How Has Gamification Within Digital Platforms Affected Self-Regulated Learning Skills During the COVID-19 Pandemic? Mixed-Methods Research

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Abstract—Gamification systems on digital platforms are among the essential systems that can motivate learners towards achieving educational gains and goals. Self-regulated learning skills (SRLS) have become one of the most important learning requirements in the COVID-19 pandemic context so that the learner can plan and manage their learning tasks. The current research examines the impact of using Digital Platform Based Gamification (DPBG) on SRLS during the pandemic. A blended research approach based on a combination of quantitative and qualitative approaches was used to better understand the impact of gamification on digital platforms for SRLS during the pandemic. The descriptive approach was used to analyze the previous literature and develop SRLS. The quasi-experimental approach was used to compare the first experimental group that used the DPBG (G1-DPBG) and the second experimental group that used the same Digital Platform without Gamification (DPWG) (G2-DPWG). The phenomenological approach was used to gain a better understanding of how gamification affects SRLS. The research sample in the quantitative study consisted of 60 students from the tenth-grade students in Jeddah who were randomly distributed to the two research groups. The participants in the qualitative research were eight students who were intentionally selected from students who use gamification. A scale of SRLS was developed that included four themes: Goal Setting and Planning, Monitoring, Rehearsing and Memorizing, and Seeking Social Assistance with a total of 28 items. A qualitative tool was developed that includes a set of open-ended questions for semi-structured interviews that were carried out after completing all quantitative data collection. The quantitative results demonstrated the superiority of gamification via digital platforms in developing SRLS. The outputs of the objective analysis of the qualitative data also provided more in-depth explanations and insights from the students' perspective on the role of DPBG in enhancing SRLS during the COVID-19 pandemic.

Keywords—gamification, digital platforms, self-regulated learning skills (SRLS), COVID-19 pandemic

1   Introduction

The COVID-19 pandemic has led to inevitable radical changes in all areas of life, including education, as it can be considered the largest crisis faced by educational institutions in modern history [1]. The COVID-19 pandemic has imposed a new educational reality that is radically different from the educational context prior to the pandemic [2]. To ensure the continuity of learning despite the total closure of educational institutions, relying on digital platforms has become the best option [3-5]. Gamification-based platforms are among the most important digital content platforms that could be relied upon to support teaching and learning during the pandemic, as they contain several incentives such as points, badges, leaderboards, and progress bars that can be employed in non-play-based educational situations to motivate and excite the student towards implementing learning tasks [6]. These incentives thereby relieve the pressures and constraints that can face the student in the learning process during the COVID-19 pandemic [3, 7]. As the COVID-19 pandemic has led to a state of fear in educational institutions, it is important to work on developing various strategies to ensure the effective sustainability of the educational process [8].

The advantages that gamification can offer have motivated many researchers to investigate the effectiveness of gamification in developing a variety of learning outcomes, and how to employ digital incentives in digital platforms [9, 10]. The increasing trend towards employing gamification in digital platforms is due to the direct impact of motivation on learners' learning outcomes [6]. This is because gamification is an educational approach that facilitates learning, improves learner participation and interaction with educational content, and stimulates learners to expand their knowledge and develop their thinking [11, 12]. Additionally, the use of gamification across educational platforms may lead to significantly higher rates of social interaction for learners and encourage electronic feedback to digital learning objects [13, 14]. The modular design of gamification leads to improving the performance of learners, and raising their rates of motivation to complete learning tasks, which is reflected in the achievement rates [15]. Digital stimuli also have a significant role in motivating learners to participate in voluntary activities and perform challenging tasks, added to this their ability to reduce the gap among students' cognitive levels [16]. It also works on gamification to enhance psychological well-being among learners [17].

In the context of the learning process during the COVID-19 pandemic, which occurred entirely through digital platforms, students must acquire qualitative skills to help them adapt to the nature of learning in this new context [18, 19]. Self-regulated learning skills (SRLS) are among the most important skills that should be taken care of to reinforce the learner in the context of the COVID-19 pandemic [20]. The importance of SRLS is that they are among the most important skills that help students plan and control their learning and take measures to carry out all learning tasks with full awareness [21]. Among the constraints affecting learning outcomes across educational environments during the COVID-19 pandemic is students' lack of various SRLS and that these environments are not structured to promote SRLS [22]. The level of self-regulation affects students' ability to organize their learning during the COVID-19 pandemic [23]. There is no doubt that promoting self-organized learning as a behavior of learners

greatly contributes to supporting students towards learning efficiently and understanding during the COVID-19 pandemic [24].

Additionally, Digital Platform Based Gamification (DPBG) is a fertile environment for the delivery of learning content in unusual contexts; therefore, it is important to study the structure of gamification across platforms and determine the mechanism of its provision and management in order to achieve the optimum use of these platforms [25]. This is consistent with what many indicators have demonstrated regarding the possibility of the pandemic and its consequences for long periods. Therefore, research priority should be on digital tools that can be used to enhance and improve learning contexts during a pandemic [26]. This also coincides with the general trend of relying on digital resources as the main source for managing the learning process during the pandemic [27]. Research on how to employ digital resources to support qualitative skills is one of the basic solutions that could be relied upon in managing the COVID-19 crisis and reducing the negative effects of the pandemic [5].

The research gap on which the current research is based lies in the need for more studies aimed at studying the variables affecting the design of digital platforms in the context of the COVID-19 pandemic, and gamification is among the most important of these variables that can play an active role in the efficiency of the digital platform. The research gap of the current study is also related to the need to study the context of learning via digital platforms in public education schools in the Kingdom of Saudi Arabia during the COVID-19 pandemic, as the Kingdom closed all educational institutions completely on March 9, 2020 and was completely oriented towards digital platforms. Numerous studies have stressed the importance of paying attention to the structure of platforms that address gamification elements [28]. COVID-19 pandemic as a new context for education calls for research into the variables that can influence in this context [29]. Given, the different types of platforms and their different tools used during the pandemic, it seems crucial to examine the variables of their design and their impact on learning [30].When the research team reviewed several educational institutions, it was found that certain teachers have activated gamification systems through digital platforms, and others have not. Moreover, tenth grade students face difficulties in learning certain content of ICT courses because they are studied completely across platforms without a practical demonstration of skills. Nonetheless, gamification is one of the most important ways to motivate learners in computer and communication technology courses [31]. Therefore, we study whether gamification systems via digital platforms can play an influential role in enhancing learning efficiency during the pandemic by playing an active role in enhancing students' SRLS. This research trend is supported by the existence of many digital platforms that allow activating or disabling gamification options that are based on multiple gamification tools such as points, badges, levels, and leaderboards. Examples of these platforms are the Talent LMS platform and Edmodo platform [32-36], all of which were used in Saudi Arabia during the COVID-19 pandemic. A unique aspect of the current research is the use of mixed-methods approach, to broaden our understanding of the use of gamification across digital platforms during the pandemic and its impact on the SRLS of tenth graders students in Saudi Arabia.

