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Is GBL Good for Teachers? A Game for Teachers on How to Foster Students' Self-Regulated Learning

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Abstract: This explorative case study investigates a game-based approach to the professional development of in-service teachers in Self-Regulated Learning. The impact of this approach was assessed in terms of acceptance of the game, knowledge gain and changes in teachers' beliefs concerning the importance of nine design principles that can be adopted to foster the development of students' SRL skills. Our findings suggest that the game-based approach adopted in this study was well-accepted, with Wilcoxon tests revealing that the mean rating is significantly different from the median point of the scale for all items measured after game use. As for teachers' learning gains and changes in beliefs, a questionnaire submitted to participants before and after the gameplay showed significant changes in knowledge and a more varied but generally positive trend in terms of changes in beliefs. Thus, the study's findings advocate for increased dedication to researching and experimenting with the incorporation of games in teacher professional development, potentially extending these efforts to other educational domains.

Keywords: game-based learning; serious games; Self-Regulated Learning; teacher professional development

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1. Introduction

The COVID-19 pandemic has brought to light many needs and inadequacies of our education systems [1]. Among these, on the one hand, teachers' inadequate skill in designing and running student-centered educational interventions, especially when technology-enhanced learning environments come into the equation, and on the other, the need for students to become better learners, by taking the reins of their own learning processes and become active participants in their own learning community. However, these apparently separate issues are indeed two faces of the same coin. If teachers' skills to get students involved in their own learning process improved, then it would be much easier for students to increasingly take responsibility. Moreover, much teacher professional development is still carried out in a transmissive way, perhaps in the belief that teachers, being adults, do not need to be motivated or engaged in their professional development. However, this leads teachers to replicate the same teaching strategies, as if they did not believe in the power of active learning. This is a conundrum without escape unless we start from the beginning, i.e., from how we train teachers, especially those who are already working and for so many years have taught in the same way they were taught themselves, in the implicit assumption that students cannot make important decisions about their learning process [2].

It is against this backdrop that this paper presents the outcomes of an explorative case study aimed at investigating the impact of a learner-centered approach, more specifically, a Game-Based Learning (GBL) approach, on teachers' knowledge and beliefs regarding Self-Regulated Learning (SRL), along with their reactions to the use of a hybrid game in the context of a Teacher Professional Development (TPD) initiative intended to enhance both teachers' understanding of the SRL construct and their ability to design learning activities that can promote their students' SRL skills.

The game, namely the SRL-4Ts game, is a hybrid (partly digital, partly tangible) game developed on purpose to support an experiential approach to the design of learning activities incorporating features intended to foster SRL practice.

Thus, the study lies at the crossroads between different research fields, GBL, SRL, and TPD, and seeks to fill in a critical gap in the existing literature because the use of games in TPD is rather under-investigated and this is at odds with the emphasis given to learner-centered and, particularly, game-based approaches when it comes to training teachers and encourage them to adopt these approaches with their students.

In the following sections, we provide an overview of the above-mentioned research fields based on the extant literature from a dual perspective: on the one hand, game-based approaches for TDP, and on the other, SRL and TDP.

1.1. Game-Based Teacher Professional Development

According to three recent literature reviews [3–5], while there has been a lot of attention paid to GBL [6–8] and TPD [9–11] as separate fields, there is a dearth of research and experiences on the use of GBL approaches in teacher training. In fact, although several studies have investigated GBL in combination with TPD, the above three reviews conclude unanimously that most of them are aimed at sensitizing or training teachers on the use of GBL in their classrooms (TPD on GBL) rather than using GBL to enhance the outcomes of teacher training (GBL for TPD). This finding is quite paradoxical because it suggests that, almost 20 years after [12] published their paper entitled "Do we practice what we preach?: putting policy into practice in teacher education" in teacher education and TPD, we are still not practicing what we preach, perhaps due to an implicit belief that GBL is not good for adults, let alone teachers.

As a matter of fact, several authors see games as an important component of people's learning ecologies [13], and attempts to exploit their affordances for learning have proliferated, especially under the push of the explosive spread of digital entertainment games, on the one hand, and the pressures for increased use of technology in education, on the other. Such pressures are motivated by the potential of technology to support a paradigm shift from teacher-centered, transmissive teaching to student-centered learning environments where learners take an active stance and are encouraged to gradually take the reins of their own learning process. The efforts made by researchers and educators to harness the potential of games for learning are in line with this paradigm shift and have led to the development of so-called "serious games", i.e., games developed for purposes beyond pure entertainment [14]. However, the development of these games tends to concentrate on a limited set of fields, first and foremost children's learning and school education [15], but also niche sectors like rehabilitation and health in general [16–18] or games aimed to change older adults behaviors [19,20]. So, in spite of the evidence available about (serious) game's effectiveness in engaging and motivating learners, including adults [7,21,22], teacher training and especially TPD seems to be rather impermeable to GBL, and few studies have been reported where games or gamification have been used to this purpose [23–27]. Interestingly enough, one of the above studies [27] concerns the development of Regulatia, a game conceived to foster SRL in higher education students, including pre-service teachers. Unfortunately, though, Regulatia was still under development at the time of writing, so no data about its use were reported. In addition, the paper focuses mostly on teaching the theoretical underpinnings of the SRL construct rather than taking a learning-by-doing approach by engaging prospective teachers in possible applications of SRL theory. In the present study, instead, we take a more pragmatic approach and use GBL to improve teachers' skills to design learning activities that foster students' SRL skills.

