TEACHERS' STRATEGIES AND DIFFICULTIES IN DESIGNING GAMIFICATION ACTIVITIES

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ABSTRACT

The spread of technological and IT tools in recent decades has contributed to the demand for new methods, approaches, and tools, such as games, in the field of education. In recent years, gamification has gained considerable interest in various areas, including industry, healthcare, business and education. Teachers are often attracted to gamification but sometimes do not know how to implement it. It is therefore necessary to train teachers not only on the theoretical content but also and above all on how to plan didactic activities using innovative educational approaches. The context of this research is the immersive 3-hour workshop on the theme "Gamification and education: innovative approaches to facilitate learning" which involved 54 teachers from all over Italy from primary to secondary school. The workshop was organized as part of the Italian Ministry of Education's national PP&S project, which aims to improve teaching and learning using new methodologies and technologies. After a short theoretical introduction, the teachers were guided through the individual step-by-step creation of a gamification activity. The research questions are: Which are the most frequent characteristics, factors, and elements of gaming employed in the planning of didactic activities by school teachers? What were the most adopted gamification strategies? What were the most common difficulties in designing gamification activities? To answer the research questions, we analyzed teachers' responses to the initial questionnaire before the workshop and to the final questionnaire at the end. We considered also the designed forms filled by teachers in order to understand how they employed the proposed methodology within their educational activity and to detect which were the most common difficulties in designing gamification activities. Through the designed form, we considered how teachers incorporated gamification strategies into their activities, whether they did so in a marginal way or in a structured way. The results show that, even if some strategies were more complex to develop, teachers really appreciated the proposed methodologies and they tried immediately to put them into practice. The study is an opportunity to reflect on the difficulties that teachers may have in designing didactic activities on different topics with a gamified approach, in order to redesign teacher training to overcome them.

KEYWORDS

Gamification, Gaming and Edutainment, Mathematics, Primary School, Secondary School, Teacher Training

1. INTRODUCTION

Technological developments and teaching methodologies associated with them represent new opportunities in education but also a challenge for teachers. Gamification has proved to be a valuable strategy for teaching, with a positive impact on learning, but it has also revealed itself as a complex research theme (Araújo & Carvalho, 2022). When a didactic approach like gamification becomes a trending topic in education, teachers want to use it, but at the same time, they fear the cost of developing new skills and the uncertainty of the expected learning outcomes or students' satisfaction with the new teaching methodology (Sánchez-Mena & Martí-Parreño, 2017). The term gamification refers to the use of the typical mechanisms of the game, such as the challenge, the use of points, levels, and prizes, in a context that is essentially not a game (Deterding et al., 2011). It also represents a multidisciplinary approach that includes theories, practices, and technologies. According to the opinion of several researchers, if properly planned, gamification can favor and improve the learning and teaching of the subject to be studied (Behl et al., 2022). In education, teachers are often attracted by gamification but do not know how to implement it within their teaching practices. At the same time, many teachers frequently use gamification in class even if they have not yet heard of the term "gamification" itself. It is necessary to train teachers not only on the theoretical contents inherent to these themes but also and above all on the planning of didactic activities to adopt innovative educational approaches. In this sense, the Problem Posing and Solving (PP&S) project of the Ministry of Education (www.progettopps.it) promotes the training of Italian teachers of primary and secondary schools on innovative teaching methods, such as Gamification, with the use of ICT, and gives continuous support to teachers of all types and disciplines (Barana et al., 2019a; Fissore et al., 2020).

The context of this research is the immersive 3-hour workshop on the theme "Gamification and education: innovative approaches to facilitate learning", organized within the PP&S project. This paper is the extended version of the paper presented at the 17th International Conference on e-Learning and Digital Learning (ELDL 2023) with the title "Design didactic activities using gamification: the perspective of teachers" (Fissore et al., 2023). In this version, we have expanded the results section to include a research question about the most common difficulties teachers face when designing gamification activities. The workshop involved 54 teachers from all over Italy from primary to secondary school and it took place face-to-face in March 2023 with a desire to learn and innovate their teaching practices. The first hour of the workshop was focused on a theoretical introduction to the topic with group discussion and interactions between teachers and trainers. Then, several examples of educational activities of different levels using the gamification approach were given. The rest of the workshop was spent on group planning of didactic activities using gamification. In this workshop, teachers reflected on gamification strategies to be used in their activity, as well as on the theoretical contents, objectives, and prerequisites. Trainers have provided teachers with a designed form to guide them in planning the activity, which asks to explain the main characteristics of their work (e.g. synchronous/asynchronous, individual/in groups), the gaming factors (e.g. involvement, control, rewards, fun, progress, accumulation, personalization, and adaptability) and the gaming elements (e.g. challenge, leaderboard, points/coins/treasures, make choices, variation depending on choices, avatars, storytelling). Participants were asked to complete an initial and final questionnaire at the beginning and end of the workshop. The research questions are:

