

## Article

# Using Gamification to Facilitate Students' Self-Regulation in E-Learning: A Case Study on Students' L2 English Learning

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**Abstract:** E-learning has been an important learning approach in the information era by providing flexible environments and rich resources for learners. However, it also faces several challenges, the biggest one being that students need to have strong self-regulation competence to control and manage their e-learning. As gamification has been widely used in primary education to facilitate children's learning motivation and engagement, it is valuable to explore the impacts of gamification on children's self-regulated learning. In this study, the role of gamification in children's English learning in Hong Kong was investigated through a gamified e-learning system. A quasi-experiment with pre-test/post-test design was conducted among primary level 3 students over a semester. Both quantitative and qualitative data were gathered through academic tests, questionnaires, and interviews to provide comprehensive insights into the research questions. The key findings enable the identification of: (1) students' gaining of self-regulated learning interest and academic performance from the gamified learning system; (2) students' developed self-regulated learning strategies; and (3) the connection between gamification and students' self-regulated learning. These findings have implications for e-learning designers and educators with regards to the practice of gamified learning to enhance students' self-regulated learning and second language learning.

**Keywords:** gamification; gamified e-learning; L2 English learning; self-regulated learning



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## 1. Introduction

E-learning, “the learning supported by digital electronic tools and media” [1], has been a flexible learning approach with sufficient supports of digital environments and resources [2]. The demand for e-learning has increased in recent years as curriculum planners and educators have actively sought e-learning systems, activities, and resources to supplement students' traditional offline learning. The scope of e-learning application in educating students is summarized into two aspects: computer-based learning and web-based learning [2]. Computer-based e-learning originates from the idea of programmed instruction by BF Skinner and extends to several subsets of learning, such as online learning, distance learning, blended learning, and m-learning [3]. However, e-learning also has its weakness and barriers in helping students achieve deep learning, especially for children who have limited self-regulated learning abilities. Although children can access a mass of e-learning tools and resources to enhance their after-class learning, they are accustomed to being reminded and enforced by parents or teachers [4]. Being isolated from teachers and classmates enables students to be especially prone to feeling alone, helpless, and lazy when they implement e-learning outside school. Teachers fail to supervise everyone who hides behind the screen. Therefore, it is meaningful to guide students to be self-regulated learners who can manage, control, and regulate their learning process in an e-learning environment.

## 2. Literature Review

### 2.1. Self-Regulated Learning in E-Learning

Self-regulated learning (SRL) refers to an effective learning style whereby learners can recognize and control their learning with a series of self-regulation strategies [5]. Being a highly self-regulated learner is one of society's current human resource requirements. Unlike a learning machine that accepts knowledge passively from teachers, students need to "learn to learn" and be capable of managing and regulating their own learning, as well as enjoying learning. Self-regulated learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behaviors [6]. It is believed that highly self-regulated learners are more likely to succeed academically and be more confident in their learning [6]. It has been found that SRL is the key to success in e-learning and MOOCs [7]. Several e-learning programs in the context of the COVID-19 pandemic have shown that the results of e-learning vary in individual SRL competence (e.g., [8,9]). Additionally, it has been found that SRL competence is highly related to students' self-efficacy, as self-efficacy is a significant predictor of SRL competence [10]. However, a large number of children are dominated by traditional learning methods and atmosphere, resulting in low levels of SRL [9]. Therefore, it is necessary to develop children's SRL interest and competence when they experience e-learning environments and tools [11].

According to [12], SRL ingredients include motivation, agency, forethought, performance, reflection, monitoring, and management. The initiation of SRL involves developing students' SRL attitude, as they are expected to have a strong intrinsic motivation to learn and to display inner interest, effort, and perseverance for learning [13]. Furthermore, students should master various SRL skills, strategies, and technologies. SRL skills and strategies can be developed through goal-directed and self-exploration activities involving different types of scaffoldings, as well as traditional lecturing and/or teaching [6,13]. According to the literature [4,7,14], prompts, timekeeping, feedback, questioning, gaming, and dashboards can be designed into e-learning systems as learning scaffoldings to induce SRL strategies. [14] proposed seven feedback principles for facilitating SRL. SRL supports are widely discussed and investigated in online learning and MOOCs for higher and adult education [7], while little is known regarding how children's SRL can be developed in e-learning environments.

### 2.2. Gamification in E-Learning

Gamification is defined as using game elements and activities in a non-gaming context to increase participants' engagement. Game elements include but are not limited to competition, rewards, leaderboards, points, narrative, avatars, and role-play. There has been a long history of game being used to organize the learning of children of all ages [15]. Piaget's and Vygotsky's theories explain the impacts of playing games in children's behavioral, cognitive, and social development [15]. Gamification is increasingly being incorporated into e-learning—known as gamified learning—to enhance the productivity and fun of e-learning [16], as its potential for promoting primary school students' learning motivation and participation has been identified [17]. Various gamification elements are integrated with learning content and activities, such as combat, gifting, certificates, social graphs, memes, and unlocking actions [18]. The positive effects of gamified learning can be summarized into four outcomes: knowledge building, enhanced motivation and emotion, improved behaviors, and developed cognition [19].

