

## PAPER

# Social Learning and Gamification Strategies for Optimizing Online Learning in a Computer Science Course

Hiba Gharbaoui<sup>1,2</sup>✉,  
Khalifa Mansouri<sup>1</sup>,  
Franck Poirier<sup>2</sup>

<sup>1</sup>M2S2I Lab (ENSET  
Mohammed VI, University  
Hassan II of Casablanca),  
Casablanca, Morocco

<sup>2</sup>Lab-STICC Brittany South  
University, Vannes, France

[hiba.gharbaoui-etu@etu.univh2c.ma](mailto:hiba.gharbaoui-etu@etu.univh2c.ma)

## ABSTRACT

This paper investigates the effectiveness of social and gamified learning strategies to assess their impact on computer science education, using a comparative analysis between the Moodle and Quizizz platforms. Gamified learning, with its interactive and competitive elements, is an ideal tool for fostering engagement and collaboration in social learning. The hypothesis of this study is that the integration of social and gamified elements can significantly improve student performance and motivation in computer science education. Group 1 took a traditional Moodle course without social interaction, Group 2 used Moodle with additional social interaction features, and Group 3 engaged with a gamified learning platform with integrated social interaction. Each group's unique online learning environment aimed to provide nuanced insights with implications for educators, institutions and policymakers seeking to improve the effectiveness of computer science education in the digital landscape. The results of the study show a positive correlation between the implementation of gamification and increased student motivation, which ultimately translates into improved pass rates.

## KEYWORDS

gamification, learning outcomes, social learning, student motivation

## 1 INTRODUCTION

In computer science education, online learning environments are becoming increasingly widespread, but they often pose significant problems for students. Problems such as limited interactivity, high drop-out rates and declining motivation are ubiquitous, requiring innovative strategies to enhance engagement and improve learning outcomes. Social learning [1] and gamified learning [2] are two approaches that have shown promise in addressing these challenges. However, their combined effects in a single educational framework remain underexplored. This study seeks to bridge this gap by investigating the integration of social and gamified learning

Gharbaoui, H., Mansouri, K., Poirier, F. (2025). Social Learning and Gamification Strategies for Optimizing Online Learning in a Computer Science Course. *International Journal of Engineering Pedagogy (iJEP)*, 15(3), pp. 60–74. <https://doi.org/10.3991/ijep.v15i3.54101>

Article submitted 2024-10-10. Revision uploaded 2025-01-28. Final acceptance 2025-01-28.

© 2025 by the authors of this article. Published under CC-BY.

strategies and their impact on student performance and motivation in computer science education.

While existing research highlights the benefits of social learning, such as fostering collaboration, communication, and shared experiences [3], and the advantages of gamification, such as increased engagement and enjoyment [4], few studies have examined the effects of these two strategies. Our work contributes to this area by adopting a comprehensive experimental design that evaluates three distinct instructional strategies. The first group follows a traditional Moodle course without social interaction, serving as a baseline. The second group uses Moodle enhanced with social interaction features, exploring the role of social learning within an established platform. The third group engages in a gamified learning platform that incorporates social interactions, enabling an analysis of the combined effects of gamification and social learning. This comparative approach allows us to uncover the unique and integrated benefits of these strategies in an online learning context.

The originality of this study lies in its multidimensional exploration of these pedagogical approaches. Unlike previous research that focuses primarily on social learning or gamification in isolation, our investigation examines their integration into the field of computer science education. In addition, this study integrates a variety of data sources, including final test results, chat and forum interactions, and motivation and engagement surveys. Our aim is to provide solid evidence on how these strategies influence learning outcomes, collaborative behaviors and student satisfaction in digital learning environments.

Through this study, we aim to provide meaningful insights for educators, institutions and policymakers seeking to optimize online computer science education. By highlighting the importance of integrating social and gamified learning strategies, this study offers a new perspective on addressing the persistent challenges of motivation, engagement and performance in digital learning environments.

This paper is structured as follows. Section 2 reviews the relevant literature on social learning and learning through play. Section 3 discusses the principles of play-based learning and its application. Section 4 presents the research hypotheses guiding the study. Section 5 presents the tools and platforms used in the experiment, while Section 6 details the experimental design, including the proposed model, participant demographics and study objectives. Results and discussion are presented in Sections 7 and 8, with subsections analyzing chat and forum interactions, as well as differences in learning outcomes according to different teaching strategies. Finally, Section 9 concludes the paper by summarizing the results and suggesting avenues for future research.

## 2 RELATED WORK

Programming is often perceived as challenging, with high dropout rates in introductory courses. Studies [5], [6] highlight the effectiveness of visual programming tools such as Alice, App Inventor, and robotics in enhancing engagement and learning. These tools simplify programming concepts through interactive, hands-on approaches, making them accessible and fostering creativity in diverse educational contexts.

Recent research shows that integrating gamification and social technologies in learning environments can enhance student motivation, engagement, and performance. A notable study [4] examines the impact of competitive and collaborative environments on summative assessment, using the StarQuest platform to encourage collaboration and content co-curation within a gamified context. This study involved second-year sports psychology students ( $n = 94$ ) in an 11-week module,

revealing both strengths and weaknesses of this approach for teamwork. Estrella et al. [7] propose the SocialWire platform, which incorporates social media elements to improve the learning experience. After three years of successful use across various disciplines, they found that social and gamification features increase motivation and enrich learning experiences, based on feedback from teachers and students. This highlights the importance of socially integrated learning platforms. During the pandemic, a systematic review [8], analyzed gamification usage, showing that in 11 studies across fields such as chemistry, business, computer science, biology, and medicine, students found gamification engaging, innovative, and effective in sustaining motivation despite remote learning.