Accordingly, the current research attempts to answer the following research questions:

— (*RQ1*) What is the effectiveness of the proposed design of the DPBG in developing SRLS during the COVID-19 pandemic through evidence extracted from a quantitative analysis?
— (*RQ2*) How does DPBG affect SRLS from the perspective of grade 10 students during the COVID-19 pandemic via evidence from a qualitative analysis?

The current research also attempts to validate the following hypothesis:

— (*H1*) There is no statistically significant difference at the level ≥ 0.05 between the mean scores of the G1-DPBG that use a DPBG and the G2-DPWG (digital platform without gamification) that uses DPWG in the post-measurement of SRLS.

2   Literature review

2.1   Gamification across digital platforms

Gamification as terminology is more closely related to the term "Games than Play". This is because playing means having more freedom and fewer restrictions, unlike games that mean restrictions, challenges, competition, and goals that must be pursued [37, 38]. Gamification is defined as the use of game design elements in non-game-based contexts [39]. DPBG are among the most important digital content platforms that could be relied on to support teaching and learning processes during the COVID-19 pandemic, as these platforms rely on several game motivators such as points, badges, levels, and leaderboards that can motivate and excite students towards implementing the tasks of learning and continuing to learn without stopping [40-45].

The COVID-19 pandemic has raised the importance of digital educational platforms to a new level [9]. However, not all digital platforms can achieve the desired positive effects equally. The quality of the platform and its general structure greatly contribute to determining the effectiveness of the platform [46]. The structure of the platform and the tools it offers can determine its role in addressing specific issues [47]. Therefore, it is important to consider the type of platforms that can be relied upon to improve teaching and learning processes in the context of the COVID-19 pandemic, which is what the current research is trying to achieve by trying to identify the effectiveness of a specific type of platforms, which are platforms based on digital game stimuli in the context of the COVID-19 pandemic.

Additionally, the necessities of interest in employing gamification through digital platforms can be deduced from what was indicated by several analytical studies. Porto and his research team [48] conducted a post-analysis of 101 studies that focused on gamification, and the results of the study clarified that gamification has an effective role in raising participation rates and motivating students to perform tasks. Additionally, by analyzing the results of 32 qualitative studies concerned with gamification

through the study of Bai and his colleagues [49], it was found that the reasons for students' happiness with gamification are due to gamification elements being among the powerful tools to encourage students' enthusiasm, and can provide immediate feedback as well as meeting the cognitive needs of students. The results of the longitudinal study conducted by Putz and his research team [50], which were carried out on 617 students for two years, demonstrated that digital incentives stimulate attention processes to the content and increase students' retention rates of the knowledge acquired during the educational process. The study of Cheng et al. [51] was also interested in examining 70 research papers through which products based on gamification elements were developed. The results of the study revealed that 59% of the research papers indicated that the elements gamification had had a role in improving mental health and quality of life as well as improving active participation, which drives the need to pay attention to gamification and its elements when designing applications.

2.2 SRLS

Self-organized learning is an organized cognitive mental process in which learners play active roles in their learning process. They set their goals, plan their learning, monitor it, organize it, and control it, until his goal of the learning process is achieved [52]. Self-regulatory learning helps motivate students, reflect on the learning process, contribute to providing solutions, and provide a deep understanding of complex educational topics, ultimately enhancing student self-confidence [53, 54]. In the context of the emergence of advanced and state-of-the-art technologies, self-regulation is no longer limited to the interactions and learning of people themselves but extends to include interaction with the technology itself [55]. Learning through technologies and digital resources requires students to have SRLS. The implementation of educational tasks through digital resources means that the student must be aware of the requirements of the task, the requirements for its completion, and the skills that must be demonstrated and that all of this is formulated in the form of goals that he seeks to achieve [56]. In this context, Lai and Hwang [53] stress that the level of self-organization affects students' ability to organize their learning outside the classroom. Learners with a low level of self-organization face difficulties interacting with the materials and activities presented to them outside the classroom; this greatly affects the overall efficiency of the technology used.

In using SRLS during the COVID-19 pandemic, SRLS are the basic skills that must be planned for general education students in the pandemic. In the survey results for one of the most important learning challenges facing young students during the COVID-19 pandemic, Dong, et al. [57] mentioned students' lack of SRLS. Therefore, redesigning digital platforms to include effective tools for enhancing SRLS is an important matter [58]. The importance of paying attention to SRLS is based on their ability to positively influence other learning outcomes [59].

The SRLS are based on four basic skills that can be presented as follows [60]:

- Goal Setting and Planning: This component refers to the student's ability to set general and specific goals, plan to achieve them according to a specific timetable, and carry out activities related to achieving those goals.
- Monitoring: It refers to the student's ability to monitor the activities he carries out to achieve the goals, follow up on these activities, evaluate the results he obtains, and improve his performance according to the results.
- Rehearsing and Memorizing: It refers to the student's ability to recall, remember, assimilate, and become aware of the educational material through repeated discussion and memorization.
- Seeking Social Assistance: It is the learner's recourse to those around him, such as a teacher or colleagues, to obtain a variety of assistance to help him understand the educational material or perform the duties entrusted to him to implement.

3　　Theoretical framework

According to the theory of Social Cognitive Learning SCL, learners can adjust their behaviors through their perceptions and beliefs regarding the consequences of these behaviors, and self-regulation processes contribute significantly to the changes in behavior [61]. This can be supported and achieved by gamification, as gamification motivates learners towards achieving their goals related to obtaining incentives and rewards, thus accompanying multiple stages of behavior modification [17]. In a related context, the Expectancy Value Theory (EVT) asserts that the learner determines his choices and steps based on his assessment of the extent to which the expected results match the behaviors he practices with the desired results [62, 63]. The digital incentives provided by gamification systems in this context can push the learner to build plans according to their learning system to achieve the learner's expectations [17]. According to the Goal Setting Theory (GST), the learner seeks to practice multiple processes of self-organization to achieve the goals he seeks, and to achieve his goals, he practices multiple management processes by objectives [64]. There is no doubt that managing learning through objectives by the learner reflects positively on the learner's SRLS, especially when this is linked to a set of digital incentives provided by gamification systems to the learner and gives the learner a feeling that what he sought has been achieved. According to Cognitive Evaluation Theory, the learner's access to digital incentives is an informational outcome that confirms to the learner the extent to which he has succeeded in carrying out his educational tasks [65, 66]. This means that digital incentives within the gamification system, according to the theory of cognitive assessment, represent an incentive for the learner to self-organize his learning to achieve his goals and implement his educational tasks. Additionally, the Causality Orientation Theory (COT) is based on the need for specific reasons that push the learner towards achieving his goals [65-67]. Accordingly, the digital stimuli provided by gamification systems in this context can be considered one reason that enhances the learner's practice of SRLS to obtain digital stimuli.

