Mobile Information Systems

Impact of Mobile Systems on the Evaluation and Design of Collaborative Learning

Lead Guest Editor: César A. Collazos
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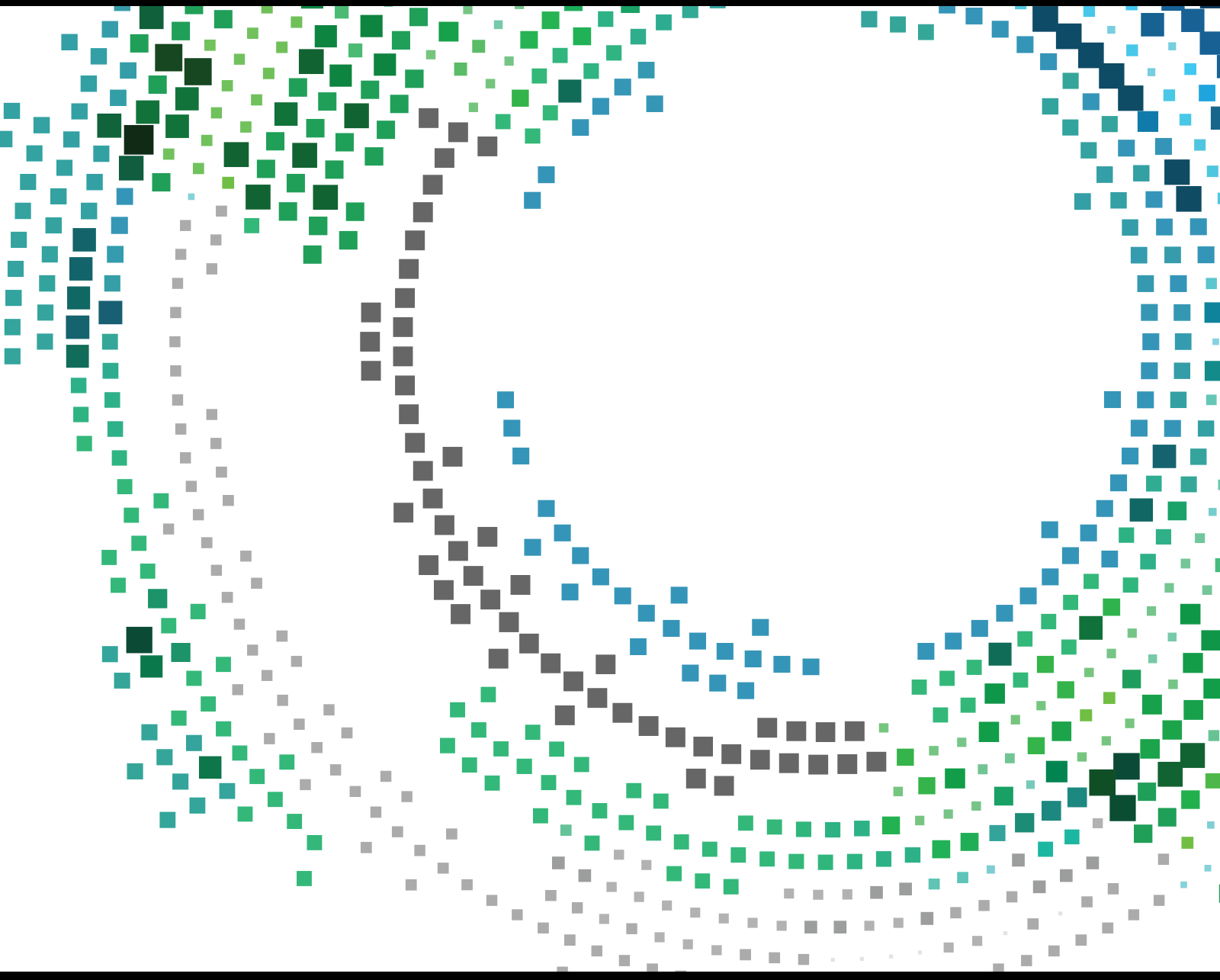

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Hindawi
Mobile Information Systems
Volume 2022, Article ID 2787848, 16 pages
https://doi.org/10.1155/2022/2787848

Research Article

Evaluating the Impact of a Mobile Gaming System on the Collaborative Learning Process in a Hospitality Business Simulator

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Received 8 February 2022; Accepted 22 February 2022; Published 30 March 2022

Academic Editor: César A. Collazos

Simulation-based pedagogy is fully considered when designing collaborative learning processes. However, particularly for training managerial skills in hospitality industries, limited work has been performed on analysing the impact of business simulations in the direction of a mobile gaming system. This paper presents a tablet gaming setup for a hospitality business simulator representing tourist flow characteristics, resource management, and the interaction of actors based on a competition relationship among hotel chain operators involved in the hospitality industry. The mobile gaming system was tested in game-based learning exercises, as in distance and classroom learning case studies, following identically parameterised scenarios. First, survey scores were collected using the self-report Learning Experience and Outcomes Questionnaire to evaluate ubiquitous human mobile-web interaction. Second, lag sequential analysis was employed to examine learning effects. Finally, a regression analysis was carried out to understand whether mobile gaming behaviours were likely to predict hotel performance as the outcome of the collaborative learning process. A total of 90 graduate students participated in game-based learning sessions in the autumn and spring semesters of 2020 and 2021, respectively. For the self-efficacy section, there were no significant differences in the scores. Sixty percent of the scored items in the classroom learning case study outperformed those in distance learning. Face-to-face participation enables more interaction between participants and mobile devices. The regression analysis delivered a $\triangle R^2$ of 0.43 ($F_{4,31} = 7.56$, $P < 0.001$) for the classroom learning case study and 0.49 ($F_{4,47} = 13.19$, $P < 0.001$) for the distance learning case study. The significant correlation between changes in hotel performance and learning behaviours could be attributed to the collaborative learning process. A business simulator powered by a well-designed mobile gaming system could be used to improve hospitality management.

1. Introduction

Mobile gaming systems in education strive to integrate situations, active learning, and social dynamics in an allegorically informed visual-audio environment [1]. Despite its rapidly changing technological components, educational mobile games offer an opportunity to revise the learning process [2]. Here, the intended learning outcomes are closely connected with the overall design of the game [3], player behaviours [4], and human mobile-web interactions [5].

The instruction method to encourage learners to work together towards a common goal, bearing in mind the positive interdependence [6], is collaborative learning that achieves the intended goals via a group-based setting [7]. Improved problem-solving skills, increased respect, becoming better team members, and improved understanding of the course content are benefits of collaborative learning in medicine [8], health care [9], electronic services [10], crisis preparedness [11], and information management [12], which require effective communication, shared institutions, and leadership from diverse perspectives. Digital games [13], mobile applications [14], augmented reality [15], and simulators [16] are productive environments that capitalise on these skills.

Business simulators are defined as simulations, games, and experimental techniques as teaching methods in business, management, and related fields [17]. They deliver a sequential decision-making exercise structured around a business intelligence model in which participants assume responsibility for operation management [18], which plays an important role in extending the case study teaching method to feature the projection of players into the gamified version of the whole experience [19]. An early example was the "Top Management Decision Simulation," after which the majority of US business schools used gaming techniques in lectures [20].

Business simulations characterise a type of gaming media that can address strategic and operational decision-making. Recent business simulations have relied on corporate training to understand fundamental economic and operational theories for administering service-based organisations [21, 22]. As the most remarkable exercise in a classroom setting, the Beer Distribution Game, originally a board game, illustrates the system dynamics of food distribution systems [23], in particular, the "bullwhip" effect observed in real operations [24]. Subsequently, the board game format evolved into more recent screen-based simulations [25].

A recent opportunity that has opened up embraces mobile systems, while they play in a way that supports the collaborative learning process, specifically if the task is in the request of teamwork coordination. While the conventional approach is for human-computer interaction to occur on the computer screen, it is worthwhile to note that a higher proportion of effective learning today already takes place on the tactile screen. Interaction design elements such as numbers [26], sliders [27], and selections are, in most cases, the most frequently employed channels for sending values but are rarely elucidated with the learning experience enabled by mobile devices. Progress is in the intersection of gaming and learning calls for the quantitative analysis of mobile gaming systems. In this regard, motivation theory on learning serves as an appropriate design framework for a one-to-one correspondence between psychological needs and a collaborative learning process [28].

Provided these compelling evidences, this study poses the following research question:

(1) Does a mobile gaming system over business simulation assist participants in realising collaborative learning?

To answer this research question, this study evaluated its impact on a hospitality business simulator (Figure 1). Based on proxy attributes in human mobile-web interactions, a regression model was used to evaluate the association between variables. Specifically, behavioural transition graphs were plotted using lag sequential analysis. The remainder of this paper is organised as follows: methods to measure proxy attributes in human mobile-web interaction, investigate the association between variables, and present the theory of lag sequential analysis are presented in Section 2. The game-based sessions in both case studies are presented in Section 3, followed by their application to the hospitality management simulator (Section 4). The paper concludes with a critical discussion of practical implications (Section 5) and suggestions for further studies (Section 6).

2. Methodology

Through practical implementation of the required activities and tasks in a hospitality business simulator, the collaborative learning process was designed to motivate participants to exercise relevant management skills to assure quality services. More specifically, updates on hotel performance strive to raise awareness and understand the dynamics of the hotel industry. While game-based studies are largely based on meeting the cognitive and social relevance needs of players in the field of mobile learning [30], the design of this study is anchored in the reinforcement theory of motivation. This theory was pioneered in skills training in practical production settings for health care and logistics [31].

Motivational reinforcement theory is concerned with the consequences to individuals when undertaking actions to align with organisational objectives. Positive and negative reinforcement mechanisms are integrated into all the hotel performance indicators. If participants indicate the optimal choice in relation to tourist flow in the simulated environment, the frequent features of gamification schemes exploit decisions in accordance with the intended outcomes. Positive feedback is then provided as a result of revisiting the same destination and increasing levels of customer satisfaction, which translates into excellent financial outcomes for hospitality service providers.

It is worthwhile to note that the collaborative learning environment outlined above will not accomplish its intended outcomes if human-mobile interaction is not accurately measured. Therefore, to measure human-mobile interaction, this study experimented with the following game activities to characterise the active participation as well as the effectiveness of gameplays (Figure 2). First, the game roles were overseen. The players address supply insufficiency issues by inserting the exact number of planned rooms, hotel prices, and selecting a more advanced interior decoration level. Therefore, player input is measured by the number of updates based on market variations, customer demand, and hotel operations. Moreover, we measured the decision-making process. The purpose was to indicate the player's focus in delivering customer-centred values. Only reasoning among possible alternative options until prompt action leads to increased levels of customer satisfaction. Last but not least, we assessed the effect of game mechanism on succeeding behaviours that have not been activated previously. Figure 2 describes the mapping of the three types of game activities to human-mobile interactions, bearing in mind the psychological requirements. This undermines the business simulation course to induce effective learning of managerial skills, especially when predicting hotel performance.

2.1. Lag Sequential Analysis: Theory and Application. Sackett introduced lag sequential analysis in 1978 to identify the probability of one behaviour occurring subsequent to another and its statistical significance [33]. This

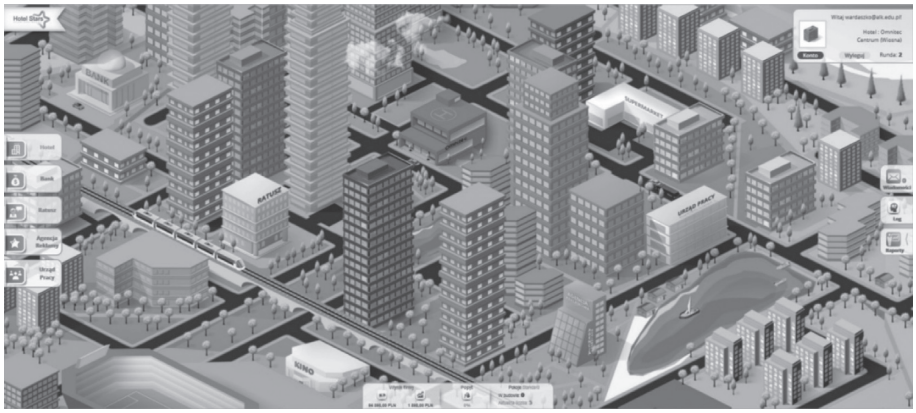

Figure 1: The homepage of the hospitality business simulator displayed on the mobile interface [29].

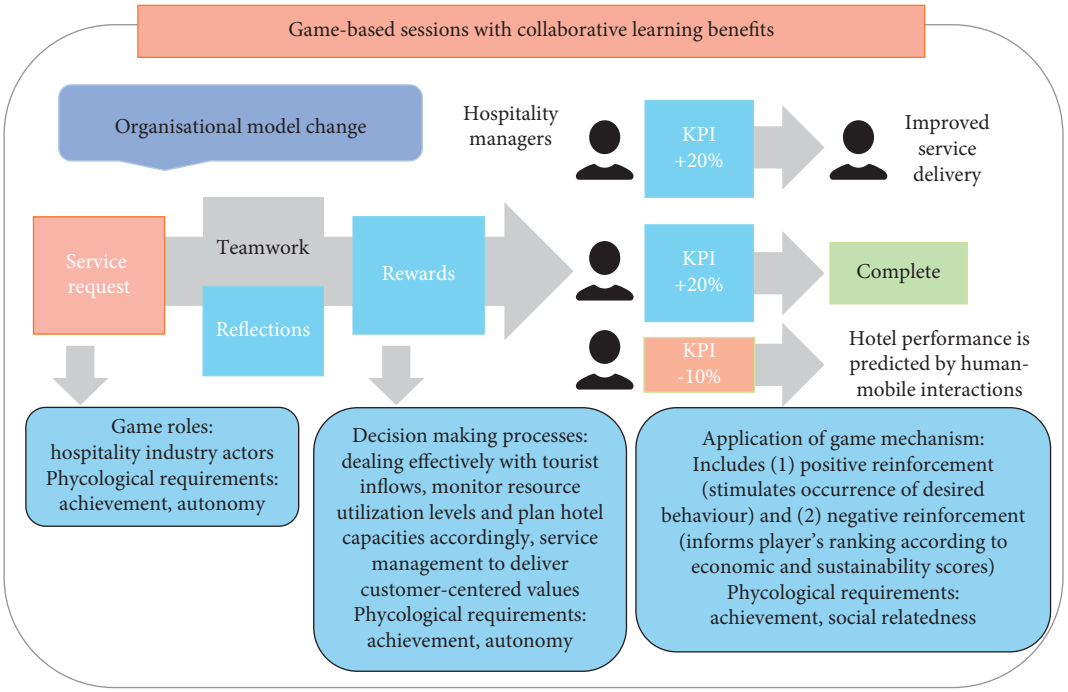

Figure 2: Flowchart of the hospitality management simulation based on the reinforcement theory of motivation [32].

methodology has been adapted to analyse pathways in medicine [34], optimise online learning experiences in educational science [35], and analyse players' proxy attributes in digital games [36]. Owing to its application to any time-sequenced series of dichotomous codes, lag sequential analysis is accepted in the field of behaviour analysis, enabling researchers and pedagogues to pinpoint subtle transition patterns. This brings in the benefits of technology-enhanced learning from a behavioural perspective to inform the design of collaborative learning processes. The remainder of this section presents the theoretical background.