- Which are the most frequent characteristics, factors, and elements of gaming employed in the planning of didactic activities by school teachers?
- Which were the most adopted gamification strategies?
- What are the most common difficulties in designing gamification activities?

To answer the research questions, we analyzed teachers' responses to the initial questionnaire and to the final questionnaire. We considered also the 36 designed forms developed by teachers in groups in order to understand how teachers employed the proposed methodology within their didactic planning and to find out which were their most common difficulties in designing gamification activities.

The paper is structured as follows: in Section 2 the State of the art is outlined, in Section 3 research Methodology is presented together with workshop modalities and type of data collected, in Section 4 the Results are shown while in the final sections results are discussed and Conclusions are drawn.

2. STATE OF THE ART

2.1 Gamification

The proliferation of technological and IT tools over the last few decades, such as computers, smartphones, tablets, which make it possible to play anywhere, has contributed to the demand for new methods, approaches and tools, such as games, in the field of education. At the beginning there was a strong skepticism towards the use of games in education, since it was believed that games had the only purpose of entertaining the participants (De Freitas, 2006). Although, today gaming and gamification represent new ways of interaction, learning and exploration and contribute to the achievement of a defined purpose, different from pure entertainment (Dimoulas et al., 2021). The term gamification refers to the use of the typical mechanisms of the game, such as the challenge, the use of points, levels and prizes, in a context that is essentially not a game (Deterding et al., 2011). Unlike serious games, which are tools designed and developed as game tools from the very beginning, gamification represents an approach that involves the application of characteristic elements of the game within modules or learning units that were not necessarily born as games (Deterding et al., 2011). Many studies have shown how gamification can be successfully adopted in higher education contexts (Čeponienė et al., 2019) and how in the case of distance learning it can stimulate interaction and engagement (De la Peña et al., 2021). However, gamification can be used in education at different levels, from primary and secondary schools to universities and adult education (Vrcelj et. Al., 2023). Gamification can be adopted as a methodology to simplify students' approach to disciplines, especially when combined with the use of adaptive learning, formative assessment, and interactive feedback (Barana et al., 2022, Corino et al., 2022a). Furthermore, gamification enables the user to experience situations that would otherwise not be accessible and provides a safe place where multiple trials can be performed. For example, it is used in the health and safety field to educate people to behave responsibly (Dimoulas et al., 2021).

People who play are motivated by certain factors that characterize games:
- Involvement: players like to feel they have an active role in the game and they are therefore encouraged to participate dynamically. The challenge is one of the key elements to engage users within the game.

- Control: players like to feel they have power and control over their actions.
- Rewards: prizes, even small ones (e.g. badges or achievements) encourage players to keep going, especially when the rewards are regular.
- Fun: users enjoy the game because it is interesting and they will continue to play as long as there is interest.
- Progress: players are stimulated to continue the game if they have the impression that they are moving forward, getting better, and gaining skills. The use of levels in the game is an incentive factor for the user who can be motivated by the progression of the challenge. Another element used in games is the leaderboard to stimulate users to play and get better and better results.
- Accumulation: those who play appreciate the possibility of being able to accumulate rewards (e.g., money, treasure, points).
- Personalization: players like to customize the game, for example by choosing an avatar to develop their own identity.
- Adaptability: players like the possibility of making the game vary depending on their decisions, whose path is the result of their own choices.