The issue of high dropout rates in online courses (MOOCs) is addressed in another study [9] through social exchange and cognitive evaluation theories. This research shows that social interactions and gamification rewards play a crucial role in student satisfaction and persistence, emphasizing the importance of highlighting the professional value of courses and carefully integrating gamification. The influence of psychological and social factors in gamification experiences was explored by Chung et al. [10] in a study based on the engagement mediation model. With 250 students in Taiwan, the study uses the PLS-SEM model and concludes that perceived challenges and peer interactions influence learning through engagement, which proves to be the main predictor of success in gamified learning.

Another study [11] explores intrinsic motivation within a gamified framework based on self-determination theory. It identifies that social, achievement, and immersion aspects foster intrinsic motivation, with students' psychological needs playing a mediating role, offering guidance on pedagogical design for gamification. A specific study on struggling students [12] examines the impact of the GamiClass platform, designed using the ADDIE model and Grasha's learning styles. Among Malaysian students, game elements such as onboarding tutorials, social pressure, and teams proved effective in sparking increased interest among struggling students, suggesting these elements are crucial for motivating participation. Finally, the use of social networks to support physical education at the secondary level is studied within a gamified context on the "Edmodo" platform [13]. Involving 10 teachers and 56 students, this qualitative research shows positive appreciation for gamification as an active teaching method and reveals that integrating digital technologies motivates students to be more physically active. Recent research highlights the significance of adaptive gamification in fostering student motivation. For example, Zourmpakis et al. [14] explore the impact of tailored game elements, while Papadakis [15], [16] evaluates collaborative programming and game-based approaches in secondary education. These findings reinforce the importance of gamified strategies in online computer science education.

Based on the insights from previous studies, our research aims to address the following questions: Can a social learning approach enhance students' performance in computer science courses? Can a gamified learning approach lead to improved performance? Finally, how do gamification and social learning influence learners' motivation in their educational journey?

### 3 GAME-BASED LEARNING

As video games, particularly social games, are growing in popularity and number of users, there has been an increasing interest in their potential as innovative teaching tools. Gamification is an approach intending to use elements from video games in non-game applications. Education is an area with high potential for application of this concept since it seeks to promote motivation and engagement [17].

Game-based learning is an active learning strategy that employs elements of games to help students learn. In this situation, the learning occurs through gameplay, which fosters critical thinking and problem-solving abilities and helps to achieve a state of flow. Game-based learning can take the form of digital or non-digital games and simulations that allow students to learn directly [18]. Game-based learning refers to the borrowing of certain gaming principles and applying them to real-life settings to engage users [19]. The expected emotions are positive emotions generated by students so that they can increase their enthusiasm for learning to take part in learning. The potential of game content is well designed to be able to improve the teaching and learning process [20], [21].

## 4 HYPOTHESES

Our hypotheses (see Figure 1) explore the impact of social learning and gamification on computer science education. H1 posits that social learning, through collaboration and interaction, enhances academic performance. H2 suggests that gamification, by incorporating game elements such as challenges and rewards, improves performance by fostering engagement. H3 examines whether the combination of these approaches increases learner motivation, driving active participation. Together, these strategies aim to enhance both academic outcomes and motivation, creating a more engaging and effective educational environment [22], [23].

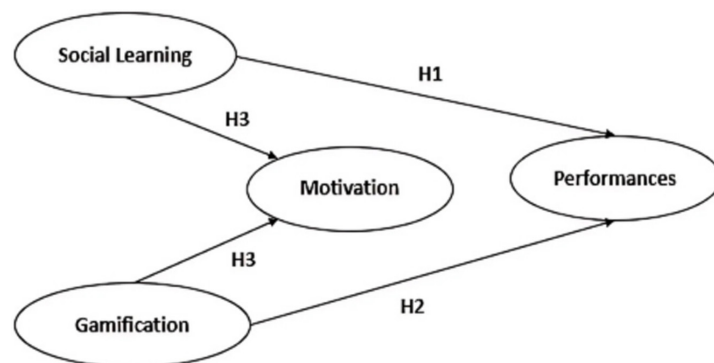


Fig. 1. Hypotheses formulated in this study

## 5 MAIN TOOLS

We conducted an experiment to investigate the effectiveness of social and gamified learning strategies in computer science education, utilizing two prominent online learning platforms: Moodle and Quizizz. Moodle [24], chosen for its widespread use and versatility, provided a solid foundation for traditional online learning experiences. Recognized for its flexibility, Moodle enables educators to create interactive lessons, assessments, and forums, and more. Its robust features in content delivery, support for multimedia, and communication tools make it an essential part of online education. The stability of Moodle, extensive plugin options, and established reputation in the e-learning community positioned it as an ideal starting point for our investigation. In contrast, Quizizz [25] was selected for its gamified approach to learning, capitalizing on interactive quizzes and competitive elements to enhance student engagement. The real-time feedback, leaderboard, and humorous memes of this platform contribute to an enjoyable learning experience while emphasizing educational objectives.