With the trend of globalization in many fields, second language learning and multilingualism literacy have been an important subject for children's learning [20]. Many countries have directed abundant resources towards second language education [20], yet a mass of children are struggling with learning a second language (e.g., English) in primary education. They feel that it is boring and challenging to learn a second language with low motivation and limited opportunities to practice, especially when they use traditional pen-and-paper approaches with a limited range of language concepts [21,22]. They exces-

sively reject reciting words and sentences forced by parents and teachers, the corresponding learning result of which is inefficient [23].

Considering the potential value of gamified learning, various gamification applications have been developed to enhance children's second language learning, such as gamified word apps [24], gamified e-quizzes [25], gamified e-books [26], and thematic storyline games [27]. For example, [28] showed that task-driven and avatar design empowers at-risk second language learners through using 3D virtual technology (Second Life). Ref. [29] has explored the role of classroom-situated gamified pedagogy in promoting students' language communicative competence. Scientific literature shows that gamified environments and activities for second language learning can enhance students' motivation [30], engagement [31], and confidence [32] by providing them with fun and freedom to fail without fear [33]. Ref. [34] indicates that boys engage with gaming conditions significantly more than girls, especially for oral and written English learning. However, most previous studies have focused on emotional, cognitive, and behavioral effects of gamification on children's learning [35], while few analyzed students' acquisition of how to self-regulate learning, i.e., the impact of gamification on the metacognitive process.

### 2.3. Self-Regulated Learning and Gamified Learning

A few SRL models describe the strategies and dimensions of students' SRL according to the literature (e.g., [11,36]). Of these, [37] model considers goal setting and self-motivation as the initial step to implementing SRL. Since much evidence shows that gamification pedagogy can enable students to be active learners by improving their learning motivation and behaviors [17,19], several studies have begun exploring the relationship between SRL and gamified learning. It is found that gamification, if used properly, is a powerful tool to facilitate students' self-regulation process [38–40]. For example, Ref. [39] applied a gamified e-quiz system (Kahoot! Quizzes) in college linguistics courses. They found that gamified elements facilitate students' SRL by changing learning environments, providing effective feedback, and training meta-cognitive skills. The main benefit of the gamified e-quiz is that it provides immediate and effective feedback that arouses students' SRL [36]. Another study [41] analyzed how gamification facilitates SRL's process of self-monitoring, planning, collaboration and comparison, and self-evaluation. The related gaming elements involve points, rewards, challenge, competition, and game aesthetics. Ref. [42] reviewed related studies of adaptive gamified learning systems and summarized seven gamification design principles for enhancing SRL: progress visualization, feedback, hints/guidance, goal setting and self-challenge, error management, and collaboration. While the effects of gamified e-learning tools on self-regulation are gaining popularity, most of the current studies focused on college students in higher education [38–40,43], while only a few studies discussed children's SRL in gamified learning [43].

### 2.4. Summary

As gamification pedagogy is effective at enhancing students' learning motivation and process, it is promising to facilitate primary students' SRL interest and competence through gamification. Given that Hong Kong was ranked 5th in a recent index of global cities, Hong Kong's educational authorities have developed policies and e-learning resources to enhance students' trilingual (English, Cantonese, and Mandarin) abilities [44]. Hong Kong children have more opportunities to access e-learning applications to promote their second language learning, some of which are gamified [45]. However, several studies argue that children prefer playing over learning and are motivated by extrinsic incentives in gamified learning [30,46]. In other words, such studies doubt whether gamification pedagogy facilitates children's SRL to enable them to learn autonomously in the long term in an e-learning environment. Therefore, this study aims to explore the effects of gamified systems and environment on children's self-regulated learning in Hong Kong. We adopted a gamified e-learning system, "Oxford Achiever" (OA), as the research tool and environment. The research questions are as follows:

RQ1: To what extent can the gamified e-learning system affect students' English academic performance?

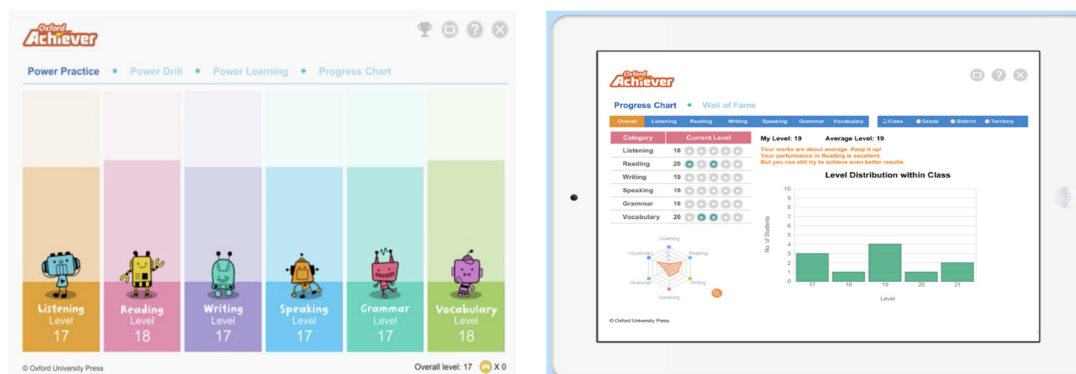
RQ2: How does the gamified e-learning system affect students' SRL interest and self-efficacy?

RQ3: How does the gamified e-learning system develop students' SRL strategies?