1.2. Self-Regulated Learning and Teacher Professional Development

SRL refers to the processes through which individuals actively and consciously monitor, regulate and control their own learning. This requires that they are metacognitively,

motivationally, and behaviorally active participants in their own learning process [28]. In this effort, they are guided and constrained by their goals and contextual features [29,30].

It should be noted, though, that SRL does not necessarily take place only in individual learning contexts; on the contrary, there are many studies that investigate how SRL happens in collaborative learning contexts [31]. Similarly, SRL can and should be encouraged at all ages, from pre-school children [32,33] to adults [34], because it is through practice that learners learn to self-regulate [35,36].

SRL has been widely investigated in the last decades, with theoretical studies concerning models of self-regulation [37], studies concerning the role technology can play in SRL [38–40] and more pragmatic studies tackling the issue of how teachers can provide their students with opportunities for SRL practice [41]. The importance of this field of investigation is due not only to the positive relationship between SRL and academic achievement [42] but also to the need to develop learners' life-long learning competencies and to the essential role played by teacher professional development in this view [43,44].

One of the most well-known models of SRL [28] sees SRL as a cyclic process consisting of three phases: forethought, performance, and self-reflection. These three phases are all needed during the process of self-regulation, and the last one, self-reflection, normally stimulates a further phase of forethought that leads to improving the adopted learning strategies and, consequently, the following performance phase. Therefore, teachers who wish to support their students in practicing SRL should make sure that, for each phase of Zimmerman's model, the relevant sub-processes are supported.

For example, in the forethought phase, the design should activate previous knowledge and meta-cognitive skills; learners should be able to make decisions on their learning goals, plan their own learning process, take into account their own preferences and aptitudes, make choices regarding objectives, contents, methods, learning paths, evaluation methods, and organization of work.

To support SRL in the performance phase, on the other hand, the design and learning environment should offer opportunities to monitor progress in the learning pathway, control and manage time, constantly check results, and seek help and constructive feedback when needed. The control of the learning environment is also crucial [45], and technology can play both a supporting and a hindering role in this regard [46].

To facilitate self-reflection, assessment for learning should be preferred to assessment of learning, different forms of feedback should be provided (including peer feedback), and students should be able to choose between different forms of assessment, their timing, and the type of artifacts they wish to produce for assessment [47].

Having said that, when training teachers on how to design their teaching activities so that they foster learners' SRL, an experiential approach is needed [48,49]. In other words, teacher training on SRL is yet another case where there are good reasons for trainers to "practise what they preach" [2,12] by adopting approaches where trainees are engaged in real-world tasks, in this case, in the design of learning activities for their students, and at the same time reflect on what they are learning. GBL is particularly suited to achieve this aim because it has been found to support reflection and SRL skills development [50,51].

Finally, in the SRL field, teachers' beliefs are an important predictor of teacher behaviors [52]. Thus, to assess the effectiveness of teacher professional development in this field, evaluating the impact on teachers' beliefs is of paramount importance. While the relationship between teachers' beliefs and their actual practice is a very complex one because inconsistencies between the two are frequent [53], the case of SRL skills is even more critical. In fact, teachers tend to resist the idea that students should be given enough freedom to make significant decisions about their learning processes. The whole school system is, in most countries, designed in such a way that even the teachers have limited autonomy in deciding the learning aims, the disciplinary content, and the assessment methods. Thus, changing teachers' beliefs about who should make these decisions and the extent to which students should be empowered is a difficult endeavor, especially when

considering primary and lower secondary teachers and their students' autonomy in the forethought and self-reflection phases of the SRL process [54].

1.3. Aim of the Study and Research Questions

In the following, we intend to explore how GBL can help improve in-service teachers' ability to design for the development of students' SRL skills through reflection on related design principles. To this end:

- We describe the SRL-4Ts game, a board game developed to stimulate teachers' reflections on how to improve the SRL-development affordances of a given learning activity. The description discusses the game features against the recommendations provided by a recent literature review [55] investigating the theoretical bases of gamification and GBL;
- We report on a case study aimed at collecting evidence on the effects of the game in terms of knowledge, design skills and beliefs of the teachers involved;
- We provide and discuss the results of the case study in terms of acceptance of the approach, knowledge acquisition, and changes in teachers' beliefs;
- We conclude by discussing the main limitations of the study and its future developments.

The research questions addressed by the study are the following.

What was the impact of the SRL-4Ts game on in-service teachers in terms of (1) game acceptance, (2) teachers' learning outcomes regarding SRL, and (3) changes in teachers' beliefs concerning SRL?

2. Materials and Methods

2.1. The SRL-4Ts Game

The SRL-4Ts game is a serious game for teachers developed and used within the framework of the SuperRED Erasmus+ project as an additional component of the 4Ts game [56]. However, the two games can be used independently, and they have different but complementary aims. While the 4Ts game is intended to support teams of teachers in designing collaborative activities for their students, the SRL-4Ts game aims to foster teachers' reflection on how to endow the design of a collaborative activity with features that can support students' SRL practice and hence the development of related skills.

