Gamification to foster student engagement: A mixed methods study in higher education

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Abstract

Gamification has gained prominence in higher education, involving the combination of game elements into non-game contexts to capture attention and influence behavioral dynamics. While scholars agree on its conceptualization, empirical studies reveal conflicting results on its impact on student motivation, engagement, and academic performance. This paper addresses this duality by examining the influence of gamification on key dimensions, such as students' engagement and perceptions of gamified experiences. The goal is to contribute to the scholarly discourse on gamification in higher education, offering insights to design more engaging learning experiences, particularly in the context of declining motivation observed during the pandemic.

Author Contributions

The article has been collaboratively conceived by the authors and reports the results of a study that has been jointly carried out by the authors. For the purpose of this paper, the paragraphs can be attributed as it follows: Elena Gabbri has written Procedures, Measures and Data Analysis, Participants and Typologies of learning engagement fostered by gamified activities; Cristina Gaggioli has edited Theoretical framework, Context and design of gamified learning activities; Maria Ranieri has elaborated Introduction, Discussion and Conclusion; Cristina Gaggioli and Maria Ranieri have collaboratively written the paragraph Students' learning experiences and perceptions of involvement in gamified learning activities. The research questions have been jointly formulated by the authors.

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Introduction

Gamification has emerged as a prominent pedagogical strategy within higher education over the past decade, garnering significant scholarly attention (Khaldi et al., 2023; Murillo-Zamorano et al., 2023). Consensus among scholars was reached on the conceptualization of gamification as the infusion of game elements into non-game contexts, with the primary objectives of capturing attention and influencing behavioral dynamics (Dichev & Dicheva, 2017). Within the higher education milieu, gamification is employed to promote student motivation and engagement (Adams & Du Preez, 2022; Chen & Liang, 2022), with the aim at enhancing academic performance and elevating final grades (Arufe Giráldez et al., 2022). Nevertheless, there exist also empirical studies presenting inconclusive effects of gamification on these educational variables (Khaldi et al., 2023). This duality indicates the need for further examination of the influence of gamification on students' engagement, knowledge and behaviors.

This paper intends to contribute to the scholarly discourse surrounding gamification in higher education through the examination of its impact on key dimensions such as students' engagement and perceptions of gamified experiences. A better understanding of the relationship between gamified learning and its influence on engagement can help designing more involving learning experience, especially in a period where researchers have found an increasing sense of declining motivation (Corpus et al., 2022; Syakur et al., 2023), as a consequence of the pandemic period.

Theoretical framework

Over the last years, a number of studies on the adoption of gamified learning design in higher education have been carried out whose findings have been summarized in a series of reviews. Among them, Dichev and Dicheva (2017) found the absence of a critical justification for using certain game elements, emphasizing the need for further research, while Zainuddin and colleagues (2020) identified the predominant use of motivational theories in gamification studies, including self-determination theory, flow theory, and goal-setting. Khalil et al. (2018) and Majuri et al. (2018) reported that badges, leaderboards, progress, and challenges were the most commonly gamification affordances, and van Gaalen et al. (2021) showed that 'assessment' and/or 'conflict/challenge' were frequently embedded in the learning environment. Kalogiannakis et al. (2021) and Khaldi et al. (2023) underscored the tendency to adopt simplistic gamified designs. Consequently, scholars advocate for the integration of diverse features beyond conventional points, badges, and leaderboards, as suggested by extant literature (Ritzhaupt et al., 2021).

Coming to the effects of gamification on motivation and engagement, it must be firstly acknowledged that the lack of enjoyment within the learning experience is recognized as a main factor contributing to various inadequacies in students' engagement with the learning process (Lumby, 2011). Educators often face challenges when students are demotivated and don't actively participate in learning activities. These concerns have even increased in the exacerbated context of the COVID-19 disruptions, where decreases in motivation and self-regulation were noted during online instruction (Corpus et al., 2022; Syakur et al., 2023). Despite some limitations in these studies, such as a reliance on retrospective reports and a lack of consideration for longer-term assessments, there is a pressing need to reshape education for rekindling motivation. Therefore, researchers identified gamification as a promising strategy,

since it has proven to be effective in cultivating students' motivation and active engagement (Kim et al., 2018). The strategic incorporation of game elements, a well-established technique in commerce and marketing for capturing users' attention has been substantiated by research (Seiffert-Brockmann et al., 2018). Engaging in competitive challenges not only elicits pleasure but also enhances users' involvement with the experience (Howard-Jones et al., 2016). Within higher education, several studies (Adams & Du Preez, 2022; Chen & Liang, 2022) indicate the positive impact of gamification on student engagement and motivation.