### 3. Methodology

#### 3.1. Research Tool

The research tool of this study, OA, is a gamified e-exercise and e-quiz system for L2 English learning. It aims at "gamifying" students' L2 English learning experiences by providing gaming elements such as challenges, level-up, points system, leaderboards, dashboards, trophies, and avatars. Gaming terms were used to suit children's discourse context, including 'Adventure land', 'Trophy Bank', 'Power Drill', and 'Wall of Fame'. Besides gaming affordances, the system provides targeted practice and personalized feedback for young learners. Students are first given an online placement pre-test to assess their original English level. The aim of identifying learners' English initial level is to provide a personalized learning plan and suitable tasks so that students can remain confident and trace their improvement as the course progresses. A range of practice exercises in reading, writing, listening, speaking, grammar, and vocabulary through 36 levels of difficulty are provided, as shown in Figure 1. Students have a report of learning analytics in an e-portfolio, which helps them reflect on how well they are doing and identify future areas for improvement.



**Figure 1.** Power Practice page in the gamified e-learning system and student's placement report and progress chart in the e-portfolio of the system (screenshot from OA by Oxford University Press).

#### 3.2. Research Design and Procedure

This study implemented an exploratory quasi-experiment with a pre-test–post-test design in March 2018. We sampled P3 students aging 8–10 as targeted subjects for two reasons. Firstly, literature shows that the age of 8–10 is the critical stage of starting SRL and reading-based language learning [47]. Ref. [48] assumed that children at this age become able to think about themselves in a high-level thinking way and think about how they learn. Second, we adopted Hong Kong Territory-wide System Assessment (TSA) as the research instrument to evaluate students' English academic performance. TSA is an authoritative assessment tool for P3 students in Hong Kong, which can ensure the validity of the research instrument and match academic performance assessment to the samples' grade-appropriate difficulty levels.

We sent an invitation letter to five primary school principals in Hong Kong to look for collaboration and recruit volunteer participants. One principal replied that he agreed to encourage his students to join in with this program. After receiving the approval of parents, students, and teachers, 217 P3 students in this school were directed to freely use OA for a semester as an extracurricular English learning tool during the study. None of the P3 students had used OA before the study. Before using OA, all students completed a

pre-test comprising a reading test and a questionnaire. To investigate and analyze students' self-regulation learning behaviors, their use of OA was a self-determined and voluntary activity instead of a compulsory task. At the end of the experimental semester, in July 2018, students who used OA took part in a post-test. Table 1 shows that 43.32% of the students (94 users) used OA during the study. A total of 86 out of the 94 users completed reading tests and a questionnaire survey. The average number of completed exercises was 20 (SD = 24.53). Most users finished exercises of the reading sections. Users were divided into two groups (H-group and L-group) after the experimental semester based on their participation level in OA. The variable of "median" was used as the split-point of the two groups because "median" is more reasonable than "average" as the split-point in post-event grouping design when the SD is large [49]. Many exploratory experimental studies based on post-event grouping design took "median" as the split-point, e.g., [50].

**Table 1.** Descriptive statistics results of students' participation information in OA.

| Item                                                                       | P3   |
|----------------------------------------------------------------------------|------|
| Total students                                                             | 217  |
| Students who used OA                                                       | 94   |
| Students who attended the pre-/post-test or pre-/post-questionnaire        | 86   |
| Students who attended both the pre-test and post-test reading exams        | 80   |
| Students who attended both the pre-test and post-test questionnaire survey | 83   |
| Average of finished exercises in OA                                        | 20   |
| Median of finished exercised in OA                                         | 14.5 |

Notes: the statistics of finished exercises in OA was based on the students who attended the pre-/post- reading exams or pre-/post- questionnaire survey (86 and 25).

As a pre-test–post-test exploratory quasi-experiment design, the validity of this study may be threatened by several factors, such as instruments, sampling, and grouping. Some measures were undertaken to decrease the potential threats of the research validity according to [51]. First, this study used mixed methods and gathered different types of "rich data" such as academic exam score, digital system data, questionnaire, and interview. Ref. [52] proposed four triangulation methods of strengthening the quality of the research: using multiple investigators, theories, methods, and data. Rich data collected by mixed methods that are detailed and varied help provide a full and revealing picture of what is going on. Second, the research instruments in the quantitative approach were adopted from authoritative tools which have been proven to have good validity and reliability and are commonly used in existing studies; these include the SRL interest scale [53]. Finally, we also sampled negative cases, as [51] states that identifying and analyzing negative cases with discrepant data is a necessary part of the logic of validity testing.

### 3.3. Data Collection and Analysis

**Reading tests:** Reading tests were adapted from TSA to evaluate students' academic performance of English reading before and after using OA as TSA is a territory-wide assessment set for P3 and P6 students in Hong Kong.

**Questionnaire:** This study investigated students' SRL interest and self-efficacy to indicate their SRL motivation and competence. A questionnaire consisting of 15 four-point Likert items was used to assess students' SRL interest [53] in four core aspects of English literacy: reading, writing, speaking, and listening. A single item for "self-efficacy" was provided in the questionnaire because the P3 students were too young to afford much cognitive load when they answered the questionnaire. Students were required to rate the items ranging from 1 (strongly disagree) to 4 (strongly agree). Cronbach's alpha of internal consistency was used to estimate the reliability of the SRL interest scale instrument. The results shown in Table 2 indicate that the items for reading, writing, and speaking are deemed reliable (i.e.,  $\alpha > 0.70$ ), and the reliability of listening items is acceptable.