Game-like features of Quizizz align with one of the current trends of incorporating gamification in education, aiming to make learning more dynamic and captivating. By exploring the potential synergies between gamification and social learning on the Quizizz platform, we sought to understand how this approach could positively influence student motivation and success rates in the realm of computer science education.

## 6 EXPERIMENTAL DESIGN

In the course of the experiment, we conducted a comparative analysis of social and gamified learning strategies in computer science education using the Moodle and Quizizz platforms. Three distinct student groups were established to assess the impact on engagement and performance. Initially, we grouped participants and administered a learning preference questionnaire to gauge their interest in social learning. Subsequently, the third group completed a gaming preference questionnaire, partly based on the BrainHex questionnaire [26], to evaluate their interest towards gamified elements. The experiment spanned five weeks, during which the groups underwent lectures, practical sessions, tutorials, quizzes, and a final test. At the conclusion of the experiment, a motivation questionnaire was provided to gather their final impressions.

### 6.1 Proposed model

In our proposed model, we employed two platforms, Moodle for Groups 1 and 2 and Quizizz for Group 3. Group 1 experienced a traditional Moodle course without social learning elements, while Group 2 engaged in a Moodle course enhanced with integrated social features. Group 3 participated in a gamified learning environment using the Quizizz platform, incorporating social interaction. Over the past weeks, we meticulously collected data from these platforms, including test scores, social interactions, and learner preferences and motivation through questionnaires. After completing the experiment, we proceeded to clean up the data in order to refine and prepare the collected information. The subsequent analysis will focus on test results, social interaction patterns, and learner preferences, providing insights into the impact of these various learning strategies on computer science education.

### 6.2 Participants and procedure

In this study (see Figure 2), we organized three distinct groups of engineering students from ENSET Mohammedia, Morocco, totaling 73 participants, to explore the impact of different learning environments on their C++ programming course. Group 1, comprising 25 students, engaged in a conventional Moodle-based course where they attended lectures and completed quizzes individually. Group 2, consisting of 24 students, participated in a Moodle-based course with added social elements. They not only attended lectures on Moodle but also interacted synchronously through group chats and asynchronously [27] through forums, fostering collaborative learning. Group 3, comprising 24 students, immersed themselves in a gamified learning experience on the Quizizz platform, creating and sharing quizzes among themselves to enhance the social aspect. In addition, Group 3 took the final test in the form of a team quiz with badges, rewards, and memes.

The demographics of the participant groups, as detailed in Table 1, provide additional insights into the composition of each group. Group 1, with 24% females and

76% males; Group 2, with 25% females and 75% males; and Group 3, with 29% females and 71% males, show a balanced representation across genders. Additionally, the age distribution within each group illustrates the diversity of participants. In Group 1, 20% were aged 18–20, 80% were aged 21–24, and none were aged 22–25. Group 2 displayed a similar trend with 21%, 79%, and 0% in the respective age brackets. Group 3 had 12%, 88%, and 0% in the respective age categories, further enhancing the diversity and representativeness of the participant pool across all groups.

Informed consent was obtained from all participants, ensuring awareness of their rights and study objectives. Data privacy measures included anonymizing responses and securely storing data. To mitigate biases, participant selection and gamified elements were uniformly applied, promoting fairness and accuracy in the research process.

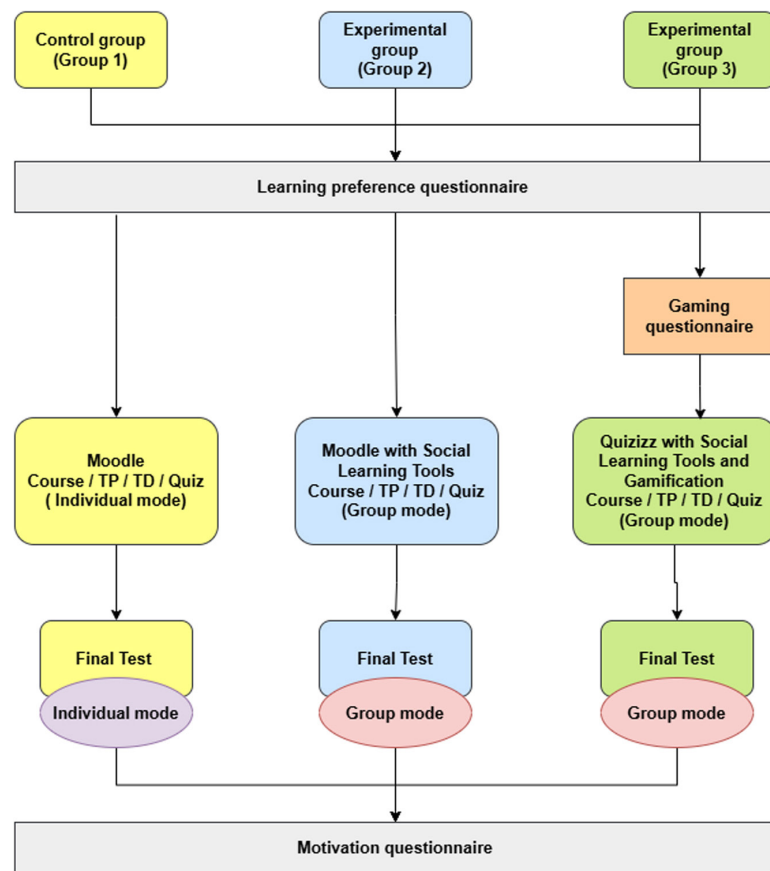


Fig. 2. Experimental design

Table 1. Demographics of participants

	G1	%	G2	%	G3	%
Female	6	24	6	25	7	29
Male	19	76	18	75	17	71
Total	25	100	24	100	24	100
Age						
18–20	5	20	5	21	3	12
21–24	20	80	19	79	21	88
22–25	.0	.0	0	.0	.0	.0

