Design and Implementation of an Educational Game in Virtual Business Administration Courses

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ABSTRACT

Introduction: In distance higher education, student dropout remains a persistent challenge, largely associated with extra-pedagogical factors such as work or family responsibilities. Student motivation emerges as a central element for fostering persistence and academic achievement.

Methods: This study proposes incorporating serious game mechanics as a strategy to stimulate motivation in self-paced online courses. Using Design and Development Research (DDR) methodology, we developed a prototype educational game inspired by "Who Wants to Be a Millionaire?" following a User-Centered Design and Development (UCDD) approach. The prototype was tested with students from the Financial Administration I (FIN 1020) course during Fall 2024. Data collection included perception questionnaires with Likert-scale items addressing four dimensions: perceived usefulness, engagement, motivation, and overall learning experience, complemented by analysis of SCORM interaction data.

Results: Results indicate that the majority perceived the game as useful for understanding key course concepts, with high engagement levels and positive impact

on motivation. The game-maintained student attention and fostered active participation. Behavioral analysis revealed a 65.5% completion rate, average session duration of 11 minutes, and peak usage on Mondays and between 13h-14h.

Discussion: These preliminary findings demonstrate the positive impact of educational games in online financial courses, supporting their integration as motivational tools to enhance student persistence and learning outcomes in distance education contexts.

1. INTRODUCTION

In the field of distance higher education, student dropout continues to be a persistent problem, largely associated with extra-pedagogical factors such as work or family responsibilities (Papi, Thériault, & Sauvé, 2021). Student motivation emerges as a central element for fostering persistence and academic achievement. This reality is particularly evident in self-managed online courses, where traditional classroom dynamics and direct instructor interaction are absent, creating additional challenges for maintaining student engagement and commitment to learning objectives.

The application of serious games in education is not a novelty, yet recent research validates their benefits for enhancing learning experiences and outcomes (Ryan & Rigby, 2020). Digital educational games have shown promising results in addressing motivational challenges by incorporating game mechanics that naturally engage users and promote sustained interaction with educational content. These games leverage intrinsic motivational factors such as autonomy, mastery, and purpose, which align with established theories of human motivation and learning.

The challenge of student retention in distance education is particularly acute in business administration programs, where complex conceptual frameworks

and quantitative analysis skills require sustained cognitive engagement. Traditional online learning approaches often fail to provide the immediate feedback, social interaction, and progressive achievement recognition that characterize effective learning environments. Educational games offer a potential solution by creating structured, interactive experiences that can bridge these gaps while maintaining educational rigor (Yang & Kang, 2020).

Current literature demonstrates that game-based learning environments can positively influence student engagement, motivation, and academic performance across various educational contexts (Alsawaier, 2018). By integrating elements such as competition, rewards, narrative structures, and immediate feedback, these environments foster active participation and sustain learners' interest more effectively than many traditional instructional approaches. Gamification strategies have been shown to enhance intrinsic motivation, promote deeper cognitive processing, and support the development of problem-solving and collaborative skills, which are crucial for academic success.

However, there remains a gap in understanding how these benefits translate specifically to distance learning environments in business education, where students often balance multiple competing priorities and may have varying levels of technological familiarity and learning preferences (Lohmann et al., 2019).

Building on this foundation, this study proposes a first phase of experimentation oriented toward evaluating the effectiveness of serious game mechanics in stimulating motivation within self-managed online courses, such as those offered by *Université TÉLUQ*. The research focuses specifically on their potential integration into business administration courses, where high

dropout rates and complex subject matter create challenges for student success.

This study aims to: (1) design and develop an educational game prototype for a distance learning business administration course; (2) evaluate student perceptions of the game's usefulness, engagement potential, motivational impact, and contribution to overall learning experience; (3) analyze behavioral patterns of game usage to understand student interaction and completion rates; and (4) assess the feasibility and effectiveness of integrating game-based learning tools in distance business education contexts.