**Table 2.** Results of Cronbach’s alpha assessment of the SRL interest scale.

| Type of Sub-Scale | Number of Items | Cronbach’s Alpha |
|-------------------|-----------------|------------------|
| Reading           | 5               | 0.807            |
| Writing           | 3               | 0.805            |
| Speaking          | 5               | 0.856            |
| Listening         | 2               | 0.660            |

The data of reading tests and questionnaires were analyzed through the Statistical Package for the Social Sciences (SPSS) 24.0 software. The normality of the quantitative data was tested to determine whether a non-parametric test or t-test was used in the following analysis, with a significance level of 0.05 (two-tailed). Cramér’s V coefficient was used to evaluate the effect sizes of the results, and a medium effect was found for each sub-scale ( $0.1 < \text{Cramér’s V} < 0.45$ ) based on Cohen’s criteria [54].

**Interview:** To explain the process of how the gamified e-learning system affects children’s SRL, qualitative evidence was gathered by semi-structured interviews after the post-test. We sampled interview respondents from different groups of related stakeholders involving six active users (half of whom were girls), three light users, two P3 English teachers, and three active users’ mothers. The semi-structured interview questions were designed according to three aspects: why the users like or dislike using OA actively, how they self-learn English through OA, and what they think they gain from OA. Each interview lasted for 30 min and was audio-recorded for data transcription. Interviewees’ responses were coded in NVivo 10.0 with thematic analysis based on Nodousha’s classification of SRL [11]. Two independent coders handled the interview data to ensure the reliability of the results. The Kappa Coefficient of each node was above 0.75, which was considered as a good agreement to indicate the inter-rater reliability of coding [55].

#### 4. Results

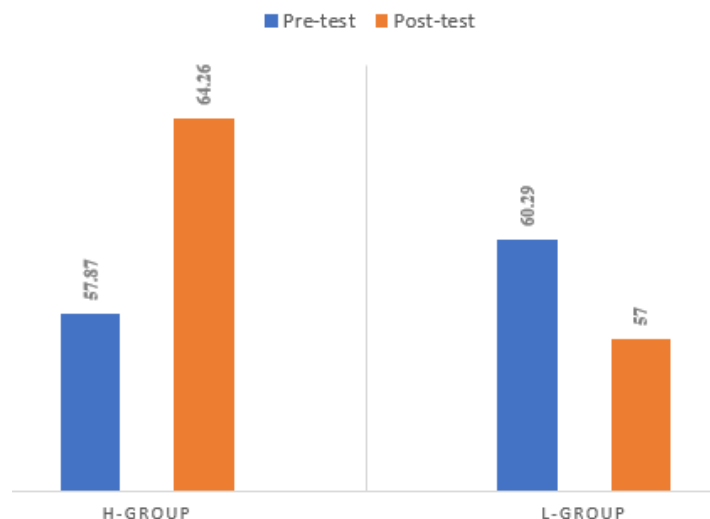
##### 4.1. RQ1: To What Extent Can the Gamified E-Learning System Affect Students’ English Academic Performance?

The first research question was answered by the change of reading test scores. According to grouping criteria, 43 light users (completed practices  $\leq 14$ ) were allocated to L-group, while 40 active users (completed practices  $> 14$ ) were allocated to H-group. As shown in Figure 2, the average of H-group’s pre-test score is 57.87 and that of L-group is 60.29. No significant difference existed between the two groups in the pre-tests, showing that the two groups had similar levels in the TSA P3 English test. However, H-group students gained an increase of 7.76, while L-group decreased by 2.88 in the post-test. The change of test scores from pre-test to post-test in H-group was significantly greater than that of L-group ( $t = -2.38, p = 0.021$ ), as shown in Table 3. This implies that active users appeared to progress significantly more than light users. Understandably, active users finished more exercises in OA, leading to the increase of their English knowledge and skills. Besides, the difference of reading test score between the pre-test and post-test in L-group was not significant, meaning that L-group students’ reading English performance did not change greatly.

##### 4.2. RQ2: How Does the Gamified E-Learning System Affect Students’ SRL Interest and Self-Efficacy?

Non-parametric tests (Mann–Whitney U test) were used to compare students’ questionnaire data between the two groups as the data violated the normal distribution. It was found that H-group students’ SRL interest ( $M = 2.50, SD = 0.74$ ) and self-efficacy ( $M = 2.15, SD = 0.73$ ) were significantly lower than L-group in the pre-test. L-group students’ SRL interest was 3.01 ( $SD = 0.72$ ) and self-efficacy was 2.79 ( $SD = 0.77$ ). However, the two groups did not show significant differences in the post-test regarding the two variables. This implies that H-group students’ SRL interest and self-efficacy were lower before using OA, but that they improved after the study. In other words, gamification

has more attraction for the students who had low SRL interest so that they “play” more heavily. The use of a gamified e-learning system helps develop their SRL motivation and competence. More details regarding descriptive statistics of user ratings on items of SRL interest and self-efficacy are presented in Appendix A.