These are real needs of the players that the game must be able to satisfy. Gamification exploits the most commonly appreciated advantages and aspects of games to keep students' participation, involvement, and motivation high in order to generate positive attitudes that can promote learning (Deterding et al., 2011). By combining different tools such as points, challenges, leaderboards, levels, and badges, it is possible to create multiple and different game systems (Sümer & Aydın, 2022). Storytelling represents another gamification strategy: telling a story, event, myth, legend or mission is one of the most used ways to involve the user (Chorianopoulos & Giannakos, 2014). A gamification activity can also be an opportunity to favor collaborative learning among students and for the achievement of specific common goals, for example by taking part in a challenge that involves teamwork. In fact, many games make available chats, forums, or other tools to allow communication and interaction between users, which helps to create a community that plays (Chorianopoulos & Giannakos, 2014). In addition, communication and collaboration are important skills identified by the Digital Competence Framework for Citizens (DigComp) (European Commission, 2016).

One of the most attractive aspects of gamification for teachers is to increase students' engagement. As quoted in DigCompEdu (Area 5 – Empowering Learners), competent educators will select, create, and adapt digital resources to empower learners. Educators must personalize students' learning pathways and design resources to actively involve and engage all learners (Punye, 2017). Although there is ample evidence that gamification can engage students in learning, it is less used than one would expect (Araújo & Carvalho, 2022). This raises the question of the difficulties teachers face in planning and implementing gamification in their classes. One of the most difficult parts of using game mechanisms in non-game contexts consists of knowing how to wisely balance learning and game aspects (Bente & Breuer, 2010). On the one hand, game elements are important to engage and motivate students, but on the other hand, it is necessary not to lose sight of the learning goals.

The perception of teachers towards gamification is important in the implementation of its techniques in learning. Teachers perceive the use of gamification both as beneficial and also as a potential risk for classroom atmosphere. According to Sánchez-Mena & Martí-Parreño (2017), the main factors that encourage teachers working in higher education institutions to use gamification in their courses are: the ability of gamification to attract students' attention; the

entertaining nature of gamification to motivate students to learn; the contribution of gamification to more interactive and facilitated learning. Lack of resources (including time to prepare gamified activities and the classroom environment), students' lack of interest in gamification, teachers' beliefs about the suitability of gamification for the subjects they teach, and classroom dynamics (exciting and playful atmosphere), which could ultimately harm the college atmosphere, are the main barriers that prevent teachers from using gamification.

Much research has been done on the difficulties teachers face when implementing gamification activities in the classroom. However, it is also important to study the difficulties in the planning phase of classroom activities as well as the most used strategies. This is the purpose of this study.

2.2 The Digital Learning Environment of the PP&S Project

The PP&S – "Problem Posing and Solving" – project (available at www.progettopps.it), headed by the Italian Ministry of Education, since 2012 has been promoting the training of teachers from primary to secondary schools on innovative teaching methods through the use of digital technologies. Teachers involved in the project learn how to use different kinds of digital tools and new methodologies, such as gamification, in order to enhance their daily didactic (Fissore et al., 2020). By signing up for the project, which is completely free of charge, teachers have the opportunity to have an integrated Digital Learning Environment (DLE) for all the classes of students they need. The use of a DLE, for online or hybrid teaching, can support the implementation of gamification teaching activities (Barana et al., 2022). Within the DLE, students are provided with multiple resources (interactive materials, links, videos, theoretical explanations, etc.) and numerous synchronous and other asynchronous activities. Teachers develop gamification teaching activities for their students in online training activities within a DLE dedicated to the community of PP&S teachers. Teachers also collaborate with each other, sharing ideas, teaching strategies, and materials that have been reviewed and tested in their classrooms. They also develop activities in collaboration with the tutors at a distance during the online training sessions (Barana et al., 2020). A lot of gamification studies focused on specific software or mechanics applied to Learning Management Systems. However, it is possible for teachers to create their own gamified activities when provided with the necessary knowledge. Teachers have an important role in gamification and in the design of educational activities.

Table 1 shows an example of designing a mathematical activity using gamification, illustrated to teachers during online training activities and during this workshop. The activity also offered an example of a compilation of the guided form that teachers have to fill in the planning of their activity.

