Impact of 'Help! Serious Game' on Motivation and Achievement: A Study on Undergraduate Students Majoring in Special Education

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Manuscript received April 1, 2024; revised June 18, 2024; accepted July 18, 2024; published September 19, 2024

***Abstract*—Serious games and collaborative learning are becoming increasingly important intersections as educational technology advances. The combination of serious games and collaborative learning has been hypothesized to improve academic achievement and student engagement when used in conjunction with collaborative learning. However, most of the current research remains fragmented, not thoroughly addressing the synergy between these two methodologies. A serious game designed for collaborative learning, "Help! The Serious Game", is introduced in this study, particularly designed for undergraduate students majoring in special education. The primary objective was to examine the potential for improving motivation and Achievement through the use of collaborative learning and serious games. The research utilized a one-group pre-posttest design in which 44 participants participated in sessions involving "Help! The Serious Game" followed by data collection on motivation and academic outcomes. As a result of the convergence of serious games and collaborative learning, student engagement is significantly enhanced, academic skill development is enhanced, and real-world knowledge is broadened. With its immersive design, "Help! The Serious Game" not only captures students' attention, but also enriches the learning trajectory by emphasizing peer interaction and mutual reinforcement, as well as enriching the learning trajectory. A promising beacon for a comprehensive and enhanced educational experience emerges as education undergoes rapid metamorphosis, blending serious games with cooperative learning strategies.**

***Keywords*—serious games, collaborative, motivation, achievement, special education**

I. Introduction

Due to its wide variety of platforms, genres, and cutting-edge technology, video games have rapidly grown in popularity [1]. Projections indicate that by 2023, the global gaming population will surpass three billion, potentially generating revenues exceeding $204.6 billion [2]. This growth is not just on a global scale; for instance, the gaming market in regions such as the Middle East and Africa has experienced an expansion of approximately 10.8% since 2022. Such high engagement, as highlighted by [3], indicates that by the age of 21, young Americans may have played video games for 10,000 hours. Beyond mere entertainment, the allure of video games lies in their interactive stories, captivating visual elements, and a structured progression, among other factors [4]. In recognition of these attributes, educators and developers have created Serious Games (SGs), which are primarily designed as educational materials rather than mere entertainment [5, 6]. Serious games are designed to train and educate learners through interactive and engaging environments. They have been successfully implemented in various educational contexts aiming to improve learning and motivation.

Over the past couple of years, serious games and collaborative learning have emerged as central components of contemporary pedagogy. Moreover, educators have long recognized that serious games with an educational purpose can engage students and enhance the learning process. Collaborative learning has been praised for its ability to develop critical thinking skills, improve communication skills, and improve academic performance [3]. Hence, the increasing integration of technology into education requires a deeper understanding of the synergistic potential of SGs within a collaborative learning context. Moreover, implementing serious games in the field of special education can offer several benefits, including improving engagement and motivation, enhancing the availability of resources, and bolstering learning outcomes. Motivation is highlighted as a crucial element of learning and a strategy for determining academic achievement. However, there is a pressing need to explore the combined potential of serious games used within collaborative learning environments. Previous research has primarily focused on the isolated effects of either serious games or collaborative learning on learner outcomes.

Additionally, within the realm of serious games, Virtual Reality (VR) has emerged as an innovative technology supported by several learning theories, including constructivist learning theory, situated learning theory, and cognitive load theory. VR can offer a context-rich environment that enhances learning by promoting active exploration of virtual contexts. In this way, VR can be particularly beneficial in special education settings, further enhancing the educational impact of serious games.

This gap is particularly evident in the special education context, where such integration could offer significant benefits in terms of motivation, engagement, and learning outcomes [4–6]. Therefore, the objective of this study are: 1). To investigate how the integration of serious games within collaborative learning environments affects student engagement and motivation, 2). To assess the impact of this integration on students' academic achievement and learning outcomes, and 3. To provide educators and stakeholders with insights and strategies for harnessing the combined power of serious games and collaborative learning to create a more enriching and productive educational experience.

II. Literature Review

A. Serious Games

Health care, education, cultural heritage, and the military are some of the industries that are making extensive use of serious games. Furthermore, researchers are exploring the most effective ways to incorporate serious games into the classroom to ensure that the objectives of teaching and learning are met. Serious games have been examined primarily from the perspective of learners rather than from the viewpoint of teachers. Despite this, there is a lack of research exploring the best practices for integrating serious games into the classroom [7]. Therefore, teachers and institutions are responsible for incorporating serious games effectively into classrooms.

B. Serious Games and Motivation

Several studies have shown that serious games can be effective tools for engaging and motivating students during the learning process [8–14]. According to Zairi, Ben Dhiab [15], serious games can improve motivation and achievement among students; their study found a significant difference between the results of the pre- and post-tests. The study also suggested exploring more about using serious games in education and that teachers must develop new techniques to effectively utilize serious games. The results of this study are consistent with those reported by [16], that indicates that serious games are highly engaging, motivating, and cognitively stimulating, which may result in improvements in student performance.