To understand student motivation and involvement three types of engagement can be identified (Fredricks et al., 2004): Behavioral, emotional and cognitive. Behavioral engagement is the extent to which a student shows expected behaviors in a class: Listening, doing schoolwork, following directions. Cognitive engagement is the extent to which a student applies mental energy, e.g. thinking about content, trying to understand new material, and grappling with mental challenges. On an affective level, emotional engagement denotes the extent to which a student feels positively about a class, such as enjoying it, feeling comfortable and interested, and wanting to do well. Although engagement occurs through these three dimensions, they are also synergistic, such that they feed on each other, blurring the boundaries among them (Cooper, 2014). Briefly, one can say that engagement is a meta-construct including the behavioral, emotional and cognitive dimensions. To measure it observable forms of involvement must be taken into account, such as: a) the use of students' body to participate in activities and tasks, b) the manipulation of materials and c) the participation in social interactions (Johnson et al., 2021). Even the agentic perspective makes differences in how students strive to be active during learning process. The agentic engagement is what students say and do for creating a more supportive learning environment for themselves and can be observed through students' actions such as offering inputs, expressing preferences, enriching and personalizing learning opportunities (Bandura, 2001). Gamification showed to have positive effects on all types of learning engagement, including agentic engagement (Zainuddin et al., 2020).

Method

This study aims to explore the extent to which applying gamification to higher education context may increase students' motivation and involvement in collaborative learning processes. It focuses on the impact of gamified learning pathways on student engagement with the purpose of understanding whether and how gamification may improve the quality of students' participation and collaboration. By evaluating students' experiences in a gamified course, the study examined the following research questions:

- *RQ1*. What are the students' learning experiences and perceptions of involvement in gamified learning activities?
- *RQ2*. What types of engagement have the gamified learning activities fostered?

Based on a mixed methods approach, a convergent parallel design was used to collect data (Creswell & Plano Clark, 2011). This strategy was deemed appropriate as the integration of both qualitative and quantitative data was expected to provide a fuller and more comprehensive understanding of the research issues.

Context and design of gamified learning activities

The gamified course New Technologies for Education and Training (A.A. 2021/2022) was in hybrid mode, with students connected synchronously via a videoconferencing application or being present in the classroom. It was designed by combining technological tools, inclusive digital education content and gaming elements to increase student engagement and motivation. Two hours per lesson were devoted to gamified activities, for an overall number of 10 hours in six weeks between February and March 2022. The topics addressed in the lectures were: special needs education, game-based learning, design of game mechanics and gamification in education. Therefore, during the course, the students simultaneously learnt course contents and engaged in hands-on exploration of gamification practices (Gabbi et al., 2023).

Three main instructional design principles were adopted to ensure effective learning processes: a) activating students' prior knowledge and guarantee the links between the previous knowledge and the new concepts (Ausubel, 1960); b) allowing students to apply their knowledge to solve specific problems (Merrill, 2002), and c) providing formative assessment to sustain authentic learning (Hattie & Timperley, 2018). Therefore, each lesson was planned according to the following structure: a) *activation*, the lesson began with an introduction to digital technology topics for inclusive education, followed by the presentation of course content; b) *application*, the main part of each lesson involved students engaging in collaborative learning activities; c) *assessment*, the final phase involved formative assessment of the students' results and scoring.

To avoid generating cognitive overload, a sequencing strategy was adopted (van Merriënboer & Kirschner, 2017), starting with relatively simple learning tasks and progressing to more complex activities (Figure 1).

Figure 1.

Summary of key elements of the gamified lessons' design

Game 1: **Creating an Effective Digital Self-Representation**
- Each group created an avatar symbolizing inclusion using the same online tool.
- Avatars were uploaded to an online board with a slogan summarizing the message of inclusion.
- Groups rated each other's products based on originality, slogan relevance and communicative coherence.

Game 2: **Observation of Game-Based Digital Tools**
- Students observed two audiovisual stimuli about technology for inclusion.
- They used a student response system in challenge mode: each video had 7 true-false within a time limit.
- Individual scores contributed to the group's overall score for the best result.