The SRL-4Ts game comes in three different formats:

- Digital format;
- Tangible format;
- Hybrid format (partly tangible, partly digital).

In this paper, we report on the use of the hybrid format, which is the only one that has been experimented with so far. Therefore, in the following, we describe only this version of the game.

2.1.1. Game Components

The hybrid SRL-4Ts game is composed of a digital main board (Figure 1), a tangible leaderboard with colored badges (Figure 2), 4 digital decks of cards (Figure 3), 4 digital (or tangible) dice, and 6 player tokens for up to 6 players.

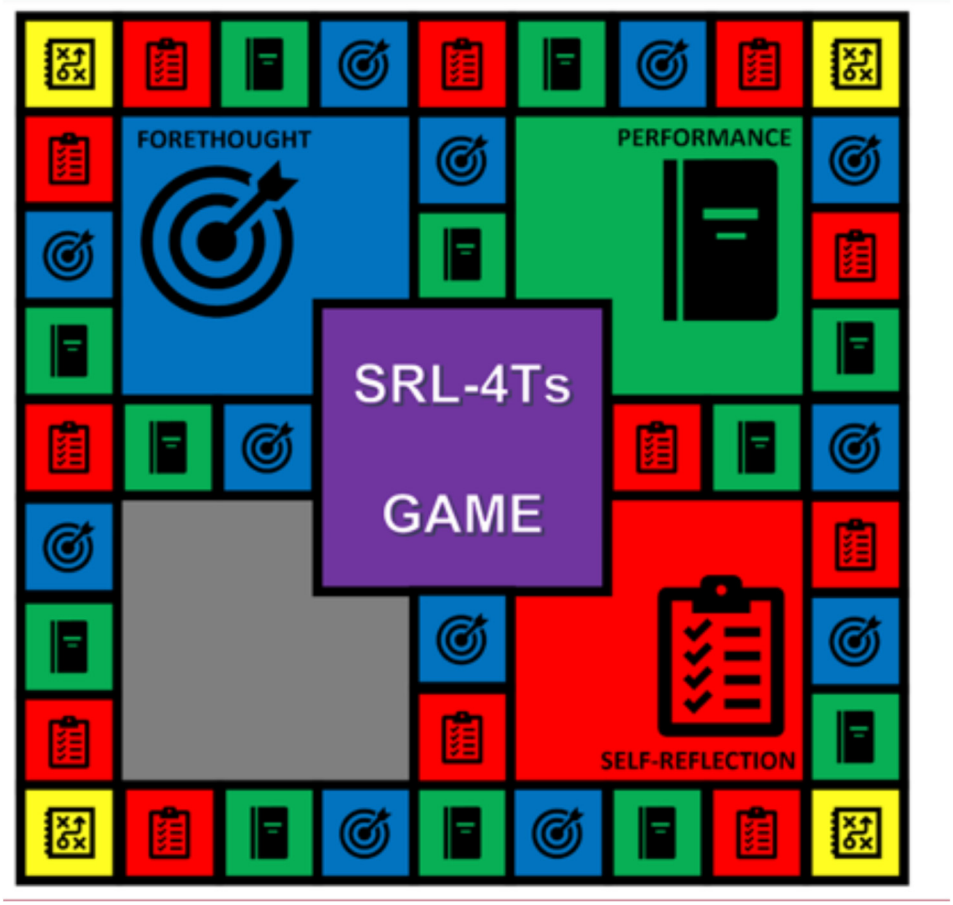

Figure 1. Main board of the SRL-4Ts game.

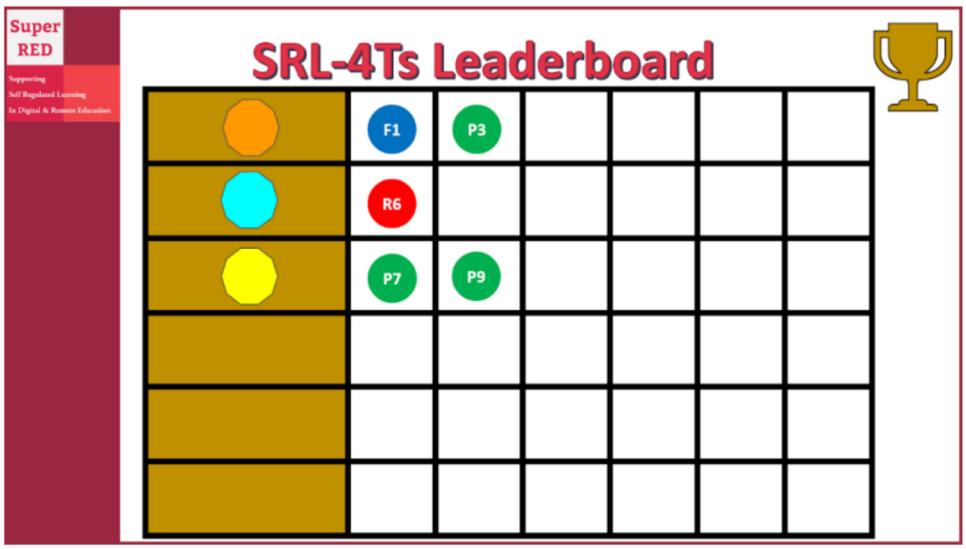

Figure 2. The SRL-4Ts leaderboard: each row of the leaderboard corresponds to a player and contains the colored badges gained by that player during gameplay.