Furthermore, learners assisted with serious games display better cognitive and motivational abilities compared to students not assisted with serious games. It was also suggested that teachers and designers should explore more ways to improve motivation through the learning process in order to enhance student motivation. Moreover, creating an immersive learning environment through a serious game can engage and absorb learners, which is an example of flow theory, in which learners become so absorbed in an activity that they lose sight of time and the surroundings [15, 17]. Due to serious games' reputation for high engagement, motivation, immersion, and flow-inducing properties [18], serious games have been explored by educators as tools for enhancing player engagement in educational settings. Students are motivated to continue playing a game by their curiosity as they feel that they need to explore a new immersive environment to discover new things since many learners have high levels of curiosity, and many of them engage in serious game-assisted learning instead of learning on their own through painstaking methods [16]. Additionally, the learning skills students can gain from serious games are significant and provide an engaging learning environment for them, as stated by [19]. The integration of Virtual Reality (VR) in SGs has shown promise in enhancing motivation, engagement and learning outcomes since VR provides an immersive learning environment that stimulates real-world scenarios to enhance students' learning experiences.

C. Virtual Reality and Learning Theories

The use of VR in educational contexts is supported by numerous learning theories, including Situated Learning Theory, which posits that learning occurs most effectively in context. VR environments offer immersive and context-rich settings where a variety of engaging tasks can be conducted, making them ideal for situated learning. Constructivist Learning Theory emphasizes active learning and knowledge construction through experiences. VR experiences encourage learners to interact with and explore a virtual environment, allowing them to construct a deeper understanding of that environment. Furthermore, Cognitive Load Theory suggests that learning and retention can be enhanced through hands-on experiences. VR environments provide such experiences, helping learners manage cognitive load by offering intuitive and engaging ways to interact with educational content.

D. Serious Games and Achievement

According to research, serious games are more effective in improving achievement than conventional teaching methods, and one study that supports this is by [20], which demonstrated that SGs were found to be more effective than conventional instruction in terms of all three learning outcomes examined (descriptive knowledge, knowledge retention, and procedural knowledge) compared to conventional instructional methods. By employing pre and post-tests to measure students' knowledge of the subject before and after playing a serious game, Cagiltay, Ozcelik [21] found that serious games can motivate learners and enhance their knowledge and skills, based on a study involving 142 undergraduate students from Atilim University, Turkey. An intriguing finding from the study was that cooperation during serious gameplay is more effective than competition. In comparison to competition, cooperation can enhance students' achievement and learning attitudes. On the other hand, competition might not improve learning attitudes. This aligns with the findings of [22], which suggested that competitive gameplay lacks a crucial motivational component, namely the appropriate difficulty level.

Based on the aforementioned results, it is recommended that learners' gaming experiences be enriched with cooperative learning activities to enhance motivation, achievement, and attitude towards learning. Furthermore, Studies such as [23] support these findings by demonstrating that participants experiencing a sense of flow and enjoyment were significantly greater when playing against a human-controlled opponent as compared to participants playing against a computer-controlled opponent. And it is important to note that the incorporation of instructional technologies into serious games is one of the major reasons for the improvement of students' learning because it gives them the ability to analyze and explain their newly acquired skills and knowledge. Another interesting result is a study by Dennis, Bhagwatwar [24], which concluded that games can be useful when students are preparing for an upcoming test, since they will increase their confidence level and help them to learn concepts more quickly. Furthermore, students can gain confidence through feedback provided by games which can scaffold the learning process and assist them in moving forward in their gaming careers.

E. 'Help! The Serious Game

'Help! The serious game is a serious game aimed at improving knowledge on how to assist persons with disabilities in a variety of situations, such as in emergency

situations. This serious game includes a number of key features and mechanics designed to improve the learning experiences:

1) Scenario-Based Learning: Scenario-based learning helps students contextualize and relate learning to their everyday lives by using avatars to progress through different phases of the game to simulate real-life situations.
2) Guided Learning: In each level, players are provided with hints and instructions from the avatars, which helps learners to understand the strategies and concepts in order to accomplish their objectives.
3) Progressive Difficulty: With each level of the serious game, the difficulty increases, requiring students to develop high-level strategies to enhance their problem-solving abilities.
4) Feedback mechanism: Continuous feedback is provided to students in order to enhance their skills and learning. This feedback enables students to correct their misconceptions and to improve their learning.
5) The interactive elements and realistic scenarios of the game draw the attention of students, and they remain motivated and engaged throughout the course of the game.

As part of this game, players interact with various avatars in order to progress through various scenarios and events. Developed by the HCI Lab of Udine, this game is a component of the project "Advanced emergency medical services utilizing innovative information and communication technologies for the disabled" [25]. Additionally, the serious game adheres to the guidelines recommended by the National Fire Services. It has different levels designed to cater to a variety of disabilities, including physical, visual, and hearing impairments. Initially, for each type of disability, players are given the opportunity to learn the concepts necessary to achieve the goal, under the guidance of a professional. Additionally, the serious game progresses at a faster pace as players' progress through the levels, requiring them to develop increasingly complex strategies as they proceed. Moreover, players receive feedback that allows them to continuously improve their skills. A screenshot of Help! The serious game is shown in Fig. 1 below.