Table 1. Battleship: example of a mathematical activity using gamification used to train teachers

Title	Battleship
Discipline	Mathematics
School grade	Grade 9/10
Duration	3 hours
Topic	Representation of points on the Cartesian plane
Goals	Familiarize with the Cartesian plane
	Use the Cartesian plane to locate points
	Recognize points, segments, and figures on the Cartesian plane
	Synchronous and asynchronous moments

General characteristics the activity	Groups of 2/3 students Self-assessment
Brief description of the activity	Sink the enemy ship which lies in the rectangle [-2,-1]x[1,2] (see Fig.1). In turn, a student chooses a point on the plane and communicates it to his mate, who selects an abscissa and an ordinate and shoot to hit the goal. More rounds of the game are foreseen if the teacher varies the position of the goal and it is possible to introduce a partial and total leaderboard of the participants. A score based on the number of attempts is assigned (high number of attempts = low score). More levels could be inserted depending on the score obtained. The prize for each round could be the chance to choose the goal position, instead of the teacher, for the next round during which the other teams will compete. The activity continues with a common mission for the class: sink the enemy ship which is located in an unknown area of the Cartesian plane. The exchange of information among groups is fundamental in identifying the winning area and can take place in asynchronous ways, such as through a forum or a specific chat. The game can be repeated several times by varying the winning area
Gaming factors	Involvement, control, rewards, fun, progress, accumulation, and adaptability
Gaming elements	Challenge, leaderboard, points, make choices, variation depending on choices, storytelling

Sink the enemy ship which lies in the rectangle [-2,-1]x[1,2].
Drag the two sliders horizontally and vertically to select the position of the enemy ship, clic on Shoot! to fire.
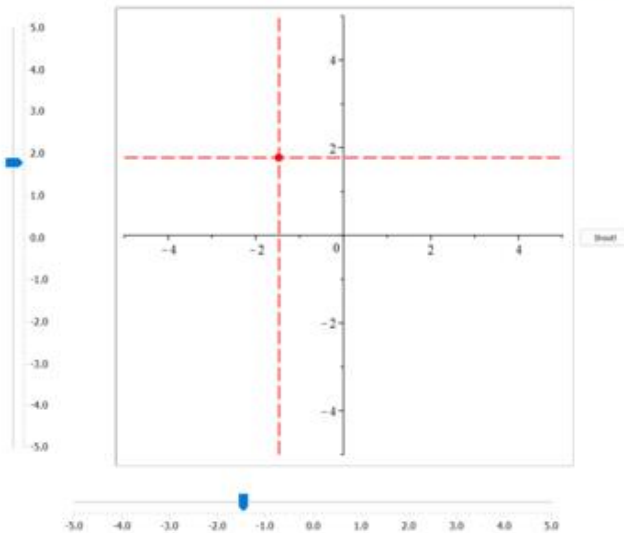

Figure 1. Interactive educational material used for the "Battleship" activity in Table 1

The DLE of the PP&S supports gamification strategies. For example, it contributes to the development of a learning community by providing tools that support communication and collaboration between students (Barana et al., 2021). The forum activity, for example, stimulates collaboration and discussion between users. There are several tools to show students the level achieved, the position in the ranking, and the progress. Moreover, it is possible to access

interactive worksheets, which we used to build the "Battleship" activity. The platform also allows users to receive badges depending on their goals.