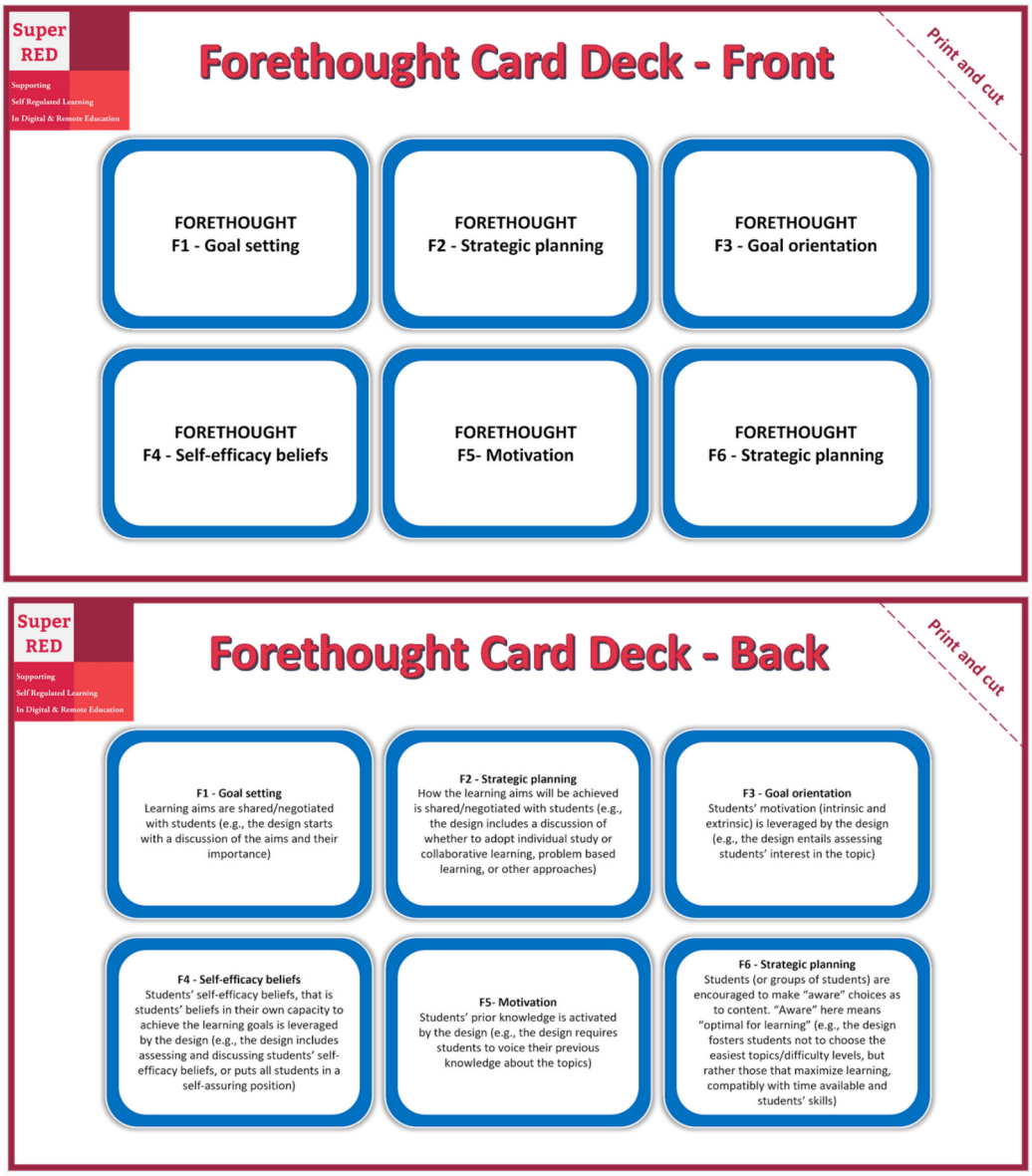

Figure 3. Front and back of the first 6 cards of the forethought deck.

The digital main board (Figure 1), inspired by the Trivial Pursuit board game, contains 40 boxes: 12 for "Forethought" (blue), 12 for "Performance" (green), 12 for "Self-Reflection" (red), and 4 yellow "choice" boxes corresponding to any of the above based on player choice. The central violet box is the starting point of the game, where digital players' placeholders are positioned at the beginning of the game.

The leaderboard (Figure 2) is meant to keep track of players' progress.

The 4 decks of cards are in digital format and contain 12 "Forethought" (blue) cards, 11 "Performance" (green) cards, and 6 "Self-reflection" (red) cards, for a total of 29 cards.