Fig. 1. A screenshot of Help! The serious game [26].

F. Employing Serious Games with Collaborative Learning

In constructivist learning, students are encouraged to collaborate, share their ideas and opinions, develop communication skills, and learn from each other in order to develop their learning skills. As a result, students can work together to identify their strengths, improve their weaknesses, and enhance their skills in critical thinking, problem solving, and creativity [27]. As well, it has been demonstrated by [28] that collaborative learning activities with serious games can improve student motivation and learning outcomes. Moreover, as part of the study, students were involved in collaborative activities such as scripted collaboration, which enhanced their learning outcomes.

Furthermore, it is interesting to note that the more students participated, the higher the level of discussion was. As a result of these collaborative activities, participants gained a deeper understanding of the game and acquired knowledge about it through communication. Students were also observed cooperating to overcome obstacles, potentially enhancing their problem-solving skills. An exploratory analysis showed a positive correlation between increased dialogic acts and higher posttest scores, underscoring the effectiveness of integrating collaborative activities into serious games. Using VR in collaborative SGs can enhance these benefits by offering an immersive learning environment in which students can interact in a natural way and improve their collaboration and social skills. To improve students' learning outcomes and experiences, it is recommended that these activities be utilized in future research. By collaborating with peers, students can improve their social skills as well as exchange ideas and collaborate so they may execute tasks and enhance their abilities. A serious game's highly interactive nature, combined with the rich discussion characteristic of collaborative learning, ensures learners are constantly challenged, supported, and inspired as they learn.

G. Implementing Serious Games in Special Education

There has been a growing body of evidence that serious games can be effective tools for improving students' motivation and learning across a variety of fields, including education, health, and training, etc. Hence, researchers have explored employing serious games in special education field to teach special education students to improve their skills as well as train special educator teachers on how to interact with special education students. A study by [29] concluded that VR serious games act as complementary form of training that can be delivered at low cost and at a convenient time. Moreover, teachers, parents, and caregivers could benefit from a reduction in their daily workloads. A key function of education and training in the special education sector is to help and support people with disabilities and to improve the quality of their lives.

A study by Gregoriou [30] employed a 3D gaming environment in order to train and teach specialist and teachers of special education on how to interact with person with intellectual and developmental disabilities in a simulated real life situations, where they can play and learn at the same time in a safe environment. Such environments can minimize the risk of failure in real world situations. What is more, the participants' attitudes towards the gamed based approach was positive and they mentioned that participating in such serious game experience is helpful and can tackle challenges that they may face in real world situations. Also, the previous study suggested to explore more pedagogical approaches to be employed in order to enhance the learning

process of the special education teachers and experts in such field. As well, [31] suggest that implementing serious games with future teacher can improve the learning process and can help them to provide a bridge between theoretical and practical preparation for teaching, hence, the current study aims to improve special students' achievement and motivation as well as help them to practice the theoretical knowledge and put in into practice to improve their performance in real-life situations.

III. Materials and Methods

1) Participants: This study included 44 undergraduate students majoring in special education at Amman Arab University, Jordan. They were registered in the "Assistive Technology for People with Disabilities" course during the second semester of the 2022/2023 academic year.
2) Instruments:
   - Achievement Tests: Pre and post achievement tests comprised of 10 questions were employed to assess students' achievement and understanding before and after the intervention of the serious game and collaborative learning activities. The test comprises both knowledge-based questions and judgmental items tailored to evaluate the student's comprehension of assisting individuals with diverse disabilities. Additionally, the students were required to apply practical knowledge of assisting those with mobility disabilities and blind individuals to a variety of situations. Moreover, multiple cognitive levels were assessed in the tests such as remembering, understating, applying, etc. Furthermore, the students' ability to evaluate the safety and appropriateness of certain actions were also evaluated.
   - Motivation questionnaire: The motivation questionnaire that was utilized in this study was adapted from Keller [32] Course Interest Survey (CIS) and instructional materials motivation survey (IMMS). The first section of the questionnaire contained general information about the students' backgrounds, and the second section contains twenty-one items with a Likert scale of five points. The questionnaire items covered four subscales related to attention, relevance, confidence and satisfaction. To determine the reliability of the questionnaire, Cronbach's Alpha coefficient for all items was calculated. Using the Cronbach Alpha reliability coefficient for each dimension, the stability of the study tool was determined. This coefficient indicates how the questionnaire items were internally consistent. Strong and Hensley determined that for a tool to be stable, the Cronbach alpha coefficient must be greater than or equal to 0.60. In the exploratory study sample, the reliability coefficient achieved a value of 0.952. When the study was replicated with a larger sample, the reliability coefficient was found to be 0.938. Both these values are acceptable, indicating the stability of the study.
   - Semi-Structured Interviews: A subset of students was interviewed post-intervention to gain qualitative insight into how they experienced Help! serious game, collaborative learning, and its impact on learning and motivation. Additionally, the interviews sought to identify factors contributing to the effectiveness of collaborative learning with Help! The serious game. Furthermore, an interview development protocol was followed to systematically develop the interview questions.
   - 'Help! The serious game: Help! The serious games were employed in this study to improve students' achievement and motivation towards learning. The serious game was employed to promote student collaboration. Through engagement with the game, students' levels of achievement and motivation were measured based on their interactions. Moreover, a variety of platforms can be used to play Silang, including mobile phones and personal computers. The flexibility of Silang makes it possible to provide accessibility and adaptability to the preferences and needs of users. Additionally, it is possible to significantly improve an immersive experience and offer interactive and engaging learning environments if VR is employed.
3) Procedures: This study was conducted on a period of six weeks. The 44 students who registered in "assistive technology for people with disabilities" class were involved in serious game activity called Help! The serious game and collaborative learning. The first week of the program was devoted to measuring students' academic achievement through utilizing a pre-achievement test. Furthermore, the intervention consisted of two sessions twice a week using Help! The Serious game and the collaborative learning. Additionally, these sessions lasted about 60 minutes each that were conducted in the classroom. The collaborative activities that were employed inside the classroom were: teacher-led discussion, collaborative gaming and group reflection and sharing. In the teacher-led discussion, the teacher initiated the topic which was about people with disabilities and how to help them in various scenarios, such activity helped students to understand the context and the importance of the topic.