The analysis assumes that the events are sequenced in a time series [37], which is a collection of data labelled by the period in which observations occur. In general, we begin gathering data from a specific time to another stamp. This can be represented as

$$(\ldots, y_1, y_2, \ldots, y_T, \ldots) = \{y_t\}_{t=-\infty}^{t=+\infty}. \quad (1)$$

x_t is a time series assigned to the transformation relation $y_t = \beta x_t$. This operator converts the event from each period by multiplying it by a constant to obtain a new time series:

An operator serves as a lag operator, denoted L, if it converts the previous period's event of a time series into that of the current period; that is, for any time series x_t, the lag operator satisfies

$$L(x_t) \equiv x_{t-1}. \quad (2)$$

Analogously, it is possible to define a higher-order lag operator; for example, a second-order lag operator denoted L^2. For any time series x_t, the second-order lag operator satisfies

$$L^2(x_t) \equiv L[L(x_t)] = x_{t-2}. \tag{3}$$

For any positive integer k, we have

$$L^k(x_t) = x_{t-k}. \tag{4}$$

The first-order difference equation can be expressed in lag operator form, as shown in equation (5). Equation (6) shows an identical expression:

$$\begin{aligned} y_t &= \phi y_{t-1} + w_t \\ &= \phi L y_t + w_t, \end{aligned} \tag{5}$$

$$(1 - \phi L) y_t = w_t. \tag{6}$$

Applying arithmetic $(1 + \phi L + \phi^2 L^2 + \cdots + \phi^t L^t)$ simultaneously on both sides of the above equation, we obtain

$$\left(1 + \phi L + \cdots + \phi^t L^t\right)(1 - \phi L) y_t = \left(1 + \phi L + \cdots + \phi^t L^t\right) w_t. \tag{7}$$

According to properties of the lag operator, we get

$$y_t = \phi^{t+1} y_{t-1} + w_t + \phi w_{t-1} + \cdots + \phi^t w_0. \tag{8}$$

If the time series y_t is bounded, there exists a finite constant M such that at any time $|y_t| \le M$ and $|\phi| < 1$. The trailing term in the above equation tends to zero as time increases. Therefore, we have

$$\lim_{t \longrightarrow \infty} \left[\left(1 + \phi L + \cdots + \phi^t L^t\right)\right](1 - \phi L) y_t = y_t. \tag{9}$$

For any given time series y_t, we have

$$\begin{aligned} (1 - \phi L)^{-1} y_t &= \sum_{j=0}^{\infty} \phi^j L^j (y_t) \\ &= \sum_{j=0}^{\infty} \phi^j y_{t-j}. \end{aligned} \tag{10}$$

If time series y_t is bounded, the solution of the first-order difference equation can be expressed as equation (11). For any real number a_0, the expression in (12) is a solution.

$$\begin{aligned} y_t &= w_t + \phi w_{t-1} + \phi^2 w_{t-2} + \cdots \\ &= \sum_{j=0}^{\infty} \phi^j w_{t-j}, \end{aligned} \tag{11}$$

$$y_t = a_0 \phi^t + \sum_{j=0}^{\infty} \phi^j w_{t-j}. \tag{12}$$

The solution to the difference equation comprises the coefficients to be determined. Once the interactions registered by the user, as recorded events in the gaming system, were coded according to the behavioural types, the probabilities were calculated as the transitions from one event to another were tabulated from overlapped sampling.

Z-scores were measured for the links to determine the significance of the probabilities. To this end, the adjusted residual equation proposed by Backman and Gottman is deployed:

$$z_{i \longrightarrow j} = \frac{p_{ij} - e_{ij}}{\sqrt{e_{ij}\left(1 - \Gamma_{i+}/N\right)\left(1 - \Gamma_{+j}/N\right)}}, \tag{13}$$

where p_{ij} is the pragmatic number; e_{ij} is the expected number of transitions from behaviour i to j; Γ_{i+} is the observed counts of the i-th row; Γ_{+j} is the observed counts for the j-th column; and N is the number of transactions in the table.

2.2. Categorisation of Log Files. Log files were used to study the interaction sequences in the greatest detail. Behaviour coding was performed in accordance with Table 1. Depending on the content of the business simulator and the research question, adjustments were made to the behavioural schemes used in previous studies. This is due to the fact that the mobile gaming system already decides the nature of interactive participation. For example, if the system does not allow a wide variety of categories, that is, editing specific profiles, then this classification is aborted. Seen from the limited options, this is an advantage, providing that it emphasises learning. The initial datasets were automatically exported from the simulator. The raw dataset was then created by transcribing the log files into proxy attributes. The hotel performance-dependent variable was calculated as the sum of the scores for the economy, sustainability, and work environment satisfaction.

2.3. Learning Experience Analysis Based on the Questionnaire. At the end of the game, each player was instrumented to respond to the Learning Experience and Outcomes Questionnaire (LEOQ) to obtain information on the role of the mobile game-based collaborative learning process in conveying hospitality managerial skills. The skills were categorised according to the construct of searching, planning, marshalling, implementing-people, implementing-financial, and attitude towards venturing as self-report measures, totalling 22 items. This self-report survey has been validated in a prior study investigating the impact of flow experience on learning performance [38], and the authors demonstrated the reliability of player perceptions when situated in simulation-based learning. Subsequently, players registered their degree of compliments with the remaining 28 statements on challenge-skill balance, playability, goal, feedback, and control. Each item was scored on a 7-point Likert scale (1 = "strongly disagree" to 7 = "strongly agree").

3. Game-Based Learning Practices

The players in the case studies were recruited from graduate courses at Beijing Technology and Business University. Ninety students joined the hospitality business simulator in the autumn semester of 2020 and the spring semester of 2021. The diverse background and even gender distribution offered an edge in analysing the real impact of interactive participation on learning outcomes. In the case studies, the

Table 1: Coding guidelines of gaming behaviours in the hospitality business simulator.

Catalogue and item		Behaviour (code)	Note
Managing resources	Optimising utilisation of hospitality infrastructure	Hotel investment (HI)	Buying and selling real estate
		Hotel equipment (HP)	Provision of disposable amenities
		Hotel price (HP)	Decision on prices for each type of accommodation
	Managing services and functions	Hotel service (HS)	Coordinating cleaning services
		Hotel basic service (HBS)	Supply of value-added service options
		Hotel advanced service (HAS)	Supply of service options with special interests
		Hotel crew (HC)	Addressing employment and work environment issues
Inviting cooperation	Inviting institutional cooperation	Cityhall project (CP)	Sponsoring external events
		Bank loan (BL)	Engagement with borrowing and saving
		Market research (MR)	Gathering tourist's preferences
	Promoting brand presence	Hotel self-promotion (HSP)	Publicizing oneself via webpages
		Local advertisement (LA)	Targeting audiences close to the tourism destination
		Regional advertisement (RA)	Broadcasting in certain cities
		National advertisement (NA)	Marketing throughout various channels

players had no previous experience in business simulators and were novice users.

In either course, as presented in Figure 3, the hotel receives a seasonal volume of incoming visitors for hospitalisation each season based on the destination's tourism popularity, and updates should be handled as a preparation for the operation by players for a wide variety of hotel attributes. The visitors who chose to stay at the hotel were taken care of by the employees and administrative staff who were recruited to work in the tourism destination. The session lasted 16 rounds, representing four full financial years in real-time. Each financial year was assigned a fully pledged challenge, requiring planned upgrades to growing competition in the multipolar tourism market. A portable Samsung Tablet A7 Lite T220 was deployed in both case studies.

3.1. First Case Study: Distance Learning. The first case study was administered via a mobile gaming system, whereby the players were not physically present in the classroom. The game requires interactive participation from four players: facility management, marketing, service delivery, and public relations.

3.2. Second Case Study: Classroom Learning. The second case study took place via physical presentation with the same distribution of tasks, activities, and players. The players were granted a total atmosphere as a social group in face-to-face communication. This structure potentially affects student learning. It is noteworthy that the actual game parameters are identical.

4. Results

The gameplay saw 8,854 entries of human-mobile interactions generated from the mobile gaming system. Players had an average age of 21.74 (SD 2.09) years, held a background in engineering and design, and spent 214 hours with the hospitality business simulator.

4.1. Entrepreneurial Self-Efficacy Questionnaire. In view of the distance learning case study, all participants indicated that the game gave rise to comprehension of leadership skills and a rightful attitude towards learning, as Figure 4 illustrates. We can see from the graph that the "Implementing-people" presented high scores at "Inspire, encourage and motivate" and "Train employees" in comparison with the rest components. "Attitude towards venturing" was made up of average values at 5.60, 5.30, and 5.53, respectively. More specifically, touching upon business management was considered "Worthwhile, Rewarding, and "Positive," whereas there was the potential for growing confidence in skills. More players were confident to "Networking-making contact with others," "Get others to identify with my vision," and "Clearly explain my business idea," as the average scores for these items stood at 4.51, 4.26, and 4.42. In contrast, although "Design a new product or service" was rated 3.05, "Brainstorming with new idea for product" and "Identify the need for a new product" were graded with values below 3. No significant item-specific differences were identified within any block of questions.

The graph in Figure 5 describes the values of the items as per the questionnaire construct in the classroom learning case study. Clearly, 16 out of the 22 items scored higher than in the previous trials. The boxes demonstrated that "Implementing-people" was associated with the most diverse results (4.83, 4.39, 4.59, 4.24, 4.57, and 4.91 for "Supervise employees," "Recruit and hire employees," "Delegate tasks and responsibilities," "Deal effectively with daily problems," "Inspire, encourage and motivate," and "Train employees," respectively). While searching as a whole was the least valued block, "design a new product or service" remained the most popular item. This was followed by "Networking" (4.46) and "Get others to identify with my vision" (4.35). "Implementing-financial," on the other hand, were not rated very high among the constructs (4.37, 4.07, and 4.11 for "Organise and maintain finance," "Manage the financial assets," and "Interpret financial statements," respectively). "Marshalling," however, showed relatively forthcoming average values, from 4.33 for "Determine a competitive price" to 4.67 for "Estimate customer's product demand."

4.2. Lag Sequential Analysis of Learning Behaviours. It is clear from the chart in Figure 6 that a consequential chain existed among the behavioural objects. During the simulation of the first financial year, participants had at their disposal managing hotel equipment (hotel investment ⟶ hotel equipment: z-score of 7.29 for the distance learning case study and 8.75 for the classroom learning case study, respectively), updating hotel prices (hotel investment ⟶ hotel price: z-score of 4.56 for the distance learning case study only), and sponsoring cityhall projects (hotel investment ⟶ cityhall project: z-score of 2.00 for the distance learning case study only). Over the time span, the participant would have the option to access updating hotel prices (hotel equipment ⟶ hotel prices: z-score of 6.29 for the distance learning case study and 7.08 for the classroom learning case study) and further engaged managing hotel services (hotel prices ⟶ hotel services: z-score of 2.30 for the distance learning case study and 2.92 for the classroom learning case study). Thereafter, hotel self-promotion (hotel services ⟶ hotel self-promotion: z-score of 4.06 for the distance learning case study and 2.13 for the classroom learning case study, respectively). Hotel basic services were provisionally accompanied by market research (hotel basic service-⟶ market research: z-score of 2.25 for the classroom learning case study only), while the latter would proceed to hotel investment (market research ⟶ hotel investment: z-score of 13.72 for the classroom learning case study only). During the collaborative learning process, participants adopted continuous and consistent actions after receiving updates on tourist flow and operational conditions, thus activating higher-order learning behaviours.

As shown in the graph in Figure 7, long behavioural chains were superseded by shorter paths during the simulation of the second financial year. Bank loan pathed to hotel

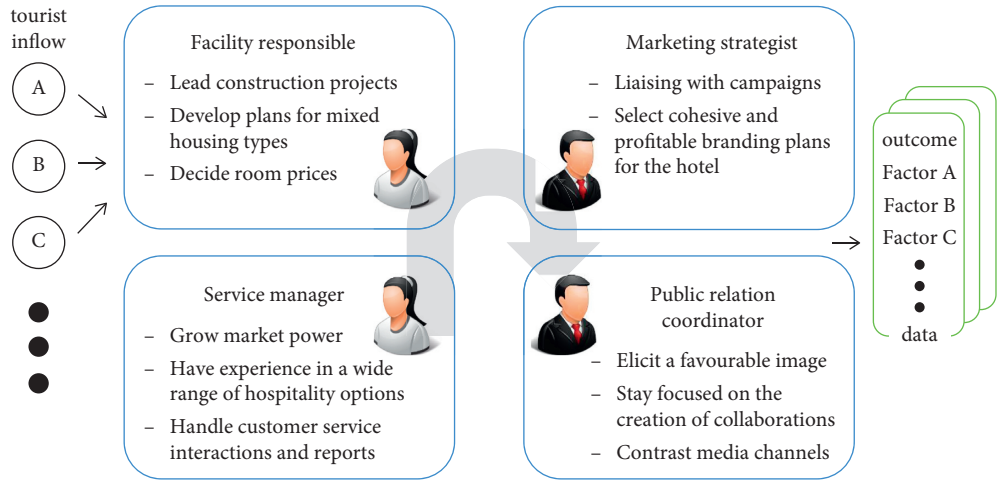

Figure 3: Observation of game roles and accountability frameworks in both case studies.

investment (bank loan ⟶ hotel investment: z-score of 2.40 for the distance learning case study and 3.94 for the classroom learning case study) and thereafter associated with either market research (hotel investment ⟶ market research: z-score of 2.39 for the distance learning case study) or hotel prices (hotel investment ⟶ hotel prices: z-score of 2.01 for the distance learning case study and 2.95 for the classroom learning case study). More specifically, there was a path from hotel investment to bank loan (hotel investment ⟶ bank loan: z-score of 3.21 for the distance learning case study). Hotel prices appeared to be the destination occurrence following hotel equipment (hotel equipment ⟶ hotel prices: z-score of 3.85 for the distance learning case study). Hotel basic service and cityhall projects presented a two-way significant relationship (hotel basic service ⟶ cityhall project: z-score of 4.18 for the distance learning case study; cityhall project ⟶ hotel basic service: z-score of 2.07 for the classroom learning case study). On the other hand, bank loan could also path to market research (bank loan ⟶ market research: z-score of 2.67 for the distance learning case study and 4.95 for the classroom learning case study). If market research had been reached, local advertisement (market research ⟶ local advertisement: z-score of 3.13 for the classroom learning case study) and regional advertisement (local advertisement ⟶ regional advertisement: z-score of 9.07 for the distance learning case study and 8.33 for the classroom learning case study) would be subsequent. During this stage of simulation, a conversion in learning behaviour was evident, as participants actively interacted with the gamification elements in this more complex simulation environment.