### 6.3 Dimensions of the game experience

Gamification is a deeply integrated aspect of the Quizizz platform's game-based learning environment, with the goal of inspiring and involving students in a distinctive and engaging manner. The game's dimensions comprise multiple components, all of which work together to create a comprehensive and engaging learning experience.

Quizizz emerges as an innovative learning platform that transforms traditional classrooms into engaging and interactive spaces. This game-based educational app, recognized for its multiplayer activities, injects an element of excitement into in-class exercises, fostering a lively and participative learning environment [28]. What sets Quizizz apart is its incorporation of game characteristics, including avatars, themes, memes, and music, elevating the learning process beyond conventional methods. The platform operates in two main modes: the instructor mode, accessible through Quizizz.com for quiz creation, and the player mode, where students participate via [www.Quizizz.com/join](http://www.Quizizz.com/join) [29].

Notably, Quizizz employs a timed question-answering system, rewarding students who respond quickly with more points, thereby introducing an element of competition [30]. In our experiment, we did not use a timer because the speed with which a question is answered is not relevant to assessing the learner's learning performance. The platform facilitates student-to-student competition, motivating them to actively engage in their studies. Live rankings (see Figure 3) displayed on the leaderboard during simultaneous in-class quizzes enhance the competitive spirit, with randomized questions and answers minimizing the potential for cheating [31]. Instructors benefit from real-time monitoring and post-quiz performance evaluation through downloadable reports [32].

By integrating these gamification elements, Quizizz endeavors to create a learning environment where the pursuit of knowledge is not only intellectually stimulating but also inherently enjoyable. The strategic use of badges, rewards, memes, and sound effects serves to transform the educational experience into a gamified adventure, promoting active participation, healthy competition, and sustained motivation among learners.

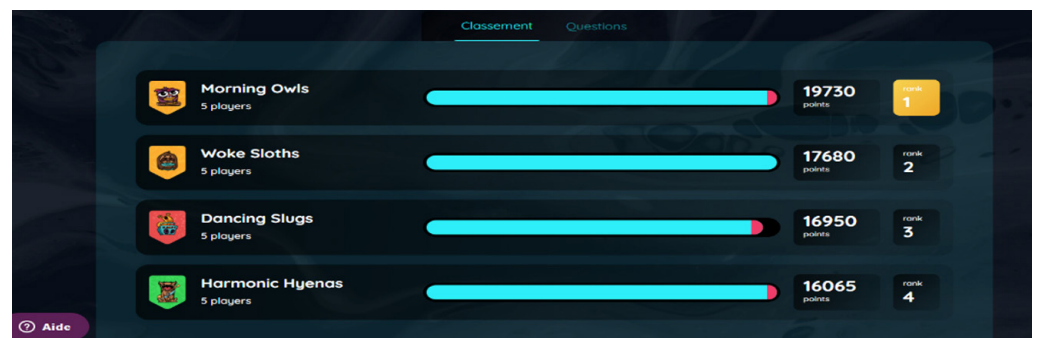


Fig. 3. Groups ranking in Quizizz

### 6.4 Goal

Our overarching goal is to underscore the central role of social and gamified learning in influencing learner performances and fostering a heightened level of motivation. In the contemporary landscape of computer science education, where challenges such as limited engagement and high dropout rates persist, our focus is

on showcasing the significance of integrating social interaction and gamification elements. By shedding light on the positive outcomes observed in our study, we aim to emphasize that the implementation of these strategies not only enhances academic performance but also acts as a powerful motivator, thereby ensuring students are more actively engaged in the learning process. Through this exploration, we seek to provide valuable insights that contribute to the ongoing discourse on optimizing online learning experiences, particularly in the field of computer science education, with a view to enhancing overall educational efficacy and student success.

## 7 MAIN RESULTS

In this section, we aim to uncover the nuanced impact of gamification dimensions on student motivation, engagement, and performance in the context of a C++ course.

### 7.1 Chats

We used a Python procedure to conduct an analysis of chat data, calculating the number of messages per student, the total number of messages, and offering a qualitative analysis based on the total number of messages. The minimum number of messages sent by a student is five, and the maximum number is 26. As is always the case in e-learning, students exchange very little in chat rooms. Students converse with one another in chat rooms quite little, as is typical with e-learning. The total average of messages per student is 15.82, suggesting that, on average, each student contributes approximately 15.82 of the total messages. This value closely aligns with the median, confirming a relatively balanced distribution. The results provide insights into the social aspect based on the number of messages per student, offering valuable information to study student interactions and messaging trends within the group.