Following this, the students were divided into groups were they played the Help! The serious game collaboratively in which they shared their perspectives and strategies for executing the game's tasks as well as they were engaged in a real-time problem solving scenarios through the games various tasks. Finally, the students were engaged in a class discussion with their peers about their learning experiences where they deepen their understanding of the topic by sharing their thoughts and ideas. Additionally, they were engaged in analyzing their actions and outcomes during their gaming experiences. Post-intervention data collection occurred in the sixth week of the intervention where the students' achievements were assessed through a post achievement test and their motivation was assessed through the motivation questionnaire. As well, a number of students were

interviewed to get in depth information about their learning experiences. Furthermore, this study was conducted in accordance with ethical considerations, such as maintaining student anonymity in the collected data.

4) Data analysis: The motivation level post-intervention was assessed using descriptive statistics and a pre- and post-intervention achievement tests were conducted to assess academic achievement, including means and standard deviations. Moreover, quantitative data were analyzed using SPSS software, including means and standard deviations. To determine the differences in scores between these two tests, paired sample t-tests were conducted. Furthermore, to analyze the qualitative data, thematic analysis was used in this study to identify, analyze, and report themes within the obtained interview data as a method of qualitative descriptive analysis. NVivo software was utilized to extract the final themes of the interviews, through three phases of coding system. The initial coding, similar to open coding, involved capturing preliminary codes from the data. Following this, there was a revision phase where the codes were revised and grouped based on similarities and differences, forming main codes. After refining these codes, the final phase culminated in the extraction of overarching themes.

IV. Result and Discussion

This study addresses the following research questions: 1. What is the level of motivation in undergraduate students majoring in Special Education after participating in collaborative learning with 'Help! The Serious Game"? 2. What is the effect of collaborative learning with Help! The Serious Game on the academic achievement of undergraduate students majoring in Special Education before and after the intervention? 3.What factors contribute to the effectiveness of collaborative learning with 'Help! The Serious Game" in improving motivation and achievement for undergraduate students majoring in Special Education?". Further, the quantitative results of the study are presented first, followed by the qualitative results and a detailed discussion.

A. The Results of the Quantitative Data

Using a method that applied a five-point Likert scale to the study scales for the purpose of adjusting the motivation scale, each item was given a rating from among its options (very true, mostly true, moderately true, somewhat true, not true). To numerically analyze the results, scores (1,2,3,4,5) were assigned to each option. The subsequent equation illustrates the adopted scale: Maximum alternatives–Minimum alternatives / Number of levels = 5-1/3

- First range: (1–2.33), a low indicator.
- Second range: (2.34–3.67) is an average indicator.
- Third range: (3.68–5.00) is a high indicator.

Table 1. Descriptive statistics of the motivation questionnaire

	Minimum	Maximum	Mean	Std. Deviation
Mean	2.81	5.00	4.1818	0.68163

Based on Table 1 above, the general arithmetic mean for the level of motivation was (4.18) with a standard deviation of (0.68), which represents a high degree. Moreover, Fig. 2 below shows that the data falls between the mean scores of 2.81 and 5.00, indicating that most respondents are motivated to succeed.

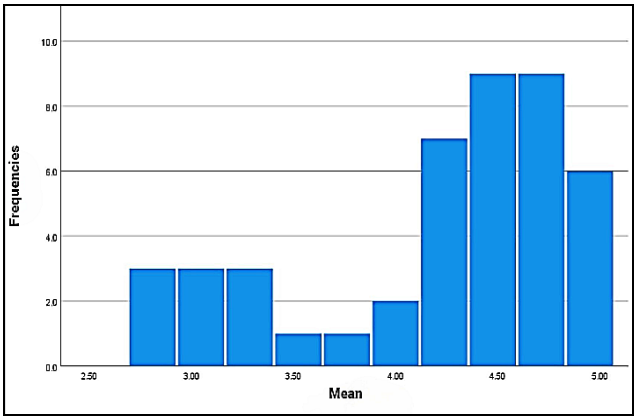

Fig. 2. Distribution of mean motivation scores among respondents.

