct (Gokhale & Kulkarni, 2022), the current research examines the links between distinct gamification aspects and intrinsic needs (autonomy, competence, and relatedness) to clarify the effect of gamified features. The present study supports the idea that higher intrinsic motivation results in better outcomes (Ryan & Deci, 2000), the inclusion of gamified features leads to engagement (Ekici, 2021), social collaboration, and teamwork (An, 2021), and above all, success in academics (Bai et al., 2020). Gamified learning apps can offer cognitive benefits and positive learning outcomes (Sailer & Homner, 2020) as they can provide methods and mechanisms through which a learner understands things and solves problems (Lamb et al., 2018).

The current analysis supports earlier research that used empirical data to demonstrate links between gamification and learning outcomes (Koivisto & Hamari, 2019). It also reinforces the importance of not only catering to the student's learning preferences but also creating education management strategies to create personalized learning paths for the students. Through strategic implementation of education management practices, the learning experiences may be enhanced significantly. Careful planning and proper execution are needed. It is crucial to communicate the goals, adapt the instructions to the needs of the students, use student-centric approaches, and consider the students' preferred methods of learning. In short, the study emphasizes the need for ongoing innovation in educational practices; as new technologies emerge and evolve so too should education management approaches to keep pace with modern trends (Oliveira et al., 2023).

Managerial/Theoretical Implications/Policy Implications

The study contributes to research by integrating SDT with gamification, offering a new perspective on their combined impact on motivation and outcomes. It introduces improved scales to measure the effects of gamified experiences and validates a model linking gamification with intrinsic need fulfillment and learning outcomes. The research challenges existing theories by questioning the significance of autonomy in this context, suggesting a need for refined models. By linking these findings with established theories, the study enhances our understanding of gamification's theoretical underpinnings and offers practical guidance for its application in industry settings.

This study provides actionable insights for industry professionals, especially managers and marketers, on how to utilize gamification to enhance engagement and performance. The research demonstrates that gamified elements like personalization and social presence can effectively meet intrinsic needs, offering a strategic framework for developing more engaging customer loyalty programs, employee training modules, and educational tools. For instance, education technology managers can design learning apps that not only engage users but also lead to better retention and application of knowledge. Innovation in organizational culture, driven by strategy, leadership, and organizational support, is essential for fostering creativity in education, though

reforms are often inadequately implemented (Chandel & Kaur, 2023). Marketers can apply these principles to build stronger customer relationships and brand loyalty, while HR managers can enhance employee motivation and productivity through tailored gamification strategies.

The study's conclusions can also help educational administrators add gamification to their courses to improve learning results and student engagement. Practical applications include using game elements like points and badges to motivate students, personalizing learning experiences to match student abilities, and adopting gamified assessments for immediate feedback. Additionally, teacher training in gamification design is crucial for effectively implementing these strategies in educational settings. The study confirms prior research, which emphasizes the importance of a comprehensive approach to education management in Indian higher education, highlighting the need for policy support and the incorporation of the latest technological advancements to enhance teaching, learning, and learning outcomes (Kumar, 2023).

Conclusion

To conclude, the study demonstrates the dynamic interplay between education management gamification using augmented reality, virtual reality, and 3D visualization in learning apps, which have recently revolutionized the landscape of learning. Based on SDT, the study successfully assesses how gamified elements influence students' perceptions and the impact of gamification on their experience and intent to use. The study enriches the comprehension of the interplay of diverse factors on students' reception of gamified learning in a developing country, India, highlighting the pivotal role of education management in designing engaging learning environments for students to meet their diverse educational needs as well as the demands of the market and industry. Thus, the study paves the way for future research into the continuous implementation of modern technology in learning to strengthen its efficacy and effectiveness for students in India and beyond. Future research can explore the long-term effects of gamification on student learning outcomes, particularly how sustained engagement through gamified elements influences deeper learning and retention. Additionally, studies could examine the differential impact of gamification on various student demographics, such as age groups, learning styles, and cultural backgrounds, to develop more tailored strategies.