Further analyses were conducted to deepen the understanding of the data:

1. Median of messages per student: 15.0
  - Half of the students sent 15 messages or fewer, while the other half sent more than 15. This suggests a balanced distribution of messages among students, with a concentration around 15 messages per student.
2. Standard deviation of messages per student: 7.47
  - A standard deviation of 7.47 suggests some variability in the number of messages sent by students, although not extremely high. Most students send a relatively similar number of messages close to the average.

The subsequent analysis delved into the social network of interactions among students. The identification of highly connected students, based on degree centrality, unveiled those individuals who played influential roles within the network. For example, if one of the students has a degree of centrality of 0.5, then he has interactions with half of the students. Students exchanged with a minimum of 4% and a maximum of 11% of students, i.e., with 1 to 3 other students.

### 7.2 Forums

In the analysis of discussion forums, we employed a multifaceted approach to gain insights into the dynamics of student interactions. The Python procedure

utilized various techniques, including identifying popular discussion subjects, visualizing the popularity of these subjects, pinpointing highly connected students, and analyzing individual participation through message counts. The analysis of popular subjects allowed us to discern the prevalent themes of discussion among students. By ranking topics according to popularity, we have gained a clear picture of which topics have generated the most interest and participation on the forum. This step provided valuable insights into the overarching topics that engaged students, shedding light on the focal points of their discussions.

The examination of forum topics, as illustrated in Figure 4, and quantitative results reveal a variation in the way themes are handled, with certain topics garnering more attention from the experimental group than others. The most frequent talks on the topic “Heritage” indicate that students focus especially on this idea, maybe due to its significance in the course or its complexity in the C++ programming language. This discrepancy could be caused by a number of things, including the perceived difficulty of the concepts, their practical applicability, or the curriculum’s order of emergence.

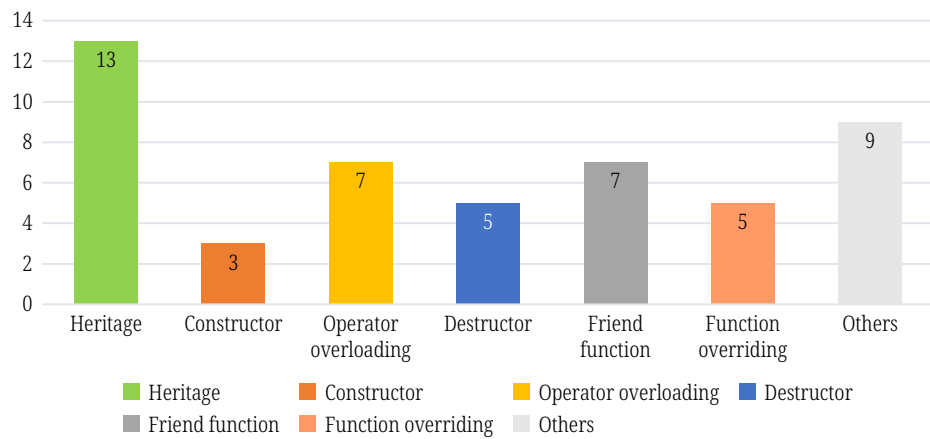


Fig. 4. The most frequent forum topics

### 7.3 Difference in learning outcomes with distinct instructional strategies

We collected data, focusing notably on the outcomes of the final tests administered to the three distinct groups—Group 1, Group 2, and Group 3. The collected data includes key statistical measures such as the mean, median, and standard deviation (refer to Table 2), which provide insights into the performance distribution within each group.

Table 2. Learners’ outcomes

	Group 1	Group 2	Group 3
Mean	13.56	17.67	18.08
Median	13	18	18
SD	1.88	1.11	0.91

Group 1 had a median score of 13 and an average score of 13.56. There appears to be a significant variation in individual results within this group, as indicated by the comparatively high 1.88 standard deviation. This suggests that there were

differences in the achievement levels of the learners in Group 1, which added to the wider range of scores. Group 2 displayed a higher mean of 17.67 and a median of 18. The reduced standard deviation of 1.11 indicates a tighter distribution of scores compared to Group 1. The narrower spread suggests that students in Group 2 generally performed more consistently, with scores closer to the group mean. Group 3 emerged as the highest-performing group, boasting a mean of 18.08 and a median of 18. Notably, the standard deviation of 0.91 is the lowest among the three groups, signifying a tight clustering of scores around the mean. This suggests a high level of consistency in performance among students in Group 3, with the majority achieving elevated scores. In summary, Group 3 stands out with the highest average performance and the least variability in scores, indicating a uniform level of achievement. On the contrary, Group 1 demonstrates lower average performance and a higher spread of scores, reflecting greater heterogeneity in individual achievements. Group 2 falls between the two extremes, displaying overall better performance than Group 1 but slightly behind Group 3 in terms of both mean and score consistency.

#### 7.4 Satisfaction survey results

In this comprehensive study, we designed a questionnaire utilizing a Likert scale ranging from 1 to 5 to assess students' satisfaction with their learning experience and their motivation levels. The survey consisted of five key questions (refer to Table 3), each addressing different aspects of the learning experience, and participants were required to rate their responses. The questions covered aspects such as overall enjoyment of the learning experience, perceived learning outcomes, evaluation of the teaching methodology, motivation to learn, and likelihood to recommend the experience.