B. Pretest and Post Test

The arithmetic means for pre- and post-tests of 'Help! The serious game' with the collaborative learning were extracted from Table 2 below to determine whether there are statistically significant differences between the two.

Table 2. Comparison of pre-test and post-test mean scores and standard deviations

	After_Before	Mean	Std. Deviation
Total	Pre-test	4.41	2.203
	Post-test	7.39	2.423

It is shown that the pre-test average academic achievement was 4.41, with a standard deviation of 2.2, whereas in the post-test, the average academic achievement was 7.39, with a standard deviation of 2.4. Moreover, a visual representation of the average scores from the pre- and post-test is shown in Fig. 3.

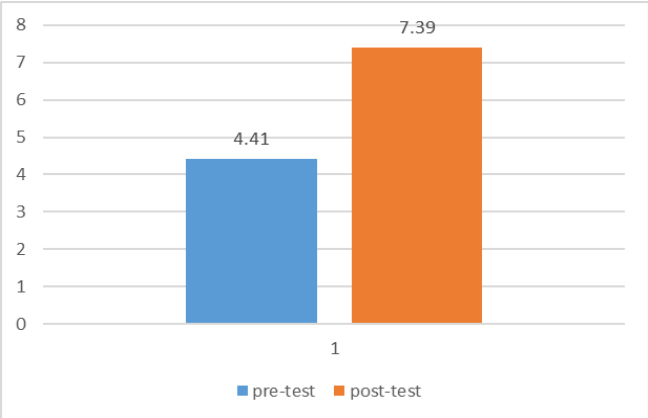

Fig. 3. Visual representation of pre-test and post-test average scores.

As a means of determining whether there was a difference between pre- and post-tests, Table 3 presents the results of Levene's Test for Equality of Variances and the t-test for Equality of Means.

The results from the Independent Samples T-Test shown in Table 3 suggest that the variances between the two tests are comparable. This is supported by Levene's Test for equality of variances, which yielded a significance level of 0.509,

surpassing the 0.05 threshold. Additionally, the t-test highlighted statistically significant distinctions between the pretest and posttest results when assuming equivalent variances, with a significance level of 0.000, which falls below the 0.05 threshold. The mean difference between the pre- and post-test scores indicates an increase in the post-test scores.

Table 3. Independent samples T-Test and Levene's test results for pretest and post-test scores

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
total	Equal variances assumed	0.440	0.509	−6.031	86	0.000	−2.977	0.494	−3.959	−1.996
	Equal variances not assumed			−6.031	85.231	0.000	−2.977	0.494	−3.959	−1.996

C. The Results of the Qualitative Data

In the preliminary phase of the qualitative analysis, NVivo 14 data analysis software was utilized to facilitate the identification of potential thematic patterns emerging from the interview transcripts. The generation of a word cloud enabled a visual depiction of the frequency of word occurrences in the participants' responses, thus offering an initial insight into the predominant concepts and discussions recurrent throughout the interviews. Fig. 4 below shows a word cloud depicts the frequently used words and phrases from the interview responses. This serves to reveal prevailing themes and patterns within the qualitative data.

Fig. 4. Word cloud of frequently used words and phrases from interview responses.

Based on Fig. 4 above, it is clear that the most frequent used words and phrases in the interviewee answers are: game, learning, help, experience, serious, motivation, academic, collaborative, etc. and following is the detailed numbers of frequency and weighted percentage of key words from Interview responses.

Several key words such as "game," "learning," "help," "experience," "serious," "motivation," "academic," and "collaborative" were frequently used in the responses of the interviewees, as indicated in Fig. 4 and Table 4. This section highlights the nuanced insights these frequently used words provide into participants' perceptions and experiences, aligning them with the research questions in this study. Hence, the following is Table 5 which shows the most common words in the interview data aligned with the relevant research questions. Through this alignment, a framework can be developed to better understand the nuanced experiences and outcomes documented in the qualitative data, providing a better understanding of the potential impacts and perceptions surrounding the implementation of "Help! The Serious Game" in special education field.

Table 4. Frequency and weighted percentage of key words from interview responses

	Word Count	Weighted Percentage (%)
Game	61	4.71
Learning	34	2.63
Help	23	1.78
Experience	20	1.54
Serious	17	1.31
Motivation	13	1.00
Academic	12	0.93
Collaborative	12	0.93
Knowledge	12	0.93
Engaging	11	0.85
Understanding	11	0.85
Group	10	0.77

This study was guided by four cardinal research questions to determine how "Help! The serious game" fosters motivation and academic progress among students majoring in special education. An in-depth interview was utilized to collect data in order to address these questions, followed by an analysis of interviews using NVivo 14 software to identify emergent patterns and themes. Data analysis was conducted in phases, starting with open coding and then synthesizing the codes into final themes, which were then meticulously aligned with the research questions. Through examining the predominant keywords/phrases that appeared in the interviews, the term "game" and "serious" were identified and linked back to the extracted codes and themes of the students' interviews that appeared in Table 5. Furthermore, Fig. 5 below illustrate the emerged codes final codes and the main themes of the students'.