4 Methodology

4.1 Approach

Mixed-method Research has been followed, where implementation of the research requires quantitative and qualitative approaches to reach results that provide a better understanding of the impact of cross-platform gamification DPBG on SRLS in the context of the new educational context associated with the COVID-19 pandemic. Table 1 presents the quantitative and qualitative methods used in the research.

Table 1. Qualitative and quantitative approaches used in this research

No	Approach	Type	Objective
1	Descriptive Approach	Quantitative	▪ Analysis of previous studies that focused on digital platforms and gamification. ▪ Analyze and develop SRLS.
2	Quasi-Experimental Approach	Quantitative	The quasi-experimental approach was used to study the causal relationship represented in the results of the quantitative effect of the independent variable - gamification - on the dependent variable self-regulating learning skills.
3	Phenomenological Approach	Qualitative	This is to obtain an analysis and a deeper understanding of how gamification works across digital platforms during the COVID-19 pandemic and the mechanisms for enhancing SRLS through conducting in-depth interviews with several of the students who used gamification effectively via the DPBG.

As presented in Table 1, the current research is based on mixing quantitative and qualitative approaches in one framework to achieve the research goal. The quantitative methods are based on the descriptive method and the quasi-experimental method, which is the most widely used method in human research. It is used to verify the effectiveness of a specific technique in influencing several dependent variables, and the result of the research here is quantitative [68]. Regarding the qualitative approach used in the current research, it was based on the phenomenological approach, which is one of the important research approaches used in qualitative studies based on specific contexts. Therefore, it is one of the most appropriate approaches for studying techniques in the context of COVID-19, and in which a thematic analysis is carried out for details of the phenomenon from the participants' point of view [69].

4.2 Design

Embedded Design is followed because it is one of those designs in which qualitative approaches are integrated into the general framework of quantitative approaches [70]. Embedded designs give unequal priority to quantitative and qualitative components when answering research questions. In this type of design, several basic questions can be answered with the quantitative approach, and then several other complementary questions provide a deeper understanding of the qualitative approach [71]. Thus, through the design included in, quantitative data on the digital impact of DPBG on

SRLS will first be collected, and then qualitative data will be collected and used to answer research questions related to understanding the phenomenon of learning from DPBG during COVID-19. Then both quantitative and qualitative data will be merged for interpretation and discussion of the research results, to understand and construct the subjective meanings generated from experience, and to examine the complexity of the phenomenon as experienced by individuals [71].

Thus, the discussion of quantitative and qualitative research results will be in an integrative framework in which qualitative results are included in overlapping with quantitative results to illustrate how respondents have been affected by the experience of gamification across digital platforms during the COVID-19 pandemic. This integrated interpretation will provide a clear view of all the complex aspects associated of using DPBG to enhance SRLS among 10th graders based on their experiential experiences with the TalentLMS platform. Figure 1 displays the design steps involved in the quantitative and qualitative approaches used in the current research.

Steps	Procedures	Results
▪ Quantitative data collection	▪ Build a research tool. ▪ TalentLMS platform design. ▪ Application of research tools and platform.	▪ Access to the three measurement tools. ▪ A gamification platform. ▪ Quantitative data regarding the effectiveness of the platform.
▪ Quantitative data analysis	▪ Using t-Test.	▪ Ensuring the effectiveness and impact of gamification on SRLS.
▪ The transition to qualitative design	▪ Develop in-depth interview questions. ▪ Determine the specifications of the participants in the interviews.	▪ Key questions for the interview. ▪ Determine the group of participants with in-depth interviews.
▪ Qualitative data collection	▪ Conduct semi-structured interviews with participants.	▪ Individual transcript of the interview content.
▪ qualitative data analysis	▪ Use thematic analysis process.	▪ Themes
▪ Combine quantitative and qualitative explanations	▪ Discuss and interpret results.	▪ Discussing the search results. ▪ Recommendations and suggestions.

Fig. 1. The steps and stages of design included within the research

Figure 1 displays the steps and stages of the research design and the transition between quantitative and qualitative approaches to answer the research questions. Figure 2 displays how to implement the experimental design of the research and include qualitative data with quantitative data to identify the effect of DPBG in improving SRLS during the COVID-19 pandemic among 10th graders.
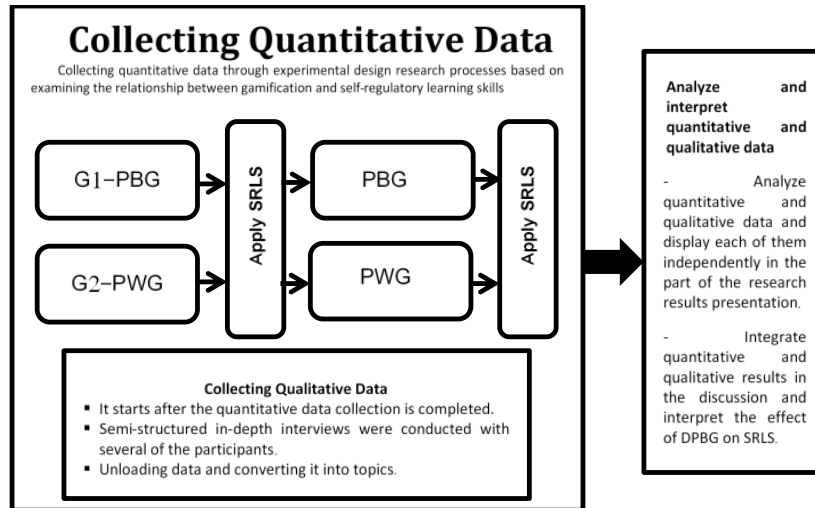
Fig. 2. Inclusion of a qualitative approach in the context of a quantitative approach

4.3 Participants

Participating students at quantitative study. The sample of participating students consisted of 60 students from the tenth grade at Al-Dua'a International School in the city of Jeddah for the first semester (2020/2021) and those studying in the distance education system in the context of the COVID-19 pandemic (3/10/2020 to 7/ 11/ 2020). The sample individuals were identified in two stages: the first stage in which they were intentionally selected according to two criteria, their regular attendance through the school's digital platform and their registration for the ICT course. The second stage was the random distribution of the sample individuals by 30 students for each of the two research groups, where the first group is the group that studies using the TalentLMS platform, which uses the methods of gamification, while the second group studies through the same platform, but without gamification being activated.

