

Kahoot! Quizzes: A Formative Assessment Tool to Promote Students' Self-Regulated Learning Skills

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Abstract

Gamified student response systems (GSRs) have been increasingly used for formative assessment (FA) purposes in higher education. While previous studies on Kahoot! have given empirical evidence of the effectiveness of its gamified features in increasing students' motivation, enhancing classroom dynamics and providing immediate feedback on students' learning, the present study mainly investigates the students' ratings of Kahoot! Quizzes (KQs) as a FA tool that facilitates the development of self-regulatory learning (SRL) skills. The study uses the seven principles of effective feedback to design a FA model that promotes students' self-regulatory skills by defining the teacher's role and students' responsibilities while administering KQs. The study is a classroom action research that was done during a summer course and involved ($n = 70$) female students in two linguistics courses. The researchers used a questionnaire and a focus group discussion to get students' feedback on the effectiveness of KQs in enhancing their self-regulated learning. The results consistently showed positive evaluation of KQs along three dimensions: effective feedback, classroom environment and developing students' meta-cognitive skills, the three essential ingredients of self-regulated learning. The model proved to be extremely effective in designing effective KQs that enhance students' self-regulatory skills.

Keywords: Gamified student response system (GSRs), Kahoot! Quizzes (KQs), formative assessment (FA), feedback principles, self-regulated learning (SRL), and higher education

INTRODUCTION

With the increased access to mobile phones and PCs, educators manage to integrate gamified student response systems (GSRs) such as Kahoot! in their instruction and classroom assessments. These available and often free of charge assessment tools combine game elements such as leaderboards, badges, competitive scoring systems and time limits to enhance students' experience of classroom assessments. Previous studies have repeatedly reported favorable student responses to using GSRs in classroom assessment as they can increase attendance and participation (Aljaloud et al., 2016;

Beatty & Gerace, 2009; Burnstein & Lederman 2001; Cutts et al., 2004; Ferrándiz et al., 2016, Elmahdi et al. 2018; Sun & Hsieh, 2018; Turan & Meral, 2018; Wang, 2015; Wang & Lieberoth, 2016; Welbers et al. 2019), help sustain student attention, support individualized learning, provide opportunities for interaction (Featherstone, 2016; Ramsey & Duffy, 2016; Russel, 2019; Sánchez-Mena & Martí-Parreño, 2017), and have a positive effect on students' attitudes, motivation and academic achievement (Lim et al., 2017; Preszler et al, 2007; Sánchez-Mena et al. 2016; Sharples, 2000). These Gamified tools are also shown to enhance classroom dynamics (Caldwell, 2007), students' thinking, classroom discussion and students' scores in summative tests (Iwamoto et al., 2017).

The literature provides accumulative evidence that these digital assessment tools particularly Kahoot! help motivate learners and provide immediate feedback to teachers and learners about their learning progress (Biçen & Kocakoyun, 2018; Borrell, et al., 2017; Chaiyo & Nokham, 2017; Hanus & Fox, 2015; Ismail & Mohammad, 2017; Kapp, 2012; Lee & Hamer 2011; Licorish et al., 2017; Licorish et al., 2018; Medina & Hurtado, 2017; Rodrigo et al., 2016; Solmaz & Çetin, 2017; Tsihouridis et al., 2017; Yapıcı & Karakoyun, 2017). The gamified features in KQs not only make lectures fun (Wang, 2015) but improve students' engagement and enjoyment (Clark et al., 2011; Cheong et al., 2013; Cutri et al., 2016; Schell et al., 2013). In academic courses particularly, the quiz features enable teachers to assess students' understanding of academic concepts/ skills and help students achieve learning outcomes (Beatty & Gerace, 2009; Elmahdi et al. 2018; Irving, 2015; Roschelle et al., 2004). They could also be adapted to students' level to allow for scaffolded instruction (Hanus & Fox, 2015).