The emerged themes that appeared after analyzing the students' interviews are: Motivational Catalyst, Academic Progression and Game Design and Support. Motivational Catalyst is the theme that was extracted from the analysis of the students' answers on the first research question where the students indicated that playing the serious games enhanced

and improved their motivation and engagement. As the serious game acts as a trigger or a stimulant that boosts motivation, possibly leading to enhanced engagement and learning outcomes as the students mentioned "This visual engagement not only added to the enjoyment of the game but also facilitated a more immersive learning experience" and *"This approach not only kept me engaged but also honed my communication skills, especially with individuals with disabilities"*. Moreover, one of the features of serious games that engage learners in the gaming experience is the adaptively of learning where the game can adjust the difficultly of levels to players' responses which can challenge the players to proceed through the game levels.

Table 5. Alignment of predominant keywords with research questions and interview quotes

Predominant keywords/ phrases	RQ	Quotes from the interviews
Game	1	a. *The collaborative learning process with "Help! The Serious* ***Game****" was genuinely captivating and engaging.* (Session 1) b. *The experience with the* ***game*** *was enjoyable, and the group dynamic enhanced my motivation and engagement*. (Session 1) c. *Playing the* ***game*** *brought about improvements in my teamwork abilities.* (session 1)
Serious		a. *The collaborative learning process with "Help! The* ***Serious*** *Game" was genuinely captivating and engaging* (Session 2) b. *The experience of engaging with 'Help! The* ***Serious*** *Game' has spurred greater motivation in my learning endeavors* (session c. *Participating in collaborative learning with 'Help! The* ***Serious*** *Game' has had a positive impact on my academic performance.* (session 2)
Learning and academic	2	a. *This strengthened my teamwork skills and demonstrated the value of collective effort in achieving* ***learning*** *objectives* (session 1) b. *This motivation naturally leads to an improvement in my academic performance* (session 2) c. *Engaging with the game led to a comfortable and enriched* ***learning*** *experience.* (session 2)
Help and collaboration	3	a. *A specific mission that stood out for me was the one where I had to* ***help*** *a person with a disability descend stairs* (session 1) b. *I prefer cooperation and working with my friends in such game to improve my learning* (session 1) c. *Playing with my friends made the experience even more enjoyable* (session 1)

Other aspects that improved their skills are the immersive nature of the serious games where they have explored the serious game missions in order to proceed through the game. What is more, collaborative learning helped students to be more engaged to the serious game as they indicated *"The involvement of my fellow students amplified the learning journey's appeal"*, *"I was able to leverage the collaborative aspect of the game to seek assistance and guidance from my peers"* and *"I prefer cooperation and working with me friends in such game to improve my learning. Working together will motivate me and it was motivating to work with my colleagues"*. It has been demonstrated in studies that collaboration with video games can motivate learners to learn by involving them in educational activities where they work together to accomplish a goal. As a result of creating an environment that students enjoy, they are more likely to participate in class activities, maintain their engagement in learning, and motivate themselves to learn [33, 34]. As well, by utilizing serious games and collaborative learning, learners are induced to develop a deeper sense of mastery goal orientation, as well as a higher degree of situational interest and enjoyment [35].

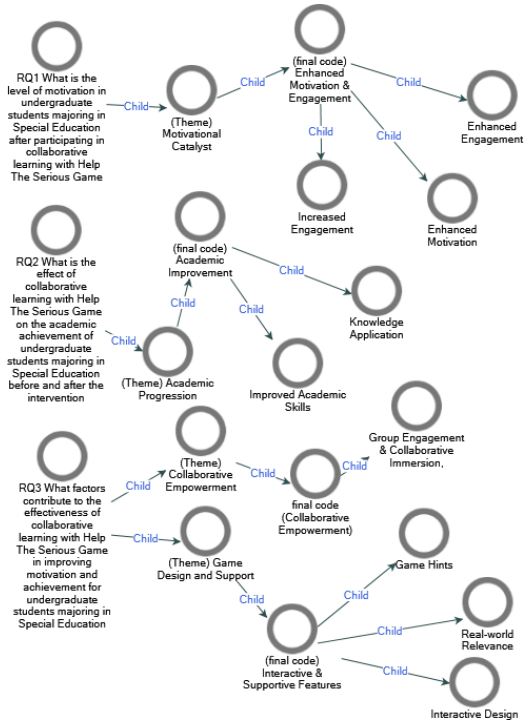

Fig. 5. Thematic progression: From emergent codes to overarching themes in students' Experiences with 'Help! The Serious Game'.

As well as stating that Help! The serious game focuses on helping people with disabilities, the interviewees also expressed interest in it. which may relate back to their studies in special education. As a result of this experience, they will be able to apply their knowledge of the field to virtual scenarios in real life. And back to the extracted theme "Motivational Catalyst", it is clear that the gaming experience improved their motivation and achievement as stated by them. This is consistent with the findings of research studies which indicate that serious games enhance learners' motivation and positive feelings greatly [19, 36]. In their answers, students expressed that they enjoyed exploring the game through playing it, which shows that the serious game attracts curiosity due to the fact that the games represent microcosms where players begin to explore and discover new things, thus providing them with an immersive experience, as stated by some of the interviewees [16, 37].