Game 3: **Analysis of the Game Mechanics of an Educational Video Game**
- Groups observed Duolingo and analysed game components, motivational processes and learning dynamics.
- Automated feedback was provided, followed by a reflective session in each group.
- The evaluation involved self- and expert-assessment of the reflection's quality and the game analysis.

Game 4: **Designing a Gameplay**
- Groups created a scenario for video games based on episodes of inclusion.
- Students gave peer feedback on other projects using specific evaluation criteria.
- Rankings were determined based on platform-assigned scores for both submissions and feedback quality.

Game 5: **Final Challenge**
- Groups completed the inclusive educational game based scenario and teachers evaluated and select the best three game designs.
- Finalist groups presented their products to others who rated them on involvement, curiosity, interest, alignment of educational objectives and clarity of communication.

Game design elements were introduced such as challenges, winners and scores, as well as specific evaluation criteria and instructions for each lesson (Majuri et al., 2018).

Procedures, measures and data analysis

Both qualitative and quantitative data was gathered at the end of the course through an online questionnaire, including closed and open-ended questions. The anonymous questionnaire was administered online in March 2022 via G-Suite's Google Forms service. 20 closed-ended questions were used from Reeve and Tseng (2011) and Zainuddin et al. (2020), translated into Italian by the authors. The questions were structured in line with a 5-point Likert Scale, ranging from strongly agree to strongly disagree and were categorized into cognitive, behavioral, emotional and agentic engagement. Cronbach's Alpha coefficient of internal consistency was used to measure the reliability of the instrument and was found to be .849, which is an acceptable level of reliability and consistent with previous implementation (Zainuddin et al., 2020). With respect to qualitative data collection, three open-ended questions were employed to obtain additional information about the students' engagement, which had not been fully covered in the quantitative analysis. The questions concern the benefits of gamification with respect to acquired knowledge and skills, social interaction and metacognition, as the ability to reflect on one's own learning process.

After data collection, the two types of data were analysed separately. The qualitative data was subjected to content analysis to identify patterns and themes. A summarizing content analysis procedure was employed to analyse the data in order to generate a smaller network of meaning units to keep the essential contents and create - through abstraction - a comprehensive overview of the base material (Mayring, 2014). To this end, the QCAmap qualitative software program was utilized during the coding and organizing of the summarizing content analysis. On the other hand, the quantitative data underwent statistical analyses to derive meaningful insights. Descriptive and correlational statistical analysis was carried out with the support of the statistical software SPSS Statistics v.27. In the final step, the results from both data sets were compared side-by-side and the findings were presented separately to ensure a comprehensive understanding of the research problem (Creswell & Plano Clark, 2011).

Participants

A total of 254 students were enrolled in the course with no mandatory attendance requirements, of whom 213 chose to attend. The study refers to the 199 respondents of the outgoing questionnaire, following the exclusion of 11 non-attending students. The participants in the study are therefore 188 students (M=13, F=175) who attended the course lessons. The respondents have an average age of 22.8 (SD = 5.8). With regard to educational level, more than 97% have an upper secondary school diploma since the class is in the first year of the Degree Course in Education and Training Sciences.

Results

Students' learning experiences and perceptions of involvement in gamified learning activities

To answer the RQ1 qualitative data was used. They were gathered through three open-ended questions on the benefits of gamification for learning outcomes, social interaction, and the awareness about the learning methods.

The data corpus analysis was conducted in four phases (Mayring, 2014), that is a) *paraphrasing* and familiarization with data through the use of the QCAmap software; b) *generalization*, relevant coding units were identified in relation to the research questions, and labels were assigned based on data characteristics; 68 labels were used to code 689 comments; c) *reduction*, labels were aggregated into potential themes; six macro-categories were identified; ambiguous cases were resolved through researchers' discussion; the list was reviewed and refined to ensure internal coherence; d) *synthesis*, the most significant excerpts were selected to delve deeper into the data collected during the quantitative phase.

Table 1 below encompasses the results of the thematic analysis, including the six-macro-categories, the main emerging themes and examples of excerpts.

Table 1.

Inductive analysis of students' learning experiences and perceptions of gamification.