Though the literature has mainly emphasized Kahoot! effectiveness as an assessment tool, its impact on student SRL has not been examined yet. Very few studies have only provided evidence that gamification increased motivation for self-directed learning (SDL) and helped to improve the academic performance of students (Ang et al., 2018; Featherstone, 2016). In the present study, we argue that one of the main objectives of FA is to promote learner SRL strategies by sharing immediate and effective feedback on performance during instruction (Clark, 2012a; Sadler, 1998). We particularly focus on the feedback features of Kahoot! as a FA tool to help students set goals and monitor their learning and at the same time, help teachers monitor the students' development of SR skills. With this in mind, the present study aims to specifically focus on the learners' evaluation of the effectiveness of KQs as a FA tool in enhancing their SRL along three main dimensions: a) its feedback features, b) learning environment benefits and c) its effectiveness in enhancing students' meta-cognitive skills. The study aims to specifically answer the following question:

- Based on students' feedback, what were the main benefits and shortcomings of using KQs to enhance their self-regulated skills? And what are the main recommendations for course instructors?

How KQs Operate

Kahoot! is a GSRS that enables teachers to create gamified quizzes and actively engage students in classroom assessments. To use the platform, teachers only need internet

access, a free account and a laptop connected to a large screen (for more details about how Kahoot! operates see Wang, 2015; & Wang and Lieberoth, 2016). Students simply need to download the application on their smart phones and access the quizzes through a pin number that the teacher displays on the screen/ whiteboard. Then, they create a nickname or use their real names to access the game quiz. Teachers can also add a cover image and videos as extra support. During the game, multiple-choice / true and false questions are shown on the screen using different colors and graphical symbols in a way that mimics a game show. Students need to answer correctly within the time limit assigned by the teacher. Once all students give their answers, a scoreboard immediately gives the teacher and students feedback on how students perform and show the top 5 players. The students also get individualized feedback on their devices in terms of correctness, ranking, the number of points earned and the correct answer whenever necessary. After each question, the leaderboard keeps changing until the final winners with the highest score show at the end of the game. Music, sound effects, score points and leaderboards are extra features that add to the fun and competitiveness of the game. Once the game is over, the system creates multiple reports about the students' scores and performance for the teacher as well as allows students to access the game again for a replay. Kahoot! not only gives the teacher immediate feedback about the students' achievement of the course learning outcomes, but also provides him/her with a detailed report of each student's progress on each question.

Using the Seven Feedback Principles to Develop Students' SRL:

Unlike Summative assessments that evaluate students' learning at the end of an instructional unit, the goal of FA is to monitor students' learning and provide ongoing feedback that can be used by both instructors and students to improve teaching and learning (Greenstein, 2010; Stiggins, 1989; Stiggins & Chappuis, 2004). Clark (2012b) writes:

Formative assessment is a potentially powerful instructional process because the practice of sharing assessment information that supports learning is embedded into the instructional process by design (p. 1).

Timely feedback in FA is a key factor in developing students' meta-cognitive skills (Black and Wiliam 2006, p.15). Nicol & Macfarlane-Dick (2006) developed the following seven feedback principles that facilitate learner self-regulation & autonomy in FA:

The seven principles of effective feedback practice:

- 1- helps clarify what good performance is (goals, criteria, expected standards);
- 2- facilitates the development of self-assessment (reflection) in learning;
- 3- delivers high quality information to students about their learning;
- 4- encourages teacher and peer dialogue around learning;
- 5- encourages positive motivational beliefs and self-esteem;
- 6- provides opportunities to close the gap between current and desired performance;
- 7- provides information to teachers that can be used to help shape the teaching.

Previous studies focused on FA as a process that is “designed to continuously support teaching and learning by emphasizing the meta-cognitive skills and learning contexts required for SRL; planning, monitoring and a critical, yet nonjudgmental reflection on learning, which both students and teachers use collaboratively to guide further learning and improve performance outcomes” (Clark, 2012a, p. 14). Based on the external feedback students receive via digital FA tools like Kahoot!, they develop meta-cognitive skills (internal feedback) that help them regulate their learning. Clark (2012a, p.4) writes: Moving toward the core of the cross-section, one encounters the meta-cognitive (MC) components of planning (P), monitoring (M), and reflection (R) and the affective (SE) components of ambition (A), effort (E), and persistence (Pe) required for SRL to exist. Feedback (F) is located at the center of the model. Feedback is pivotal to formative assessment and therefore to the development of SRL strategies among students.