3. METHODOLOGY

The context of this research is the immersive 3-hour workshop on the theme "Gamification and education: innovative approaches to facilitate learning" which involved 54 teachers from all over Italy from primary to secondary school. To answer the research questions, we analyzed the designed forms provided by trainers to guide teachers in planning the gamification activity and their responses to the initial and final questionnaires. The first one investigated teachers' data (age, level of education, school, discipline, etc.) and prior experience and knowledge about gamification in education and the perception of their own teaching practices. Using Likert scale questions (from 1= "Not at all" to "5"= "Very much") we asked teachers how much they usually pay attention to the following aspects in their teaching practices: motivation, engagement, cooperation between students, adaptability, inclusion, and involvement. In the final questionnaire, teachers reflected on methodologies proposed to support innovative teaching and how these favor the understanding of different aspects: catching students' attention, increasing motivation for the subject to study, involving students, developing their autonomy and responsibility, and personalizing learning activities. They also expressed how much they appreciated the workshop and the methods proposed to support innovative teaching. The first hour provided a brief introduction to the topic and then a group discussion and interactions between teachers and tutors. The example of a Mathematics activity using gamification in Table 1 was also shown. The rest of the workshop was spent planning a didactic activity in groups. A guided form (as in Table 1) was created to help teachers design a didactic activity using gamification. This form was created on the basis of the illustrated theoretical framework. The activity presented to the teachers, in fact, served both to show an example of an educational gamification activity and to explain how to design the activity using the form. The first part of the form required general information about their activity, such as title, disciplines involved, target, duration, topics, and goals. The second part, focused on gamification, asked teachers to explain the main characteristics (synchronous/asynchronous, individual/in groups), the gaming factors (involvement, control, rewards, fun, progress, accumulation, personalization, and adaptability), and the gaming elements (e.g. challenge, leaderboard, points/coins/treasures, make choices, variation depending on choices, avatars, storytelling, etc.) of their gamification activities in the analysis of the forms filled in by the teachers, we looked at the extent to which they used a gamification approach. We wanted to understand if the gamification strategies were an important part of the structure of the activity or if they were a marginal aspect (for example, presenting a 'traditional' activity instead of making it gamified). The form analysis also made it possible to find out which were the most common gamification strategies used by teachers in their didactic activities on different topics. In order to answer the last research question, we analyzed the extent to which the gamification approach was used in the planning of educational activities. We defined two requirements that the activities should fulfill:

- Are the gamification strategies well integrated into the activity instead of being something external and independent from its structure?
- Are the gamification strategies developed appropriate to the objective of the activity?

We assigned a score of "1" if the requirement was met, otherwise a score of "0".

Classifying the activities designed through these two requirements allowed us to observe how teachers used gamification approaches and to analyze the difficulties encountered during the design phase.

4. RESULTS

Our sample is composed by 47 teachers for the initial questionnaire and 36 for the final questionnaire. 36 activities were designed by teachers using the guided form, less than the number of participants because some of them worked in groups and submitted the same activity. From the initial questionnaire, it was found that only one teacher was under 30 years old, 9 were between 30 and 40 years old, 21 between 41 and 50 years old, 15 between 51 and 60 and only one was more than 60 years old. Only one was a primary school teacher, 18 were lower secondary school teachers, 27 were upper secondary school teachers and one was a head teacher. As shown in Fig. 2, half of them already had prior knowledge of gamification before the workshop. Most of them stated that they usually pay attention to those aspects in their teaching practices: motivation and engagement of students (98%), collaboration between peers (98%), adaptability of learning (85%), inclusion (98%), and involvement (100%). Therefore, the sample considered is made up of teachers who are willing to actively involve and motivate their students to learn. Perhaps it is only necessary to make them reflect with a greater awareness of the methodologies they already employ for this purpose and to train them on innovative educational approaches and practices. In this sense, they attended the workshop to learn how to put these aspects into practice through gamification, and it will be easier for them to approach this methodology because the key elements will not be new.

Figure 2. Teachers' prior experience and knowledge about gamification

Even if some teachers answered only the initial questionnaire (11 teachers), since they could not stay until the end of the workshop, we consider all their responses as an expression of their pre-workshop perspectives on didactics and gamification. The gamification activity was designed by those who completed the final questionnaire.86% of teachers stated that they gained interesting ideas and stimuli from their teaching practices from the workshop. About half of them identified the workshop as a useful occasion to reflect on and rethink their teaching methodologies in order to achieve greater clarity and awareness of didactic design. Teachers created 36 different activities, lower than the number of the workshop participants, since some of them had collaborated and designed the same activity. Regarding the disciplines involved, 15 activities are focused on Mathematics topics, 5 on Science, 3 on Computer Science, 3 on Philosophy, History, and Italian, 1 on Music, and 9 are multidisciplinary activities which cover