During the simulation of the third financial year, as presented in Figure 8, hotel investment stood out as one of the most frequently visited objects; it was significantly correlated with hotel price (hotel investment ⟶ hotel price: z-score of 2.26 for the distance learning case study), cityhall project (cityhall project ⟶ hotel investment: z-score of 2.35 for the classroom learning case study), and bank loan (bank loan ⟶ hotel investment: z-score of 3.08 for the distance learning case study and 2.84 for the classroom learning case study). Hotel self-promotion had a high number of outbound transitions towards hotel service (hotel self-promotion ⟶ hotel service: z-score of 3.89 for the distance learning case study) and basic hotel service (hotel self-promotion ⟶ hotel basic service: z-score of 4.74 for the distance learning case study and 1.97 for the classroom learning case study, respectively). In marketing behaviours, local advertisements could either proceed to regional advisement (local advertisement ⟶ regional advertisement: z-score of 7.57 for the distance learning case study and 11.23 for the classroom learning case study, respectively) or national advertisement (local advertisement ⟶ national advertisement: z-score of 5.84 for the distance learning case study). A reverse chain could also be identified (national advertisement ⟶ regional advertisement: z-score of 6.06 for the distance learning case study). The human crew was the object with no significant behavioural transitions.

Finally, examining the simulation of the third financial year found that the transitions were multifaceted, as illustrated in Figure 9. It is clear from the flowchart that the cityhall project served as the original component of many paths—it proceeded to hotel investment (cityhall project-⟶ hotel price: z-score of 2.19 for the distance learning case study only), hotel price (cityhall project ⟶ hotel investment: z-score of 2.75 for the classroom learning case study only), hotel service (cityhall project ⟶ hotel service: z-score of 3.35 for the classroom learning case study only), and hotel basic service (cityhall project ⟶ hotel basic service: z-score of 2.66 for the distance learning case study only). In addition, the cityhall project trailed to by bank loans (cityhall project⟶ bank loan: z-score of 4.93 for the classroom learning case study only), hotel prices (hotel equipment ⟶ hotel price: z-score of 2.25 for the classroom learning case study only), hotel services (hotel equipment ⟶ hotel service: z-score of 5.16), and hotel basic service (hotel equipment ⟶ hotel basic service: z-score of 3.54 for the distance learning case study only). Market research connected bank loans (market research ⟶ bank loan: z-score of 3.78 for the distance learning case study only) and national

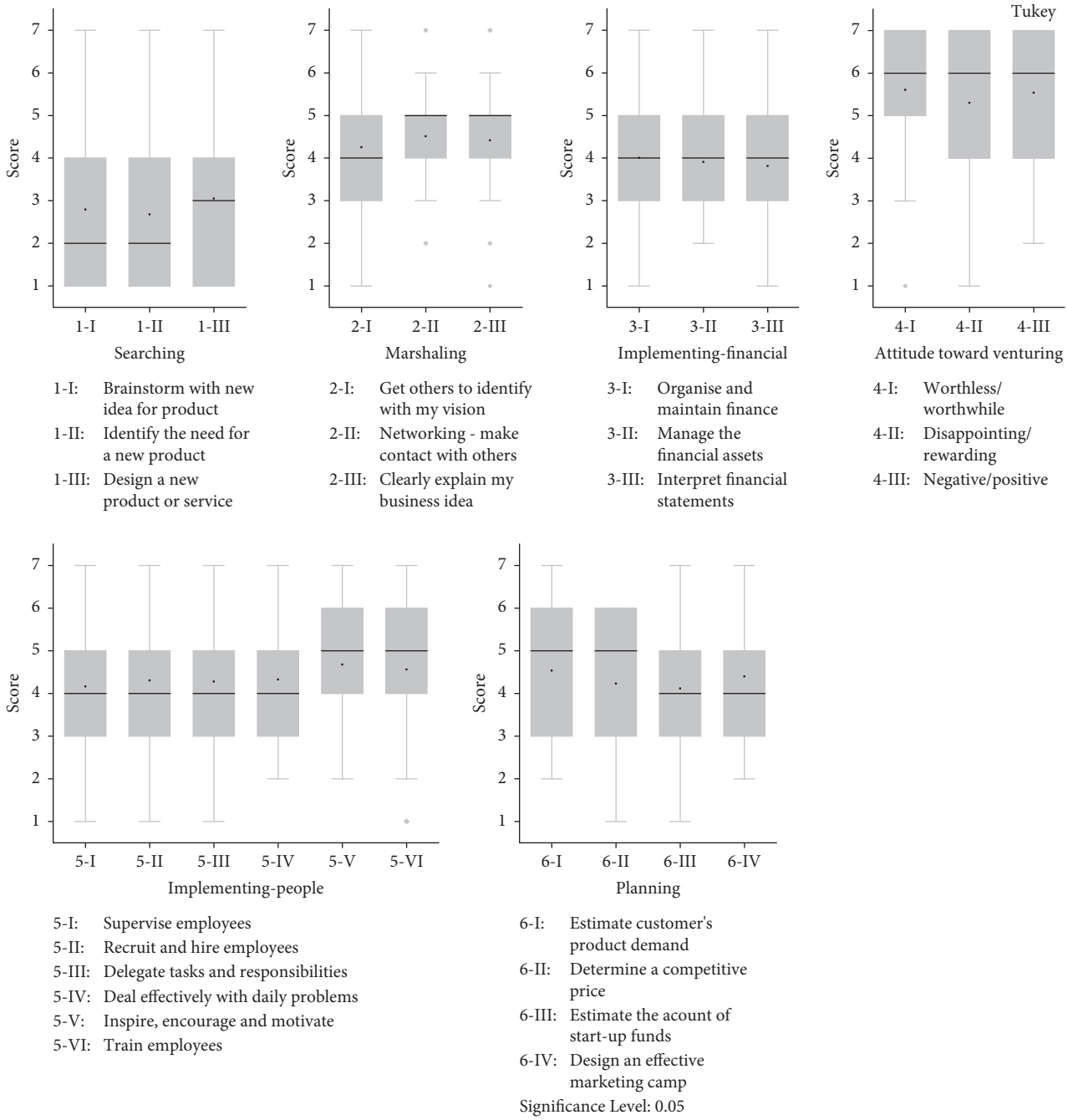

Figure 4: Participant's entrepreneurial self-efficacy questionnaire results for the distance learning case study.

advertisement (market research ⟶ national advertisement: z-score of 4.35 for the classroom learning case study only). Remarkably, local and regional advertisements interacted only with each other. Hotel basic service seemed to be the destination component; however, it also pointed to hotel self-promotion (hotel basic service ⟶ hotel self-promotion: z-score of 6.23 for the distance learning case study only). It is worth noting that no significant transitions were identified for advanced hotel services and hotel crews. The participants' synthesis, reasoning, and negotiation were revealed as they approached the later stages of the simulation.

4.3. Human Mobile-Web Interaction and Hotel Performance. The standard regression analyses for classroom learning and distance learning case studies are shown in Tables 2 and 3, respectively. The estimation yielded a ΔR^2 of 0.43 and 0.49, respectively ($F_{4,31} = 7.56$, $P < 0.001$, for the classroom learning and $F_{4,47} = 13.19$, $P < 0.001$, for the distance learning) positively anticipated hotel performances. More specifically, the same holds true for the number of entries optimising hospitality infrastructure ($\beta = 28.54$, $P = 0.045$, for the board game; $\beta = 22.45$, $P = 0.04$, for the online game), improving customer services, and inviting institutional cooperation ($\beta = 7.30$, $P = 0.01$, for the board game;

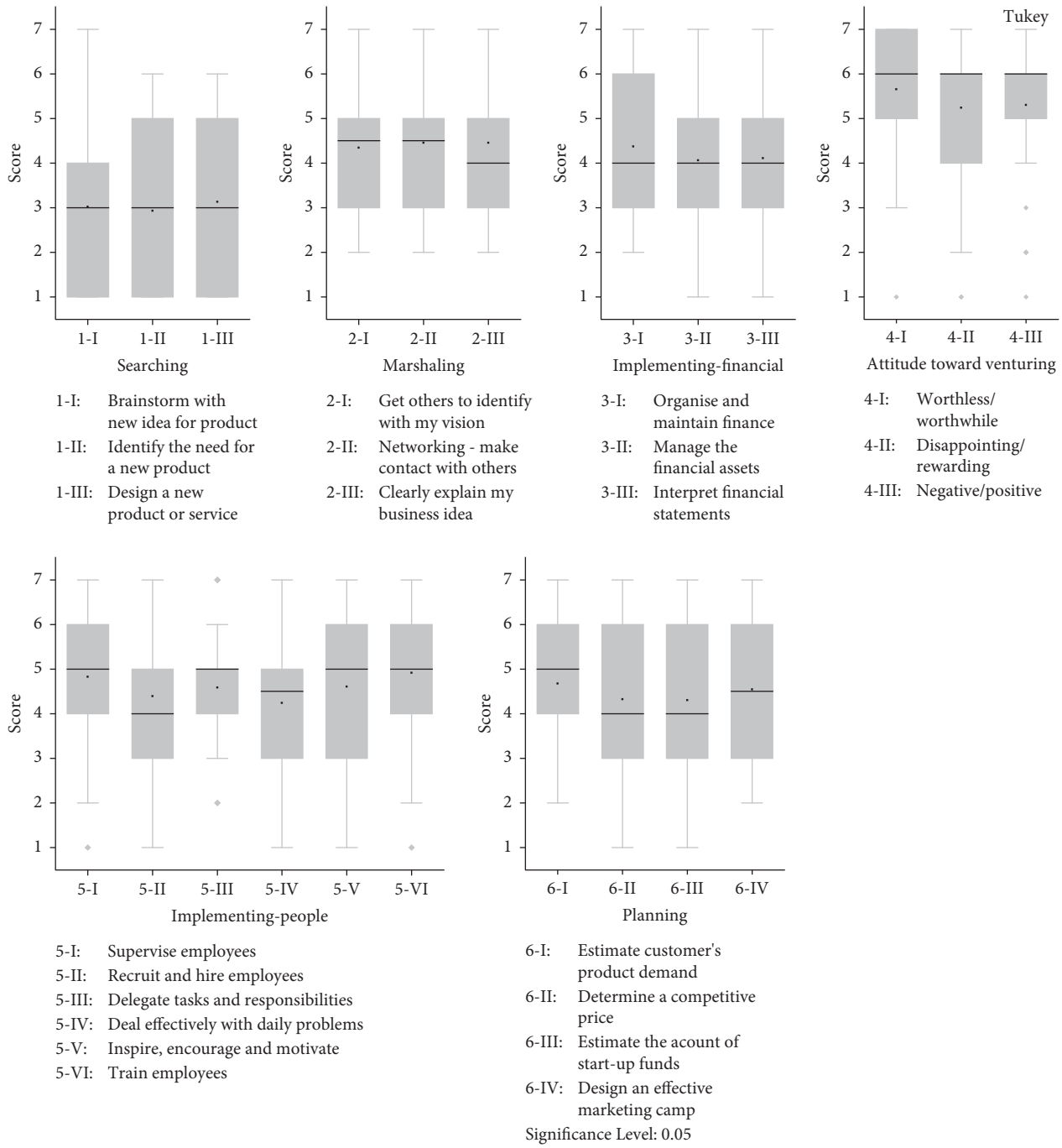

Figure 5: Participant's entrepreneurial self-efficacy questionnaire results for the classroom learning case study.

$\beta = 36.48$, $P < 0.001$, for the online game). In summary, the majority of hypotheses were accepted for serious gaming in distance learning, confirming the significant relationships between learning behaviours and hotel performance in the hospitality business simulator.

Learning performance items were scored above 4 for both case studies, indicating that this was the highest percentage of positive feedback in any construct of the questionnaire. Players offered the most positive feedback for "I can learn new skills if I use business simulation games" and "I can gain knowledge when I use business simulation games." In Figure 10, 40% of all participants supplied full credit. In contrast, scores below 4 were found in three of the four sections of the flow experience construct. First, when the participants were asked about the effort and total concentration of the mind, the proportion of positive feedback decreased. This tendency applies to items related to feelings and time distortion. A slight difference between the case studies exists in the autotelic experience section, which received average scores above 4. For questions such as "I really enjoyed the playing experience" and "I found the experience extremely rewarding," full scores represented

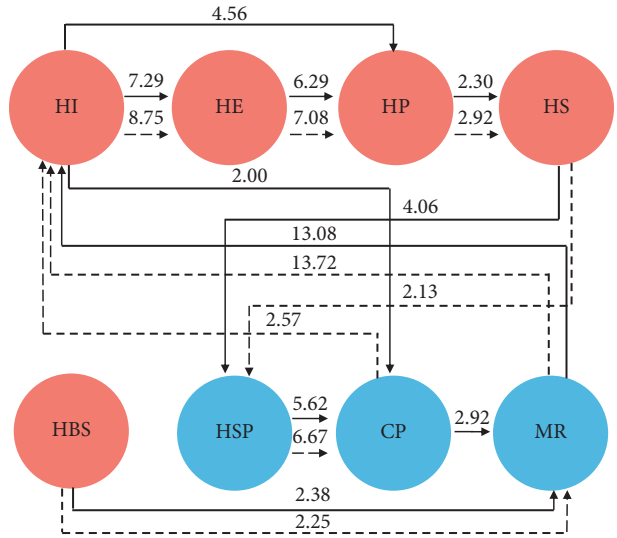

Figure 6: Behaviour transition flowchart for the first year of hospitality management. Solid lines: distance learning case study. Dash lines: classroom learning case study.