Figure 3 shows the first 6 forethought cards as an example. The content of these cards is the result of a piece of desk research that led to identifying a set of principles for SRL-oriented learning design containing 12, 11, and 6 principles for the three phases of Zimmerman's model [57]. The outcome of this work is incorporated into the cards of the game. Each card contains one principle and is marked by a keyword identifying the aspect of self-regulation it refers to (i.e., goal setting, strategic planning, goal orientation, self-efficacy beliefs, motivation, personalization, time management, supporting orientation, meta-cognition, help-seeking, attention focusing, emotional support, self-

assessment, causal attribution). The cards, and hence the principles, are at the core of the SRL-4Ts game, as the teacher-players will have to apply the principles in the design process during gameplay.

The four dice comprise a main die with 6 faces and one die for each of the SRL phases with as many faces as the related principles, i.e., 12 for the forethought, 11 for the performance, and 6 for the self-reflection die.

2.1.2. How to Play the SRL-4Ts Game

The game can be played by small groups of teachers (team sizes ranging from 2–6), sitting around a table with a game master (typically a teacher trainer). Before gameplay, in accordance with [55], the game master illustrates the goals and their relevance, while teachers should do a preparatory phase.

In the preparatory phase, each player is provided with a printed design of a learning activity and is asked to (1) identify SRL design principles already implemented in the design and (2) devise ways to enhance the design by following the SRL design principles of the cards. In doing so, the player keeps track of the principles implemented in the enhanced design by sticking colored badges with codes on the design. At the end of this preparatory phase, each player should have stuck on the design all the badges corresponding to the principles they believe that design uses.

Actual gameplay takes place after the preparatory phase. It starts with each player positioning their (digital) tokens in the central violet box of the main board (Figure 1) while the tangible leaderboard is placed on the table. Players take turns rolling the main die and then moving in whichever direction they wish on the board. According to the color of the cell they land in, the cards of the respective Zimmerman phase are activated: blue cards for the forethought principles, green for the performance, and red for self-reflection. If the cell is yellow, the player can choose the deck they wish to activate. Thus, they will roll the respective die and check if the principle in the corresponding card has been used in their design. The card drawn will name one of the SRL-promoting design principles; if the player stuck the badge corresponding to that principle on the design and can successfully argue that the design implements or could be improved by applying the principle, they are awarded a point that will be added to the leaderboard. The game master resolves ambiguities and disagreements.

The gameplay ends after one hour, and four awards are given to the winning players: the SRL award to the player with the highest number of badges and the forethought, performance, and self-reflection awards to the players with the highest number of badges in the respective categories. This type of mechanics aligns well with most of Krath's recommendations on how to design GBL [55] because players' good performance is positively reinforced by their progress on the leaderboard and because content is adaptive (teachers can choose which principles they wish to apply and how) while the game nudges them towards the application of as many design principles as possible.

2.2. Context and Data Collection Method

The game was tested in the context of the SuperRED project's teacher training activities. This project is still in progress and is implementing a 3-year training initiative on SRL whose outcomes in terms of changes in teacher practices and students' learning will be assessed at the end of the project. However, we took advantage of the first intensive training event of the project to carry out a real-life intervention with the SRL-4Ts game and, contextually, an exploratory study investigating the game's impact in an international context. Specifically, 15 teachers involved in the project volunteered to take part in the intensive face-to-face event during which they were trained on SRL and learning design. The event lasted a total of three full days. The SRL-4Ts game session was on the third day, after a theoretical introduction to the concepts underpinning it (including the Zimmerman model). The participants were from Italy (8), Belgium (4), and Spain (2), 10 females and 5 males, aged from 27 to 68. Although this sample is rather small, it yields a diversified picture of Western

European teachers in terms of previous competence in the field of SRL. In fact, their self-assessment of their own competencies in the area was rather low (average 2.2 on a range of 1 to 5), with Belgian teachers being more knowledgeable than their South European counterparts. The majority (10) teach in secondary schools, and they all have significant experience (years of teaching: 15.78 ± 8.52). The distribution of teaching subjects is quite even (six teach STEM subjects, four teach foreign languages, and five teach social sciences or humanities subjects). As for qualifications, six participants reported having a teaching certificate, eight a bachelor's degree, five a master's degree, and two a Ph.D.

Prior to and after the training, participants were asked to fill in two short, anonymous and paper-based questionnaires developed on purpose for this study. The questionnaire filled in by participants after the training contained the same questions as the other, plus a set of questions intended to explore respondents' acceptance of the game. In the context of this study—"game acceptance" is defined as the degree to which participants perceived the SRL-4Ts game as a useful, easy to use, engaging, effective, and reusable tool for facilitating understanding and implementation of (SRL-aware) strategies in their teaching practices. This definition aligns with the broader literature on technology acceptance [58,59] and GBL, which often considers similar dimensions to gauge users' acceptance and the potential effectiveness of a digital tool or game in educational contexts.

For the questions in common between the two questionnaires, a personal code was used to couple the pre- and post-data of individual participants and the Wilcoxon signed-rank test was used to compare the results. For the questions concerning game acceptance contained only in the post-test, Wilcoxon tests were carried out to assess whether the mean was significantly different from the median point of the scale.