Participating students in the qualitative study. After applying the research experiment and collecting quantitative data, the participants in the qualitative study were selected from the students enrolled in the first experimental group who studied using DPBG. Namely, after completing their studies for the (systems life cycle) unit in the ICT course via the platform, they were subsequently applied to an SRLS scale. Eight participants were selected according to the following:

- Students with the highest scores in SRLS.
- After fulfilling the condition of rates, the statistics of obtaining digital incentives for each student were reviewed to ensure that the participating students work effectively within the platform and interact with most of the platform's tools. Students were excluded if they obtained less than 75% of the digital incentives via the platform and were replaced by the next student in order.

Participant statements and ethics. The researcher adhered to the ethical rules for scientific research stipulated in King Abdulaziz University Guide to Research Ethics. The researcher explained the scope and purpose of the research, and the consent of the students' families was obtained through a digital form. Students and their families have been notified that the student has the right to withdraw at any time without any justification if he feels not satisfied at any point. The approval of the school administration was obtained and coordination with it in all steps related to the research. All data of participating students has been kept confidential. The data of students in both experimental groups were encrypted, where the first experimental group was given a symbol (A) and the second experimental group a symbol (B), and then each student was numbered from 1-30 after each letter, the first student in the first group was A1, and the last student was A30 and so on. According to the rules for each treatment, the individuals involved were as follows:

- G1-DPBG: 30 students from A1 to A30.
- G2-DPWG: 30 students from B1 to B30.
- The participants in the qualitative study were eight students, and they are A6- A7- A12-A15- A17- A21-A23- A25.

4.4 Quantitative and qualitative instruments

Scale of SRLS. To prepare an SRLS scale through DPBG, various scales that concerned SRLS were reviewed [72-74]. According to the nature of the self-organized learning themes on which the previous measures were based, in addition to the nature of learning through DPBG during the COVID-19 pandemic, an SRLS scale was developed. The scale was based on four themes: Goal Setting and Planning, Monitoring, Rehearsing and Memorizing, and Seeking Social Assistance. Each of the four themes included seven items, with a total of 28 items. The scale was presented to a group of experts and educators who used digital platforms efficiently during the COVID-19 crisis to check the validity of statements. Students were asked to rate each item according to the quintiles (always - often - sometimes - rarely - never). The stability of the scale was confirmed before application, as it reached Cronbach's $\alpha = 0.812$ (Cronbach's $\alpha = 0.812$). The average stability of re-application was 0.79.

Building the instrument for semi-structured interview. In the qualitative aspect, the current research relied on in-depth interviews with students who studied through the DPBG to identify their perceptions regarding the role of gamification in enhancing their SRLS. To implement these in-depth interviews, a set of open-ended questions was prepared that provided an opportunity to discuss the details that the student presented. The researcher can also intervene by reformulating the question in another way that encourages the student to answer if he provided a short answer. Accordingly, (5) preliminary questions were prepared as follows:

- How did you rely on DPBG in your SRLS?
- How did digital incentives help you achieve your educational goals?
- How were you able to use DPBG to overcome the challenges of learning during home isolation?
- How did your performance in carrying out educational duties differ from the DPBG platform during the pandemic and in the classrooms before the pandemic?
- What can you ask your teachers about applying digital incentives when studying other educational topics?

4.5   Procedure

Quantitative procedure. The main platform used in the current research is the TalentLMS platform, which allows activating or disabling the gamification options, facilitating the implementation of the research experiment where the first experimental group (G1-DPBG) uses the platform with the activation of the gamification system. In contrast, the second experimental group (G2-DPWG) uses the same platform without activating the gamification system. Through the platform, four digital incentives were activated, represented in points, badges, levels, and leaderboards, as displayed in Figure 3.
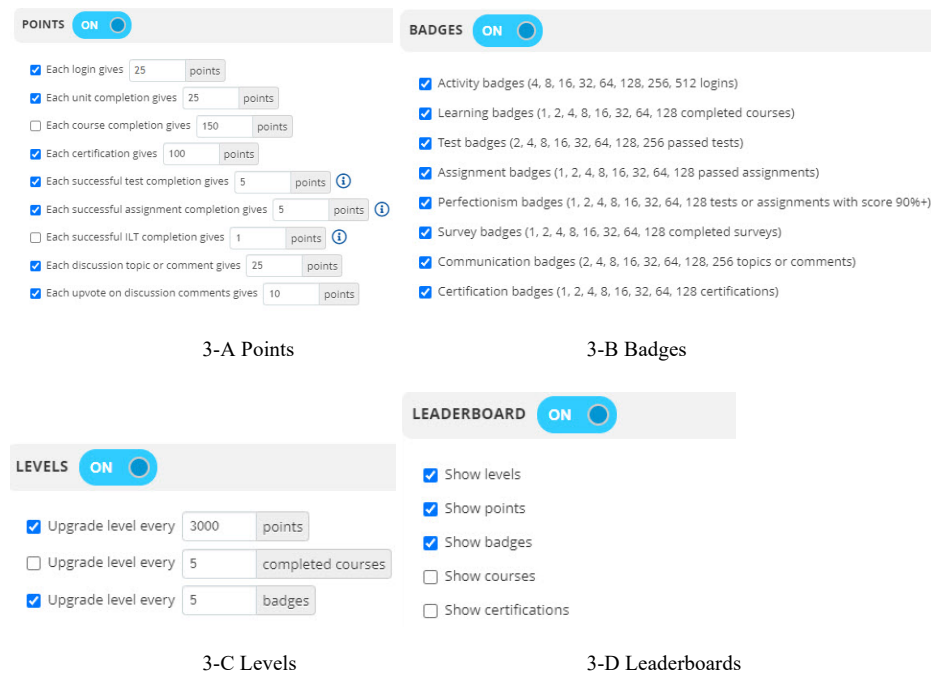
3-A Points

3-B Badges

3-C Levels

3-D Leaderboards

Fig. 3.   Gamification system and the digital incentives used across the platform

As displayed in Figure 3, digital incentives have been configured as follows:

— Points: Granting students 25 points each time they enter the platform and complete any learning unit, and one hundred points for each certificate obtained. Twenty-five points for each test or assignment provided the number of points is multiplied by the student's grades. Twenty-five points for each participant in a discussion and 10 points for each vote.
— Badges: Each student is awarded badges according to a consecutive number of activities related to the student's entry to the platform, completion of learning units, answering test questions, performing assignments, making comments, obtaining certificates, performing communications, and participating in surveys.
— Levels: If a student obtains 3000 points, he will move to the higher level, the same applies when he obtains five badges.
— Leaderboards: three leaderboards were activated according to the number of points, the number of badges, and levels.