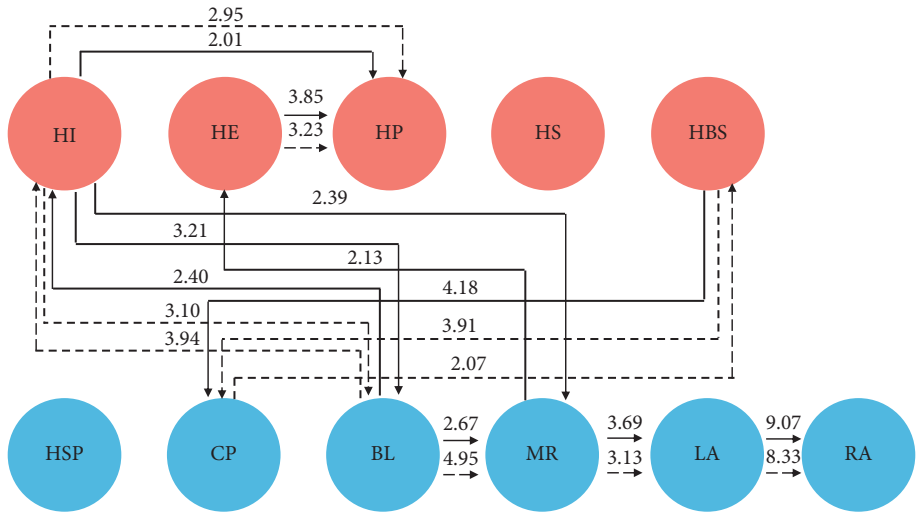

Figure 7: Behaviour transition patterns for the second year of hospitality management. Solid lines: distance learning case study. Dash lines: classroom learning case study.

about 51% of the answers. This is in remarkable contrast to only 12% for the loss of self-consciousness section.

Overall, the constructs, in addition to learning performance and flow experience, had the largest number of positive answers (nine of ten items). In Figure 11, "The challenge that the game provided and my skills were at an equally high level" had scores above 6 for both case studies. Similar profiles were found for playability, goal, and feedback constructs. For each construct, more participants took the classroom learning option than distance learning, except in the case of "Using the user interface was easy" and "I could tell by the way I was performing how well I was doing." "I felt in total control of my playing actions" had the least scores in the control construct. In fact, the more relevant the question was on learning, playability, and goals, the higher was the percentage of confidence in both cases. In comparison, control and immersion were inversely connected to engagement with the hospitality business simulator, providing that the better a hotel's performance, the stronger the dependency of participants on the collaborative learning process.

4.4. Notes of In-Game Collaboration. An examination of the interaction comments with the simulator indicated that the participants adopted a cooperation-oriented strategy in the first two fiscal years, working together to improve the performance of their units. In particular, participants were prudent about satisfying tourism needs and attempted to coordinate services as efficiently as possible. Thus, although the frequency and number of human mobile-web interactions were not as high as in the simulation of the latter two years, meaningful discussions at the beginning eventually paid off also prepared them for follow-up. With the emergence of more diverse travel needs and the possibilities offered by the combination of service

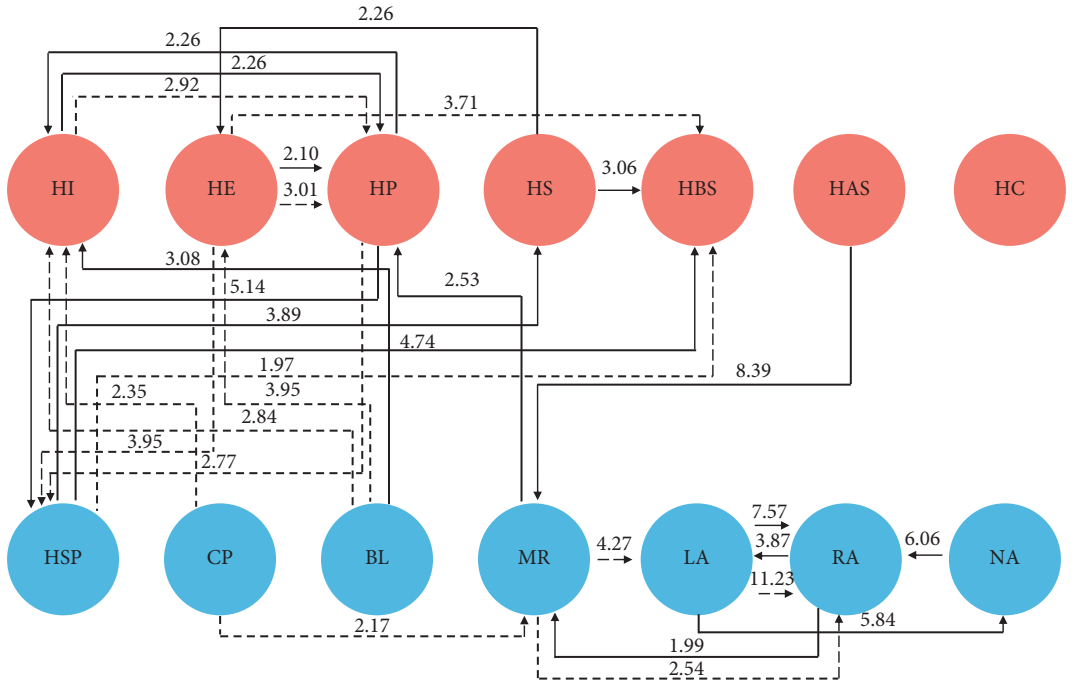

Figure 8: Behaviour transition patterns for the third year of hospitality management. Solid lines: distance learning case study. Dash lines: classroom learning case study.

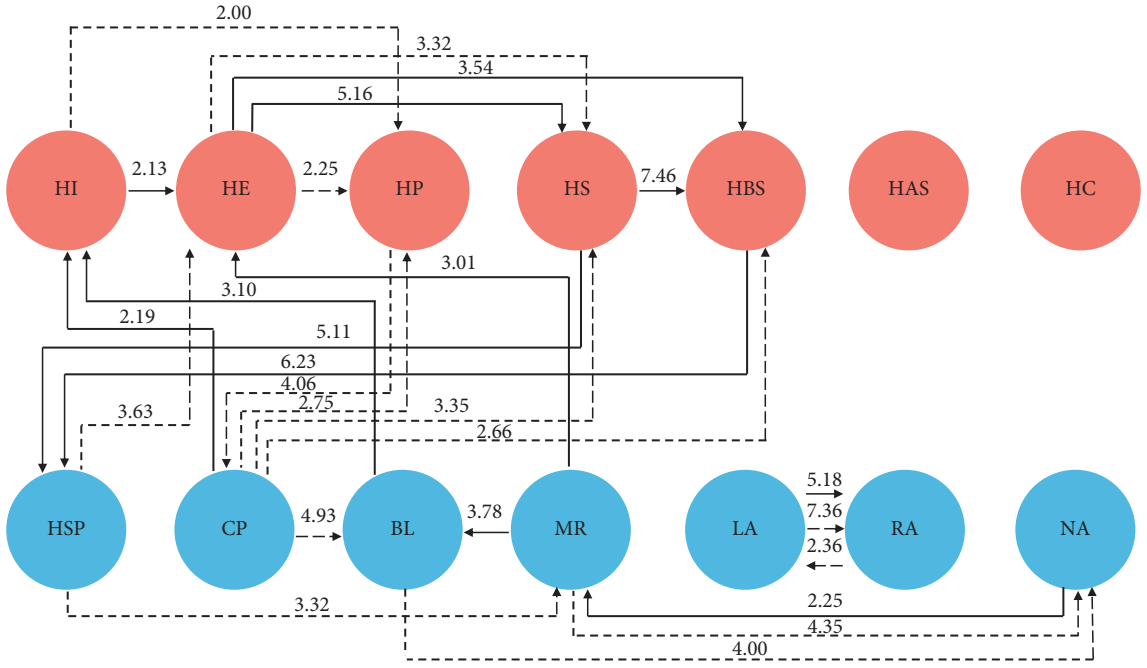

Figure 9: Behaviour transition patterns for the fourth year of hospitality management. Solid lines: distance learning case study. Dash lines: classroom learning case study.

Table 2: Regression model for predicting hotel performance based on interactive behaviours in the classroom learning case study.

Variables	R^2	$\triangle R^2$	β (SE)	P value
Hotel performance	0.49	0.43	N/A[a]	N/A
Optimise hospitality infrastructure	N/A	N/A	28.54(9.66)	0.005
Improve customer services	N/A	N/A	−0.81(5.10)	0.87
Invite institutional cooperation	N/A	N/A	7.30(29.04)	0.80
Promote brand presence	N/A	N/A	0.91(7.33)	0.90

[a]N/A: not applicable.

Table 3: Regression model for predicting hotel performance based on interactive behaviours in the distance learning case study.

Variables	R^2	$\triangle R^2$	β (SE)	P value
Hotel performance	0.53	0.49	N/A[a]	N/A
Optimise hospitality infrastructure	N/A	N/A	22.45(4.64)	<0.001
Improve customer services	N/A	N/A	−10.05(4.55)	0.03
Invite institutional cooperation	N/A	N/A	36.48(12.57)	0.006
Promote brand presence	N/A	N/A	−5.21(6.34)	0.42

[a]N/A: not applicable.

Figure 10: Average ratings of measurement in learning performance and flow experience. Case 1: distance learning; Case 2: classroom learning.

options, verbal interaction of participants gradually declined in sight; rather, a greater focus was placed on the mobile interface, visual cues, and simulation. It is worth noting that after simulating all 16 sessions, the exchange of ideas was again facilitated among participants in contrasting their successful endeavours and pitfalls. This means that the design of the collaborative learning process, overarched by the framework illustrated in Figure 2 (Section 2), facilitated an effective translation of managerial skills towards the delivery of intended outcomes. This not only supports the pillar of business simulators in collaborative learning but also demonstrates the unique advantages of using a mobile gaming system specialised in human mobile-web interaction.

5. Critical Discussion

5.1. Representative Findings. This study carried out a quantitative study of questionnaire results, behavioural transitions, and prediction models of learning outcomes in simulation-based learning. While the questionnaire was based on various business case dimensions, lag sequential analysis was applied to expose the dependency of serially sequenced trials in the learning process. More importantly, regression modelling was conducted to predict or analyse individual performance in the simulation.

The results demonstrated that human mobile-web interaction could estimate learning outcomes, as represented by the hotel performances in this study, in simulation-based distance learning. This is clearly seen in the regression models with significant statistical scores, as well as satisfactory values obtained from the adjusted R-squared. In addition, the case studies relied on a large sample of participants to identify interesting trends that may not be apparent in similar human mobile-web interaction studies. Questionnaire scores on a Likert scale complied with the results of previous studies [39], with new insights on the

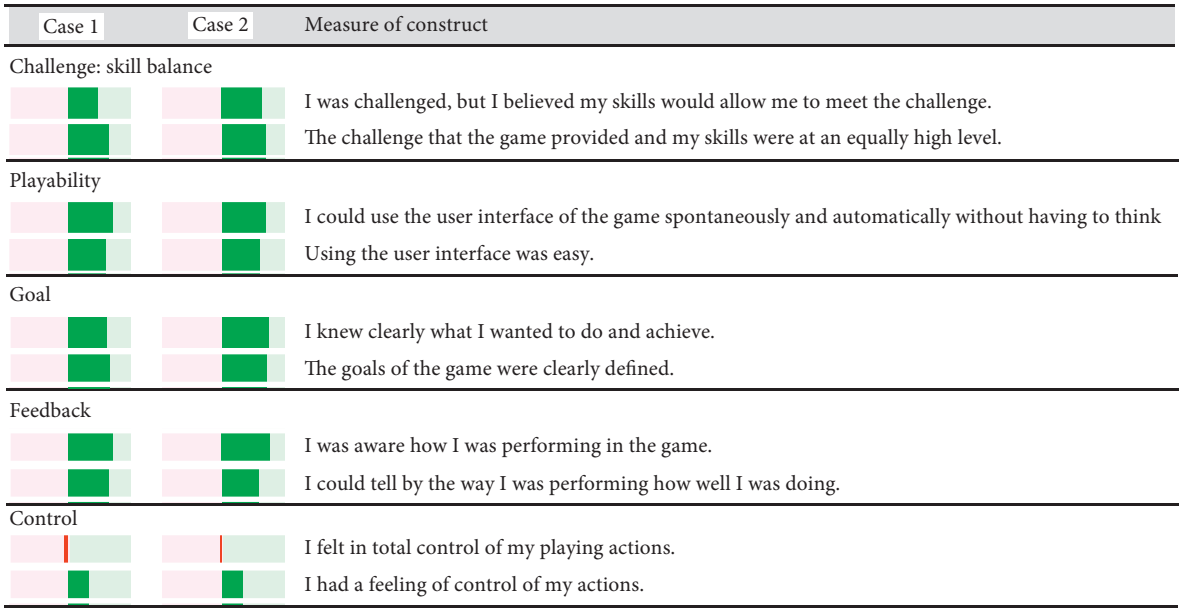

Figure 11: Average ratings of measurement in challenge, playability, goal, feedback, and control. Case 1: distance learning; Case 2: classroom learning.

design of the collaborative learning process. In classroom learning, over 60% of the items have since been rated higher than those in the counterpart case study. This revealed growing confidence in comprehending managerial skills as long as participants were physically present to each other as part of the simulation. To summarise what has been stated so far, the results were a remarkable account of the learning effects; distance learning made it easier to analyse individual performance, whereas classroom learning would more likely bring in trustworthy experiences.

5.2. The Design Pyramid of a Meaningful Learning Process. Currently, there are no mobile gaming studies of business simulations in which participants capitalise on managerial skills, as this study has achieved. Pedagogy-oriented studies mainly focus on the various functionality designs for user acceptability [40], matching technological features with user preferences [39], and learning interventions with stakeholder-involved collaborative frameworks [41]. In addition, interdisciplinary research is interested in studying the complexity of gaming systems from different perspectives of design science [42]. Design frameworks have not been fully pledged; therefore, future studies should evaluate how existing frameworks can be effectively integrated with collaborative skill transfer via online business simulations as a platform for team-based learning.

This study explored the feasibility of using business simulators as the pillar for constructing collaborative learning processes based on a mobile gaming system, as illustrated in Figure 12. This is a pyramid where the closed part is for the training aspect in the request of realistic simulations, and the principal can add monotonous details for adjusting the aspects and supervision. On the top layer, collaborative learning serves as an enabler of how individuals would reflect on their roles, which cannot be represented on computers.

5.3. Analytical Approaches to Gaming Experience and Learning Telemetry. Experience and patterns of learning behaviours through gaming practices are key to understand the impact of play and assessment of core design elements [43]. Although serious games do not pursue pure recreational aims, player experience has been identified as an important channel for bridging the gap between designers and users by observing "what players think." Boletsis and McCallum studied elderly clients' experience with a serious game application with regard to cognitive ability training and screening [44]. Peng et al. screened the motivation and engagement outcomes of media enjoyment underlying the self-determination theory [45]. With the growing trend of further improving player experience, subjective methods for enquiring about player experience revolve around interviews, focus groups, in-game data collection, and questionnaires.