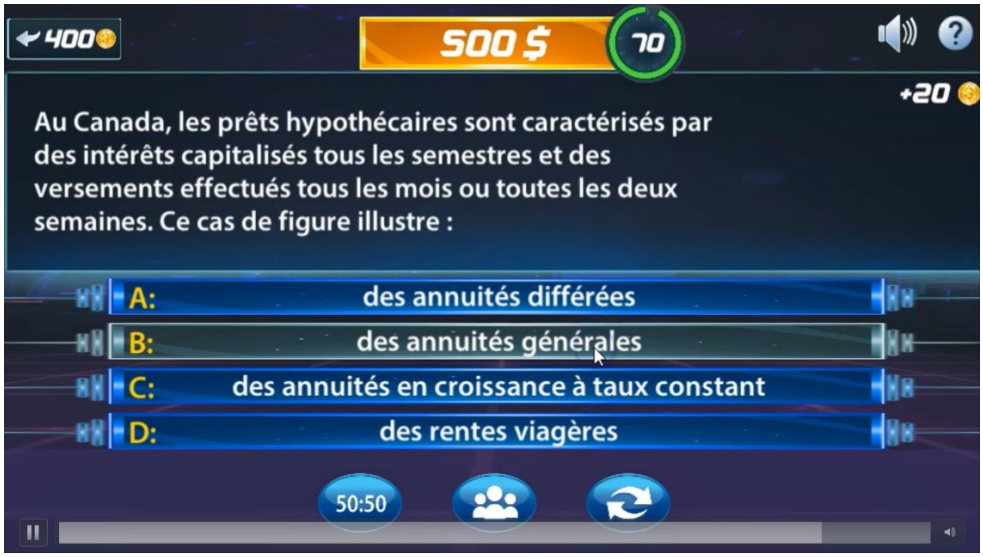
2. METHOD

This innovation proposal is inscribed within the Design and Development Research (DDR) methodology, whose purpose is to generate new knowledge and validate existing practices (Richey & Klein, 2014). DDR provides a systematic approach to creating educational interventions while simultaneously studying their effectiveness and implementation processes. This methodology is particularly suited for exploratory research that seeks to both develop practical solutions and contribute to theoretical understanding of educational technology applications.

An educational game prototype inspired by "Who Wants to Be a Millionaire?" (Figure 1) was developed using a User-Centered Design and Development (UCDD) approach (Lowdermilk, 2013), considering user needs and characteristics throughout the entire process. The UCDD framework ensures that design decisions are grounded in actual user requirements rather than assumptions, leading to more effective and usable educational tools. This approach involved iterative cycles of design, prototyping, testing, and refinement based on user feedback and behavioral observations.

Figure 1

Game session screenshot



Source: Authors

To facilitate agile development, the https://www.chouette.cool/ platform was employed, following an iterative methodology that allowed for rapid prototyping and continuous improvement based on user feedback. This platform provides tools specifically designed for educational game development, enabling the creation of interactive learning experiences without extensive programming expertise while maintaining professional quality standards.

During the Fall 2024 semester, an experimentation of the prototype was conducted with students from the Financial Administration I (FIN 1020) course. The course represents a typical distance learning environment where students work independently through structured modules while having access to instructor support and peer interaction through online forums and virtual office hours. The game was integrated as a supplementary review tool to help students prepare for course evaluations.

Students who used the game were invited to respond to a perception questionnaire with Likert-scale items that addressed four dimensions: perceived usefulness for course content comprehension, engagement, motivation, and overall learning experience. The questionnaire was designed to capture both cognitive and affective aspects of the learning experience, providing insights into how game-based learning tools influence different aspects of student engagement with course material.

As a complement, data collected through the SCORM (Sharable Content Object) system were analyzed, which records student interactions with the game. This analysis identified usage patterns, completion rates, and behaviors linked to learning, thus offering a deeper understanding of the resource's impact and guiding the improvement of future pedagogical strategies. The SCORM data provided objective behavioral measures that complemented the subjective perceptions captured through the questionnaire, creating a comprehensive evaluation framework.

3. RESULTS

The results obtained indicate that the majority perceived the game as a useful tool for understanding key course concepts, highlighting the relevance of questions in relation to content and their capacity to clarify complex aspects. In terms of engagement, students positively valued the interactive format, noting that it was attractive, maintained their attention, and fostered active participation.

3.1. Perception Questionnaire Analysis

The perception questionnaire collected responses across four key dimensions, providing comprehensive insights into student experiences with the educational game.

3.1.1. Perceived Usefulness for Course Content Comprehension

Results demonstrate strong positive perceptions across all usefulness measures (Table 1).

Table 1

Perceived Usefulness for Course Content Understanding

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The game helped me better understand the key concepts of the FIN 1020 course	0	0	2	11	16
The game questions were well aligned with the course content	0	0	2	4	23
I felt more confident in my understanding of the material after playing	0	0	1	10	18
The game clarified certain aspects of the course that I found difficult	0	0	9	10	10
The difficulty level of the game was appropriate for the course level	0	0	1	11	17

The vast majority of participants (93%) agreed or strongly agreed that the game helped them better understand key FIN 1020 concepts, with 55% expressing strong agreement. Alignment between game questions and course content received unanimous positive response, with 93% of participants rating this aspect favorably.