The educational content of the "System Life Cycle" unit was prepared from the ICT course, and the content was based on 12 educational objectives covering the topics of the system life cycle, which are based on six educational topics: analysis, design, development, application, and documentation. Five tasks were identified for each of the educational topics, with a total of 30 tasks for the six educational topics. Each student was asked to complete assignments in specific time slots to receive digital incentives. The assignments revolve around students creating educational discussions, answering tests, writing reports on each learning topic, uploading student-made multimedia, and participating in voting.

The rules for each assignment were based on the assignment delivery dates, evaluation criteria, and cooperation and communication mechanisms. The nature of the challenges in each learning task is explained to students, the incentives that each student can get as a result of carrying out the educational tasks, the mechanisms of positive competition between learners, how to cooperate among learners, the timing of providing the feedback, and the status of each student is determined according to the points and badges they have collected. The final winners were announced according to the leaderboards and how each student expressed himself and his achievements.

To promote SRLS through the platform, several procedures and strategies have been identified, and students have been directed towards implementing them regularly through the platform. These strategies include planning to obtain digital incentives, searching for information that helps students to succeed in carrying out educational tasks, recording all the elements and events that helped students in obtaining digital incentives, directing students to take the initiative in requesting social assistance to carry out tasks through the platform, and carrying out self-evaluation processes through the continuous review of the digital stimuli obtained according to a student's performance and implementation of educational tasks.

The learning process was activated across the platform according to two experimental treatments; the first treatment includes the gamification system, while the second treatment includes the platform activated without the gamification system. Table 2 presents the working mechanism of the experimental groups during the implementation of the experiment:

Table 2. Mechanism of work of the experimental groups during the experiment'

(G1-DPBG)	(G2-DPWG)
G1-DPBG students study the proposed educational content on the platform. Students study all digital subjects and lessons, including digital videos, presentations, essays, and tests. All tasks on the platform were linked to various digital triggers. Each main task takes five days, and each sub-task one day.	G2-DPBG students study all digital content and topics presented on the platform without any digital incentives, as the platform gamification system has been closed. Students in this group do the same tasks, answer all the tests, and see all the topics just like the first group, but without the digital incentives. Students complete all tasks on the same schedule as the first group.

Qualitative procedure. The qualitative procedures for the research began after the completion of the research experiment and the post application of the SRLS scale. Semi-structured in-depth interviews were planned with the individuals of the first experimental group who studied the platform based on gamification DPBG. The research team seeks to find out whether the experimental treatment was successful or not; therefore, the team does not need to conduct interviews with the group that does not include the independent variable under study [70]. A schedule has been set for qualitative interviews with 8 students, where the interviews were conducted over 4 days, so that only two students were interviewed per day. Students were asked questions according to the questions formulated to determine the impact of the gamification platform on the SRLS while engaging in other inquiry formulations during the dialogue as based on students' answers to get the most information and explanations from the students. The duration of the interview with each student was from 20 to 30 minutes, and was conducted in the evening period from 8:00 to 10:00 pm after making sure that students finish their regular studies. The school administration and parents were notified of the interview date and allowed to be present as observers without participating in the talks. The interviews were conducted entirely via zoom in Arabic due to the precautionary nature of the scale. The interviews were fully audio-recorded, and thematic analyzes were then carried out using Maxqda software.

5 Results

5.1 RQ1: The quantitative effect of DPBG on the SRLS

To answer the RQ1, verify the validity of H1, a t-test was used to identify the significance of the differences between the two experimental groups. Table 3 presents the results of the t-test for the two research groups.

Table 3. Arithmetic mean, standard deviation, and t-value of SRLS total skills

Group	n	Mean	SD	t	df	sig
G1-DPBG	30	133.53	4.73	22.10	58	0.000
G2-DPWG	30	107.77	4.30			

Extrapolating the data from Table 3 displays the preference of G1-DPBG that used gamification systems compared to G2-DPWG in SRLS. Figure 4 displays the comparison between the two experimental groups in the average total skill set for SRLS.
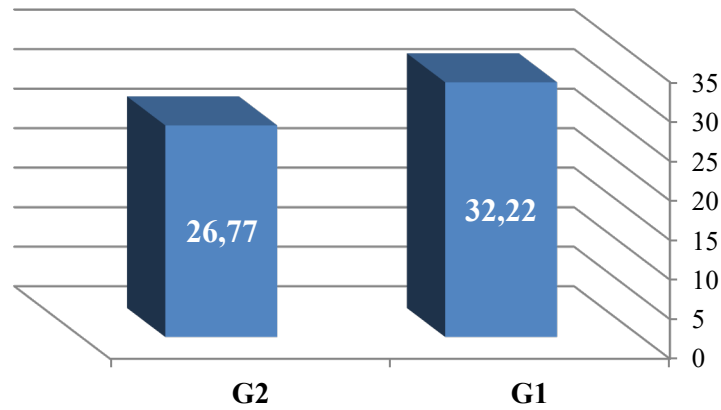

Fig. 4. Difference between experimental groups in total skill Set for SRLS

The significance of the differences between both experimental groups was also verified regarding the sub-skills constituting self-organized learning, as presented in Table 4.

Table 4. Arithmetic mean, standard deviation, and t-value of SRLS sub-skills

Skill	group	N	Mean	SD	t	DF	Sig
Goal Setting and Planning	G1-DPBG	30	32.22	2.61	7.32	58	0.000
	G2-DPwG	30	26.77	3.15			
Monitoring	G1-DPBG	30	34.16	1.56	9.76	58	0.000
	G2-DPwG	30	28.22	2.94			
Rehearsing and Memorizing	G1-DPBG	30	33.77	1.85	11.20	58	0.000
	G2-DPwG	30	25.21	3.73			
Seeking Social Assistance	G1-DPBG	30	33.38	2.28	6.33	58	0.000
	G2-DPwG	30	27.57	4.05			

It is evident from Table 4 that there are statistically significant differences in favor of the G1-DPBG and the G2-DPWG in the four basic SRLS: Goal Setting and Planning, Monitoring, Rehearsing and Memorizing, and Seeking Social Assistance.

Figure 5 displays the comparison between the two experimental groups in each of the SRLS themes.