As a side option for surveying entrepreneurial self-efficacy items, an experience questionnaire might be an alternative that incorporates three modules requesting players' feedback on approximately 50 items on a Likert scale [46]. Such instruments are popular and have been extensively tested because of their relatively in-depth design of questions on multiple psychological dimensions. For example, the GEQ was applied to both multiplayer board gaming and computer-mediated digital games, so it represents the only survey applied to all types of games [47]. Another template is the User Experience questionnaire [48]. This provides an excellent method for understanding whether the attributes of a particular product can play a significant role in utility, usefulness, and efficiency [49]. The realisation of a game model in modalities is not an exception in practice—mobile

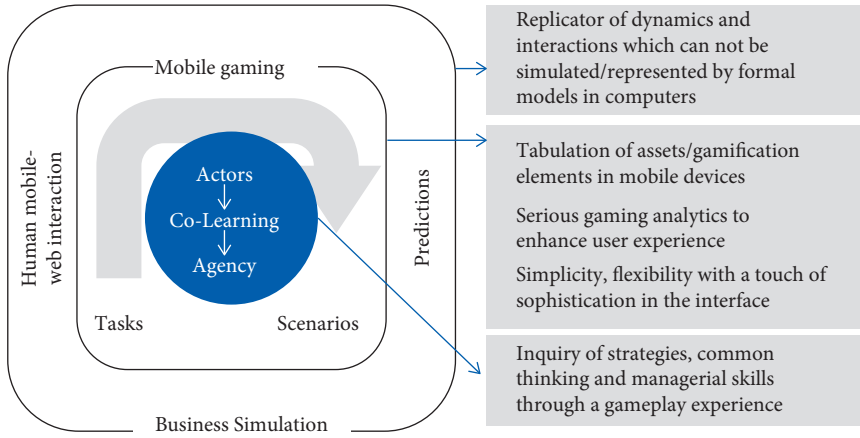

Figure 12: Business simulation-mobile gaming-collaborative learning pyramid for training managerial skills.

games, with their educational merits, are treated as offering online, playful experiences to touch screen devices. Many applications include monopoly and the Beer Distribution Game in tablets and classic computers.

In this study, multiple quantitative methods were used to examine the game experience and learning effect. As pointed out by Liu et al., gamified practices can be counted successfully only if the catalyst and experience goals are met [50]. The catalyst goal refers to active participation, responses, or engagement from players; thus, it is easy to standardise and enquire. In contrast, the present research on experience evaluation is subject to a limited choice of measuring tools; therefore, the rightful combination of traditional analytic tools and visualisation methods [51] might serve as an even better instrument to complement learning performance prediction models and collect information regarding experience.

The limitation is the absence of a mixed-method approach, considering that lag sequential analysis, regression modelling, and scale-based surveying are quantitative measurements. This was because of the limited time availability of the participants. In addition, no statistical analysis was conducted to explore the differences in behavioural patterns potentially engendered by socioeconomic background [52]. Futuristic game sessions might sharpen the time horizon of the play and provide opportunities for interviews, open discussions, and a more extensive background survey.

6. Conclusions

This study shows that business simulations in both distance and classroom learning formats, supported by mobile gaming systems, can uncover the key challenges of hospitality management in collaborative learning processes.

Previous studies have shown the authenticity of simulations as a tool for studying the relationship between teamwork, learning outcomes, and satisfaction of business students with socially constructed meanings [53].

In addition to the several proxy attributes of human mobile-web interaction to significantly predict learning outcomes, the results show that if participants are engaged in hotel management simulation according to a well-established visual communication design, behavioural transitions manifest high levels of frequency, diversity, and exploration from the whole to the parts of the system, among other key features.

However, this collaborative learning process design framework can only attest to the behavioural transitions directed by the gamification elements of the hotel business simulation, rather than how participants would respond in the context of their teamwork experience. Therefore, the results presented in the next step will be applied to fine-tune the mobile version of the game and make the task and scenario design more relevant to the hotel situation. This will then be assessed in the next semester by specialists in hospitality services management and students enrolled in the same master's courses.

Data Availability

Data used to support the findings of this study are available from the author upon request.

Conflicts of Interest

The author declares no conflicts of interest.

Acknowledgments

The author would like to thank Dr. Marcin Wardaszko at Kozminski University, Warsaw, Poland, and members of the Gaming and Participatory Simulation Laboratories, Kungliga Tekniska Högskolan, Stockholm, Sweden, for their technical support and inspirational discussions. This work was supported by KTH-CSC funding (201600160048).

References

[1] I. O. Pappas, P. Mikalef, M. N. Giannakos, and P. E. Kourouthanassis, "Explaining user experience in mobile gaming applications: an fsQCA approach," *Internet Research*, vol. 29, no. 2, pp. 293–314, 2019.

[2] A. K. Yadav and S. S. Oyelere, "Contextualized mobile game-based learning application for computing education,"

Education and Information Technologies, vol. 26, no. 3, pp. 2539–2562, 2021.

[3] J. Huizenga, W. Admiraal, G. t. Dam, and J. Voogt, "Mobile game-based learning in secondary education: students' immersion, game activities, team performance and learning outcomes," *Computers in Human Behavior*, vol. 99, pp. 137–143, 2019.

[4] R. Edmonds and S. Smith, "From playing to designing: enhancing educational experiences with location-based mobile learning games," *Australasian Journal of Educational Technology*, vol. 33, no. 6, pp. 41–53, 2017.

[5] M. K. Othman, S. Aman, N. N. Anuar, and I. Ahmad, "Improving children's cultural heritage experience using game-based learning at a living museum," *Journal on Computing and Cultural Heritage*, vol. 14, no. 3, pp. 1–39, 2021.

[6] H. Srinivas, "Collaborative Learning," 2022, http://www.gdrc.org/kmgmt/c-learn/.

[7] Y.-T. Chuang, "SSCLS: a smartphone-supported collaborative learning system," *Telematics and Informatics*, vol. 32, no. 3, pp. 463–474, Aug. 2015.

[8] S. C. Jackson, L. A. Bilich, and N. Skuza, "The benefits and challenges of collaborative learning: educating dental and dental hygiene students together," *Journal of Dental Education*, vol. 82, no. 12, pp. 1279–1286, 2018.

[9] R. Myron, C. French, P. Sullivan, G. Sathyamoorthy, J. Barlow, and L. Pomeroy, "Professionals learning together with patients: an exploratory study of a collaborative learning Fellowship programme for healthcare improvement," *Journal of Interprofessional Care*, vol. 32, no. 3, pp. 257–265, 2018.

[10] Y.-C. J. Wu, J.-P. Shen, and C.-L. Chang, "Electronic service quality of Facebook social commerce and collaborative learning," *Computers in Human Behavior*, vol. 51, pp. 1395–1402, 2015.

[11] C. P. Subbe, fnm au, J. Kellett et al., "Crisis checklists for in-hospital emergencies: expert consensus, simulation testing and recommendations for a template determined by a multi-institutional and multi-disciplinary learning collaborative," *BMC Health Services Research*, vol. 17, no. 1, p. 334, 2017.

[12] R. Meseguer Pallarès, P. Damián-Reyes, J. Favela Vara, and L. Navarro Moldes, "Context awareness for collaborative learning with uncertainty management," *J. Univers. Comput. Sci. JUCS*, vol. 16, no. 12, pp. 1556–1576, 2010.

[13] Y.-F. Yang, A. P. I. Goh, Y.-C. Hong, and N.-S. Chen, "Primary school students' foreign language anxiety in collaborative and individual digital game-based learning," *Computer Assisted Language Learning*, pp. 1–21, 2021.

[14] E. G. Ko and K. Y. Lim, "Promoting English learning in secondary schools: design-based research to develop a mobile application for collaborative learning," *The Asia-Pacific Education Researcher*, 2021.

[15] H.-Y. Wang, H. B.-L. Duh, N. Li, T.-J. Lin, and C.-C. Tsai, "An investigation of university students' collaborative inquiry learning behaviors in an augmented reality simulation and a traditional simulation," *Journal of Science Education and Technology*, vol. 23, no. 5, pp. 682–691, 2014.

[16] F. Ke and P. Carafano, "Collaborative science learning in an immersive flight simulation," *Computers & Education*, vol. 103, pp. 114–123, 2016.

[17] ABSEL, "Association for Business Simulation and Experiential Learning," 2022, https://absel.org/.

[18] P. Greenlaw, L. Herron, and R. Rawdon, *Business Simulation in Industrial and University Education*, Literary Licensing, LLC, MT 59937, United States, 2012.

[19] K. J. Cohen and E. Rhenman, "The role of management games in education and research," *Management Science*, vol. 7, no. 2, pp. 131–166, 1961.

[20] C. R. Klasson, "Business gaming: a progress report," *Academy of Management Journal*, vol. 7, no. 3, pp. 175–188, 1964.

[21] A. J. Faria, D. Hutchinson, W. J. Wellington, and S. Gold, "Developments in business gaming," *Simulation & Gaming*, vol. 40, no. 4, pp. 464–487, 2009.

[22] T. Rogmans and W. Abaza, "The impact of international business strategy simulation games on student engagement," *Simulation & Gaming*, vol. 50, no. 3, pp. 393–407, 2019.

[23] J. D. Sterman, "Modeling managerial behavior: misperceptions of feedback in a dynamic decision making experiment," *Management Science*, vol. 35, no. 3, pp. 321–339, 1989.

[24] H. L. Lee, V. Padmanabhan, and S. Whang, "The bullwhip effect in supply chains," *Sloan Management Review*, vol. 11, 1997.

[25] F. R. Jacobs, "Playing the beer distribution game over the internet," *Production and Operations Management*, vol. 9, no. 1, pp. 31–39, 2000.

[26] S. J. Franciosi, "Simulation game impacts on perceptions of nuclear energy," in *Intersections in Simulation and Gaming*, pp. 331–341, Springer, Cham, 2018.

[27] P. C. Adams, "Teaching and learning with SimCity 2000," *Journal of Geography*, vol. 97, no. 2, pp. 47–55, 1998.

[28] K. Seifert and R. Sutton, "Motivation Theories on Learning," Found. Learn. Instr. Des. Technol," 2018, https://edtechbooks.org/lidtfoundations/motivation_theories_on_learning.

[29] Hotel Stars, "Development of the Simulation Game–Based Teaching Programme," in *The Shift from Teaching to Learning: Individual, Collective and Organizational Learning through Gaming Simulation*, pp. 624–638, Dornbirn: International Simulation and Gaming Association, Dornbirn, Austria, 2014.

[30] M. Sailer, J. U. Hense, S. K. Mayr, and H. Mandl, "How gamification motivates: an experimental study of the effects of specific game design elements on psychological need satisfaction," *Computers in Human Behavior*, vol. 69, pp. 371–380, 2017.

[31] C. Zhang, J. Baalsrud Hauge, K. P. Härenstam, and S. Meijer, "Game experience and learning effects of a scoring-based mechanic for logistical aspects of pediatric emergency medicine: development and feasibility study," *JMIR Serious Games*, vol. 9, no. 1, Article ID e21988, 2021.

[32] C. Zhang, J. Baalsrud Hauge, K. P. Härenstam, and S. Meijer, "A Serious Logistical Game of Paediatric Emergency Medicine: Proposed Scoring Mechanism and Pilot Test," in *Lecture Notes in Computer Science*, pp. 468–478, Games and Learning Alliance, Cham, 2019.

[33] G. Sackett, "The lag sequential analysis of contingency and cyclicity on behavioral interaction research," in *Handbook of Infant Development*, pp. 623–649, Wiley, NY, USA, 1979.

[34] E. Montague, J. Xu, P.-y. Chen, O. Asan, B. P. Barrett, and B. Chewning, "Modeling eye gaze patterns in clinician-patient interaction with lag sequential analysis," *Human Factors: The Journal of the Human Factors and Ergonomics Society*, vol. 53, no. 5, pp. 502–516, 2011.

[35] A. Tlili, H. Wang, B. Gao et al., "Impact of cultural diversity on students' learning behavioral patterns in open and online courses: a lag sequential analysis approach," *Interactive Learning Environments*, pp. 1–20, 2021.

[36] K.-H. Yang, "Learning behavior and achievement analysis of a digital game-based learning approach integrating mastery learning theory and different feedback models," *Interactive Learning Environments*, vol. 25, no. 2, pp. 235–248, 2017.

[37] M. Allen, *The SAGE Encyclopedia of Communication Research Methods. 2455 Teller Road*, SAGE Publications, Inc, Thousand Oaks California 91320, USA, 2017.

[38] W.-C. Yen and H.-H. Lin, "Investigating the effect of flow experience on learning performance and entrepreneurial self-efficacy in a business simulation systems context," *Interactive Learning Environments*, pp. 1–16, 2020.

[39] M. Tabak, F. de Vette, H. van Dijk, and M. Vollenbroek-Hutten, "A game-based, physical activity coaching application for older adults: design approach and user experience in daily life," *Games for Health Journal*, vol. 9, no. 3, pp. 215–226, 2020.

[40] J. Ko, J. J. Lee, S.-W. Jang et al., "An epiduroscopy simulator based on a serious game for spatial cognitive training (EpiduroSIM): user-centered design approach," *JMIR Serious Games*, vol. 7, no. 3, Article ID e12678, 2019.

[41] M. Ward, E. McAuliffe, É. Ní Shé et al., "Imbuing medical professionalism in relation to safety: a study protocol for a mixed-methods intervention focused on trialling an embedded learning approach that centres on the use of a custom designed board game," *BMJ Open*, vol. 7, no. 7, Article ID e014122, 2017.

[42] J. H. G. Klabbers, "Gaming and simulation: principles of a science of design," *Simulation & Gaming*, vol. 34, no. 4, pp. 569–591, 2003.

[43] I. Mayer, G. Bekebrede, C. Harteveld et al., "The research and evaluation of serious games: toward a comprehensive methodology," *British Journal of Educational Technology*, vol. 45, no. 3, pp. 502–527, 2014.

[44] C. Boletsis and S. McCallum, "Smartkuber: a serious game for cognitive health screening of elderly players," *Games for Health Journal*, vol. 5, no. 4, pp. 241–251, 2016.

[45] W. Peng, J.-H. Lin, K. A. Pfeiffer, and B. Winn, "Need satisfaction supportive game features as motivational determinants: an experimental study of a self-determination theory guided exergame," *Media Psychology*, vol. 15, no. 2, pp. 175–196, 2012.

[46] W. A. IJsselsteijn, Y. A. W. de Kort, and K. Poels, "The game experience questionnaire," 2013, https://research.tue.nl/en/publications/the-game-experience-questionnaire.

[47] J. Barbara, "Measuring user experience in multiplayer board games," *Games and Culture*, vol. 12, no. 7-8, pp. 623–649, 2015.

[48] M. Schrepp, A. Hinderks, and J. Thomaschewski, "Applying the user experience questionnaire (UEQ) in different evaluation scenarios," *Design, User Experience, and Usability. Theories, Methods, and Tools for Designing the User Experience*, Springer, Cham, pp. 383–392, 2014.

