Enhancing Learner Satisfaction in Simulation-Based Learning: The Impact of Learner Characteristics and Expectancy

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Abstract: Digital game-based learning, facilitated by immersive virtual reality technology, has become integral to modern education. This study investigates learner satisfaction within the context of marketing simulations, exploring the roles of Performance Expectancy (PE) and Effort Expectancy (EE), their interplay with learner characteristics, and their alignment with the Self-Determination Theory (SDT). The study's theoretical framework draws from the Technology Acceptance Model (TAM), Expectancy-Confirmation Theory, and SDT. Through factor analyses and hierarchical regression, the research reveals the significance of Performance and Effort Expectancy in influencing Learner Satisfaction. Notably, Performance Expectancy emerges as a stronger driver than Effort Expectancy. The study also explores the impact of learner characteristics, such as gender and game-playing motivations rooted in SDT's principles of intrinsic motivation, on Learner Satisfaction, identifying Striving as a potential deterrent to satisfaction. Despite limitations like sample specificity and self-reported data, this research provides valuable insights into learner engagement in technology-mediated educational contexts, taking into account both cognitive and motivational aspects. The findings underscore the importance of considering individual motives and characteristics in optimizing educational technology interventions.

Keywords: simulation-based learning, game-based learning, learner satisfaction, learner characteristics, game-playing motives, Self-Determination Theory (SDT), Technology Acceptance Model (TAM), Expectancy-Confirmation Theory, gamified learning environments, educational gamification, higher education

1. Introduction

Digital game-based learning, facilitated by immersive virtual reality technology (Merchant et al., 2014), is integrated into education for engaging and realistic experiences that promote critical thinking (Byun & Joung, 2018; Tsai & Tsai, 2018). Simulations within serious games offer contextualized cognition, skill acquisition, and attitudinal changes (Batko, 2016), fostering interactive and social learning (Buzzard et al., 2011). In STEM fields, simulation-based learning fosters critical thinking, problem-solving, and decision-making skills (Cook et al., 2013; Hegland et al., 2017), while marketing simulations enhance strategic management and decision-making (Hall, 2014; Caruana et al., 2016). Learner satisfaction and user motives are pivotal in simulation effectiveness (Vos & Brennan, 2010; Kolb, 1984), driving the need to explore factors influencing user satisfaction (Caruana et al., 2016).

1.1 Business and Marketing Simulation: Bridging Theory and Practice

Marketing simulations like "Hubro Marketing Simulation (HMS)" and "Markstrat" engage students in decision-making processes (Hall, 2014; Caruana et al., 2016). These simulations offer immediate feedback and objective data on market behaviors (Tompson & Dass, 2000), enabling longitudinal analysis (Kietzmann & Pitt, 2016). Complexity challenges decision-making, with the acceptance and effectiveness of simulations impacting learning outcomes (Vos & Brennan, 2010). User satisfaction is vital, considering (dis)confirmation and specific aspects of the product (Giese & Cote, 2000).

1.2 User Satisfaction as an Outcome Variable

Building on Caruana et al. (2016), this study examines learner satisfaction (Caruana et al., 2016) and explores influencing variables such as gender and age (Caruana et al., 2016). The study integrates the Expectancy-Confirmation Theory and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Caruana et al., 2016). Learner motives, crucial in simulation effectiveness (Deci & Ryan, 1985), are explored alongside user satisfaction, crucial for educational tool optimization (Bartle, 1996; Yee, 2006; Kahn et al., 2015).

1.3 Learner Game-Playing Motivations as a Crucial Part of Learner Characteristics

Learner motives have been identified as critical factors in the context of simulation games, encompassing intrinsic motivation, extrinsic rewards, social interaction, skill development, and personal interest (Deci & Ryan, 1985). Different motives, such as the application of theoretical concepts, hands-on experience, and competition, significantly impact learner engagement, effort, and overall satisfaction with the learning experience. The diversity of student motivation, prior knowledge, and background has been found to have the greatest influence on the effectiveness of teaching interventions (Hattie, 2015). Thus, understanding learner motives is essential for identifying the most effective educational methods.