Students also reported increased confidence in their understanding (97% positive responses) and found the game's difficulty level appropriate for the course (97% positive responses). However, the game's effectiveness in clarifying difficult course aspects showed more moderate results, with 31% remaining neutral, suggesting room for improvement in addressing complex concepts.

3.1.2. Engagement

The engagement dimension yielded exceptionally positive results, with near-universal appreciation for the game as a learning tool (Table 2). All participants (100%) appreciated using the game as a review tool, with complete consensus on strong agreement.

Table 2

Engagement

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I found that the game made learning more engaging	0	0	0	7	22
The game made the course content more interesting	0	0	2	3	24
I appreciated using the game as a review tool for the course	0	0	0	0	29
The interactive format of the game maintained my attention during learning	0	0	2	7	20
I felt involved and active while playing the game	0	0	1	7	21

The game's capacity to make learning more engaging received 100% positive responses (76% strongly agree, 24% agree), while its ability to make course content more interesting achieved 93% positive ratings. The interactive format maintained student attention effectively (93% positive responses), and participants felt actively involved during gameplay (97% positive responses).

3.1.3. Motivation

Motivational impacts showed positive but varied results (Table 3). The game increased study motivation for 76% of participants, though 21% remained neutral and 3% disagreed. Regular game usage motivation was strong among

83% of participants, with 17% neutral responses. The game encouraged additional time spent on course content for 72% of participants, while 24% remained neutral.

Table 3

Motivation

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The game increased my motivation to study the course content	0	1	6	7	15
I felt motivated to use the game regularly to review the course content	0	0	5	8	16
The game encouraged me to spend more time on the course content	0	1	7	9	12
The game reinforced my interest in the subject taught in the course	0	0	10	11	8
Success in the game motivated me to continue learning	0	0	3	13	13

Interest reinforcement for the subject matter showed the most diverse responses, with 66% positive, 34% neutral, and no negative responses. Success in the game motivated continued learning for 90% of participants, demonstrating the power of achievement in sustaining engagement.

3.1.4. Overall Learning Experience

The overall experience category demonstrated overwhelmingly positive results (Table 4). Global game experience was positive for 100% of participants, with 76% strongly agreeing. Recommendation for similar games in other courses received near-universal endorsement (97% positive, with 93% strongly agreeing). The game added value to the learning experience for

100% of participants (69% strongly agree, 31% agree), and 97% preferred similar game integration in other courses. The game's contribution to overall course engagement was positive for 79% of participants, though 17% remained neutral and 3% disagreed.

Table 4

Overall Learning Experience

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Overall, my experience with the game was positive	0	0	0	7	22
I would recommend the use of this type of game as a learning tool in other courses	0	0	0	2	27
The game added value to my learning experience in the course	0	0	0	9	20
I would prefer other courses to integrate similar games as learning tools	0	0	0	6	23
The game contributed to improving my overall engagement in the course	0	1	5	7	16

3.2. Behavioral Analysis from SCORM Data

The analysis of SCORM interaction data revealed important patterns in student behavior and game utilization that complement the perception data.

3.2.1. Completion and Attempt Patterns

The game achieved a 65.5% completion rate, with 287 completed sessions out of 438 launched sessions. This completion rate indicates strong student engagement, as participants who began the game were likely to finish it. The average number of attempts per user was 2.5, suggesting that many students returned to improve their performance or reinforce their learning.

3.2.2. Performance Analysis

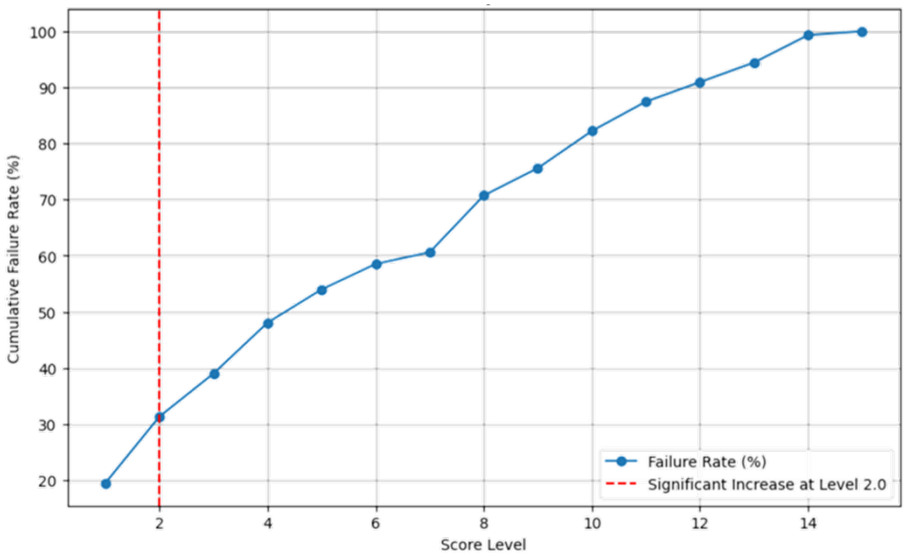
The mean score achieved was 5.88 questions correct (median: 6.0, standard deviation: 4.1), indicating moderate difficulty levels that challenged students without being prohibitively difficult. Score distribution analysis revealed that 56 students achieved a score of 1, representing the most common outcome, while scores gradually decreased in frequency as difficulty increased, with only 2 students reaching the maximum score of 15.