(5-A)

Deference between groups in goal setting and planning

(5-B)

Deference between groups in monitoring

(5-c)

Deference between groups in rehearsing and memorizing

(5-D)

deference between groups in seeking social assistance
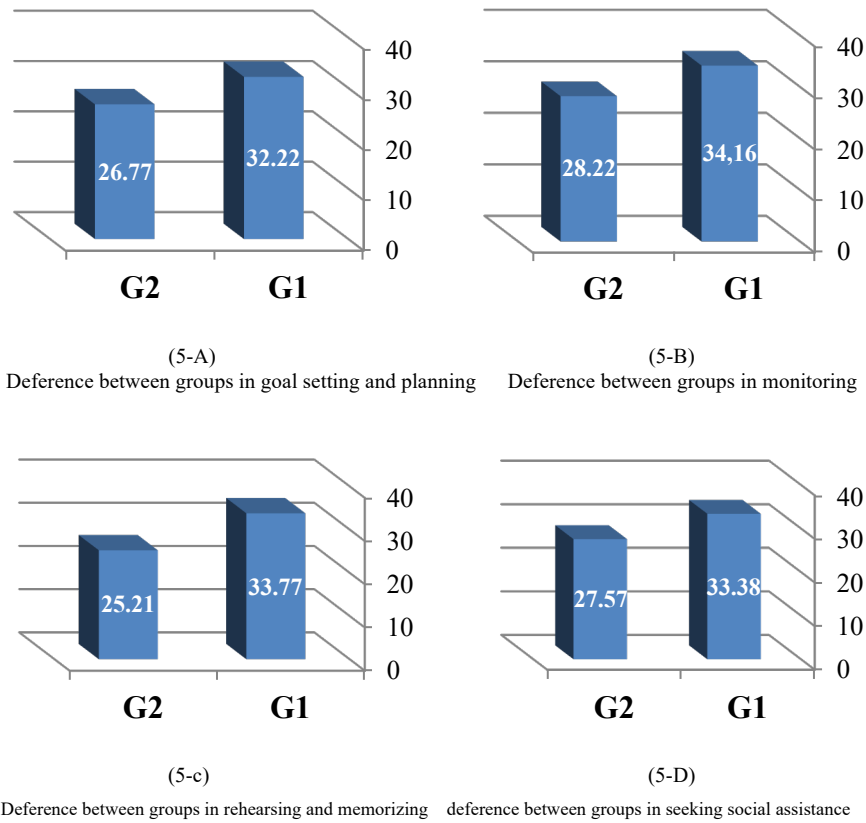
Fig. 5. Difference between experimental groups in sub-themes of SRLS

5.2 RQ2: The qualitative effect of gamification-based platforms on SRL

This section presents the results of the second research question on the qualitative effect of G1-DPBG platforms on SRLS from the perspective of students participating in the research experiment. According to the semi-structured interviews carried out with the students, these interviews were coded, and the related codes were grouped, demonstrating the role of gamification and digital platforms in influencing the SRLS. This process identifies specific influences of gamification on SRLS in four key areas, as displayed in Figure 6.

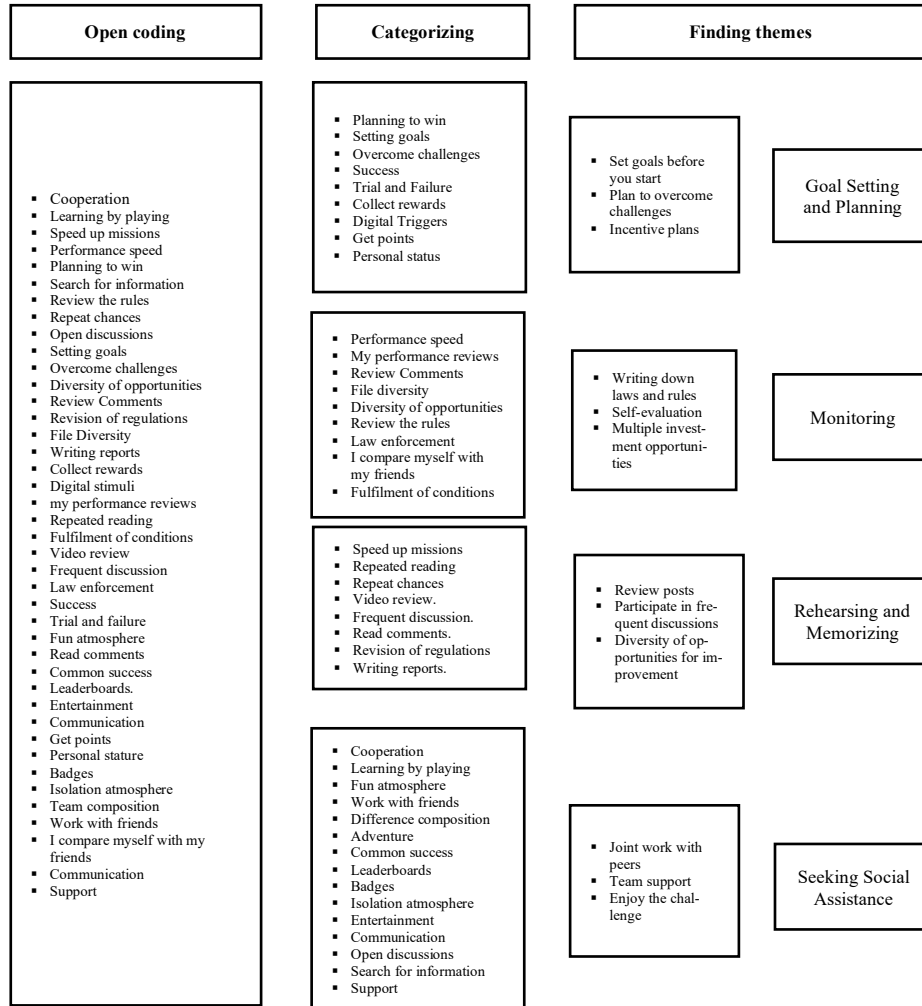| Open coding	Categorizing	Finding themes
▪ Cooperation ▪ Learning by playing ▪ Speed up missions ▪ Performance speed ▪ Planning to win ▪ Search for information ▪ Review the rules ▪ Repeat chances ▪ Open discussions ▪ Setting goals ▪ Overcome challenges ▪ Diversity of opportunities ▪ Review Comments ▪ Revision of regulations ▪ File Diversity ▪ Writing reports ▪ Collect rewards ▪ Digital stimuli ▪ my performance reviews ▪ Repeated reading ▪ Fulfilment of conditions ▪ Video review ▪ Frequent discussion ▪ Law enforcement ▪ Success ▪ Trial and failure ▪ Fun atmosphere ▪ Read comments ▪ Common success ▪ Leaderboards. ▪ Entertainment ▪ Communication ▪ Get points ▪ Personal stature ▪ Badges ▪ Isolation atmosphere ▪ Team composition ▪ Work with friends ▪ I compare myself with my friends ▪ Communication ▪ Support	▪ Planning to win ▪ Setting goals ▪ Overcome challenges ▪ Success ▪ Trial and Failure ▪ Collect rewards ▪ Digital Triggers ▪ Get points ▪ Personal status ▪ Performance speed ▪ My performance reviews ▪ Review Comments ▪ File diversity ▪ Diversity of opportunities ▪ Review the rules ▪ Law enforcement ▪ I compare myself with my friends ▪ Fulfilment of conditions ▪ Speed up missions ▪ Repeated reading ▪ Repeat chances ▪ Video review. ▪ Frequent discussion. ▪ Read comments. ▪ Revision of regulations ▪ Writing reports. ▪ Cooperation ▪ Learning by playing ▪ Fun atmosphere ▪ Work with friends ▪ Difference composition ▪ Adventure ▪ Common success ▪ Leaderboards ▪ Badges ▪ Isolation atmosphere ▪ Entertainment ▪ Communication ▪ Open discussions ▪ Search for information ▪ Support	▪ Set goals before you start ▪ Plan to overcome challenges ▪ Incentive plans → **Goal Setting and Planning** ▪ Writing down laws and rules ▪ Self-evaluation ▪ Multiple investment opportunities → **Monitoring** ▪ Review posts ▪ Participate in frequent discussions ▪ Diversity of opportunities for improvement → **Rehearsing and Memorizing** ▪ Joint work with peers ▪ Team support ▪ Enjoy the challenge → **Seeking Social Assistance**