**Table 3.** Satisfaction survey questions

How much did you enjoy the learning experience you took?
How much do you think you learned from this learning experience?
How would you rate the teaching method used in this group?
To what extent do you think this learning experience motivated you to learn?
To what extent would you recommend this learning experience to others?
How would you rate the learning experience?

In this study, we employed a one-way analysis of variance (ANOVA) to compare the means of the three groups for each question. This method is widely used for testing differences between more than two groups, making it particularly suitable for our analysis. According to the study by Atia et al. [33], ANOVA is used to analyze data variations under different conditions. It covers two models: one-way and two-way fixed-effects ANOVA. The one-way ANOVA tests if means of different groups are equal, based on three assumptions: normal distribution, equal variances, and independence. The two-way ANOVA decomposes data variance into contributions from two factors and their interaction. Post hoc Tukey HSD tests were then used to identify specific differences between group pairs.

Post hoc analysis (refer to Table 4) further indicated that the gamified, socially interactive platform in Group 3 significantly enhanced recommendation likelihood over both traditional and socially enhanced Moodle platforms, as evidenced by substantial pairwise differences with Groups 1 and 2 ( $p = 0.00073$ ,  $p = 0.00030$ ).

**Table 4.** ANOVA post hoc Tukey HDS

	F-Ratio	p-Value
Question 1	9.24909	0.000273
Question 2	7.11990	0.001532
Question 3	9.78345	0.000179
Question 4	8.96888	0.000341
Question 5	7.57737	0.001050

## 8 DISCUSSION

This study demonstrates the impact of gamification and social interaction on student engagement, performance, and perceptions of learning, addressing key research questions and shedding light on the effectiveness of the instructional strategies implemented. Analyses of chat and forum interactions revealed active student participation, with highly connected individuals playing influential roles in fostering collaboration and social cohesion. Certain themes, such as “Heritage” and “Operator Overloading,” dominated discussions due to their complexity and relevance to the C++ curriculum, while others, such as “Builder” and “Destructor,” received less attention, suggesting a need for targeted teaching strategies to clarify complex concepts and encourage balanced participation. Quantitative comparisons between groups highlighted the advantages of gamification and social interaction. Group 3, with enhanced instructional features, achieved the highest mean performance with minimal variability, indicating consistent and superior outcomes. In contrast, Group 1 exhibited lower averages and greater variability, reflecting disparities in individual achievements. Group 2 showed moderate improvements, emphasizing the effectiveness of gamified, interactive platforms in promoting equitable performance and engagement. ANOVA results confirm these trends, showing that participants in Groups 2 and 3 reported significantly higher levels of satisfaction, motivation, and perceived learning compared to Group 1. Notably, Group 3 expressed substantial appreciation for the pedagogical methods, with a higher likelihood of recommending the experience. These observations suggest that integrating gamification and interactive tools can significantly enrich the learning experience by making content more engaging and fostering student involvement. The findings highlight the importance of designing instructional content that aligns with student needs and curriculum demands. Complexity, relevance, and topic order were shown to influence participation, while influential students in social networks demonstrated the potential of peer support in fostering collaboration. Future research should refine these strategies by exploring the interplay of gamification, social interaction, and pedagogical design, employing advanced techniques such as structural equation modeling to deepen insights into the relationships between engagement, motivation, and performance. This study contributes actionable insights for educators aiming to enhance online learning environments and sets the stage for further exploration of factors driving student success.

## 9 CONCLUSIONS

The results of this study demonstrate that social and gamified learning approaches significantly improve student performance in computer science courses. Specifically, students exposed to gamified elements and social interaction through platforms such as Moodle and Quizizz performed better academically, with Group 3 achieving the highest mean score (18.08), an increase of 33.4% over Group 1 (13.56) and 2.3% over Group 2 (17.67). The implementation of gamification combined with elements of social interaction significantly boosted student motivation, overcoming crucial challenges such as drop-out rates and lack of engagement. Responses to the questionnaire showed that 86.6% of students in Group 3 were more satisfied with their learning experience, compared with 78.7% in Group 2 and 64.5% in Group 1. These results underline the effectiveness of gamification and social learning in creating a more engaging and successful educational experience for computer science students.

Future research should investigate the applicability of these strategies in different age groups and academic disciplines. Building on current findings, an adaptive gamification approach to individual preferences and cultural contexts could optimize engagement and outcomes. In addition, exploring tools other than Quizizz, with a focus on features such as personalization, accessibility and cultural relevance, would provide further insight into the design of effective gamified learning environments.

## 10 ACKNOWLEDGEMENTS

Thanks to the participants, teachers, and schools involved in this learning experience.