3.2.3. Critical Difficulty Points

Analysis revealed a significant failure rate increase at level 2, where many students encountered their first major difficulty barrier (Figure 2). This finding suggests that the transition from introductory to intermediate concepts represents a critical juncture requiring additional pedagogical support or game design refinement.

Figure 3

Percentage of errors by score level



Source: Authors

3.2.4. Learning Progression

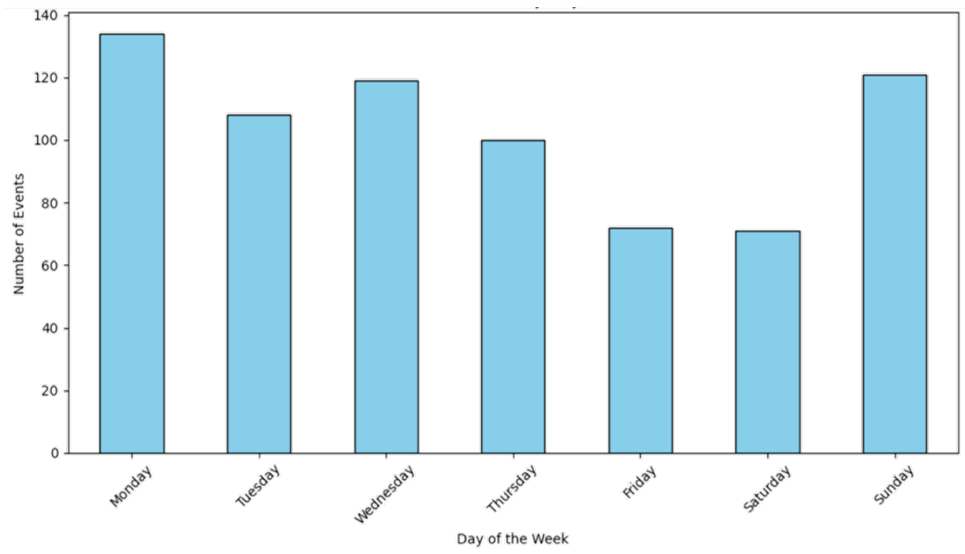
Students who attempted the game multiple times showed significant improvement, with an average score increase of 43% after two attempts. This pattern suggests effective learning reinforcement through repeated gameplay. The time interval between gaming sessions averaged 78 hours (3.25 days), indicating thoughtful engagement rather than impulsive replay behavior.

3.2.5. Usage Temporal Patterns

Peak usage occurred during specific time periods (Figure 3), with Monday showing the highest activity (134 events) and Saturday the lowest (71 events). Hourly analysis revealed peak usage between 13h-14h (70 events), suggesting that students preferred midday gaming sessions, possibly during lunch breaks or between other academic activities. The average session duration was 11 minutes, indicating focused, concentrated engagement periods that align with effective learning session lengths.

Figure 3

Distribution of SCORM events by day of the week



Source: Authors

3.3. Key Findings Summary

The integration of quantitative behavioral data with perception measures reveals a comprehensive picture of the educational game's impact. High completion rates (65.5%) combined with strong positive perceptions indicate successful engagement with the learning tool. The correlation between multiple attempts and score improvement demonstrates the game's effectiveness as a learning reinforcement mechanism. Temporal usage patterns provide valuable insights for optimizing content delivery and support services, while difficulty progression analysis identifies specific areas for pedagogical intervention.

The behavioral analysis through SCORM data tracking provides objective validation of the subjective perceptions captured in the questionnaire responses. The 65.5% completion rate substantially exceeds typical completion rates for voluntary educational activities in distance learning environments, suggesting that the game mechanics successfully sustained student engagement throughout the learning experience. This completion rate becomes even more significant when considering that students voluntarily chose to participate in the game as a supplementary learning activity, indicating intrinsic motivation rather than external compliance.