Fig. 6. Qualitative data coding matrix and extraction of gamification effects on SRLS

6 Discussion

Regarding the significant statistical differences revealed by the results of the quantitative analysis and according to thematic analysis of students' opinions regarding how DPBG affect SRLS, the role of gamification has been based on motivate students to practice SRLS during the COVIDE-19 pandemic. This can be clarified in the presence of evidence in favor of the G1-DPBG compared to the G2-DPWG. The results will be discussed according to the four themes of SRLS.

6.1 Goal setting and planning

We can state that gamification enhanced goal setting processes before starting any educational task. This is because students wanted to plan each task to obtain its digital incentives. The gamification structure helped students make various plans to overcome challenges because there were points, badges, and joining behind each challenge for the winners students. Additionally, because each task has time slots and rewards, it enhanced the student's ability to clearly visualize the time sequence for executing each task. Since the gamification structure across the platform is linked to each other, where points and badges lead to joining specific levels and joining the leaderboards, this interconnection enhanced the students' abilities to set main goals and then divide them into sub-goals according to each stage. In this context, one of the students stated:

"The platform helped me organize my lessons and motivated me to plan well for each task even if there were difficulties. This is all, so I could get the rewards on the to-do list. I wasn't worried about home quarantine or COVID-19 as much as I was pre-occupied with how to plan for getting points and badges and being on leaderboards."
(A12*)*

It is clear from the previous example that the platform based on gamification through its various mechanisms, ways of displaying tasks, and digital incentives prompted students to practice planning tasks to collect the largest possible number of points and badges, participate in specific levels, and join the leaderboards. This is consistent with the mechanism and evidence of gamification across the platform, which puts the student in a state of concentration to reap the largest number of incentives. The gamification measures also helped the students to overcome the general state of anxiety and stress regarding the pandemic. Thus, their first goal was to obtain incentives regardless of the threats of the COVID-19 pandemic. The most important characteristic of the unique learning experience in the pandemic is the attempt to develop digital applications and habitual practices to create a new educational situation that puts students in a motivational framework that make them attentive and involved in all steps and tasks of learning [75]. Gamification works to raise students' cognitive growth rates and enhance their abilities related to organizing their learning [76]. Gamification also helps develop thinking and find various methods to achieve the best learning. This matter is positively reflected in SRLS [12]. Furthermore, gamification greatly contributes to enhancing students' involvement in learning, and thus they will focus on and plan all the requirements of the educational task [77].

The current result is related to the Motivation Theory, which indicates in its content that incentives help create internal motives that motivate students towards reaching the desired level through various planning processes [78]. According to the Self-Determination Theory, students, regardless of their skills, do not work in an automatic way, there must be stimuli that support students towards continuing to organize their learnings [65, 79-81]. According to GST, learners seek to plan and manage goals to achieve their aspirations and desires. This matter is supported by digital incentives [64].

6.2 Monitoring

The gamification system motivated students to practice observational skills. Through the gamification system, the students wanted to monitor their performance to ensure that they got points and badges. Therefore, many students tended to repeat their attempts. This matter results from the intense monitoring that they made concerning their performance to obtain the appropriate incentives, join the leaderboards, and raise their levels. The gamification system prompted students to practice personal strategies to analyze their performance and the reasons for success and failure to have complete control over all opportunities that qualified them for appropriate incentives. The gamification system made the students more compliant with the rules and laws of each assignment to ensure that they were rewarded. The level systems and leaderboards also contributed to the degree that students started to compare their levels to the level of other students. This matter caused the student to be in a state of continuous self-assessment, which was reflected in the student's overall skill of observation and control. In this context, one of the students stated:

"In order to be at the top of the leaderboard and join the highest levels, I had to constantly review what I got, evaluate my performance, and compare myself with my friends, so that I improve myself. For me it was a good feeling to get over the obstacle of leaving the house during the pandemic, to sit willingly in front of the podium and review myself constantly until I get the largest number of points and badges." (A23)

What was mentioned in the previous example indicates a general state of scrutiny and control carried out by each student on themselves Gamification systems contributed to building a general state of discipline and monitoring performance and comparison with peers to obtain incentives that can be considered a reward for students because of the control and monitoring they had done. Through the stimulus measures, the students can turn the disadvantage associated with home isolation into a positive advantage, interact with the platform as soon as possible, and then get the appropriate stimuli for them. Hence the importance of having motivating practices for students is so huge while learning via digital platforms, given the psychological pressures they may go through due to total lockdown and precautionary measures taken during the pandemic [82]. Additionally, the general system of gamification enhances the opportunities for students to monitor the quality of their participation, leading to a higher quality of output [83]. Students' productivity is affected by practices based on monitoring and control through the gamification system [84]. Students' access to digital incentives is linked to their keenness and follow-up on the work they participate in so that it is according to the highest level of quality [13].

The current result is consistent with several theoretical trends. According to the EVT, learners continuously monitor their performance until they get the incentives they expect from their performance [62, 63]. In this context, it can be inferred from the theory of cognitive evaluation that students' exercise of the control skill results from them receiving numerical incentives that represent an informational result regarding the extent of their success in implementing educational tasks [65, 66]. According to the Social

Comparison Theory, students' practice of the upward comparison processes continuously pushes them towards reviewing their performance and working towards continuous improvement and reaching higher levels of performance [85, 86].