## 11 REFERENCES

- [1] H. Gharbaoui, K. Mansouri, and F. Poirier, "Towards a social learning analysis using learning management system and learning experience to predict learners' success," in *Augmented Intelligence and Intelligent Tutoring Systems. ITS 2023*, in Lecture Notes in Computer Science, C. Frasson, P. Mylonas, and C. Troussas, Eds., vol. 13891, 2023, pp. 364–370. [https://doi.org/10.1007/978-3-031-32883-1\\_33](https://doi.org/10.1007/978-3-031-32883-1_33)
- [2] S. M. Y. Zuluaga and M. P. Arias, "Games and arts as tools for developing generic skills in engineering students," *International Journal of Engineering Pedagogy (ijEP)*, vol. 14, no. 3, pp. 36–52, 2024. <https://doi.org/10.3991/ijep.v14i3.46229>
- [3] H. Gharbaoui, K. Mansouri, and F. Poirier, "Improving student engagement and success in computer programming courses through social learning in online environments," *International Journal of Engineering Pedagogy (ijEP)*, vol. 14, no. 6, pp. 54–68, 2024. <https://doi.org/10.3991/ijep.v14i6.48705>
- [4] S. Arnab, R. Bhakta, S. K. Merry, M. Smith, K. Star, and M. Duncan, "Competition and collaboration using a social and gamified online learning platform," in *Proceedings of the European Conference on Games-Based Learning*, L. Boyle and T. M. Connolly, Eds., Reading, UK, 2016, pp. 19–26. <https://core.ac.uk/download/pdf/228158637.pdf>
- [5] S. Papadakis and V. Orfanakis, "Comparing novice programming environments for use in secondary education: App Inventor for Android vs. Alice," *International Journal of Technology Enhanced Learning (IJTEL)*, vol. 10, nos. 1/2, pp. 44–72, 2018. <https://doi.org/10.1504/IJTEL.2018.088333>

- [6] S. Papadakis and V. Orfanakis, "The combined use of Lego Mindstorms NXT and App Inventor for teaching novice programmers," in *Educational Robotics in the Makers Era*, D. Alimisis, M. Moro, and E. Menegatti, Eds., vol. 560, Cham: Springer International Publishing, 2017, pp. 193–204. [https://doi.org/10.1007/978-3-319-55553-9\\_15](https://doi.org/10.1007/978-3-319-55553-9_15)
- [7] M. E. Sousa-Vieira, J. C. Lopez-Ardao, M. Fernandez-Veiga, M. Rodriguez-Perez, and S. Herreria-Alonso, "An open-source platform for using gamification and social learning methodologies in engineering education: Design and experience," *Computer Applications in Engineering Education*, vol. 24, pp. 813–826, 2016. <https://onlinelibrary.wiley.com/doi/10.1002/cae.21746>
- [8] F. A. Nieto-Escamez and M. D. Roldán-Tapia, "Gamification as online teaching strategy during COVID-19: A mini-review," *Front. Psychol.*, vol. 12, p. 648552, 2021. <https://doi.org/10.3389/fpsyg.2021.648552>
- [9] V. Dikcius, S. Urbonavicius, K. Adomaviciute, M. Degutis, and I. Zimaitis, "Learning marketing online: The role of social interactions and gamification rewards," *Journal of Marketing Education*, vol. 43, no. 2, pp. 159–173, 2021. <https://doi.org/10.1177/0273475320968252>
- [10] C.-H. Chung and H.-L. W. Pan, "Assessing the effects of flow, social interaction, and engagement on students' gamified learning: A mediation analysis," *Sustainability*, vol. 15, no. 2, p. 983, 2023. <https://doi.org/10.3390/su15020983>
- [11] P. Luarn, C. C. Chen, and Y. P. Chiu, "Enhancing intrinsic learning motivation through gamification: A self-determination theory perspective," *The International Journal of Information and Learning Technology*, vol. 40, no. 5, pp. 413–424, 2023. <https://doi.org/10.1108/IJILT-07-2022-0145>
- [12] W. Kian Tan, M. Shahrizal Sunar, and E. Su Goh, "Analysis of the college underachievers' transformation via gamified learning experience," *Entertainment Computing*, vol. 44, p. 100524, 2023. <https://doi.org/10.1016/j.entcom.2022.100524>
- [13] F. J. Montiel-Ruiz, M.-M. Sánchez-Vera, and I. M. Solano-Fernández, "Social networks and gamification in physical education: A case study," *Contemporary Educational Technology*, vol. 15, no. 1, pp. 1–15, 2023. <https://eric.ed.gov/?id=EJ1377187>
- [14] A.-I. Zourmpakis, M. Kalogiannakis, and S. Papadakis, "Adaptive gamification in science education: An analysis of the impact of implementation and adapted game elements on students' motivation," *Computers*, vol. 12, no. 7, p. 143, 2023. <https://doi.org/10.3390/computers12070143>
- [15] S. Papadakis, "Is pair programming more effective than solo programming for secondary education novice programmers?: A case study," *International Journal of Technology Enhanced Learning*, vol. 13, no. 1, pp. 1–16, 2018. <https://doi.org/10.4018/IJWLTT.2018010101>
- [16] S. Papadakis, "Evaluating a game-development approach to teach introductory programming concepts in secondary education," *International Journal of Technology Enhanced Learning*, vol. 12, no. 2, pp. 127–145, 2020. <https://doi.org/10.1504/IJTEL.2020.106282>
- [17] J. Simoes, R. D. Redondo, and A. F. Vilas, "A social gamification framework for a K-6 learning platform," *Computers in Human Behavior*, vol. 29, no. 2, pp. 345–353, 2013. <https://doi.org/10.1016/j.chb.2012.06.007>
- [18] R. Tamosevicius, "Why is game-based learning important?" *eLearning Industry*, 2022. <https://elearningindustry.com/why-is-game-based-learning-important>
- [19] J. Trybus, *Game-Based Learning: What it is, Why it Works, and Where it's Going*. Miami: New Media Institute, 2015.
- [20] M. Wang and X. Zheng, "Using game-based learning to support learning science: A study with middle school students," *Asia-Pacific Edu Res*, vol. 30, pp. 167–176, 2021. <https://doi.org/10.1007/s40299-020-00523-z>