**Figure 2.** Pre-test and post-test scores of two groups.

**Table 3.** Descriptive statistics and *t*-test results of the changes in students’ reading test scores.

| Variables               | Group | N  | Mean  | SD    | t-Test |       |                         |         |
|-------------------------|-------|----|-------|-------|--------|-------|-------------------------|---------|
|                         |       |    |       |       | F      | t     | Effect Size (Cohen’s d) | Sig.    |
| change of reading score | L     | 34 | −2.88 | 12.78 | 9.41   | −2.38 | −0.57                   | 0.021 * |
|                         | H     | 36 | 7.76  | 23.40 |        |       |                         |         |

\* at a significant level ( $p < 0.05$ ).

This study compared the change of SRL interest and self-efficacy variables between the two groups, as shown in Table 4. A significant difference of two variables between two groups was found only in reading (SRL interest:  $Z = -2.35$ ,  $p = 0.019$ ; self-efficacy:  $Z = -2.14$ ,  $p = 0.032$ ). These results of the change of SRL interest and self-efficacy variables verify and supplement the conclusion above that the deep use of OA can help develop children’s self-regulated learning motivation and competence to some extent, especially for those who had low self-regulated learning experience.

According to the interviews, four active users reported that their interest in learning English increased. They found English learning in OA more interesting than the traditional pen-and-paper methods. One student (Joy) said, “we just read English books and recited words before, but now we can listen to videos and watch movies on OA. I like competing with classmates and achieving a high ranking on OA. I often use it without others’ reminder”. Another student (Beatty) had a similar response, saying that OA was more interesting as it provided a variety of engaging learning experiences that included gaming experience, videos, storybooks, practices and story writing. These responses also verify the conclusion that the use of OA developed active users’ SRL motivation and competence.

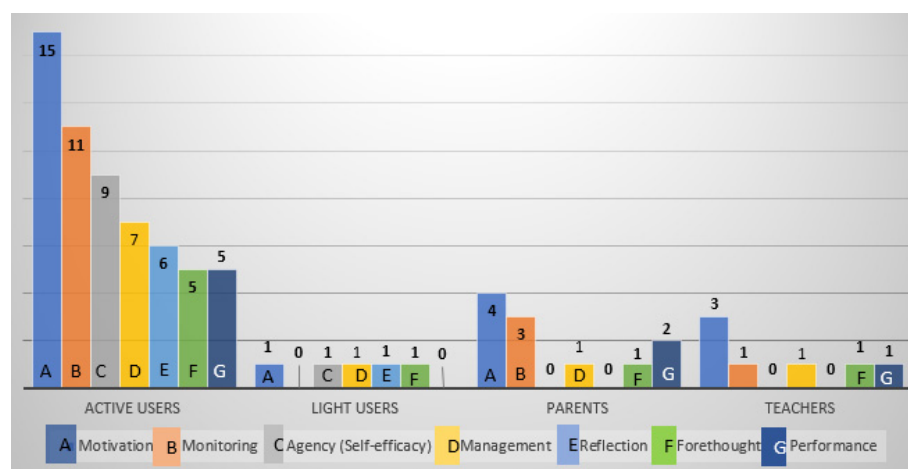
#### 4.3. RQ3: How Does the Gamified E-Learning System Develop Students’ SRL Strategies?

This question would be answered by analyzing qualitative evidence from the interviews. Interview data were coded based on Nodoushan’s classification [11], and the coding map was shown in Figure 3. It seems that active users reported more perceptions of SRL, especially in the aspects of motivation and monitoring.

**Table 4.** Changes in P3 students' SRL interest and self-efficacy in English learning before and after OA.

| Components             | Group | N  | Change of Rating |      | Non-Parametric Test |       |         |
|------------------------|-------|----|------------------|------|---------------------|-------|---------|
|                        |       |    | Mean             | SD   | Effect Size         | Z     | Sig.    |
| Change—R SRL interest  | L     | 43 | −0.21            | 0.75 | 0.582               | −2.35 | 0.019 * |
|                        | H     | 40 | 0.22             | 0.76 |                     |       |         |
| Change—S SRL interest  | L     | 43 | 0.05             | 0.80 | 0.485               | −0.24 | 0.811   |
|                        | H     | 40 | 0.11             | 0.85 |                     |       |         |
| Change—W SRL interest  | L     | 43 | 0.09             | 1.41 | 0.354               | −1.63 | 0.102   |
|                        | H     | 40 | 0.55             | 0.95 |                     |       |         |
| Change—L SRL interest  | L     | 43 | −0.37            | 1.29 | 0.317               | −0.43 | 0.669   |
|                        | H     | 40 | −0.32            | 1.26 |                     |       |         |
| Change—R self-efficacy | L     | 43 | −0.06            | 0.93 | 0.332               | −2.14 | 0.032 * |
|                        | H     | 40 | 0.45             | 0.99 |                     |       |         |
| Change—S self-efficacy | L     | 43 | 0.16             | 1.04 | 0.303               | −0.14 | 0.890   |
|                        | H     | 40 | 0.29             | 1.09 |                     |       |         |
| Change—W self-efficacy | L     | 43 | 0.30             | 1.11 | 0.281               | −0.33 | 0.742   |
|                        | H     | 40 | 0.25             | 0.91 |                     |       |         |
| Change—L self-efficacy | L     | 43 | −0.21            | 1.4  | 0.272               | −0.14 | 0.891   |
|                        | H     | 40 | −0.20            | 1.2  |                     |       |         |

Notes: (1) R-reading, S-speaking, W-writing, L-listening; (2) \* at a significant level ( $p < 0.05$ ).