Additionally, it is well known that "free to fail", a feature that is associated with the Help! serious game, is one that encourages players to play and learn without worrying about losing any real-world consequences if they fail. Consequently, such features encouraged them to explore more of the serious game knowing that they will be

scaffolded with appropriate feedback and support. As well, studies have shown that games can act as a motivation catalysts that motivate students to learn with a higher degree of motivation [38]. Furthermore, the immersive experience of the serious game engaged students at the highest level, which kept them motivated through the gaming experiences. What is more, the components that motivated them were the visual realities, the exploration of experiences, and the storyline that was aligned with their field of study.

In their answers to the second research question, the students indicated that the collaborative learning and the serious game enhanced their academic achievement in two dimensions which are: academic skill development and knowledge application. Both codes could be grouped under one final code which is "academic improvement" where improvement and applying the gained knowledge in life refer to effective improvement. In addition, and according to the interviewee's response, *"I was able to improve my skills and knowledge by participating in the engaging experience"*, it is implied that one of the things that improved students' academic achievement is their engagement with the serious game as *"The game's comprehensive elements, as well as its interactive design, further contributed to enhancing my academic progress"*. Several studies have shown that learners who are actively engaged in the learning process are more likely to integrate new knowledge with prior knowledge and transfer that knowledge to new situations [39–41].

Furthermore, the interviewees indicated that the design elements of the serious game engaged them as well as improved their performance. Such design can help attract students' attention, as they are required to solve puzzles or follow instructions carefully, as demonstrated in an activity in one of the serious game's level in which students were asked to assist a person with a disability in leaving the place and saving his life. In such activities, students are required to come up with solutions that stimulate their cognitive abilities, including problem solving abilities. For example, they stated *"This task was especially intriguing to me because of its unique nature. To successfully complete the mission, I carefully observed and analyzed the most effective approach, utilizing the game's hints to aid my learning"* and *"I was particularly fascinated by a mission which involved assisting a person with a disability to descend stairs."* And *"This challenge demanded focused attention, as my initial assumption was limited to conventional methods like carrying or using their wheelchair"*.

Another emergent theme from the interviews was "academic improvement." The students stated that Help! serious game improved their performance. As one of them has mentioned, the continuous feedback helped them identify their mistakes and correct their misunderstandings as serious games' feedback can encourage students' curiosity and motivate them [42]. Furthermore, the serious game help provides learners with an immediate response that reinforces their correct responses and identifies their misconceptions and provides assistance in correcting them, as opposed to when they learn through traditional teaching methods where their teachers or peers must correct them. In order to determine the reasons why students are learning better, a study by [43] found that when a player engages in a goal-directed and rewarding aspect of a video game, Dopamine, a neurotransmitter associated with pleasure, reward, and motivation, is released more. The increase in dopamine strengthens neural connections and results in more positive actions and responses. As for collaborative learning and its impact on student motivation, the students stated that collaborative learning motivated them and improved their learning since they were able to share their experiences and learn from each other *"In case I encounter difficulties while progressing through game levels, my friends were always available to assist me, and this collaborative environment enabled us to share knowledge"*.

A final theme that emerges is a continuous forward movement in academic progress, referred to as "Academic Progression". In light of the findings on this question, other studies have demonstrated that collaborative and serious games can improve students' knowledge, which contributes to their achievement. [44]. Help! Serious game was mentioned in some of the interview responses by students as a contributing factor to their academic progress *"The engaging experience resulted in an improvement in my skills and knowledge"*, which indicates that there is continuity in the process of academic improvement. The students also demonstrated continued exploration through the serious game experience, as they said *"there were specific instances where the game, "Help! The Serious Game," facilitated a deeper understanding of the subject matter"*. By providing such opportunities, students were encouraged to continuously explore and delve deeper into the game activities and missions, which resulted in improved learning.

Moreover, the students indicated that, "Help! The Serious Game," enabled a deeper understanding of the subject matter and practical application of the knowledge. As an example, *"I was able to provide assistance to others in need by utilizing the insights I gained from the game. As a result of this experience, I was able to clear up any misconceptions I previously had regarding special education and supporting individuals with disabilities"*. It is evident from these answers that Help! Serious game simulations played a crucial role. In addition to bringing students' theoretical learning to life, such simulations are also intended to correct any misconceptions about special education and people with disabilities, as stated by one of the interviewees. Moreover, students majoring in special education can benefit from such an experience by being exposed to real-life experiences to improve their skills and help them gain a deeper understanding of the needs of individuals with disabilities. For example, in one of the serious game's missions, students were required to assist a disabled individual in navigating stairs in an emergency, which caught their attention and helped them to focus more while playing the mission as they mentioned, *"A particular engaging moment within the game was when I encountered a mission that required me to assist a person with a disability in navigating stairs. The uniqueness of this task attracted my attention"*. As well, *"The moment that captured my focus was a mission centered around aiding a person with a disability in navigating stairs. My initial approach was traditional, involving physically carrying them downstairs. However, I discovered an*

eye-opening alternative: employing specialized equipment for a smoother and more effective method".