The progression patterns observed among repeat users demonstrate clear evidence of learning effectiveness. Students who engaged with the game multiple times (averaging 2.5 attempts per user) showed consistent score improvements, with average increases of 43% between initial and subsequent attempts. This improvement trajectory indicates that the game not only maintained engagement but actively facilitated knowledge retention and skill development. The 78-hour average interval between gaming sessions

suggests thoughtful, spaced practice rather than compulsive gameplay, aligning with established principles of effective learning consolidation.

Temporal usage analysis reveals strategic patterns that have important implications for course design and student support. The concentration of activity on Mondays (134 events) and during midday hours (13h-14h peak with 70 events) suggests that students integrate game-based review into their weekly study routines and utilize natural break periods for learning reinforcement. These patterns provide valuable intelligence for scheduling instructor availability, releasing new content, and timing motivational communications to maximize student engagement.

The identification of critical difficulty transition points, particularly the steep failure rate increase between levels 1 and 2, offers specific targets for pedagogical intervention. This finding suggests that while students can successfully engage with introductory concepts, the cognitive leap to more complex material requires additional scaffolding or support mechanisms. Future iterations could incorporate adaptive feedback systems, supplementary explanatory resources, or peer collaboration features specifically targeting these transition points to improve learning outcomes.

4. DISCUSSION AND CONCLUSIONS

The preliminary results of this exploratory study demonstrate the positive impact of the educational game implemented in the FIN 1020 course. Most students who responded to the questionnaire considered that the game was an effective tool for facilitating comprehension of key concepts, fostering their engagement, and stimulating their motivation for study. Likewise, the experience was valued very positively in general, and several participants

expressed their interest in seeing this type of resource integrated into other courses.

The high completion rate (65.5%) observed in our study aligns with previous research demonstrating the effectiveness of game-based learning in maintaining student engagement (Ryan & Rigby, 2020). This completion rate is particularly significant in the context of distance education, where student dropout and disengagement are persistent challenges. The fact that nearly two-thirds of students who initiated the game completed it suggests that the game mechanics successfully sustained motivation throughout the learning experience.

The behavioral patterns revealed through SCORM data analysis provide valuable insights that complement and support the perception data. The average score improvement of 43% among students who attempted multiple sessions demonstrates the game's effectiveness as a learning reinforcement tool. This finding is consistent with established principles of spaced repetition and active recall, which are fundamental to effective learning (Papi, Thériault, & Sauvé,2021). The 78-hour average interval between gaming sessions suggests that students were engaging thoughtfully withthe material rather than engaging in mindless repetition.

The identification of level 2 as a critical difficulty juncture has important implications for both game design and pedagogical strategy. This finding suggests that while students can successfully navigate introductory concepts, the transition to more complex material requires additional support mechanisms. Future iterations of the game could incorporate adaptive feedback systems or supplementary resources specifically targeting this transition point.

The temporal usage patterns observed—with peak activity on Mondays and during midday hours—provide practical insights for course design and student support services. These patterns suggest that students prefer to engage with review materials at the beginning of the week and during natural break periods, information that could inform the timing of supplementary learning resources and instructor availability.

However, this study also reveals areas for improvement and further research. The relatively moderate impact on subject matter interest (66% positive responses) suggests that while the game effectively supports learning comprehension and engagement, it may have limited influence on intrinsic motivation toward the discipline itself. This finding highlights the distinction between engagement with learning tools and engagement with subject matter content, an important consideration for educational game design.

The study's limitations include its exploratory nature and relatively small sample size, which limit the generalizability of findings. Additionally, the study focused on one specific course within business administration, and results may vary across different subject matters and student populations. Future research should examine the long-term impact of game-based learning tools on academic performance and course completion rates, as well as their effectiveness across diverse student demographics and learning contexts.

Despite these limitations, the convergence of positive perception data and behavioral evidence provides strong support for the integration of educational games in distance business education. The findings suggest that carefully designed game-based learning tools can effectively address key challenges in distance education, including student engagement, motivation, and content comprehension. The overwhelmingly positive responses to questions about

recommending similar tools for other courses (97% positive) indicate strong student appetite for expanded game-based learning opportunities.

In conclusion, this study provides preliminary evidence supporting the effectiveness of educational games as motivational and learning tools in distance business education. The combination of high completion rates, positive student perceptions, and demonstrated learning progression suggests that game-based approaches can meaningfully contribute to addressing persistent challenges in distance learning environments. Future research should focus on scaling these approaches across broader contexts while continuing to refine design principles based on empirical evidence of student behavior and learning outcomes.

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