**Figure 3.** Coding frequency of interview answers.

Before explaining how the gamified e-learning system affects students' SRL strategies, this study reports the reasons why users like or dislike using OA. Active users' motivation for heavy use of OA was summarized into three aspects. First and most importantly, gaming elements were mentioned by all active users on multiple occasions as the main sources of motivation to use the system. For example, one student (Albert) answered, "I want to go onto the next level as soon as possible; therefore, I keep using OA to obtain more stars". Active users also remarked that the leaderboard spurred them to improve in future exercises. Additionally, one active user mentioned that she had little pressure when doing tasks in OA because it allows the user to fail several times and try again and again. What she described is an important feature of gaming: providing opportunities to fail without any negative consequences, as has been stated by [33]. Furthermore, three active users stated that they preferred the gamified system for several social needs, including competing with classmates and siblings, meeting their mother's requirement, and gaining rewards

from their parents. Lastly, two interviewees reported that they did the exercises frequently because they wanted to improve their English exam score.

Three light users explained two reasons for their low participation in the gamified system. Two students reported that their out-of-class time was fully occupied by other extracurricular tutoring classes and homework, leaving little time to use the e-learning system. One student said that he found it boring to complete the learning tasks in OA and so he refused to use the system.

The coding of students' SRL interest and strategies developed from gamified learning is shown in Appendix B. For active users, the coding results show that they had a developing self-regulated learning process during the use of OA. They were not forced by parents to use OA but to be active explorers in L2 English learning. The use of OA can arouse students' learning motivation and agency. They regarded progressing through levels and gaining badges as learning goals which are clear and personalized. As three active users reported, they wanted to get more points and rank higher on the leaderboard; therefore, they took more OA exercises. Moreover, progress visualization features of the gamified e-learning system, such as dashboard/progress bar/hints, can help monitor users' learning process. As one student (Nancy) said, *"I like to see the dashboard to let myself know how my English competence is distributed."* Students learned several management strategies, such as control, time administration, scaffolding, and regulation, to improve their self-monitoring. Immediate feedback, hints, and guidance could help decrease students' frustration and anxiety. Finally, the students would reflect on their learning performance in OA. For example, one student (Lily) reported that she knew her English learning weakness according to the performance radar map and further adjusted her learning time and energy to strengthen the weak points. Furthermore, some students better showed their thinking regarding how to learn English in OA.

## 5. Discussion

This study aims to explore the effects of OA on children's English SRL interest and performance. To investigate the real attitudes of students toward the gamified learning system, this study allowed the participants to use OA freely. The results show that the attraction and effects of gamification vary for different children. Active users can gain more improvement in academic performance because they finished more exercises. The questionnaire result shows that H-group users had lower SRL interest and self-efficacy than L-group users in the pre-test before using OA, implying that OA attracts those who had low SRL motivation and competence. However, the two groups showed no significant differences in terms of the variables in the post-test. This means that H-group members enhanced their SRL interest and competence during the gamified learning. The students' responses in the interviews also verify this conclusion. It is thought that gamification has more attraction and effects for the students who have low original SRL interest and competence, leading to their heavy use of the gamified system. This phenomenon is reasonable as [56] suggested that low-SRL students are usually forced to learn by extrinsic motivation such as rewards and reminders. During the process of gamified learning, they developed their SRL motivation and competence, potentially being active learners. This might be an important conclusion that has not been discussed in the previous literature.

Regarding the reasons for low-use of OA, besides the limitation of time and devices, there are two possible scenarios. The first one is that students with high SRL usually have strong intrinsic motivation and interest in knowledge itself [57]. Therefore, they would prefer to learn what they like under a self-determined condition beyond the temptation of gaming elements in OA. As two light users reported, they were over-scheduled for their learning. Secondly, gaming elements in OA are not enough fun in some children's eyes. As [58] states, the initial power of gamified learning that motivates students is "fun", which enables them into the "flow" state. Different people have different preference for gaming fun. Therefore, [59] defines four kinds of players (explorer, achiever, socializer, and killer) based on their choices of fun. The classification of fun can explain why children have

different participation levels in OA. In summary, the different results between H-group and L-group are attributed to the participation degree in the gamified learning process. The participation degree in the gamified learning process depends on the extent that users are attracted by the system [60]. According to [18], OA can be defined as a gamified formative assessment tool with exercises and e-quizzes. Results of this study imply that such a gamified learning system has more attraction for the students who have low SRL interest and competence and who like points and rewards.

Another important finding is that active users enhanced their SRL interest and competence during the use of OA. Their enhanced SRL skills include motivation arousing, goal setting, time management and effort regulation, which were found to correlate with academic success in e-learning. Ref. [61] stated that a student's SRL level is strongly related to their learning satisfaction and persistence. These SRL skills were trained through gamified contexts and activities. First, gamified elements in OA can arouse students' learning motivation and interest, such as challenging, competing with others, leaderboard, rewards, and immediate feedback [62]. Children are happy to obtain some virtual badges and want to be a winner in activities and life. They set a clear goal for the gamified tasks (gain more points or be higher ranking than somebody) to guide their learning process and maintain learning efforts. Gamified tasks involve both short-term goals that provide a sense of progression and long-term goals leading to intrinsic interest in learning and sustained learning habits [63]. To achieve the goals and "win" in the game, they need to spend a great deal of energy to keep track or be aware of their on-going progress. They tried to use personalized strategies and resources to complete more gamified learning tasks as accurately as possible. Whether by leaderboards, progress bar or communities, progression visualization is a great feature of gamification to develop students' goal setting, time management and resources management skills, as [61] stated.