Macro-categories	Definition	Themes*	Quotations
Engaging learning experience	It focuses on creating an enjoyable and captivating learning environment for individual learners. It includes sparking curiosity and maintaining students' interest and attention throughout the learning process. Learning is facilitated through interactive and hands-on activities, fostering meaningful understanding, promoting metacognition and providing new insights and inspirations.	• New learning experience (22) • Facilitation of learning (27) • Meaningful learning (2) • Learning by doing (7) • Metacognition and awareness (23) • Fun (12) • Interest and attention (11) • Curiosity (1) • Learning by playing (18) • Learning while having fun (10) • Specific learning disorders (1)	"I am 35 years old and not a digital native. I am used to study independently from textbooks and absorbing course content, especially in my previous academic career, through traditional lectures. After initially being skeptical about the proposed learning path, I discovered, with pleasure, that gamification activities have assisted me in understanding the course content itself, making learning more accessible and reinforcing retention" (RQ2-18, n.247) "This learning method allows for acquiring knowledge in a simple, enjoyable, and spontaneous manner, almost without realizing it" (RQ2-58, n.597).
Social interaction and collaboration	It emphasizes the importance of socialization and collaboration in the learning process. It includes active participation, motivation, and engagement through inclusive interactions. Students felt encouraged to share ideas, work together in groups, and develop a sense of belonging while supporting each other's learning.	• Socialization (32) • Facilitation of interaction (32) • Inclusion for social interaction (15) • Involvement/motivation/participation (40) • Sharing of ideas and discussion (55) • Cooperation/collaboration/group work (43) • Feeling of belonging to a group/common goals (12) • Solidarity and mutual aid (7) • Face to face & online interaction among students (4) • New encounters (16) • Development of collaborative skills (11) • New forms of interaction (2) • Learning to work in a team (14) • Communication facilitation (4)	"The benefits include the ability to communicate, socialize, exchange ideas, and share opinions with the individuals you engage with" (PQ2-10, n.37) "The gamification journey allows for working in a group in a different, interesting, and enjoyable way. Games make the activity more collaborative, offering the opportunity to engage and cooperate, leveraging collaboration as a strength, working together, and striving towards a common goal" (RQ2-14, n.130).

Technology integration and gamification	It highlights the utilization of technology, particularly gamification and digital tools, to enhance the learning process. It involves incorporating game elements and technology-based activities to make learning more engaging, interactive, and inclusive.	- Use of technology (11) - Knowledge of games for learning (20) - Potential of ICT in education (4) - Gamification as a more inclusive method (2) - Knowledge of gamification (9) - Knowledge of new educational technologies (16)	"It has given me the opportunity to consider technologies as facilitators of learning. I hadn't considered them in this context before" (RQ2-A, n.476) "Being aware of new technologies that I can leverage, of which I was not aware before" (RQ2-60, n.620).
Personal growth, new skills and empowerment	It focuses on the individual learner's personal development and empowerment. It addresses the development of various skills including collaborative abilities, organizational skills, self-confidence, self-expression, and professional competence, leading to personal growth and a sense of accomplishment. Students felt empowered to express themselves confidently and enhance their self-efficacy in their educational journey.	- Increased professional skills (5) - Development of organizational skills (1) - Acquisition of new skills/capabilities (6) - New skills (4) - Challenge/competition (1) - Increased self-confidence (1) - Ability to express oneself (4) - Self-efficacy (1) - Creativity (10) - Critical thinking (10) - Personal growth (cognitive, emotional and social) (13) - New points of view, questioning of one's own ideas (13) - New insights (3)	"This gamification journey unfolded entirely in a group setting, through the exchange of ideas and opinions. Through this, I was able to understand and consider perspectives different from my own, collaborating to complete a project, based on the sense of belonging by the group members" (RQ2-40, n.487) "I believe that the gamification journey is useful for learning and using new technologies, involving one's creativity as well" (RQ2-21, n.278).
Innovative teaching approaches and methodologies	It centers on innovative teaching approaches and methodologies. It involves designing interventions that go beyond transmissive teaching, incorporating new forms of interaction, and adapting content to individual needs and prior knowledge. The focus is on personalized, active learning to enhance the overall learning experience.	- Learning to design instructional interventions (1) - Valid alternative to the traditional frontal lecture (8) - Personalization (2) - Activation of pre-knowledge (1) - Knowledge of new teaching methods (2) - Active teaching (2) - Didactic innovation (4) - Individualization (1) - Topic close to school students (1) - Acquisition of specific knowledge (4) - Feedback (12)	"I believe that gamification has been a different learning opportunity compared to traditional lessons. In fact, it ensured our active, enjoyable, alternative, and not burdensome participation in the lessons, allowing us to learn new things by sharing elements with other group members" (RQ2-22, n.284) "It was helpful because I had never thought of using games to learn theoretical concepts, but it was very useful and facilitating for studying the exam material" (RQ2-28, n.375).