1.4 Aims of study and research questions

The main focus of this research is to determine the contribution of Performance Expectancy (PE) and Effort Expectancy (EE) on Learner Satisfaction (LS) when the potential impact of Course Performance and Course Type are considered. On the basis of the above discussion, we, therefore, hypothesize that:

1. Hypothesis 1: Performance Expectancy (PE) has a positive influence on Learner Satisfaction with the simulation game.
2. Hypothesis 1a: The effect of Performance Expectancy on Learner Satisfaction is moderated by Learner Characteristics like Gender, Past Course Performance, Course Type, and Learner Game-Playing Motivation
3. Hypothesis 2: Effort Expectancy (EE) has a positive influence on Learner Satisfaction with the simulation game.
4. Hypothesis 2a: The effect of Effort Expectancy on Learner Satisfaction is influenced by Learner Characteristics like Gender, Past Course Performance, Course Type, and Learner Game-Playing Motivation

2. Method

2.1 Participants and simulation deployment

Scholtz and Hughes (2018) emphasized pedagogical alignment, thus meticulously crafting the deployment of the "Hubro Marketing Simulation (HMS)" to optimize connections between Learner Satisfaction (LS), Performance Expectancy (PE), Effort Expectancy (EE), and Learner Motives. Integrated as a group project in a foundational marketing course during October 2022 semester over 12 weeks, teams submitted comprehensive reports detailing marketing choices made over eight rounds, incentivizing competition and sustained decision-making. Eleven tutors, spanning 28 classes, ensured intervention uniformity. Rigorous training aligned with Chaurasia (2017), tutor toolkits, and a practice round mitigated tutor effects for student preparation. Out of 538 students, 227 participated in the survey, including a 37-item questionnaire covering Learner Satisfaction, Performance Expectancy, Effort Expectancy, Learner Motives, and demographic variables. Notably, 66% of respondents were female, reflecting typical gender distribution in Singapore's business-related diploma courses. Figure 1 illustrates the HMS interface and decision-making guidelines.

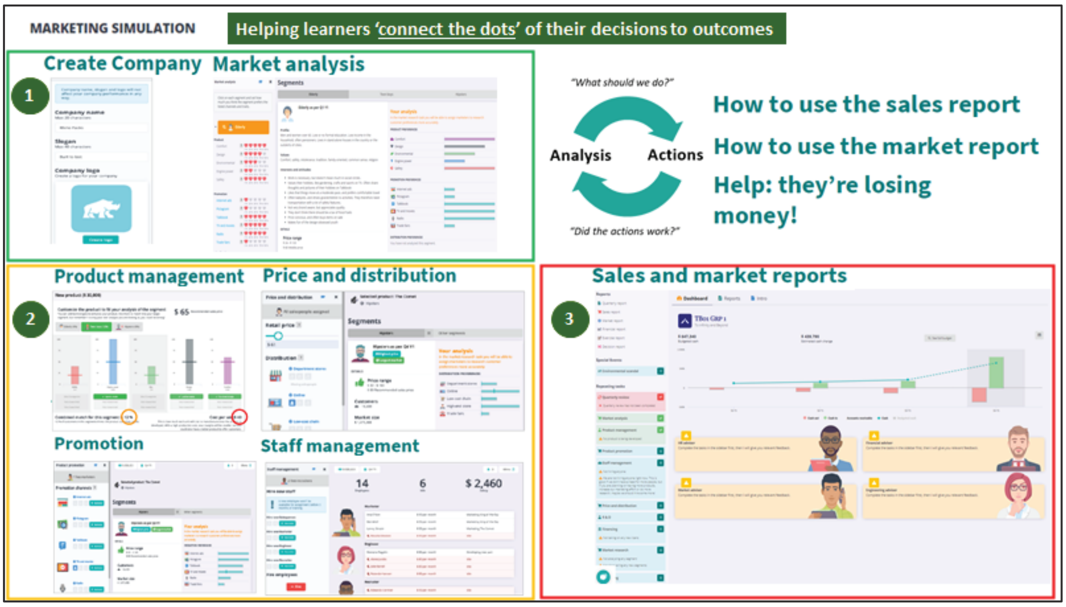

Figure 1: HMS interface and how decisions are made. Tutors were briefed to aid learners with Steps 1,2, and 3 to "connect the dots" in their group decision-making.