simultaneously different subjects, such as Civics, Art, and Geography. All activities are designed to be carried out synchronously and 17 also include asynchronous moments. 35 out of 36 activities provide collaboration between students in small or big groups. We have analyzed also the most frequent gaming factors (involvement, choice, control, rewards, fun, progress, accumulation, personalization, and adaptability) and the gaming elements (e.g. challenge, leaderboard, points/coins/treasures, make choices, variation depending on choices, avatars, storytelling, etc.) employed in their designed activities. Teachers preferred to include some gaming factors and elements rather than others, as shown in Figure 3. In particular, all the activities are designed to actively involve students and they provide rewards (75%), personalization (61%), and make students' progress (78%). Teachers employed other factors less: control (42%), fun (36%), accumulation (36%), and adaptability (25%). Perhaps they found these aspects more difficult to put into practice in a didactic activity. It is worth noting that learning adaptability was the indicator that scored the lowest in the first questionnaire: it proved difficult to implement in the teaching practice. Regarding gaming elements, teachers employed different strategies: the majority mentioned challenges (86%), levels (67%), and leaderboards (53%). About half of the activities enable students to accumulate points/coins/treasures (50%), to win prizes (44%), and make choices (44%). Only a few teachers inserted avatars (28%), or invented stories (33%), or provided variations depending on choices (33%) within their activities. These aspects are also more complex to design and implement in a teaching activity.
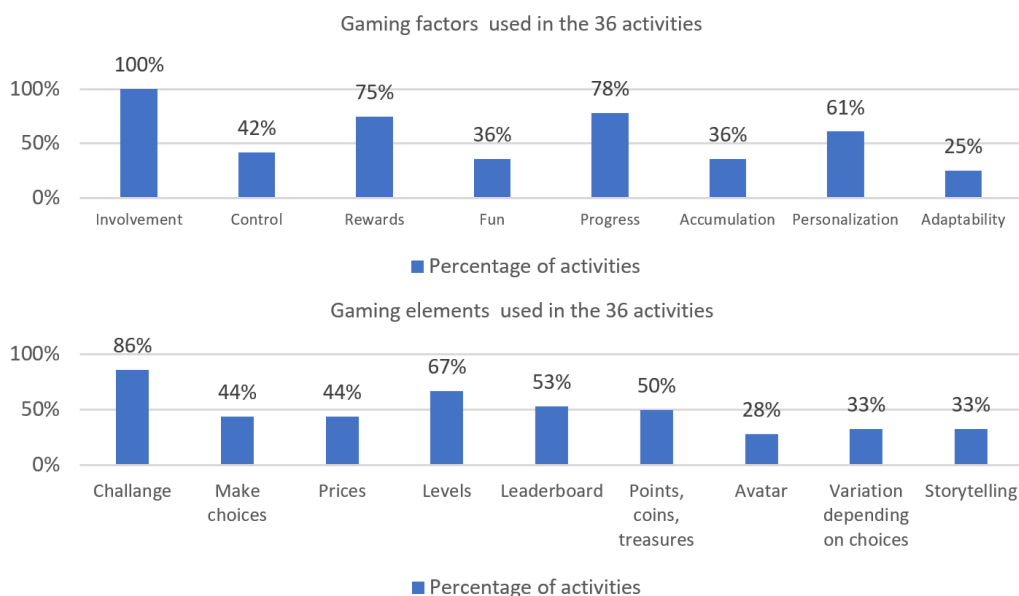

Figure 3. Teachers' choices of gaming factors and elements

One of the most successful activities, shown in Table 2, is entitled "Crossword-Euclid". The activity was designed by a teacher of Mathematics of a lower secondary school on Euclidean geometry topics. The goals of the activity are: to familiarize with fundamental geometric entities; to understand the main axioms of Euclidean geometry and to distinguish and classify fundamental geometric entities. The activity is very interesting because it uses a well-known gamification element such as the crossword puzzle, but in a completely new context. The

activity also involves both designing and solving a crossword puzzle. Since there is a score, the students know that they must not formulate the definitions either in a simplistic or in a too difficult or incomprehensible way, because then it would not be mathematically correct. The most interesting aspect of the activity is that it links linguistic aspects to mathematical aspects. The activity could lead to a collaboration among Mathematics and Italian teachers, since students do not always know how to speak and write about Mathematics topics, and often students' mathematical difficulties depend on linguistic difficulties (Corino et al., 2022b). It would be interesting to implement this task using encrypted crossword puzzles. Linguists consider these question types effective in developing language competences and have already used them profitably in traditional teaching and language learning (Barana et al., 2019b).