2.3. Data Collection Tool

In total, the questionnaire contained:

- 10 items on game acceptance (only in the post-questionnaire), including:
  - 2 items on Perceived Usefulness (i.e., teachers' perception of the game's effectiveness in enhancing their understanding of SRL and reflecting on effective teaching strategies to foster students' SRL skills),
  - 2 items on Ease of Use (i.e., teachers' opinions regarding the ease of understanding and playing the game, as well as the clarity of the contents presented in the game),
  - 3 items on Engagement and Motivation (i.e., the level of engagement and motivation the teachers experienced while playing the game, including whether the game made learning about SRL fun and motivating),
  - 1 item on Learning Enhancement (i.e., teachers' perception of the game's role in making their learning about SRL more effective compared to other learning methods),
  - 2 items on Reusability and Commandability (i.e., the teachers' willingness to reuse the game for assessing their own designs and recommending the game-based approach to their colleagues for learning about SRL).
- 5 items on learning outcomes, including:
  - 1 self-assessment question on perceived competence on SRL,
  - 3 multiple-choice questions with a correct answer (one concerning the definition of the construct, one concerning Zimmerman's model and the third concerning design principles for SRL development),
  - 1 question on the perceived importance of increasing students' SRL skills in today's teaching practice.
- 9 items about teachers' beliefs, investigating to what extent participants believed some design principles to be important for fostering SRL.

3. Results

3.1. RQ1: Game Acceptance

Results on game acceptance are reported in Table 1 and concern data from all of the 15 participants. These items required respondents to rate their agreement with the statements below on a scale from 1 = completely disagree to 5 = completely agree.

Table 1. Descriptive statistics concerning items on game acceptance. Wilcoxon tests were carried out to assess whether the mean was significantly different from the median point of the scale (3). * = $p < 0.05$, ** = $p < 0.01$.

Item	Mean ± SD (Post)	Wilcoxon Test
Using the game helped me to understand what Self-Regulated Learning is	4.38 ± 0.87	V = 55, $p = 0.004$ **
Using the game helped me to focus on effective teaching strategies to support the development of my students' SRL skills	4.08 ± 0.95	V = 62.5, $p = 0.008$ **
Understanding how to play the game was easy	4.00 ± 0.58	V = 66, $p = 0.002$ **
The contents of the cards were clear	4.00 ± 0.91	V = 36, $p = 0.012$ *
Playing the game was engaging	4.46 ± 0.66	V = 78, $p = 0.002$ **
Playing the game was motivating	4.23 ± 1.01	V = 63.5, $p = 0.006$ **
Playing the game made my learning about SRL fun	4.15 ± 1.21	V = 62, $p = 0.008$ **
Playing the game made my learning about SRL more effective	4.15 ± 0.80	V = 55, $p = 0.005$ **
I would like to play the game again to assess my own designs	4.23 ± 1.01	V = 63.5, $p = 0.006$ **
Should I advise a colleague to attend a course on SRL, I would advise him/her to follow one where the game is used	4.08 ± 1.12	V = 43.5, $p = 0.010$ *

3.2. RQ2: Learning Outcomes

Pre-post responses were compared to answer this research question. Due to issues pertaining to the code used for questionnaire anonymization, only 12 pairs of questionnaires could be used for analysis. Given the limited sample size, a Wilcoxon signed-rank test with continuity correction was used.

Responses to the question concerning self-reported competence on SRL show a significant increase in perceived competence from 2.20 ± 0.77 to 3.62 ± 0.65 (V = 0, p-value = 0.005).

Responses to the three multiple-choice questions were coded as correct or incorrect, and the number of correct responses was considered as a single variable.

The number of correct responses to the multiple-choice items rose from 0.50 ± 0.65 to 2.33 ± 0.89, a significant increase (V = 0, $p = 0.008$).

Given that the training intervention also aimed to increase participants' awareness of the importance of developing students' SRL skills, we regard changes in this belief as a learning outcome. Hence, we report in this section (rather than the following one) the answer to a question directly addressing this belief. Respondents were asked to rate on a scale from 1 (=not at all important) to 5 (=extremely important). Although the mean rating attributed to this item increased from 4.36 to 4.75, the difference is not statistically significant (V = 2.5, p-value = 0.4237).

3.3. RQ3: Changes in Beliefs about SRL Principles

Results for the beliefs are reported in Table 2; we considered responses to the 9 items investigating beliefs separately. Responses were provided on a scale from 1 (=not at all important) to 5 (=extremely important).

Table 2. Participants' beliefs on the importance of a selection of SRL principles. * = $p < 0.05$.

Item—SRL Principle	Mean ± SD (pre)	Mean ± SD (Post)	Wilcoxon Test *p*-Value
Negotiating with students how the learning aims will be achieved	3.87 ± 1.19	3.69 ± 1.18	0.943
Fostering students to choose which technology they wish to use to produce their artifacts	3.33 ± 0.90	3.38 ± 0.96	0.931
Fostering students to choose learning strategies that are suitable to achieve the learning objectives	3.67 ± 0.72	4.38 ± 0.51	0.023 *
Fostering students to manage learning timing and negotiate deadlines	3.87 ± 1.13	4.46 ± 0.66	0.072
Fostering students to reflect on their learning process	4.73 ± 0.46	5.00 ± 0.00	0.149
Making sure students receive emotional support to overcome anxiety and disappointment	4.27 ± 0.70	4.38 ± 0.77	0.586
Fostering students' self-assessment and reflection on the causes of their failures	4.40 ± 0.63	4.62 ± 0.65	0.149
Fostering students to compare their performance with that of peers	3.33 ± 0.98	4.23 ± 1.01	0.040 *
Fostering students to configure their learning environment in such a way that is conducive to learning	4.07 ± 0.70	4.00 ± 0.41	0.766

Wilcoxon signed-rank test results on the beliefs regarding the importance of specific design features for improving students' SRL are reported in Table 2.