2.2 Variables and data analysis

Factor analyses explored the Learner Game-Playing Motivation construct (Jaskari & Henna Syrjälä, 2022) and Learner Satisfaction, Performance Expectancy, and Effort Expectancy constructs. A two-stage hierarchical multiple regression examined hypothesized relationships with 227 respondents, surpassing recommended subject-to-item ratio (Nannally, 1978) and minimum requirement for hierarchical regression (Soper, 2016).

2.2.1 Game-playing motivation construct

Employing established steps (Luomala et al., 2017; Vahlo et al., 2017; Jaskari & Syrjälä, 2022), factor analysis assessed game-playing motivations. Three fixed factors – Immersivity Completing (α = .952), Socializing (α = .874), Striving (α = .909) – explained 78.1% variance (Table 1).

Table 1. Mean and Standard Deviation of Items Together With Pattern Matrix From Factor Analysis for Game-playing Motivation Construct

Items	Mean	SD	Loadings	Cronbach's Alpha
When thinking about your own learning, how important do you find the following items?				
Immersivity Completing	45.74	10.24		0.95
1. To advance well in the subject	6.00	1.20	0.74	
2. To be immersed in learning	5.67	1.24	0.73	
3. To feel that you can control your learning	5.79	1.23	0.78	
4. To feel the joy of research in learning	5.59	1.4	0.79	
5. To figure out the idea of marketing and the logic of the subject	5.64	1.31	0.85	
6. To learn the stories and principles related to the topics of the subject	5.54	1.31	0.83	
7. To notice that I have progressed in learning	5.82	1.27	0.87	
8. To set goals and achieve them	5.69	1.28	0.69	

Socializing	20.56	6.04		0.87
9. To chat with other students	5.12	1.44	0.63	
10. To compete with other students	4.84	1.67	0.72	
11. To feel that you belong to the community of subject participants	5.16	1.50	0.77	
12. To feel that you belong to the group	5.44	1.43	0.68	
Striving	10.25	3.11		0.91
13. To be one of the most skilled students	5.28	1.46	0.83	
14. To be the best student in the subject	4.97	1.65	0.83	

Note. Extraction method: Principal components analysis. Rotation method: Varimax. Loading coefficients from the factor analysis below .5 are not shown.

2.2.2 Learner Satisfaction, Performance Expectancy, and Effort Expectancy Constructs

Assessed through 7-point Likert scales (1–7), three constructs – LS, PE, EE – underwent factor analysis, aligned with Caruana et al. (2016). The KMO (.96) and Bartlett's test ($\chi 2 = 5812$, $p < .001$) supported validity. Principal components factor analysis with Oblimin rotation indicated reliability via Cronbach's alpha (.97), surpassing .7 (Nunnally, 1978). (Table 2).

Table 2. Mean and Standard Deviation of Items Together With Pattern Matrix From Factor Analysis for Learner Satisfaction, Performance Expectancy, and Effort Expectancy constructs