Table 2. Crossword-Euclid: example of an activity designed by a mathematics teacher

Title	Crossword-Euclid
Discipline	Geometry
School grade	Grade 6
Duration	3 hours
Topic	Fundamental geometric entities: segments, angles, lines, and polygons
Goals	Familiarize with fundamental geometric entities Understand the main axioms of Euclidean geometry Distinguish and classify fundamental geometric entities
General characteristics of the activity	Synchronous Groups 3/4 students, Collaboration between students
Brief description of the activity	Students create a crossword puzzle using open-source software, where they have to insert terms of the fundamental geometric entities and their respective definitions. Each group must solve the crosswords made by the other groups which will be randomly assigned in various rounds. A leaderboard of the groups that manage to achieve the highest number of correct definitions in the shortest time is drawn up for each round. There is a time penalty: in each round, those who lie in the last 3 positions of the leaderboard must wait 1 minute to solve the next crossword. The first group to complete all crosswords correctly wins a badge.
Gaming factors	Involvement, rewards, fun, adaptability
Gaming elements	Challenge, leaderboard, points, prize

To engage the learners and increase motivation, crossword puzzles can be implemented using an automatic grading system in a DLE (Barana et al., 2019b). This is why it is important to train teachers on innovative teaching methodologies, but also on the development of digital skills. Table 3 shows another example of an activity designed by teachers on conscious daily use of water. The activity not only allows the development of curricular skills but also aims to practical skills that can be used in everyday life: understanding the amount of water used in everyday life and learning to read and use different types of graphical representations.

Table 3. Use or waste: example of activity designed by a technical education teacher and a science teacher

Title	Use or waste
Discipline	Technical Education and Science
School grade	Grade 7
Duration	2 hours
Topic	Estimation, reading, and using graphs
	Understand the amount of water used in daily life
Goal	Learn to read and use different kinds of graphical representations
General characteristics of the activity	Synchronous, Asynchronous, Groups 5 students, Collaboration between students, Discussion between teachers and students
Brief description of the activity	The teacher divides the class into teams (5 students per team). Each team has an amount of water and has to manage and use it for daily uses for 3 days. The first rule is not to give up basic functions (washing and cooking). Whoever manages to survive up to 3 days with the amount of water given wins, perhaps with still water available.
Gaming factors	Involvement, rewards, fun, adaptability accumulation
Gaming elements	Challenge, make choices, variation depending on choices, levels, prize, leaderboard

Table 4 shows the analysis of the questions regarding the extent to which teachers used the gamification approach when planning educational activities. Some teachers tried to completely overturn the traditional didactic practices that they are used to applying in class and tried to fully rethink them from a gamification perspective, as suggested during the first theoretical introduction part of the workshop. But, in four activities the gamification strategies are not part of the design process. In other words, gamification has not been taken into account in the design phase and teachers focused more on other aspects of the activity, such as difficulty, time needed, etc. As a result, gamification is something marginal and external to the structure of the activity. externa. For example, three teachers tried to include elements that are characteristic of games, such as prizes, points, or levels, but within a more traditional design structure (Table 5). The gamification strategies of only two activities were not consistent with their goal. In one case, one of the objectives of an activity is collaboration between students, but the gamification strategies used consist of the use of levels and challenges between students. The collaboration between students consists only of the winners choosing what to propose to the rest of the class.

Table 4. Indicators of the consistency of teaching activities with the gamification approach and the number of activities that meet them

Indicator	Number of activities satisfying the indicator ("1")	Number of activities not satisfying the indicator ("0")
Are the gamification strategies well integrated into the activity instead of being something external and independent from its structure?	32	4
Are the gamification strategies developed appropriate to the objective of the activity?	34	2

Table 5 shows an activity designed by a Mathematics teacher. Looking at the description of the activity, the teacher claimed to have included a multi-level structure. However, the classic quiz structure has been used, with several questions of similar difficulty. This means that it is not possible to follow a progression through several levels. In this case, gamification strategies are a very marginal or almost non-existent element. Moreover, the teacher did not put the declared strategy into practice in the right way; this is one of the main teachers' difficulties. In this case, the activity seems to be a simple educational work on a specific topic, where the gamification approach is an additional external element.