[49] J. D. Guldager, S. L. Kjær, P. Lyk et al., "User experiences with a virtual alcohol prevention simulation for Danish adolescents," *International Journal of Environmental Research and Public Health*, vol. 17, no. 19, p. 6945, 2020.

[50] D. Liu, R. Santhanam, R. Santhanam, and J. Webster, "Toward meaningful engagement: a framework for design and research of gamified information systems," *MIS Quarterly*, vol. 41, no. 4, pp. 1011–1034, 2017.

[51] M. Minović, M. Milovanović, U. Šošević, and M. Á. Conde González, "Visualisation of student learning model in serious games," *Computers in Human Behavior*, vol. 47, pp. 98–107, 2015.

[52] Z. Liu, H. N. H. Cheng, S. Liu, and J. Sun, "Discovering the two-step lag behavioral patterns of learners in the college SPOC platform," *International Journal of Information and Communication Technology Education*, vol. 13, no. 1, pp. 1–13, 2017.

[53] G. Lohmann, M. A. Pratt, P. Benckendorff, P. Strickland, P. Reynolds, and P. A. Whitelaw, "Online business simulations: authentic teamwork, learning outcomes, and satisfaction," *Higher Education*, vol. 77, no. 3, pp. 455–472, 2019.

Hindawi
Mobile Information Systems
Volume 2022, Article ID 3174692, 12 pages
https://doi.org/10.1155/2022/3174692

Research Article

Propose a New Quality Model for M-Learning Application in Light of COVID-19

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Received 10 October 2021; Accepted 18 January 2022; Published 1 March 2022

Academic Editor: César A. Collazos

The coronavirus disease (COVID-19) prevented millions of students around the world from receiving their lessons, because of the closure of thousands of schools. The new COVID-19 global epidemic invaded the barriers of time and space. Using mobile phones in education is a new form of the distance learning system. M-learning is characterized by many characteristics, the most important of which are providing an interactive educational environment, flexibility in space and time, better adaptation to individual needs, acquisition of knowledge, interactive effectiveness, and developing self-learning skills for students. The main aim of this paper is to suggest a quality model for M-learning applications for children which contains the most common characteristics of M-learning, which must be taken into account when designing M-learning applications. Through previous studies related to the quality model for M-learning applications, we proposed two quality characteristics, technical and pedagogical. We proposed 8 subcharacteristics with their features following the structure of the IOS/IEC 912 and DeLone and McLean IS model to find the effect of technical and pedagogical factors on user satisfaction with M-learning applications for children. Results show that the proposed model can be useful and effective to ensure the development of high-quality M-learning applications.

1. Introduction

The COVID-19 crisis resulted in millions of students around the world being cut off from receiving their lessons, due to the closure of thousands of schools. Schools were closed as a result of the measures taken by the authorities to reduce the spread of COVID-19. Therefore, numerous educational foundations in Arab nations have turned to the choice of distance learning because the educational program should keep closing any instructive hole that may result from the emergency. Similarly, as the new corona pandemic, the virus attacked the boundaries, and the "distance learning" that went with the spread of the infection came to clear the hindrances of existence.

E-learning is characterized as an educational and instructive framework offering educational and preparing/instructive programs to undergraduates without restrictions of having space or time, using communication techniques and various technologies from the Internet, computers, smartphones, direct broadcast through electronic applications, and other technologies [1, 2]. Using mobile phones in learning is a new form of distance learning system [1]. There is a strong trend to use mobile learning (M-learning) in learning processes because one of its effects is to increase the motivation of the children to learn and improve communication with them through what they use from devices and technological applications, which may be reflected in improving their skills. Many decisions emphasized the

importance of using M-learning in educational processes [3, 4]. M-learning is characterized by many characteristics, the most important of which are providing an interactive learning environment, flexibility in space and time, better adaptation to individual needs, acquisition of knowledge, interactive effectiveness, developing self-learning skills for students, and the ability to communicate knowledge through various audio-visual media or reading [3].

Considering this knowledge explosion and the development of information and science, it is not at this point adequate to leave the teaching and properly shift to another level of education. It was necessary to prepare randomly in advance considering a clear philosophy that leads to the educational process and learning strategies for the children according to their capabilities and development requirements in a cultural environment and specific circumstances [3]. There are many good applications that children can learn but have no real learning goals because they do not follow quality models. So, parents need to note that just because an app is not in the "Education" section of digital stores, it does not mean it is non educational [5]. Most relevant studies that have addressed this problem provide few M-learning features such as usability, control, and flexibility while ignoring some important characteristics such as pedagogy, technology, and user satisfaction [5]. Although there were some critical interests in M-learning, people still neglect its advantages that we can have in the future through M-learning networks [6]. In this manner, as of late, an increment has been seen in the number of exact examinations planned to analyze the elements influencing M-learning acknowledgment and reception and the advantages colleges get from M-learning [7–10], while few have paid attention to examining the effect of quality factors on M-learning usage. These studies ignore the fact that quality factors serve as important roles for meeting students' perceptions and ensuring the successful development of M-learning applications, and, therefore, it is important for examining such factors.

Papadakis et al. [5] proposed quality model that will provide the developers with a guideline to building successful and effective children's mobile learning applications. The proposed model in this study will provide a base for building the children's mobile learning applications that meet these requirements by providing important characteristics such as pedagogy, technology, and user satisfaction.

Therefore, this study contributes to enriching the field of research in mobile learning applications especially in learning for children through proposing a new quality model that includes new important quality characteristics, analyzing the related previous studies, and the findings of the empirical study (questionnaire). Therefore, this finding may open the way for other researchers, especially those interested in children's mobile learning applications.

This paper aims to investigate previous studies related to the model of quality M-learning application for children. A quality model for M-learning application for children is suggested, which contains the most common characteristics of M-learning that must be taken into account in the design of learning for mobile applications. The validity of the proposed quality model is verified using the quantitative method to set the M-learning application. The development of the M-learning model depends on the proposed model.

2. Theoretical Background

In this section, we briefly present the concepts related to e-learning, mobile learning, and M-learning quality.

2.1. E-Learning. E-learning is one innovation of educational technology and one form of distance education that depends on the use of computers and the use of the Internet and the technology associated with it in building and developing educational resources, with less time and effort, and the greatest benefit, anytime, anywhere, and most of the time; E-learning is in an environment away from the teacher, which provided more opportunity for more education to be received with ease [1]. E-learning is among the educational and technical methods available to everyone as it provides the students or the users with information and supports it with pictures, sounds, and graphics and also provides electronic libraries with high-quality technologies and other advantages. They consider the learner according to his educational ability and following his previous experiences. From this standpoint, we can say that E-learning is a way to transform class education into education with the help of technology [1].

2.2. Mobile Learning. Previous studies viewed the benefits derived from the M-learning system from the university students' perspective. For example, one main benefit of using an M-learning system is an increment like educating and learning, just as an improvement in the cooperation among understudies and teachers [8]. Moreover, M-learning systems help educational institutions increase student enrollment, enhance their reputation, respond quickly to change, and lower costs [8].

Mobile learning, otherwise called M-learning, is another approach to get to M-learning content. M-learning upholds continuous access to the learning process [11, 12]. It is based on wireless communications. So, the learner can access educational materials and seminars anytime and anywhere, and M-learning also refers to the use of mobile devices in the teaching and learning process, as it focuses on using the techniques available in wireless communication devices to communicate information outside the classroom. It should be possible to utilize gadgets and devices, for example, telephone, PC, or tablet [11]. You can adapt to any place and at whatever point you need [3].

2.3. M-Learning and Quality. The concept of quality in this study reflects a degree of excellence of learning content quality and learning service quality of the M-learning system. Because of increasing sophistication and, with it, challenges in the information systems field, higher education institutions are eager to enhance the quality of their systems as a means of maximizing their potential for growth [7]. The importance of quality factors has been widely examined in

prior research in several fields such as e-learning quality [13], learning management system quality [14], and M-learning quality [5]. It is a set of specifications required in M-learning environments to ensure its success and the quality of its design and development, so it becomes a tool to guide the production of M-learning systems and maintain their continuity; M-learning environment standards become exemplary performance measures, evaluation criteria, and guidelines for developments and improvements and a tool that helps in decision in the sense of a set of conditions required in M-learning environments to ensure the quality of their design [12, 14–16]. Providing quality in M-learning is a very important problem for any program or academic course. If quality is a prerequisite for the success of the educational process, quality becomes a necessary problem for M-learning in particular. The success of any educational system is highly dependent on its commitment to internationally agreed quality standards. The success of the portable learning system depends on the relevance of the outputs to goals considering their achievement of the approved quality standards [12]. Quality is nowadays a major issue in modern education especially for learning via mobile devices, where the application of quality can be a key factor in success [12].

According to the existing literature, in recent years, an increase has been observed in the number of empirical studies intended to examine the factors affecting acceptance, adoption, usage, and implementation of M-learning and the benefits universities derive from M-learning systems [6–9]. For example, Almaiah and Al Mulhem [4] proposed a new model to identify the most important factors that could motivate students to accept and use M-learning system. They identified 4 success factors of mobile learning, which were subdivided into the following categories: (i) innovative factors (security, protection, similarity, relatively favorable position, and trust), (ii) hierarchical components (protection from change and technological availability), (iii) social elements, and (iv) quality variables (nature of the framework, nature of substance, and nature of administration). Then, again, [6] inspected the impact of various components on M-learning applications improvement at three primary phases of utilization (static stage, association stage, and exchange stage).

The outcomes demonstrated that the main variables identified with the point of view of the user to think about when creating M-learning in three phases were framework similarity, security, data quality, awareness, seen practical advantage, self-viability, accessibility of assets, and trust [3]. Almaiah et al. [2] Led quantitative investigation with 275 undergrad Jordanian understudies at the college of Jordan and called attention to that trust, seen security, seen convenience, and seen handiness are fundamental variables for effective selection and usage of M-learning framework. Almaiah and Alismaiel [8] proposed a structure for M-learning acknowledgment dependent on integrating the Technology Acceptance Model (TAM) with the refreshed DeLone and McLean's model (DL&ML). The examination intended to research the impact of value components and individual variables on student's fulfillment and expectation to the utilization of the M-learning network. The outcomes presumed that quality components identified with framework quality, data quality, and administration quality are fundamental measurements for guaranteeing understudies' fulfillment and goal to the utilization of the M-learning framework. Likewise, Almaiah et al. [9] proposed a half-breed quality model for M-learning dependent on researches of DeLone and McLean data framework achievement model (DL&ML) with the TAM model to look at the impact of 10 quality measurements on M-learning framework acknowledgment. They uncovered that the most basic components identified with incrementing the students acknowledgment were content plan quality, usefulness, UI configuration, learning content quality, openness, responsiveness, personalization, and intelligence. In another investigation, Almaiah et al. [9] created three structures for M-learning advancement dependent on quality variables got from the refreshed DeLone and McLean data framework achievement model.

Finally, a recent study conducted by Nizam Ismail et al. [6] investigated the important factors that affect students' acceptance of mobile learning. The study applied the Unified Theory of Acceptance and Use Technology (UTAUT) model and revealed that perceived data quality, similarity, trust, sense of awareness, and accessibility of assets, self-adequacy, and security are the principal sparks of understudies' acknowledgment of the M-learning framework and subsequently achievement of the execution of M-learning projects.

Based on Table 1, the majority of M-learning studies have considered students' perceptions for determining the factors that affect acceptance, adoption, and usage of mobile learning, while few studies have paid attention to users' perceptions of quality factors for M-learning applications. These studies ignore the fact that quality factors serve as important roles for meeting students' perceptions and ensuring the successful development of M-learning applications, and, therefore, they are important for examining such factors. The existing literature offers little insight into the quality factors of M-learning systems. There are a limited number of examples that look at this, including the studies by Almaiah et al. [9] and Qian et al. [10], which identified various M-learning quality factors in educational institutions. However, as far as we have been able to determine, few of these studies have empirically identified the important quality factors of M-learning applications development. Consequently, this study aims to propose and empirically examine a new model of the effect of quality factors on M-learning application development.

3. The Research Models and Hypothesis

There are a set of characteristics required in M-learning environments to ensure the quality of their design. Attention to quality standards has become a global movement, and it is a national demand in all areas, including education, so quality becomes a tool for guiding, producing, and maintaining portable learning systems [18]. There are many

Table 1: Related work.

Literature	Purpose of the study	Findings
Papadakis and Kalogiannakis (2017) [3]	Conducted quantitative study with 275 undergraduate Jordanian students at the University of Jordan to explore the students' acceptance of mobile information systems	Pointed out that trust, perceived security, perceived ease of use, and perceived usefulness are vital factors for successful adoption and implementation of the M-learning system
Almaiah and Mulhem (2019) [4]	Proposed a new model to identify the most important factors that could motivate students to accept and use the M-learning system	They identified 4 success factors of mobile learning, which were subdivided into the following categories: (i) innovative factors (security, protection, similarity, relatively favorable position, and trust), (ii) hierarchical components (protection from change and technological availability), (iii) social elements, and (iv) quality variables
Nizam Ismail et al. (2020) [6]	Inspected the impact of various components on M-learning applications improvement at three fundamental phases of use (static stage, communication stage, and exchange stage)	The outcomes demonstrated that the main variables identified with users' insights to contemplate when creating M-learning in three phases were framework similarity, security, data quality, mindfulness, seen practical advantage, self-viability, accessibility of assets, and perceived trust
Almaiah and Alismaiel (2019)[8]	Conducted quantitative study with 275 undergraduate Jordanian students at the University of Jordan to explore the students' acceptance of mobile information systems.	Pointed out that trust, perceived security, perceived ease of use, and perceived usefulness are vital factors for successful adoption and implementation of the M-learning system.
Almaiah et al. (2016) [9]	Developed three systems for M-learning development based on quality factors derived from the updated DeLone and McLean information system success model.	They uncovered apparent data quality, perceived similarity, trust, a level of awareness, accessibility of assets, self-viability, and security, which are the primary inspirations of student's acknowledgment of the M-learning framework.
Alrasheedi and Capretz (2020) [1]	Proposed a hybrid quality model for M-learning based on combining the updated DeLone and McLean information system success model (DL&ML) with TAM model to examine the effect of 10 quality dimensions on M-learning system acceptance.	They revealed that the most critical factors relating to increasing the students' acceptance were content design quality, functionality, user-interface design, learning content quality, accessibility, responsiveness, personalization, and interactivity.

foundations for quality paradigms to consider while designing and developing portable learning environments based on M-learning technology [1]. We have come up with a list of criteria for designing M-learning environments with a focus on the most common and important characteristics of M-learning to consider. After reviewing several studies and research, the quality model for children's M-learning applications in this paper is based on ISO 9126, the most widespread quality standard [19]. Additionally, the IS success measurement is one of the first to care about the effectiveness of information systems, which focuses on the functional requirements of information systems [19]. The proposed model defines two main characteristics: technology and pedagogy, each of them includes subcharacteristics as shown in Figure 1 which depicted the research model.