4. Discussion

Overall, the SRL-4Ts game demonstrated a positive impact on teachers in terms of game acceptance, learning outcomes, and belief changes regarding several SRL principles. While the game impact in terms of acceptance and learning effectiveness was definitely positive, the changes in participants' beliefs concerning different design principles exhibited a positive trend but were only significant for two principles, possibly due to the small sample size. This indicates the need for further investigation into the beliefs of teachers concerning the feasibility of different strategies to promote SRL.

In the following, the results are discussed in more detail based on the three research questions.

4.1. RQ1: Game Acceptance

With reference to game acceptance, results offer a substantial basis to argue in favor of the positive impact of the SRL-4Ts game on the participants in terms of game acceptance. More specifically, they indicate a high level of agreement among participants that the game helped them understand SRL and focus on effective teaching strategies to support its development in students (perceived usefulness, Mean Scores ranging from 4.08 to 4.38). This is a significant finding, aligning well with the literature that underscores the effectiveness of game-based learning in enhancing understanding and engagement with complex concepts, including in adult education settings [21,22]. The participants found the game easy to understand and the contents of the cards clear (ease of use, Mean Score: 4.00). This positive feedback is in line with the literature emphasizing the importance of clarity and ease of use in educational game design to foster effective learning [7]. The game was successful in engaging and motivating the participants (engagement and motivation, Mean Scores ranging from 4.15 to 4.46) providing a means for making their learning about SRL fun and effective. This corroborates extant results highlighting the potential of game-based learning to enhance engagement and motivation when the learners are adults [6], while it provides new evidence for the specific case where the learners are teachers. Comparison of the game-based approach with traditional teacher professional development methods was in favor of the former (learning enhancement, Mean Score 4.15). Finally, the participants

expressed their willingness to play the game again and recommend it to their colleagues (Mean Scores: 4.23 and 4.08). This is a strong endorsement of the game, and it aligns with the literature that suggests well-designed educational games can foster a positive learning experience leading to repeated engagement and recommending the game to others [7].

These results, combined with the very positive informal comments of the participants concerning the whole intervention, allow us to conclude that there is no reason to believe that teachers are not a suitable target for game-based professional development. Such positive reactions by teachers to the proposed game-based approach should at least question the commonplace that teachers are generally reluctant to learn with game-based approaches and—on the contrary—should encourage the adoption of games in teacher professional development initiatives.

4.2. RQ2: Learning Outcomes

In addressing the second research question concerning the impact of the SRL-4Ts game on in-service practicing teachers' learning outcomes regarding Self-Regulated Learning (SRL), our results suggest a positive influence on the participants' understanding and competence in SRL. The significant increase in perceived competence indicates that the game had a positive effect on the teachers' perception of their own competence in SRL. Of course, the few items aimed at assessing participants' knowledge of SRL provide only limited evidence of their knowledge improvement, but the fact that—despite the limited sample size—results are statistically significant is definitely encouraging. Additionally, the significant increase in participants' perceived competence is an important achievement, especially when combined with their increased awareness of the importance of developing students' SRL skills.

With reference to teachers' belief in the importance of SRL, while there was an increase in the mean rating attributed to the relevant item, this difference was not statistically significant. However, this outcome is understandable given the context. Because the teachers volunteered to participate in the study, it can be inferred that they already held a strong belief in the importance of SRL. Thus, the game might not have had a pronounced effect in this particular aspect, as the participants were already in favor of it. Further research might delve deeper into the effects of this approach on a random sample of teachers.

4.3. RQ3: Changes in Beliefs

RQ3 seeks to understand the impact of the SRL-4Ts game on teachers' beliefs regarding the importance and feasibility of SRL development in their classes. The intervention had a differentiated impact on teachers' beliefs according to the different SRL principles.

While there was a significant positive change in the two beliefs concerning the importance of, "encouraging students to choose suitable learning strategies" ($p = 0.023$) and "promoting peer performance comparison" ($p = 0.040$), most of the other beliefs saw positive changes, but these were not statistically significant. This is not surprising, as teachers' beliefs are rather resistant to change [52].

More specifically:

- The significant increase in the post-test scores of "encouraging students to choose suitable learning strategies" indicates that the intervention succeeded in making teachers recognize the importance of this principle, which is in line with the SRL literature emphasizing the role of strategy selection in SRL processes [28].
- The post-intervention significant increase in scores of "promoting peer performance comparison" suggests that teachers became more open to the idea of fostering a learning environment where students learn from one another rather than just from the teacher. This is consistent with the SRL literature that highlights the benefits of peer comparison in encouraging self-reflection and fostering a collaborative learning environment [31].
- The Mean Score of most of the other items increased, but the changes were not statistically significant. However, the related beliefs scored rather high already in the

pre-test, possibly due to the likelihood that their beliefs were higher than average as they had enrolled in our training initiative. Thus, extending the study to a larger and randomly selected sample might yield more favorable and reliable results as the pre-test would likely be less positive.