Items	Mean	SD	Loadings	Cronbach's Alpha
Learner Satisfaction (LS)	92.72	26.86		0.97
The use of the simulation game in the subject was one of the best experiences I could have had.	5.16	1.37	0.85	
I am satisfied with having used the simulation game in the subject.	5.31	1.44	0.80	
The choice of the simulation game for the subject was a wise one.	5.28	1.52	0.89	
I am certain it was the right thing that the simulation game was included as an integral part of the subject.	5.11	1.42	0.52	
Playing the simulation game engaged me more in the course than a regular teaching method does.	5.18	1.58	0.79	
I will recommend the use of simulation game to learn and apply marketing principles and theories.	5.22	1.67	0.85	
Performance Expectancy (PE)	30.73	8.93		0.97
Using the simulation game enabled me to accomplish tasks in the subject more quickly.	5.06	1.52	0.61	
Using the simulation game improved my study performance in this subject.	4.82	1.56	0.72	
Using the simulation game improved my understanding of marketing.	5.30	1.48	0.84	
Using the simulation game enhanced my effectiveness in my study of marketing.	5.08	1.52	0.92	
Using the simulation game made it easier to develop marketing competencies.	5.21	1.41	0.93	
I found the simulation game useful for addressing marketing-related issues.	5.26	1.44	0.94	

Effort Expectancy (EE)	29.75	9.28		0.97
Learning to use the simulation game was easy for me.	4.89	1.61	0.98	
It was easy to get the simulation game to do what I wanted it to do.	4.94	1.56	0.88	
Interfacing with the simulation game was clear and understandable.	4.99	1.55	0.78	
I found the simulation game flexible to interact with.	5.07	1.44	0.74	
It was easy for me to become skillful at using the simulation game.	4.82	1.57	0.77	
I found the simulation game easy to use.	5.04	1.55	0.86	

Note. Extraction method: Principal components analysis. Rotation method: Varimax. Loading coefficients from the factor analysis below .5 are not shown.

2.3 Relationship between Variables

Following Caruana et al. (2016), a two-stage hierarchical regression method was applied. In Stage 2, two independent variables were added beyond Stage 1 variables, ensuring normality and linearity assumptions. Harman's single-factor test revealed no significant common method bias (Podsakoff et al., 2003).

Stage 1 of the hierarchical regression involved Gender, Course Type, Past GPA Attainment, and game-playing motivations (Immersity Completing, Socializing, Striving) as independent variables predicting Learner Satisfaction. The results (Table 3) explained 41% variance. Significant predictors were Gender (β = 0.24, $p < .05$), Immensity Completing (β = 0.53, $p < .001$), Socializing (β = 0.30, $p < .001$), and Striving (β = -0.27, $p < .001$). (Table 3)

Table 3. Results From the Two-Stage Hierarchical Multiple Regression (N = 227).

	Stage 1			Stage 2		
Variable	Std. β	t	sr^2	Std. β	t	sr^2
Gender	0.24	2.16*	0.01	0.04	0.644	0.00
Course Type	0.01	0.28	0.00	0.01	0.242	0.00
Past GPA Attainment	0.15	1.48	0.00	0.02	0.82	0.00
Immersivity Completing	0.53	6.76***	0.12	0.05	1.12	0.00
Socializing	0.30	3.36***	0.03	0.05	1.09	0.00
Striving	-0.27	-3.67***	0.04	-0.09	-2.41*	0.00
Performance Expectancy				0.52	10.67***	0.08
Effort Expectancy				0.41	8.98***	0.06
R	0.66			0.92		
R2	0.43			0.85		
Adjusted R2	0.41			0.84		
Change R2	0.41			0.43		

*p<.05 **p<.01 ***p<.001

Aligned with Caruana et al. (2016), a robust Performance Expectancy-Effort Expectancy correlation drove regression score computation via exploratory factor analysis. The model variance explained 84%, $F(8, 218) = 148$, $p < .001$. Performance Expectancy, Effort Expectancy, and Striving contributed 14% to Learner Satisfaction variance post adjustment for Gender, Past GPA Attainment, and Course Type. In the final model, Performance Expectancy (β = 0.52, $p < .001$) surpassed Effort Expectancy (β = 0.41, $p < .001$), and Striving (β = -0.09, $p < .05$) was also notable (Table 3).