- [21] I. Y. V. S. Putri, S. Rahayu, and I. W. Dasna, "Game based learning application in chemistry learning a systematic literature review," *Jurnal Pendidikan MIPA*, vol. 23, no. 1, 2022. <https://doi.org/10.23960/jpmipa/v23i1.pp01-12>
- [22] M. S. Abubakari, N. Nurkhamid, and P. Priyanto, "Factors influencing online learning engagement: International students' perspective and the role of institutional support," *Turkish Online Journal of Distance Education (TOJDE)*, vol. 23, no. 3, pp. 118–136, 2022. <https://doi.org/10.17718/tojde.1137253>
- [23] E. Kyewski and N. C. Krämer, "To gamify or not to gamify? An experimental field study of the influence of badges on motivation, activity, and performance in an online learning course," *Computers & Education*, vol. 118, pp. 25–37, 2018. <https://doi.org/10.1016/j.compedu.2017.11.006>
- [24] "Moodle – Open-source learning platform," *Moodle.org*. <https://moodle.org/>
- [25] "Quizizz | Free Online Quizzes, Lessons, Activities and Homework." <https://quizizz.com/?lng=fr>
- [26] L. E. Nacke, C. Bateman, and R. L. Mandryk, "BrainHex: A neurobiological gamer typology survey," *Entertainment Computing*, vol. 5, no. 1, pp. 55–62, 2014. <https://doi.org/10.1016/j.entcom.2013.06.002>
- [27] L. Rai, C. Deng, and F. Liu, "Comparative analysis of the switching behavior of synchronous and asynchronous online learners in higher education," *International Journal of Engineering Pedagogy (iJEP)*, vol. 14, no. 5, pp. 24–36, 2024. <https://doi.org/10.3991/ijep.v14i5.48845>
- [28] F. Zhao, "Using Quizizz to integrate fun multiplayer activity in the accounting classroom," *International Journal of Higher Education (IJHE)*, vol. 8, no. 1, pp. 37–43, 2019. <https://doi.org/10.5430/ijhe.v8n1p37>
- [29] S. M. Saleh and H. Sulaiman, "Gamification in T&L of mathematics: Teacher's willingness in using Quizizz as an additional assessment tool," *AIP Conference Proceedings*, vol. 2184, no. 1, p. 030005, 2019. <https://doi.org/10.1063/1.5136373>
- [30] P. A. K. Juniarta, K. S. Dewi, G. Mahendrayana, and I. W. Swandana, "The analysis on the implementation of mobile-assisted language learning strategy through Quizizz application to improve student's reading comprehension at Undiksha Singaraja," in *Proceedings of the 3rd International Conference on Innovative Research Across Disciplines (ICIRAD 2019)*, 2020, pp. 323–327. <https://doi.org/10.2991/assehr.k.200115.053>
- [31] H. Akhtar, N. Hasanati, and I. Istiqomah, "Game-based learning: Teachers' attitude and intention to use Quizizz in the learning process," in *2nd International Conference on Educational Assessment and Policy (ICEAP 2019)*, 2019, pp. 49–54. <https://doi.org/10.26499/iceap.v0i0.202>
- [32] E. Çeker and F. Özdaml, "What 'gamification' is and what it's not," *European Journal of Contemporary Education*, vol. 6, no. 2, pp. 221–228, 2017. <https://doi.org/10.13187/ejced.2017.2.221>
- [33] N. Atia *et al.*, "Particle swarm optimization and two-way fixed-effects analysis of variance for efficient brain tumor segmentation," *Cancers*, vol. 14, p. 4399, 2022. <https://doi.org/10.3390/cancers14184399>

## 12 AUTHORS

**Hiba Gharbaoui** is a doctoral researcher specializing in adaptive gamification and social learning at the University Hassan II (M2S2I Lab) and the University of Bretagne Sud (Lab-STICC, MOTEL team). Her work focuses on enhancing online education through innovative strategies, improving student engagement, and predictive learning analysis. She also contributes to developing smart chatbot systems

for IT governance in universities. Through her research, she aims to advance educational technologies and promote student engagement and success (E-mail: [hiba.gharbaoui-etu@etu.univh2c.ma](mailto:hiba.gharbaoui-etu@etu.univh2c.ma)).

**Khalifa Mansouri** is currently a Researcher-Professor in Computer Science, Training Director and Director of the M2S2I Research Laboratory at ENSET of Mohammedia, Hassan II University of Casablanca. His research interests include Information Systems, e-Learning Systems, Real Time Systems, Artificial Intelligence and Industrial Systems. Graduated from ENSET of Mohammedia in 1991, CEA in 1992 and PhD (Computation and Optimization of Structures) in 1994, HDR in 2010 and National PhD (In Computer Science – Distributed Systems) in 2016.

**Franck Poirier** is Professor Emeritus of Computer Science at University Bretagne Sud (UBS). He has worked in the fields of Machine Learning for 10 years, Human-Computer Interaction (HCI) and Augmentative and Alternative Communication (AAC) for over 30 years and, for the past 10 years, in e-learning and Technology enhanced learning (TEL).