Educational benefits and outcomes	It refers to the positive outcomes of the educational process. It emphasizes the creation of a positive learning climate, where students feel safe and supported to express themselves. It also encompasses improved understanding of theoretical concepts, acquisition of specific knowledge and skills, and the application of learned knowledge in practical settings, leading to enhanced learning outcomes.	• Positive climate (2) • Sense of security (2) • Facilitated acquisition of content (4) • Understanding and/or consolidation of theoretical notions (13) • Acquisition of specific knowledge (4) • Acquisition of new skills/abilities (6) • Application of knowledge learned (34) • Importance of empathy (1) • Increased self-confidence (1) • Increased understanding of the topic of inclusion (3) • Useful comparison with digital natives (1) • Easy acquisition of content (4) • Learn new content (21)	"For me, this gamification journey has been very helpful because the topics have stayed with me much more than when I study on my own" (RQ2-7, n.648) "It helped me understand that I am capable of tackling and solving different types of exercises, perhaps never encountered before" (RQ2-56, n.589).

*Note. The numbers in brackets indicate the amount of comments referred to the lab

Typologies of learning engagement fostered by gamified activities

To answer the second research question quantitative analysis of the questionnaire responses was carried out. Table 2 shows a good degree of students' engagement and motivation, underlining the effectiveness of the adopted approach in stimulating active participation.

Table 2.

Perceived learning engagement of students attending the gamified course (n = 188).

Learning engagement	M	SD
Emotional engagement		
When I worked on game activities, I felt interested	4,34	,629
When I answered the questions of the games, I felt curious about the correct answers	4,32	,580
I thought this course was fun because of the game activities	4,36	,757
I enjoyed this course thanks to the gamified learning path	4,38	,664
Enjoyed learning new things in this course	4,59	,592
Behavioral engagement		
I listened carefully during the feedback sessions	4,19	,502
I paid attention to questions, comments and feedback from other students	4,15	,605
I worked hard to respond to the requests of the activities of the games	4,52	,532
I was able to collaborate with peers during discussion and feedback sessions	4,32	,714
I tried to be active in participating during the gamified learning path	4,53	,511
Cognitive engagement		
I am able to recognize my progress during the gamified learning path	4,10	,475
Game activities were a form of friendly competition	4,39	,640
I am able to remember the knowledge gained through game activities	4,15	,611
This course helped me improve my critical thinking skills through various types of activities	4,15	,759
The group work during the activities of the games was useful to solve the problems related to the performance of the task	4,29	,712
Agentic engagement		
I asked questions to actively involve the other members and make the work of the group more lively	3,93	,742
I reported to the group and/or teachers what I liked and disliked about the activity	3,36	,985
I have proposed suggestions on how to make our group's work better	4,17	,640
During the activities, I expressed my preferences and opinions	4,33	,627
I let the group and/or teacher know what I was interested in	3,68	,869

The very high average Likert scale scores (1-5) of the first emotional engagement component indicates that the integration of game elements positively influenced students' involvement from an emotional perspective, reflecting positive emotional states such as enjoyment, interest, curiosity, and fun. Students were intrigued by the questions in the games and eager to know the correct answers. The course was found fun for the integration of game activities, which contributed to the involvement and enjoyment of the learning process. Students enjoyed learning new things (M = 4.59; SD = .59) and also found the learning activities stimulating interest in the course content.

As for the behavioral engagement, students reported paying attention during the feedback sessions with a focus on listening to questions, comments and feedback from both other students and teachers. They worked hard (M = 4.52; SD = 0.53), indicating that effort and dedication were put in completing the proposed challenges. Students also collaborated with peers and tried to be active during the

gamified learning journey, suggesting an active involvement in the construction of the learning process through dialogue and sharing ideas.

As far as the cognitive engagement is concerned, benefits involving social components received more agreement. Indeed, students perceived the game activities as a form of friendly competition, encouraging participation and the desire to achieve better results than others, without creating tension or hostility. Furthermore, group work was found helpful in solving problems related to the activities' execution. Students were able to recognize their individual progress and to memorize the knowledge learnt through the game activities. To a lesser extent, the inclusion of various challenges and tasks in the course helped develop student's analytical and critical thinking skills (M = 4.15; SD = 0.76).