3. Results and Discussion

The analysis of research hypotheses and their corresponding outcomes, as presented in Table 4, furnishes a comprehensive comprehension of the intricate interplay between Performance and Effort Expectancy and their influence on Learner Satisfaction. The meticulous assessment revealed a substantial explanatory capacity of 84.4% concerning Learner Satisfaction. Importantly, both Performance and Effort Expectancy emerged as significant drivers, aligning harmoniously with established research within the Technology Acceptance Model (TAM) framework (Caruana et al., 2016; Davis, 1989; Shen & Eder, 2009; Wu & Gao, 2011). Noteworthy is the prominence of Performance Expectancy, surpassing Effort Expectancy, thereby accentuating its pivotal role.

An intriguing facet of the findings pertains to the partial validation of Striving as a game-playing motivation and its impact on the model's outcomes, diverging from Jaskari and Syrjälä's (2022) findings. Methodological distinctions are likely contributors; our study examined individual motives, whereas earlier research concentrated on aggregated clusters. The counterintuitive effect of Striving may arise from learners perceiving a curtailed sense of control, particularly in competitive scenarios where their academic performance is at stake, an aspect particularly pertinent in the Singaporean context where grades hold paramount importance for university admission. In response, our team aimed to experiment with game elements like awarding "Most Valuable Player" among high achievers within the teams to mitigate the potential negative impact of Striving.

Additionally, Gender emerged as a determinant, notably evident in Stage 2, where female learners exhibited relatively lower satisfaction compared to males, aligning with technology adoption and simulation-based educational games literature (Caruana et al., 2016; Venkatesh et al., 2003; Fenwick & Neal, 2001), underscoring the importance of addressing gender-based disparities in educational technology interventions.

To summarize, the systematic exploration of Performance and Effort Expectancy, coupled with the nuanced influence of game-playing motivation and gender, imparts valuable insights into the multifaceted dynamics underpinning Learner Satisfaction. These findings contribute to a broader comprehension of learner engagement within technology-mediated educational contexts, thereby offering implications for instructional design and suggesting avenues for further research in the field.

Table 4. Summary of Hypotheses and Conclusions on Performance and Effort Expectancy Effects on Learner Satisfaction

Hypothesis	Conclusion
1	**Accepted:** Strongly supported. Results from a two-stage hierarchical regression confirm a positive correlation between Performance Expectancy (PE) and Learner Satisfaction, in alignment with established models (TAM) (Caruana et al., 2016; Davis, 1989).
1a	**Accept with Consideration:** The impact of Performance Expectancy on Learner Satisfaction is affirmed, while the significance of Gender becomes apparent. Female participants exhibit lower satisfaction levels, indicating a moderated effect of Performance Expectancy by Gender. Further investigation into game-playing motivations and course-related attributes is crucial for a nuanced comprehension.
2	**Accepted:** Strongly supported. Substantial evidence confirms that Effort Expectancy (EE) is a significant predictor of Learner Satisfaction, aligning with established theoretical frameworks (TAM).
2a	**Accept with Reservation:** Partial support The influence of Effort Expectancy on Learner Satisfaction is validated; however, the interplay between Learner Characteristics such as Gender, Past Course Performance, Course Type, and Learner Game-Playing Motivation warrants deeper exploration.

4. Limitations and Directions for Further Research

This study responds to the call for deeper cross-cultural investigations, as advocated by Caruana et al. (2016) and Jaskari & Henna Syrjälä (2022), but is confined to a specific polytechnic business school in Singapore, limiting generalizability across diverse settings. To enhance applicability, future research should explore various educational contexts.

The reliance on self-reported data introduces potential bias and subjective interpretations. Incorporating objective measures or observational data would enhance result reliability. The cross-sectional design precludes causal inferences and temporal insights; adopting longitudinal or experimental approaches could address these limitations.

While this study focuses on Performance and Effort Expectancy, other variables like self-efficacy and engagement contribute to Learner Satisfaction. Future studies should consider broader variable inclusion to refine understanding. In conclusion, while shedding light on Performance and Effort Expectancy's impact, this study acknowledges contextual boundaries, self-report reliance, and the need for variable expansion. Overcoming these limitations would refine comprehension of technology-mediated education engagement.

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