Several studies have explained the effects of gamified learning on SRL based on Self-Determination Theory (SDT) [64], which defined three inner desires of self-regulated learners: competence, autonomy, and relatedness [65]. The main findings of this study also verify the reasonability of SDT in explaining the relationship between gamified learning and SRL. The desire for competence is closely related to the sense of achievement, satisfaction, and self-efficacy, leading to interest in being a winner in learning and life [66]. Winning rewards and improving academic performance evoke a sense of achievement which prompts students to use OA frequently, thus leading to a healthy cycle. Secondly, students can determine to use OA freely for their own reasons. A great degree of autonomy during the use of OA enables them to feel relaxed and courageous when facing challenges. Similarly, [41] also stated that game aesthetics can convey feelings of competence and autonomy in SRL. Furthermore, active users demonstrated their social desire during the use of OA, such as challenging one another, attempting to attain better rankings on the leaderboard, and communicating with families and peers. It is suggested that OA enhances the connection between participants through healthy competition, thus enabling students to satisfy their psychological need for relatedness [67]. However, as one light user reported, this gamified system is exam-orientated and boring to some extent. It suggests that the gamified system has great potential to add more fun, flexibility and diversity that allows more students to benefit from it. SDT can guide the design of gamified learning tools to help more students to be active explorers of knowledge. In summary, combining with previous studies [60,68,69], this study concludes that the degree of participation in the gamified process depends on variables of "player" types, students' extrinsic and intrinsic learning motivation, as well as students' satisfaction degree that gamified learning systems can meet their needs for fun, autonomy, competence, and relatedness.

## 6. Conclusions

The results of this study have several implications for the literature and practice of gamified learning. Regarding its contribution to the literature, this study addresses the existing research gaps regarding the relationship between children's SRL and gamified e-

learning [43]. This study found that gamified e-quizzes (e.g., OA) might be more attractive for those who had low SRL level. Gamification elements resemble cognitive and meta-cognitive scaffoldings to guide students in developing SRL interest and skills. However, we have to admit that the effectiveness of gamification pedagogy is not a yes/no question but an issue of how to design it in order to make it work. It depends on a systematic design with many factors taken into consideration, such as learners' characteristics and styles, learning content and objectives, as well as learning environment. Therefore, it is necessary to further explore how to design effective gamified pedagogies to achieve targeted learning objectives from a theoretical perspective. This study also has some practical implications for teachers and parents as well as other educational stakeholders. First, teachers can utilize gamification pedagogy to improve students' learning motivation and engagement. When choosing gamified learning tools and systems, teachers need to realize children's characteristics and hobbies (likes and dislikes) and then identify corresponding gaming elements. The gamified learning tasks should have clear targets and be related to participants' daily learning at school. Gamified e-quiz systems can be used as tools of formative evaluation for effective feedback and regulation involving fewer stressful and boring feelings. Second, parents can utilize gamified learning systems to facilitate students' SRL learning at home, especially for those who have low SRL interest and competence. Additionally, gamified learning activities at home create opportunities for children to interact with peers/parents, which is meaningful for facilitating the parent-child relationship and the child's social development [67]. Finally, children's language e-learning software developers should recognize that gamification design can increase users' engagement and persistence in e-learning applications. More deep gamification elements should be considered beyond "superficial gamification" of "PBL" (points, badges, and leaderboard) [70].

This study has some limitations to be addressed in future iterations. The generalizability of the results is limited since the data were collected from one school, so expanding this to cover more schools and samples is necessary in future research. Furthermore, due to the limitation of research implementation, little is known regarding information about and opinions of the students who did not use OA. Further exploration is necessary to investigate the difference between OA-users and non-users. Third, future studies could involve students' participation over a longitudinal time scale (i.e., one year or more), assess the effects of specific gaming elements (e.g., leaderboard or badges), and compare gamified e-learning systems with non-gaming e-learning systems.

Overall, this study found that well-designed gamified exercise and e-quiz systems can help increase students' SRL interest and competence, especially for those who have lower SRL levels, leading to positive impacts on their academic performance and learning motivation. Students with high-level participation in the gamified system gained more achievement in SRL interest and competence in English. The main reason is that gaming elements can attract some students who pursue the sense of challenging and winning to participate in learning activities voluntarily. Students' participation in the gamified learning system is closely related to their learning motivation, which is influenced by the availability of opportunities to achieve the goals of autonomy, competence, and relatedness, as suggested by SDT. The gamified learning approaches can help students develop their SRL skills by guiding them to plan, regulate, manage, and reflect on their learning. They are motivated to solve problems and perform better under the guidance of goal-orientated and performance-rewarded gamified tasks. The findings may support the current literature on effective gamified learning and contribute to the design of e-learning systems and tools. The applicable target students' characteristics suitable for specific gamification elements needs to be further explored so that more students can benefit from this innovative pedagogy.