Finally, the agentic engagement was found to be the least perceived component by students, although they stated their active involvement in interacting with the learning material and willingness to express their views (M = 4.33; SD = .63). Students also offered suggestions on how to improve the group's work, indicating a good level of initiative and interest in contributing to the optimisation of group activities.

Descriptive statistics of the different subscales (behavioral, emotional, agentic and cognitive engagement) were calculated to compare the types of student engagement elicited by the teaching activities (Table 3). The relationship between the subscales was also analysed using Pearson's bivariate correlation coefficient. The analysis showed that all types of engagement were positively correlated with each other (p < 0.01). This result confirms the findings of Reeve & Tseng (2011) and Zainuddin et al. (2020) who emphasised that learning engagement is not a one-dimensional construct and placed particular emphasis on the importance of the agentic component.

Table 3.

Descriptive statistics and correlation coefficients among sub-scales (n = 188).

	1	2	3	4	*M*	*SD*
1. Emotional engagement	-				21,98	2,41
2. Behavioral engagement	,505**	-			21,71	2,01
3. Cognitive engagement	,613**	,459**	-		21,08	1,90
4. Agentic engagement	,215**	,421**	,404**	-	19,46	2,71

**. Correlation is significant at the 0.01 level (2-tailed).

The correlations between the different dimensions of engagement are of moderate intensity (0.3 to 0.7), for example, the relationship between learning-related cognitive aspects such as attention, critical thinking and metacognition and positive emotional reactions to play activities. Collaboration and involvement in discussions were also found to be positively correlated with cognitive and agentic engagement. The only weak correlation (less than 0.3) was between the agentic and emotional components, which suggests that appreciation and enjoyment of the activity are not necessarily related to a propensity for a constructive and proactive role in the experience.

Discussion and conclusion

Consistently with previous studies (Adams & Du Preez, 2022; Arufe Giráldez et al., 2022; Chen & Liang, 2022), our findings confirm the positive impact of gamification on student engagement,

revealing the transformative effects that gamified learning environments can have on learners across various dimensions such as engagement, participation and social interaction.

Firstly, the six macro-categories, identified through the qualitative analysis, underscore the multifaceted positive influence of gamification on students' learning experiences. In particular, the qualitative analysis of students' perceptions revealed that gamification breathes life into traditional learning methods, facilitating course content comprehension and fostering retention through enjoyable and interactive experiences. Moreover, it emerges as a powerful catalyst for collaborative engagement, encouraging communication, ideas exchange, and cooperative group work. In this way, gamification contributes to holistic personal growth where learners acquire not only subject-specific knowledge but also collaborative skills, organizational abilities, and increased self-confidence. Learners felt secure, engaged, and motivated, leading to improved understanding, application of knowledge, and the acquisition of specific skills. These results lead to the consideration that, as highlighted by recent studies (Murillo-Zamorano et al., 2023), gamification is not just about points and scores, but requires well designed learning experiences which stimulate socialization, understanding and cooperation. In order to make learning meaningful, transformative processes must be designed fostering knowledge acquisition, students' exchanges and reflection on learning processes to generate a new sense of belonging after the disruptive experience of COVID-19 (Corpus et al., 2022; Syakur et al., 2023).

Second, quantitative data was generative in providing a better understanding of the types of engagement involved in gamified activities. More specifically, the typologies of learning engagement identified in the study accentuate the intricate and multifaceted nature of student engagement, revealing it as a composite of emotional, behavioral, cognitive, and agentic dimensions. This nuanced framework contributes to a comprehensive understanding of how students immerse themselves in the learning process. In particular, the challenge proposed by the game activities stimulated the students' eagerness to learn and discover new information and their proactive and motivated participation in interacting with the proposed learning material.

The playful modality made the learning experience more enjoyable and engaging. It also stimulated engagement, attention and listening during game sessions and feedback and active collaboration with peers during discussions. Collaboration with peers played a significant role in achieving the learning objectives and overcoming challenges, as well as stimulating the monitoring of one's own learning and the retrieval of learned notions. The agentic components of engagement were the least solicited, although those that stand out the most include active participation in discussion and making suggestions for improvement of workgroup products. More generally, the study's findings align with existing literature, emphasizing the holistic nature of student engagement proposed by Fredricks et al. (2004) and Reeve and Tseng (2011), even in the context of gamified learning.

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