Among the themes extracted from the students' answers to the third research question are "Game design and support" and "Collaborative Empowerment". It has long been known that game design motivates students by enhancing their intrinsic motivation, engaging them, and enhancing their learning experience. [45–47]. Researchers have found that interactive & supportive features such as game hints, interactive design, and real-world relevance can motivate learners and improve their learning since they provide learners with interactive & supportive features [48–50]. In the context of this study, the students expressed that the hints of help were helpful in raising self-efficacy. The serious game supported their learning and boosted their motivation to continue playing. As stated by one of them, *"The presence of game hints proved to be a valuable source of support, providing guidance when required, thus boosting my motivation to continue playing".* As a result, these hints are able to convince learners that they can achieve the goals and successfully complete the mission.

Incorporating interactive elements into serious games can engage students and amuse them [51], therefore, students become active learners instead of passive learners as a result of this change. In addition to interacting with leaderboards and badges, the students interacted with other avatars of the serious games, such interactive features provided the students with a sense of control. Consequently, a sense of ownership and investment in the material could be fostered. Furthermore, the student expressed that the game's interactivity not only motivated them, but it also improved their academic performance, as one of the student stated in the interview, *"The comprehensive elements and interactive design of the game further contributed to the improvement of my academic performance".* In addition, serious games have demonstrated the ability to increase student engagement, motivation, learning strategies, and cognition, which can improve performance [16, 52]. As an example, one of the codes derived from the answers of students was real-world relevance. According to the students, *"I was driven by my curiosity to learn more, and I believe that incorporating more diverse scenarios would enhance the educational value of the game".* As mentioned previously, the students played 'Help! The Serious Game.' This game is designed to train and hone learners' skills in assisting people with disabilities in various situations, aligning their interests with the goals of the serious game. As a result, their playing experience represented meaningful learning that was connected to real-life simulations in which they could apply their theoretical knowledge. As well, research studies have concluded that serious games improve real life by blending in-game educational progress with modern gaming technologies [53, 54].

The second theme that emerged from the codes "Group Engagement & Collaborative Immersion" is "Collaborative Empowerment" as "Participating in collaborative learning with "Help! The Serious Game" has had a positive impact on my academic performance" and "The experience of engaging with "Help! The Serious Game has spurred greater motivation in my learning endeavors". Participating in collaborative activities combined with the Help! Serious games engaged students and motivated them due to the "Group Engagement & Collaborative Immersion". Serious games provide interactive and engaging experiences that facilitate collaborative learning activities. And through interactive and engaging experiences, the serious game facilitated collaborative learning activities. Moreover, students are able to better comprehend concepts and reinforce their learning through peer-to-peer discussion and deeper questions as a result of these games [55, 56]. When students played the game within a collaborative learning environment, social interaction can be enhanced and students were motivated to learn, which allowed them to exchange ideas, challenge one another, as mentioned by the students. *"Whenever I encountered challenges, the group dynamic motivated me to persevere, and the shared experiences allowed us to collectively find solutions"* and *"Playing with my friends enhanced the experience".* The student mentioned that group dynamics helped to motivate them, especially when communicating with their peers as such experiences can foster a sense of community and shared purpose among them [57].

Participating in collaborative learning activities such as discussion groups motivated and engaged learners and provided them with peer support and assistance as indicated by them *"The support and insights from my group members helped me navigate the game effectively, resulting in a more satisfying and successful gameplay".* In this context, the students worked together towards common objectives knowing that they are all special education students who have a common knowledge and goals which encouraged them to work together to achieve almost the same objectives. Furthermore, peer help & group assistance helped to motivate learners and improve their skills, likely because of the assistance and support of the group members. In addition to enriching the learning experience and showing diversity of opinions and thoughts, sharing ideas and thoughts among learners enriches their learning experience. As a result of such diversity, students' problem solving skills could be improved, which contributed to their learning success. Furthermore, serious games facilitated constant communication between peers, a characteristic that makes serious games interactive. What is more, students may offer constructive criticism, share insights, and offer solutions immediately, thus creating an environment in which assistance is readily available, dynamic, and responsive.

V. Conclusion

According to this study, serious games are especially effective in increasing student achievement and engagement when employed with collaborative learning activities. A number of benefits are provided by this approach, ranging from enhancing academic skill development and applying real-world knowledge to fostering collaborative empowerment and providing students with immediate, constructive feedback. By incorporating immersive and interactive design elements, the serious game captivates students' attention and encourages a deeper understanding of the subject. Additionally, it facilitates peer-to-peer interaction, mutual assistance, and a sense of purpose. The

nature of the serious game combined with collaborative learning enhances the learning experience. In today's rapidly changing educational landscape, interactive and collaborative learning tools can provide an engaging, effective, and holistic.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

A.H. and S.A. were responsible for conducting the research and collecting data. Together with W.A.E., they also wrote and developed the literature review. The data analysis was carried out by A.H. and S.A. Additionally, A.H., S.A., and W.A.E. were involved in developing the study instruments. The discussion of the results was written by A.H., S.A., and W.A.E., who also collectively revised all sections of the manuscript. All authors have reviewed and approved the final manuscript for publication.

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