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## Appendix A

**Table A1.** Student user ratings on the items of perceived SRL interest and self-efficacy in English learning.

| Items                          | Participants |    |      |        |
|--------------------------------|--------------|----|------|--------|
|                                | Group        | N  | Mean | Std. D |
| SRL interest in reading-pre    | L            | 42 | 3.01 | 0.72   |
|                                | H            | 39 | 2.50 | 0.74   |
| SRL interest in reading-post   | L            | 43 | 2.81 | 0.73   |
|                                | H            | 40 | 2.74 | 0.75   |
| Self-efficacy in reading-pre   | L            | 43 | 2.79 | 0.77   |
|                                | H            | 40 | 2.15 | 0.73   |
| Self-efficacy in reading-post  | L            | 43 | 2.73 | 0.68   |
|                                | H            | 40 | 2.60 | 0.83   |
| SRL interest in writing-pre    | L            | 43 | 2.56 | 1.22   |
|                                | H            | 40 | 2.23 | 0.89   |
| SRL interest in writing-post   | L            | 43 | 2.65 | 1.11   |
|                                | H            | 40 | 2.78 | 1.00   |
| Self-efficacy in writing-pre   | L            | 43 | 2.47 | 0.95   |
|                                | H            | 39 | 2.37 | 0.71   |
| Self-efficacy in writing-post  | L            | 43 | 2.77 | 0.83   |
|                                | H            | 40 | 2.64 | 0.74   |
| SRL interest in speaking-pre   | L            | 43 | 2.45 | 0.83   |
|                                | H            | 40 | 2.26 | 0.76   |
| SRL interest in speaking-post  | L            | 43 | 2.50 | 0.84   |
|                                | H            | 40 | 2.37 | 0.86   |
| Self-efficacy in speaking-pre  | L            | 43 | 2.57 | 0.95   |
|                                | H            | 40 | 2.40 | 0.86   |
| Self-efficacy in speaking-post | L            | 43 | 2.73 | 0.84   |
|                                | H            | 40 | 2.69 | 0.93   |
| SRL interest in listening-pre  | L            | 43 | 2.84 | 1.15   |
|                                | H            | 40 | 2.65 | 0.98   |
| SRL interest in listening-post | L            | 43 | 2.47 | 0.98   |
|                                | H            | 40 | 2.33 | 0.97   |

Table A1. Cont.

| Items                           | Participants |    |      |        |
|---------------------------------|--------------|----|------|--------|
|                                 | Group        | N  | Mean | Std. D |
| Self-efficacy in listening-pre  | L            | 43 | 2.86 | 1.08   |
|                                 | H            | 40 | 2.63 | 0.95   |
| Self-efficacy in listening-post | L            | 43 | 2.65 | 0.95   |
|                                 | H            | 40 | 2.43 | 0.93   |

## Appendix B

Table A2. Coding results of students' SRL motivation and strategies from interview response.

| Phase       | Themes                                                                                               | Quotations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------|------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Motivation  | learning interest,<br>social interaction,<br>pleasure                                                | <i>I want to go to the next level as soon as possible and gain a higher ranking on the leaderboard.—Student-Albert</i><br><i>Both my brother and I use OA. The interaction between us increased as we competed to see our positions on the leaderboard.—Student-Rose</i>                                                                                                                                                                                                                                          |
| Agency      | self-efficacy<br>learning presence                                                                   | <i>I am very happy when I became more fluent and more courageous to speak English after using OA.—Student-Betty</i><br><i>I feel self-satisfactory when I scored five stars on OA.—Student-Albert</i>                                                                                                                                                                                                                                                                                                             |
| forethought | planning, goal setting, and prior<br>knowledge activation                                            | <i>I want to go onto the next level as soon as possible; therefore, I kept using OA to obtain more stars.—Student-Albert</i><br><i>To compete with my classmates and rank higher, I preferred to set a score before I finished a module.—Student-Peter</i>                                                                                                                                                                                                                                                        |
| Performance | engagement, initiative, feedback,<br>and hints                                                       | <i>I took the initiative to use OA without others telling me to do so as I want to improve my English.—Student-Joy</i><br><i>When I encountered difficulties, I can look for help from the smart tutors in the system.—Student-Rose</i>                                                                                                                                                                                                                                                                           |
| Monitoring  | progress                                                                                             | <i>Before using OA, I found some words difficult to pronounce. Now I find it easier to pronounce them as I can imitate them after hearing them in OA.—Student-Joy</i><br><i>I like to see the dashboard to let myself know how my English competence is distributed.—Student-Nancy</i>                                                                                                                                                                                                                            |
| Manage      | control, management, regulation,<br>scaffolding,<br>flexibility, convenience, and<br>problem-solving | <i>I looked for help from my parents when I encountered difficulties, and they would teach me how to do better.—Student-Allen</i><br><i>If he did not know a new English word, he would take out a dictionary to look it up by himself or would ask around in his private tutoring class.—Parent-penny</i><br><i>OA would tell me about the things that I have not performed well in, such that I would inform my parents about what happened in OA, and they would teach me [how to improve].—Student-Martin</i> |
| Reflection  | reaction, adjust                                                                                     | <i>The feedback of the system helps us a great deal. If we got it wrong, we immediately know what we did is wrong and keep going.—Student-Nancy</i><br><i>I know my weakness in English according to the performance radar map, and I would adjust my learning time and energy to strengthen my weakness.—Student-Lily</i>                                                                                                                                                                                        |

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