6.3 Rehearsing and memorization

The structure of the gamification system greatly enhanced the skills of recitation and memorization. Associating comments with points motivated students to review their main ideas intellectually and verbally and share them in the cross-platform commenting system. Among the educational tasks within the platform is the task of recording multimedia, whether videos, presentations, or audio files. This task was linked to digital incentives within the platform. This matter motivated students to share their ideas through multiple recording clips that enhanced their memorization and recitation skills. The elements of gamification supported several of the students' strategies. For example, students always remind themselves of what they learned, which was why they got points and badges. Students rewrote and revised the content more than once to ensure that they got the necessary incentives. Undoubtedly, all these matters supported students' memorization and recitation skills. In this context, one of the students stated:

"Learning through the platform was fun. All the missions were linked with points and badges, as well as levels and leaderboards. All these motivators helped me to develop my personal way of learning, so I review myself before each comment and recall everything I have learned to put it in a good way in the tasks so that I get the incentives. The platform helped me get out of the boredom during lockdown. I was always talking to myself about all the tasks." (A21*)*

What was indicated in the previous comment indicates that despite the general boredom of students during the COVID-19 pandemic, gamification, and its various elements have helped students with educational practices that they may not have practiced sufficiently before, such as the skill of recitation and memorization. The home quarantine has been used to transform time into an added value through which it was possible to enhance recitation and memorization skills through a full review of all learning tasks and contents and an attempt to continuously revise them through self-talk between students and themselves. It can be stated that this is what the learning environment should be in the context of the COVID-19 pandemic. The learner needs during COVID-19 to relieve stress and transform the restrictive context of the pandemic into one that helps implement educational practices [7]. Although the context of learning via digital platforms during the COVID-19 pandemic has been characterized by the availability of ample time to implement educational activities, it must be accompanied by motivational methods [87]. This is what gamification does as it motivates students and increases the time spent by the learner in the learning environment [83]. Gamification enhances achievement, which is related to memorization and recitation [88]. Gamification also enhances engagement in learning. This engagement has cognitive dimensions related to students' ability to carry out practices that facilitate retrieving what they have learned [89]. The modular design of gamification raises the motivation rates towards using all methods to complete learning tasks, which leads to higher achievement rates [15].

SCL theory presents inferences that students develop new behaviors associated with the practice of memorization skills. Students reset their behaviors according to their perception of the consequences of their behavior [61]. Additionally, according to the Behaviorism Theory, the behavior must be supported and reinforced to be strengthened and repeated. Thus, memorization and recitation skills continue with support or motivation [90]. This is per Reinforcement theory, which states that repeating performance is correlated with the presence of motivation [86].

6.4   Seeking social assistance

The use of the DPBG contributed to enhancing the skills of seeking social assistance. Gamification stimulated students' desire to discuss each other during all steps to ensure that they receive the highest number of digital incentives. Gamification also promoted social interactions between students on the one hand and their teacher conversely to get inquiries regarding challenges facing students and how to overcome them. Gamification fostered cooperation among students themselves to rise to higher levels and overcome common challenges, although this matter does not negate the existence of competition for access to leaderboards. The platform provided discussion tools that can be relied upon as a source for requesting social assistance. The effectiveness of these tools was enhanced by linking them to dots and badges, which prompted students to participate effectively. Gamification stimulated the students' desire to have a status on the platform, which prompted them to use all communication tools to obtain support that qualified them to overcome difficulties and challenges. One of the students mentioned:

"I had a desire to accumulate the largest number of points and badges and to be on the top of the leaderboards, so I did not spare any possible opportunity to benefit from my colleagues, cooperate, and communicate with them and ask the teacher about anything that would facilitate me to get incentives. Even I participated strongly in the comments and supported my colleagues... What encouraged me more to communicate is that all communications on the platform are linked to points and badges. I was very excited." (A15*)*

The previous comment suggested that the DPBG platform provided a structure of communication linked to digital incentives and supported social assistance requests by students. Additionally, the manipulations and tasks available through the platform supported the processes of cooperation among students to achieve common goals. Furthermore, the presence of Communication Badges created a desire for students to practice the tasks of cooperation and sharing and somewhat reduced the negative aspects of the competitive processes associated with the competition among students to obtain badges and points. Using gamification across educational platforms significantly enhances social interactions within the learning community [13, 14]. Humans are by nature proactive and have a strong internal desire for growth, which influences their choices. If the environment supports these motives, they resort to using all available means to enhance their motives through various processes of social interaction [80]. An educational system containing various communication tools enhances students' ability to interact and participate in discussions that enhance their cognitive needs [91, 92] especially if the communication tools are linked to a motivational system[17].

It is stated that according to the COT, students attempt to use all means to achieve their goals [65-67]. Therefore, through DPBG, students effectively used all appropriate tools to obtain social assistance. According to the constructivist theory, an active learning environment that provides a great deal of communication and interaction enhances social interaction processes and meets the social cognitive needs of learners [93]. Additionally, through the theory of Basic Psychological Needs and, in particular, the relatedness factor, gamification systems encourage the connection that is generated by learners' building of social relationships with their peers within the learning environment and their sense of belonging to the groups that are formed during the implementation of the tasks. This matter facilitates them to get support from their learning community [65, 94, 95].

7 Limitations

The effect of gamification on SRLS during the COVID-19 pandemic is related to the gamification elements used in the research, namely, points, badges, levels, and leaderboards. That effect may change if other elements are implemented. The general context of the COVID-19 pandemic has allowed the existence of an appropriate time range for teachers to interact via the platform and reinforced students' need for elements that push their motivations. It is assumed that if the context of the application is different from the time of lockdown and home quarantine, different results could be obtained. The SRLS scale has been linked to the nature of learning during the COVID-19 pandemic across digital platforms and lockdown environments. Adjustments to the scale may be appropriate if used outside the COVID-19 context.

8 Conclusion

The current research is classified as important research that focuses on how gamification promotes SRLS as an essential learning skill in the context of the COVID-19 pandemic. Additionally, the current research deals with the methods of increasing the educational effectiveness of digital platforms during the COVID-19 pandemic through gamification variables. The current research provided an effective design for gamification within digital platforms, so they can be used to enhance students' SRLS in the context of learning during emergencies. The research also identified key indicators of SRLS during the COVID-19 pandemic, which was based on four main axes: goal setting and planning, monitoring, rehearsing and memorization and seeking social assistance. The research also framed how students had dealt with digital platforms during the pandemic and how they had thought about using the gamification system to overcome the negative effects of home quarantine. The outputs of the current research paper contribute to the development of the structure of educational technologies during pandemics to be flexible and effective in dealing with emergencies. Future research should discuss differences between elements of the gamification system itself in influencing SRLS and other learning outcomes. Moreover, bibliometric studies on the context of learning from digital platforms during the COVID-19 pandemic could be conducted,

and studies on the way the educational design of digital platforms within the framework of activity theory can be reformulated according to the learning context during the COVID-19 pandemic.

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