3.1. Technology. Technology factor can be defind as the utilization of actual hardware, software, and instructive hypothetical to encourage learning and improving the education. In this manner, technical elements affect students' satisfaction of M-learning applications [11, 12, 14–20]. Therefore, the following hypothesis is formulated to test the effect of technical factors on user satisfaction.

Hypothesis 1: technical factors have a significant effect on user satisfaction with M-learning applications for children.

The M-learning technical characteristics comprise the following subcharacteristics:

Functionality: the M-learning function shows the ability of the application to provide a function that meets the explicit and implicit needs of users under specific conditions of use, meaning what the program does to meet the needs [14–16]. The application includes all the features needed to accomplish the required tasks and provide an improved educational experience [21].

Hypothesis 1a: functionality has a significant effect on user satisfaction with M-learning applications for children.

Performance: the achievement of M-learning applications relies upon the obligation to execution and improved proficiency [12, 14–21]. Application reaction time execution should be adequately quick to meet the client's needs. Significant delay times can decrease revenue and weariness by students, bringing about reluctance to utilize these applications [12].

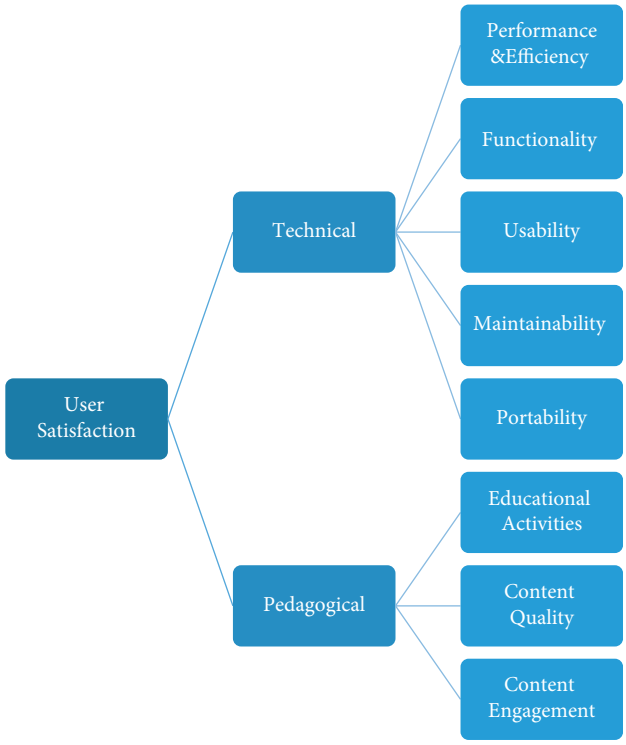

Figure 1: Quality model for M-learning application for children.

Hypothesis 1b: performance has a significant effect on user satisfaction with M-learning applications for children.

Usability: the ease of use in M-learning has been characterized as a subjective attribute that characterizes the best, productive, and good method of utilizing the UI [22]; it inspects the degree to which M-learning can accomplish explicit objectives in a powerful, proficient, and palatable way of use [21]. In learning conditions, particularly for cell phones, the interface ought to be not difficult to learn, perceive, and recall, since one of the significant focuses for clients is to acknowledge the program [11, 12]. The learning interface ought to be straightforward and simple to work by various age gatherings to guarantee better utilization of the application.

Hypothesis 1c: usability has a significant effect on user satisfaction with M-learning applications for children.

Portability: it is the ability to transfer an application from one environment to another, as well as the ability of the application to adapt to different mobile devices, with no further action configurations [15]. Besides, it is the ability of the application to be installed and uninstalled easily on different mobile devices [21].

Hypothesis 1d: portability has a significant effect on user satisfaction with M-learning applications for children.

Maintainability: it is the ability of the application to make adjustments that may include corrections, improvements, or adjustments to the program for changes in the environment, requirements, and functional specifications (the effort required for modification); the application must be designed about ease of maintenance [21].

Hypothesis 1e: maintainability has a significant effect on user satisfaction with M-learning applications for children.

3.2. Pedagogy. Pedagogically sound design for M-learning application development is a key factor for providing a pleasant and rich learning experience in a mobile environment [19]. Therefore, pedagogical factors influence user satisfaction with M-learning applications for children [11, 12, 14–20].

Hypothesis 2: pedagogical factors have a significant effect on user satisfaction with M-learning applications for children.

The M-learning's pedagogical characteristics comprise the following subcharacteristics:

Educational activities: it is a learning theory that relies upon the student in learning circumstance and incorporates all learning practices, as well as instructing methodology that intends to initiate and amplify the student's part during learning through work and research. Therefore, it also relied on the student's confidence in getting data and acquiring abilities. Furthermore, learning theory it is not just center on retention and teaching, but also focuse on creating thinking and the capacity to take care of issues [12, 21].

Hypothesis 2a: educational activities have a significant effect on user satisfaction with M-learning applications for children.

Content quality: content quality must be valid, trustworthy, and accurate. In an M-learning environment, the content must consider the pedagogical aspects to generate efficient learning. It should be useful and appropriate for initial learning objectives, age, and level of the children [8]. It should also motivate the learner to plan educational goals in the M-learning environment in a correct, accurate, and clear manner consistent with the learning strategy in a way that serves the educational content provided to achieve the general and final objectives expected by the learner [22, 23].

Hypothesis 2b: content quality has a significant effect on user satisfaction with M-learning applications for children.

Content and engagement: to get children's attention to the application, the content must be engaging. Effective content and participation in the mobile application are two measures that provide real insight into the success of the application [24, 25]. Negative content and low application sharing are a recipe for failure, while high engagement and retention are the opposite [19–26]. The success of the application can be determined through user engagement and activity, by using appropriate familiar content, language, and concepts [27].

Hypothesis 2c: content and engagement have a significant effect on user satisfaction with M-learning applications for children.

3.3. User Satisfaction. User satisfaction shows the user's response to the effective use of the information system [11, 21]. The user becomes satisfied with the system when it meets his requirements and needs. One prerequisite for successful M-learning is that students feel satisfied with the application of learning as a sign of the quality of education [19]. High user satisfaction contributes to greater educational outcomes. Therefore, technical factors and pedagogical factors influence user satisfaction with M-learning applications for children [16, 20, 28].

4. Research Methodology

The method used in this paper is based on a quantitative approach. The quantitative method provides advantages such as accurate, reliable, and fast data collection, a broader set of data analysis, elimination of bias, and tendency. Data for this paper were collected through the questionnaire because the questionnaire is the most common and practical way to collect data in quantitative studies. In our research, the sample was children who cannot understand how to fill the questionnaire and need more explanation about the questionnaire items. For this reason, we requested from the parents to help their children and explain the questions to them and then fill the form based on their answers. In the survey questionnaire, we mentioned that all answers from respondents will be confidential and we will minimize any risks of breach of confidentiality as presented in Appendix B.

The survey was conducted in Amman, Jordan. The questionnaire way is used to collect data for this study in both English and Arabic because many of the participants have Arabic as their own mother tongue; it was necessary to translate the questionnaire to reduce misunderstanding and help participants understand the research topic. The items of the questionnaire were adopted from related studies ([13, 29–31] and [32–38]) (see appendix A). The questionnaire uses Google Forms online and is delivered manually to the parents of the children. To verify the questionnaire, the researcher presented the tool to a committee composed of 4 faculty members at Al-Zaytoonah University with experience, expertise, and competence to measure the appropriateness of each element of the questionnaire in terms of language and formulate and achieve the goal. In line with their directives and proposals, the wording of some of their phrases was modified, and a few of them were added and deleted. The study community consists of parents of children in primary schools and preschools, between the ages of 3 and 12 years.

The data collected from the survey delivery included responses of 240 participants. 10 answers were rejected as they were incomplete. The statistical treatment of the data got by the researcher using the SPSS package was performed, and the data from 220 parents were analyzed. Therefore, the sample size in this paper suffices to represent the views of parents about the quality of learning applications for children as an exploratory study.

The demographic composition of the research was 52.7% females and 47.3% male. Given the age group, it was 3 to 5 (31.8%), 6 to 8 (31.4%), and 9 to 12 (36.8%) as shown in Table 2. About children mainly using their smart devices with the highest video viewing rate of 56.5%, the gameplay rate is 45.7%, followed by the educational gaming operator with 26%, taking pictures and video with 17.9%, and completing schoolwork increased by 16.6%. As shown in Table 2, the number of hours spent by children on electronic devices in one day ranged from one to two hours, 32.3%, while their use of these devices ranged from 2 to 3 hours (25.9%) in the second place, from 3 to 4 hours (19.1%) in the third position, from 5 to 6 hours (8.2%) in the fourth position, and more than 6 hours (4.1%) per day in the fifth position. For children using their smart devices, the results showed that the highest response was to watching videos (56.5%), followed by playing games (45.7%), educational games operator (26%), and taking pictures and video (17.9%). 16.6% completed school work, as shown in Table 2.

5. Data Analysis and Result

The stability coefficient was calculated using the internal consistency method according to the Cronbach alpha equation. Table 3 shows the coherence coefficient according to the Cronbach alpha equation, as it becomes clear through it that stability of the test is high, which confirms that the test is of high stability. It can be used as a research measurement tool.

Multiple regression analysis was used for the effect of technical and pedagogical factors on user satisfaction with M-learning applications for children as shown in Table 4. The table made it clear that the effect is significant on a level of significance of $a = 0.05$ of the effect of technical and educational factors on user satisfaction with M-learning for children where the correlation coefficient R was 0.293 and the coefficient of explanation for explanatory variance R^2 was 0.077, that is, the technical and educational factors explained 7.7% of the variation that occurred on the user's satisfaction with the portable learning of children. The value of "F" was 10.185 and .000 represented a statistical significance, and there was the effect of technical factors and pedagogical factors on the user satisfaction with M-learning applications for children.

Results of a simple regression analysis of the effect of technical and pedagogical on user satisfaction with M-learning applications for children are shown in Table 5.

Hypothesis 1: "Technical factors have a significant impact on user satisfaction with M-learning applications for children" is accepted.

Hypothesis 1.a: "The functionality has a great impact on the user satisfaction with M-learning applications for children" is accepted.

Hypothesis 1.b: "The performance has a great impact on the user satisfaction with M-learning applications for children" is accepted.

Table 2: Results of the demographic questions.

	Categories	Frequency	Percent
Gender	Male	104	47.3
	Female	116	52.7
Age group	3–5	70	31.8
	6–8	69	31.4
	9–12	81	36.8
Time	Less than 30 minutes	23	10.5
	From 1 to 2 hours	71	32.3
	From 2 to 3 hours	57	25.9
	From 3 to 4 hours	42	19.1
	From 5 to 6 hours	18	8.2
	More than 6 hours	9	4.1
Children mainly use their smart devices	Do school work	37	16.6
	Watch the videos	126	56.5
	Playing games	102	45.7
	Taking photos and videos	40	17.9
	Educational game player	58	26

Table 3: The internal consistency coefficient of Cronbach alpha.

Variable	Internal consistency
Technical factors	0.801
Pedagogical factors	0.773
User satisfaction	0.620
The questionnaire	0.866

Table 4: Multiple regression analysis of the effect of technical and pedagogical factors on user satisfaction with M-learning applications for children.

Independent variable	Beta	T	Sig t	R	R^2	F	Sig f
Technical factors	0.211	2.646	0.009	0.293	0.077	10.185	0.000
Pedagogical factors	0.114	1.426	0.155				

Table 5: Results of a simple regression analysis of technical and pedagogical subhypotheses.

Hypothesis	R	R^2	Unstandardized coefficients		t	f	Sig	Results
			B	Std. error				
Technical	0.278	0.073	0.495	0.116	4.272	18.249	0.000	Accepted
Functionality	0.231	0.049	0.258	0.074	8.806	12.285	0.000	Accepted
Performance	0.162	0.022	0.177	0.073	2.424	5.878	0.016	Accepted
Usability	0.150	0.018	0.194	0.087	2.241	5.024	0.026	Accepted
Portability	0.225	0.046	0.212	0.062	3.414	11.657	0.001	Accepted
Maintainability	0.320	0.099	0.351	0.070	4.993	24.933	0.000	Accepted
Pedagogical	0.237	0.052	0.470	0.130	3.607	13.013	0.000	Accepted
Educational activities	.260	0.064	0.364	0.091	3.983	15.867	0.000	Accepted
Content quality	.099	0.005	0.134	0.091	1.471	2.163	0.143	Accepted
Content engagement	.235	0.051	0.268	0.075	3.577	12.793	0.000	Accepted

Hypothesis 1c: "The usability has a great impact on the user satisfaction with M-learning applications for children" is accepted.

Hypothesis 1d: "The portability has a great impact on the user satisfaction with M-learning applications for children" is accepted.

Hypothesis 1e: "The maintainability has a great impact on the user satisfaction with M-learning applications for children" is accepted.

Hypothesis 2:" Pedagogical factors have a significant impact on user satisfaction with M-learning applications for children" is accepted.

Table 6: Questionnaire items.

1. Technical factors						
1.1. Efficiency and performance factor		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	The child takes a short time to learn and understand mobile apps					
2	Mobile learning applications respond quickly to complete a specific task					
3	Mobile learning applications provide appropriate assistance					
4	Mobile learning applications provide voice assistance					
1.2. Reliability factor						
1	In the event of application failures (such as disconnecting), the information entered into it must be preserved					
2	Ease of handling errors in mobile learning applications					
3	Mobile learning applications must resume work and recover lost data after failure					
4	Multiple versions of the application help reduce errors					
1.3. Usability factor						
1	The names of addresses, lists, and icons are compatible in mobile learning applications					
2	Mobile learning application options are easy to understand and use					
3	The child learns to use the mobile learning application easily without assistance					
4	Child uses mobile learning apps without much effort					
5	The mobile learning apps interface looks attractive to a child					
1.4. Functional factor						
1	Mobile learning apps contain a search engine, which facilitates the search for specific options					
2	Mobile learning applications contain easy and relatively complete options and meet the requirements of the child					
3	In mobile learning applications, the required tasks are performed and the result is as expected by the user					
1.5. Maintainability factor						
1	Easily diagnose errors in mobile learning applications					
2	Easily correct errors and problems in mobile learning applications					
3	If adjustments are made, the mobile learning apps will continue to work					
4	Edits in portable learning apps are easily tested					
1.6. Communication factor						
1	Mobile learning applications contain specific tools to stimulate communication with the child					
2	Mobile learning applications provide some form of social interaction/ simultaneous play/or screen sharing					
3	The application offers visual or auditory notes to children when they perform a certain task					
1.7. Advertisements factor						
1	Advertisements can completely distract the child's attention while using mobile learning applications					
2	Advertisements indirectly encourage the child to track ads and exit the application					
1.8. Portability factor						
1	Easily install mobile learning applications on mobile devices					
2	Mobile learning applications work regardless of device type					

Table 6: Continued.