- The only item where there is a slight decrease in the post-test score as compared to the pre-test concerns the need for students to be free to configure their own learning environment. This result suggests that the intervention did not significantly alter this belief, possibly because respondents do not believe this is feasible. Perhaps teachers still refer to traditional classroom settings without considering the role that technology can play in this regard [45].

From a more general view of the strategies that teachers may adopt to improve their students' SRL practice, our results show that according to our respondents, the most important design principles for SRL concern fostering students to reflect on their learning processes, with specific emphasis on self-assessment strategies that help them to identify the causes of failures, and making sure they receive emotional support. These results appear to be more positive than those reported by Dignath-van Ewijk and Van der Werf [52], whose survey of teachers' beliefs suggested that, in the absence of training, teachers seem to believe that providing room for choice to students is more important than actually helping them to reflect on ways to make informed choices. Thus, our training intervention achieved a noteworthy outcome in this regard. In addition, the importance attributed to emotional support (an aspect of SRL somewhat underestimated in many studies about SRL, including the above-mentioned one) may be informed by the recent boom in emergency remote education brought about by the COVID-19 pandemic, where it was clear that the emotional component of SRL plays a role of paramount importance [60].

5. Conclusions

Our findings suggest that the game-based approach adopted in this study was well-accepted and produced significant results in terms of learning outcomes. As far as the changes in teachers' beliefs, the results obtained are not exceptional, but they can be regarded as satisfactory, considering that the aims of a teacher training intervention of three days, even if intensive and engaging, cannot be too ambitious.

Although these results cannot be generalized to all game-based approaches, we believe we can conclude that GBL is not suitable for students only and that the present lack of research and experiences on its use with teachers is hardly justified. In line with Krath and colleagues [55], we believe the strong points of our approach are that the game aims and learning aims are well-aligned and clearly relevant (the application in practice of design principles favoring SRL development), that feedback is timely and good performance is positively reinforced through advancement in the leaderboard, content is simplified as it is represented by design principles with examples, players can pursue individual learning goals by applying the design principles as they see fit. Additionally, the playful experience was engaging, and the competitive component of the game was very mild and leveraged social comparison. We therefore encourage further research in this direction.

The primary limitation of this study is the nature of the sample: its limited size and the fact that all participants were volunteers. This second aspect might have caused a bias in their initial positive beliefs regarding the importance of developing SRL skills in students. Consequently, we view our results as preliminary and exploratory, albeit significant, given the relatively uncharted territory of game-based teacher professional development. In any case, the GBL approach adopted in this study encompasses the use of the game after a traditional introductory session, providing participants (whose initial competence on SRL was rather low) with basic theoretical knowledge of the concept. However, such an introduction, without the game-based hands-on session, triggering teachers' reflections on the design criteria, was very unlikely to succeed. A second limitation is due to the short duration of the training intervention (3 days). There is agreement in the TPD literature that significant changes in teachers' practice and consequent students' learning can only be

obtained with significantly long TPD processes, where teaching practice alternates with more theoretical or hands-on design and collaborative experiences [61,62]. This is why, in this study, we carefully avoided being overambitious and limited our data collection to knowledge acquisition, changes in beliefs, and game acceptance, in line with our research questions and the exploratory nature of the study. However, once the SuperRED project is over, further research will harness data concerning the whole 3-year-long intervention in a more systematic attempt to assess its effectiveness in terms of impact on teachers' practices and on students' learning.

Future work should envisage the possibility of investigating the added value of the use of the SRL-4Ts game as compared with a more traditional approach, possibly a hands-on design activity, or also to similar sessions involving the full digital and/or the tangible versions of the game.

In spite of the above-mentioned limitations of this study, we believe that the clearcut positive results in terms of game acceptance, learning outcomes and, to a lesser extent, changes in teachers' beliefs are encouraging. In particular, game acceptance is favored by game mechanics that are quite familiar to most people (board games with dice and cards are quite unrefined mechanics). At the same time, the integration of content with the game mechanics was easily achieved by creating one card for each design principle. This type of game can be easily adapted to any other type of reflection activity whereby players must apply some rubric to analyze, assess, and improve an artifact. For example, a set of structured assessment criteria could replace our SRL design principles to create a different game with different aims. This means that this game structure can be used as a content-free shell to host different contents. This is another interesting perspective that could be explored and a very promising research direction, addressing issues such as scalability and costs of serious game development.

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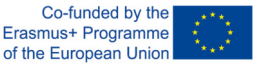

Institutional Review Board Statement: Data were collected through an anonymous self-reporting survey concerning non-sensitive topics. Respondents provided their consent and are aware of how we used the data, and the GDPR rules were applied. In these cases, we do not need to obtain approval of CNR Ethic Committee provided that we follow the Ethical Principles of Psychologists and Code of Conduct (https://www.apa.org/ethics/code#:~:text=Psychologists%20uphold%20professional%20standards%20of,lead%20to%20exploitation%20or%20harm), which we did.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data is available upon request.

Conflicts of Interest: The authors declare no conflict of interest. Informed consent was obtained from all subjects involved in the study. Participants in the study accepted voluntarily and anonymously to provide the data collected for the study.

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