Table 5. Hunt for function: example of marginal use of gamification elements in an activity designed by a mathematics teacher

Title	Hunt for function
Discipline	Mathematics
School grade	Grade 12
Duration	2 hours in class plus possible work from home
Topic	Study and graphical representation of functions
Goal	Understand the characteristics of functions by means of graph comparison
General characteristics of the activity	Synchronous, Asynchronous, Individual, On groups Collaboration and discussion between students, Students' autonomous exploration, Production of materials by students
Brief description of the activity	The game consists of different levels in which the aim is to master the steps of the function study. Each level has multiple-choice questions. 1st level: Given a domain, choose the functions that satisfy it. 2nd level: Choose which functions have a certain sign. Level 3: Identify all the discontinuities and asymptotes of a function. 4th level: Study monotony and stationary points. Level 5: Study concavity. The three students with the highest scores then propose new functions for the rest of the class to study.
Gaming factors	Involvement, progress
Gaming elements	Challenge, levels

To carry out a gamification activity, it is not enough to enter points and prizes to be awarded to the best-performing students, but it is necessary to properly study the gamification strategies, which are an integral part of the structure of the activity, as well as other basic aspects such as time, goals and objectives. From this analysis of the designed form, another difficulty for teachers in developing gamification activities emerged. In fact, in five cases teachers found it complex to rethink their usual teaching practices and to try to adapt them to innovative and more revolutionary methodologies, such as gamification, leaving aside for a moment the usual techniques to which they are familiar and anchored.

5. CONCLUSION

This paper presents the results of a workshop on gamification and education that involved 54 Italian teachers of different levels. From the initial questionnaire, we found that the sample considered is composed of teachers who are willing to actively involve and motivate their students in the learning process and that they were open to discovering and learning new teaching methodologies to use in their teaching practices for these purposes. This fact highlights the need to train teachers who are very often attracted by innovative methodologies such as gamification, but do not know how to implement them in their daily teaching practice. As the final questionnaire shows, thanks to the workshop they were able to discover interesting and clear methodologies and strategies to support innovative teaching, useful to better engage and motivate students in learning processes and to help them develop competencies. Through the analysis of the guided forms filled by teachers during the designing stage, it was possible to study which are the most frequent gamification strategies used by teachers to create activities that allow students to achieve goals and skills in the disciplines they teach. All the didactic activities entail collaboration among students, for example to achieve a common mission or goal. Regarding gaming factors, the most frequent are involvement, rewards, personalization, and progress, which have been implemented mainly through the use of challenges, levels, leaderboards, and points/coins/treasure. From the initial questionnaire and from the guided designing forms, teachers' difficulties in achieving adaptability of learning emerge. A future challenge could be to help teachers enhance their teaching practices, through practical tools and advice, to achieve greater adaptability. From the analysis of the designed form, the main difficulty in designing gamified activities was rethinking the activity by exploiting gamification strategies. Some teachers have added gamification elements but without making them a fundamental part of the activity. Teachers find it difficult to go beyond the usual teaching practices in order to experiment with more innovative strategies compared to the traditional techniques. Another difficulty was putting gamification strategies into practice in the right way. Some teachers have tried to implement the elements and factors typical of the game (such as points, prizes, and progress) to their usual teaching activities, but making these aspects irrelevant to the core of the activity. The study was useful in raising awareness of the difficulties teachers face when planning gamification activities. In the near future, the intention is to support them in overcoming these problems, paying particular attention to these aspects in teacher training. For teachers to use gamification, knowledge is required, as well as gaming experience, creativity, and resilience. Some obstacles may arise, but it is possible to adjust the plan and see changes in student behavior.

The experience led to the production of valid gamification educational activities and was full of very interesting ideas. The same experience can also be offered to the students. Since teachers really appreciated the activities and methodologies shown during the workshop, we think that a further step can be the creation of a database of didactic activities using a gamification approach on different topics and disciplines that can be shared among a wide community of teachers, from primary to upper secondary school, in a vertical perspective, as well as the PP&S community. The results show that the experience can be presented at all levels and facilitate dialogue between teachers who teach different subjects at different schools.

Future research concerns the implementation of the activities designed by the teachers within the PP&S DLE and the study of the best tools to put the designed gamification strategies into practice. Indeed, the next training courses will include the implementation of gamification activities in addition to design. Another future challenge could be to study if and how AI tools can support gamification in education, in particular in the creation of increasingly engaging, motivating, and personalized didactic activities, thereby improving the student experience. Technology can indeed enhance teaching approaches such as gamification, but the role of the teacher remains fundamental in the planning of teaching activities.

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