Limitations of the Study and Scope for Further Research

The study has several limitations, such as a relatively small sample size obtained through convenience sampling, which may hinder the generalizability of the results. The dependence on self-reported information through e-surveys introduces potential bias, and the cross-sectional design restricts the ability to infer causality. Additionally, the study focused on specific gamified elements and was conducted within a particular cultural context, which may influence the results. Future research should consider larger, more diverse samples, employ longitudinal designs to assess long-term effects, and explore a broader range of gamification features. Studies could also investigate the integration of emerging technologies like VR and AI with gamification and examine mediating and moderating factors such as learning styles and prior technology experience. These directions would help refine the understanding of how gamification can be optimized for different educational contexts and student needs.

Author's Contribution

Dr. Irum Alvi conceived the idea and developed a research design to undertake the empirical study. She extracted

research papers with high reputation, filtered these based on keywords, and generated concepts and codes relevant to the study design. She also verified the analytical methods and supervised the study. The survey, as well as the numerical computations, were done by her using SMART-PLSv3.2.9.

Conflict of Interest

The author certifies that she has no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

Funding Acknowledgment

The author received no financial support for the research, authorship, and/or for the publication of this article.

Data Availability Statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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Appendix. *List of Questionnaire Items*

Construct	Cronbach's Alpha	Items	Loadings	Item Adapted/ Adopted/ Modified from Source
Achievement	0.798	*ACH1:* I use the educational app to reach higher levels of achievement.	0.885	Li et al. (2015)
		ACH2: I enjoy earning badges or rewards that reflect my progress in the app.	0.611	
		ACH3: I use the app to showcase my abilities to others.	0.745	
Autonomy	0.856	*ANF1:* I use the app because I genuinely want to use it.	0.852	La Guardia et al. (2000)
Need Fulfillment		*ANF2:* I feel free to be myself when I am using the app.	0.743	
		ANF3: I can express my opinions freely within the app.	0.717	
		ANF4: Using this app helps me feel free from outside pressures.	0.765	
Challenge	0.732	*CH1:* The level of challenge in the educational app is suitable for me.	0.784	Fu et al. (2009)
		CH2: My skills gradually improved through using the educational app.	0.736	
Competence	0.933	*CNF1:* I feel competent when I am using the educational app.	0.805	Xi & Hamari (2019)
Need Fulfillment		*CNF2:* I am satisfied with my performance when using the app.	0.889	
		CNF3: I feel like an expert in the app's environment.	0.902	
		CNF4: I believe I perform well when using the educational app.	0.836	
		CNF5: I am motivated by seeing my skills improve within the educational app.	0.860	
Personalization	0.824	*PER1:* This educational app allows me to personalize features to suit my preferences.	0.699	Teng (2010)
		PER2: I can customize aspects of my learning experience within the app.	0.703	
		PER3: The app allows me to set up my profile to reflect my personality.	0.793	
		PER4: I can create a unique experience for myself in the app by adjusting various settings.	0.738	
Identification	0.831	*ID1:* I feel a strong sense of ownership over my profile in the app.	0.719	Moon et al. (2013)
		ID2: My profile within the app feels like an extension of myself.	0.652	and Teng (2019)
		ID3: Using the app allows me a way to express myself.	0.842	
		ID4: My profile within the app is very important to me.	0.749	
Intent to Use	0.819	*IU1:* I intend to continue using the educational app in the future.	0.773	Merhi (2016)
		IU2: I plan to keep using the educational app regularly.	0.897	
Learning	0.912	*LO1:* This app has helped me improve my learning outcomes.	0.824	Author's own
Outcomes		*LO2:* I feel that I am achieving my educational goals by using the app.	0.956	
		LO3: Using this app positively affects my academic performance.	0.861	
Relatedness	0.893	*RNF1:* I feel supported by others when I use the educational app.	0.758	Xi & Hamari (2019)
Need Fulfillment		*RNF2:* I feel understood by others in the app environment.	0.719	
		RNF3: I feel valued by others when I use the app.	0.883	
		RNF4: I feel others care about what I say and do within the app.	0.918	
Social Presence	0.818	*SP1:* There is a sense of human connection when using the educational app.	0.766	Mäntymäki & Salo (2010)
		SP2: I feel like I am part of a learning community within this app.	0.744	

		SP3: The app environment has a welcoming, supportive atmosphere.	0.814	
Social	0.878	*SEN1:* I enjoy interacting with others within this app.	0.739	Ki et al. (2020)
Engagement		*SEN2:* I actively engage in discussions or activities with others in the app.	0.848	
		SEN3: I feel more motivated when I see others participating actively.	0.693	
		SEN4: The app makes it easy to connect with other learners.	0.922	

About the Author

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