	2. Pedagogical factors					
		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
	2.1. Interactivity factor					
1	Child participates in mobile learning applications through activities that challenge the child					
2	Mobile learning applications reduce kid's keyboard usage, which means avoiding typing as much as possible					
3	The child is able to move freely and easily between different topics to choose the topic he wants					
4	Child controls the transition between the elements and contents of the mobile learning application					
5	The application allows the child to leave or return to mobile learning applications easily					
6	The user-interface helps the child to quickly access the required information					
7	Mobile learning applications to suit the capabilities of the targeted children					
8	The interface should be appropriate to the nature of the educational missions to be learned					
9	Displaying intense information on a single screen should be avoided in children's mobile learning applications					
	2.2. Educational activities factor					
1	Mobile learning activities aim at the child's interaction					
2	Mobile learning activities shift from simple to complex					
3	Mobile learning activities must be provided in an attractive and linguistically accurate manner					
4	Mobile learning activities reflect the child's surrounding and realistic environment					
5	The goals of educational activities are beneficial to the child and develop the skills he applies to his life					
6	Mobile learning activities are clear and accurate					
7	The activities and educational materials used in the application must contain text, images, graphics, multimedia, games, sound, and others					
	2.3. Content quality factor					
1	In a mobile learning application, the content provided must relate to specific educational goals					
2	In a child's mobile learning application, the general characteristics of the age group must be taken into account					
3	The child's mobile learning application takes into account the current and previous knowledge, so that there is an integrated link between old and new information					
4	In the mobile learning application for the child, we must take into account the individual differences between the children in terms of diversity in the content					
5	In a child's mobile learning application, the content should focus on building knowledge, not listing information					
6	In a mobile learning application for a child, the content must be attractive, modern and linguistically correct					
7	The educational content must conform to the standards of the quality of mobile learning applications					
	2.4. Encouragement content factor					
1	The mobile learning app provides encouraging rewards for keeping children engaged					
2	The content of the mobile learning application is satisfactory, attractive and suitable for children					
3	The app provides useful and attractive educational activities for the child's attention					
4	The concepts used are familiar and compatible with children's mental models					
	3. User satisfaction					
1	The mobile learning application performs the tasks in the best possible way and with the least time to reach the expected result					
2	The mobile learning application is effective in achieving the goals, accomplishing the mission and reaching the expected result					
3	In general, I am satisfied with mobile learning application because they are clear and consistent for children					
4	Be satisfied with mobile learning apps because they are attractive to children					

Hypothesis 2.a: "The educational activities have a great impact on the user satisfaction with M-learning applications for children" is accepted.

Hypothesis 2.b: "The content quality has a great impact on the user satisfaction with M-learning applications for children" is accepted.

Hypothesis 2c: "The content engagement has a great impact on the user satisfaction with M-learning applications for children" is accepted.

6. Conclusion and Future Works

This paper focused on proposing a quality model for M-learning applications for children. The model was created primarily from systematic references conducted in this field. It can be useful for researchers, designers, and other developers in designing M-learning applications for children aged between 3 and 12 years. Using the quantitative method, the researchers distributed the questionnaire to 220 parents of children in preschools and primary schools. The results of the sample show the influence of technical and educational factors on user satisfaction with children's mobile learning. The results of an analysis show acceptance of all subcharacteristics of the model which include functionality, performance, usability, portability, maintainability, educational activities, content quality, and content engagement; all subcharacteristics affect user satisfaction. The research presented interesting findings to the quality model for M-learning applications for children.

However, a single study cannot describe and solve the problem from all sides, so this paper has some limitations: The paper was conducted only in Amman, Jordan. The paper randomly selected 220 parents of children of different ages. The proposed model contains a specific set of quality characteristics, not all-inclusive. The results confirmed the impact of technical and pedagogical factors on user satisfaction with M-learning applications for children. The paper recommended the following: Benefiting from the results of the study when designing M-learning applications for children and enriching research in quality models for M-learning for children, especially in children learning. Educational institutions should plan to monitor, evaluate, and generalize the experience of the quality model for M-learning applications for children. One specific interesting avenue for future work would be to explore further into the antecedents to children satisfaction with M-learning application found in this study, namely, functionality, performance and efficiency, ease of use, portability, serviceability, educational activities, content quality, and content engagement. Another area of user-centric research in M-learning would be to determine the characteristics and behaviors of learners in various M-learning application adopter categories.

Appendix

A. Questinnaire Items

The questionnaire items are shown in Table 6.

B. Survey Consent Paragraph

You are being invited to participate in a research study titled: Propose a New Quality Model for M-learning Application In Light Of COVID-19. This study is being done by Ahmad Althunibat, Raneem Dawood, Mohammed Amin Almaiah and Feras Altarawneh from the Alzytoonah University of Jordan. You were selected to participate in this study because you are parent of students used mobile learning. The purpose of this research study is to suggest a quality model for M-learning applications for children. If you agree to take part in this study, you will be asked to complete the survey/questionnaire on the next page. It will take you approximately 10 minutes to complete. You may not directly benefit from this research; however, The authors hope that your participation in the study can be useful for researchers, designers, and other developers in designing M-learning applications for children between 3 and 12 years old. To the best of our ability your answers in this study will remain confidential. The authors will minimize any risks to breach of confidentiality.

Data Availability

The SPSS data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest to report regarding this study.

Acknowledgments

This research was funded by Al-Zaytoonah University of Jordan (14/11/2020-2021).

References

[1] M. Alrasheedi and L. F. Capretz, "Determination of critical success factors affecting mobile learning: a meta-analysis approach," *Turkish Online Journal of Educational Technology*, vol. 14, no. 2, pp. 41–51, 2015.

[2] M. A. Almaiah, A. Al-Khasawneh, and A. Althunibat, "Exploring the critical challenges and factors influencing the E-learning system usage during the COVID-19 pandemic," *Education and Information Technologies*, vol. 25, no. 1, pp. 5261–5280, 2020.

[3] S. Papadakis and M. Kalogiannakis, "Mobile educational applications for children: what educators and parents need to know," *International Journal of Mobile Learning and Organisation*, vol. 11, no. 3, pp. 256–277, 2017.

[4] M. A. Almaiah and A. Al Mulhem, "Analysis of the essential factors affecting of intention to use of m learning applications: a comparison between universities adopters and non-adopters," *Education and Information Technologies*, vol. 24, no. 2, pp. 1433–1468, 2019.

[5] S. Papadakis, M. Kalogiannakis, and N. Zaranis, "Designing and creating an educational app rubric for preschool teachers," *Education and Information Technologies*, vol. 22, no. 6, pp. 3147–3165, 2019.

[6] S. Nizam Ismail, S. Hamid, M. Ahmad, A. Alaboudi, and N. Jhanjhi, "Exploring students engagement towards the learning management system (lms) using learning analytics," *Computer Systems Science and Engineering*, vol. 37, no. 1, pp. 73–87, 2021.

[7] A. Althunibat, M. A. Almaiah, and F. Altarawneh, "Examining the factors influencing the mobile learning applications usage in higher education during the COVID-19 pandemic," *Electronics*, vol. 10, no. 21, p. 2676, 2021.

[8] M. A. Almaiah and O. A. Alismaiel, "Examination of factors influencing the use of m-learning system: an empirical study," *Education and Information Technologies*, vol. 24, no. 1, pp. 885–909, 2019.

[9] M. A. Almaiah, M. M. A. Jalil, and M. Man, "Empirical investigation to explore factors that achieve high quality of mobile learning system based on students' perspectives," *Engineering science and technology, an international journal*, vol. 19, no. 3, pp. 1314–1320, 2016.

[10] J. Qian, J. Cheng, Y. Zeng, and D. W. Tjondronegoro, "Design and implementation of museum educational content based on mobile augmented reality," *Computer Systems Science and Engineering*, vol. 36, no. 1, pp. 157–173, 2021.

[11] M. A. Almaiah, O. Almomani, A. Al-Khasawneh, and A. Althunibat, "Predicting the acceptance of mobile learning applications during COVID-19 using machine learning prediction algorithms," *Emerging Technologies During the Era of COVID-19 Pandemic*, vol. 348, pp. 319–332, 2021.

[12] N. Nordin, M. A. Embi, and M. M. Yunus, "M-learning framework for lifelong learning," *Procedia - Social and Behavioral Sciences*, vol. 7, no. 2, pp. 130–138, 2010.

[13] M. A. Almaiah, A. Al-Khasawneh, A. Althunibat, and O. Almomani, "Exploring the main determinants of mobile learning application usage during covid-19 pandemic in Jordanian universities," *Emerging Technologies During the Era of COVID-19 Pandemic*, vol. 348, pp. 275–290, 2021.

[14] S. A. Salloum, M. Al-Emran, K. Shaalan, and A. Tarhini, "Factors affecting the E-learning acceptance: a case study from UAE," *Education and Information Technologies*, vol. 24, no. 1, pp. 509–530, 2019.

[15] C. X. Navarro, A. I. Molina, M. A. Redondo, and R. Juárez-Ramírez, "Framework to evaluate m-learning systems: a technological and pedagogical approach," *IEEE Revista Iberoamericana de Tecnologias del Aprendizaje*, vol. 11, no. 1, pp. 33–40, 2018.

[16] M. Maqableh and M. Alia, "Evaluation online learning of undergraduate students under lockdown amidst COVID-19 Pandemic: the online learning experience and students' satisfaction," *Children and Youth Services Review*, vol. 128, Article ID 106160, 2021.

[17] W. Winarno, Y. Muhtadi, and M. A. Aldiya, "Application of learning management using non-test instrument to improve the quality of education," *Aptisi Transactions on Management (ATM)*, vol. 3, no. 1, pp. 46–56, 2019.

[18] Y. Zhang, "The implementation of an English word learning system feedback system and smartphone app," *Computer Systems Science and Engineering*, vol. 35, no. 3, pp. 207–214, 2020.

[19] H. Jeong and Y. H. Kim, "A system software quality model using DeLone & McLean model and ISO/IEC 9126," *International Journal of Digital Content Technology and its Applications*, vol. 6, no. 5, pp. 181–188, 2012.

[20] W. Rubens, B. Emans, T. Leinonen, A. G. Skarmeta, and R.-J. Simons, "Design of web-based collaborative learning environments. Translating the pedagogical learning principles to human computer interface," *Computers & Education*, vol. 45, no. 3, pp. 276–294, 2005.

[21] M. Sarrab, M. Elbasir and S. Alnaeli, "Towards a quality model of technical aspects for m-learning services: an empirical investigation," *Computers in Human Behavior*, vol. 55, no. 1, pp. 100–112, 2012.

[22] S. Kioko, M. Kimwele, and L. Nderu, "A learnability model for children mobile applications," *International Journal of Computer Applications Technology and Research*, vol. 8, no. 5, pp. 182–195, 2019.

[23] M. Abdellatief, A. B. Sultan, M. A. Jabar, and R. Abdullah, "A technique for quality evaluation of e-learning from developers' perspective," *American Journal of Economics and Business Administration*, vol. 3, no. 1, pp. 157–164, 2011.

[24] M. Al-Emran, V. Mezhuyev, and A. Kamaludin, "Technology Acceptance Model in M-learning context: a systematic review," *Computers & Education*, vol. 125, no. 1, pp. 389–412, 2012.

[25] M. A. Almaiah, "Acceptance and usage of a mobile information system services in University of Jordan," *Education and Information Technologies*, vol. 23, no. 5, pp. 1873–1895, 2018.

[26] G. Wenyuan, "Using smart phone to facilitate vocabulary m-learning and teaching in Chinese college," *International Journal of Arts and Commerce*, vol. 6, no. 4, pp. 41–36, 2017.

[27] U. Imtinan, v. Chang, and T. Issa, "Common M-learning characteristics-an analysis of M-learning models and frameworks," in *Proceedings of the International Conference Mobile Learning 2013*, pp. 3–11, IADIS Press, Portugal, 14 March 2013.

[28] A. Hussain, E. Mkpojiogu, and F. Hassan, "Dimensions and sub-dimensions for the evaluation of M-learning apps for children: a review," *International Journal of Engineering &Technology (IJET)*, vol. 7, no. 3, pp. 20–34, 2018.

[29] A. Althunibat, "Determining the factors influencing students' intention to use m-learning in Jordan higher education," *Computers in Human Behavior*, vol. 52, pp. 65–71, 2015.

[30] I. Almarashdeh, M. K. Alsmadi, G. Jaradat et al., "Looking inside and outside the system: examining the factors influencing distance learners satisfaction in learning management system," *Journal of Computer Science*, vol. 14, no. 4, pp. 453–465, 2018.

[31] M. Abduljawad, A. Ahmad, K. M. Jaber et al., "Evaluating and adopting E-learning systems in Al-zaytoonah university of Jordan," *Int. J. Advance Soft Compu. Appl*, vol. 12, no. 3, pp. 82–99, 2020.

[32] A. Althunibat, M. Binsawad, M. A. Almaiah et al., "Sustainable applications of smart-government services: a model to understand smart-government adoption," *Sustainability*, vol. 13, no. 6, p. 3028, 2021.

[33] M. A. Almaiah and Y. Nasereddin, "Factors influencing the adoption of e-government services among Jordanian citizens," *Electronic Government, an International Journal*, vol. 16, no. 3, pp. 236–259, 2020.

[34] M. A. Almaiah and M. M. Alamri, "Proposing a new technical quality requirements for mobile learning applications," *Journal of Theoretical and Applied Information Technology*, vol. 96, no. 19, 2018.

[35] S. S. Alghazi, A. Kamsin, M. A. Almaiah, S. Y. Wong, and L. Shuib, "For sustainable application of mobile learning: an extended UTAUT model to examine the effect of technical factors on the usage of mobile devices as a learning tool," *Sustainability*, vol. 13, no. 4, p. 1856, 2021 Jan.

[36] M. Al Amri and M. A. Almaiah, "Sustainability model for predicting smart education technology adoption based on student perspectives," *International Journal of Advances in Soft Computing and Its Applications*, vol. 13, no. 2, 2021 Jul 1.

[37] M. A. Almaiah, "Thematic analysis for classifying the main challenges and factors influencing the successful implementation of e-learning system using NVivo," *International Journal of Advanced Trends in Computer Science and Engineering*, vol. 9, no. 1, pp. 142–152, 2020.

[38] A. Al Mulhem and M. Almaiah, "A conceptual model to investigate the role of mobile game applications in education during the COVID-19 pandemic," *Electronics*, vol. 10, no. 17, p. 2106, 2021 Jan.