According to Hattie and Temperley’s (2007) conceptual analysis of feedback, timely feedback is essential for students to develop self-regulatory skills. They (2007) suggested using the umbrella term “feed” to cover three types of teachers’ feedback: feed up, feedback and feedforward:

- a) Feed-up addresses the question: Where are we going? And set the goals for students, so, they are aware of the intended learning objectives and able to monitor their progress against them;
- b) Feedback: How are we doing? This addresses how students monitor and assess their learning performance in a specific task or generally; and
- c) Feed-forward: Where to next? i.e., students can plan their next step to improve their performance.

Promoting Students’ SRL during the FA Process:

In addition to the timely feedback that is essential for an effective FA process, there are two key factors that promote learners’ self- regulation: a) developing meta-cognitive skills (e.g. planning, monitoring and evaluation) and the learning environment itself (Yıldızlı & Saban, 2016). Bose and Rengel (2009, p. 30) define SRL as follows:

Self-regulated learning refers to a degree to which students can regulate aspects of their own thinking, motivation and behavior during the learning process (Pintrich & Zusho, 2002). Self-regulated learners set up their own learning goals and form strategies by generating more internal feedback, responding to external feedback, using resources and increasing efforts to achieve learning goals and produce outputs that can be compared and assessed.

There are many SRL models that emphasize the role of FA process in promoting students’ SR skills in the literature (see Bandura, 1997; Black & Wiliam, 2009; Boekaerts & Corno, 2005; Bose & Rengel, 2009; Butler & Winne, 1995; Clark, 2012a; Efklides, 2011; Pintrich, 2000, Pintrich & Zusho, 2002; Schunk and Zimmerman; 1998, 2007; Zimmerman, 2002; Cleary et al., 2012). Of these Zimmerman’s (2002) model of SRL is perhaps the most widely used. It consists of three main phases: forethought, performance, and self-reflection. There are two major processes in the forethought phase: task analysis, which

involves goal-setting, and self-motivation. Initially, students need to be aware of the learning objectives and make relevant study plans. Performance phase processes fall into two major classes: self-control and self-observation. During this phase, students are actively engaged in the learning activities and tasks and simultaneously monitor their learning progress. The third phase of self-reflection entails self-judgment and self-reaction, i.e., students assess their learning performance and plan the next step accordingly (Zimmerman, 2002, p. 67-68). Recent research on FA has also shown the positive effects of SRL on students' abilities to be independent learners and develop life-long learning skills (Black & Wiliam, 2009; Bose & Rengel, 2009; Clark, 2012a, 2012b; Jarvela et al., 2018; Nicol & Macfarlane-Dick 2006; Panadero, Jönsson & Strijbos, 2016; Pintrich, 1999, 2004; Sadler, 1998). Researchers have repeatedly shown the enhancing effects of self-regulatory behaviors on students' academic performance in face-to-face classroom instruction (Kramarski & Gutman, 2006; Kramarski & Mizrachi, 2006; Lan, 1996; Orange, 1999) and in online environments (Barnard et al., 2008).

SRL is not only the regulation of the individual learning process at cognitive and meta-cognitive levels, but also comprises the regulation of students' motivation level and the classroom dynamics that enhance the development of their SR skills. Black and Wiliam's SRL model (2009, p. 8) emphasizes the joint role of teachers and students to meet the following strategic responsibilities:

- (1) clarifying and sharing learning intentions and criteria for success (teacher driven);
 - (2) engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding (teacher driven);
 - (3) providing feedback that moves learners forward (teacher driven);
 - (4) activating students as instructional resources for one another (peer-group driven);
- and (5) activating students as the owners of their own learning (individual learner driven).

Using KQs as a FA Tool to Enhance SRL:

A major advantage of using KQs is providing immediate feedback and creating the learning environment that facilitates the development of learners' meta-cognitive skills (see Tan & Saucerman, 2017; Wang, 2015; & Wang and Lieberoth, 2016). In addition to its impact on classroom dynamics, Wang (2008) maintains that web-based quiz-game-like FAs are based on seven key strategies that activate both a challenge mechanism and a game mechanism. He identified the 7 strategies as: 1) 'repeat the test', 2) 'timely feedback', 3) 'query scores' which allows tracking learning progress anytime and anywhere; 4) 'ask questions' strategy that encourages students to discuss the questions with peers or teachers; 5) 'all pass and then reward', 6) 'monitor answering history' that lets students query their own answering history; and finally 7) 'Ask-Hint' strategy that provides the info about how their peers answer each question for the less-competent students. KQs have all the above features besides offering students many opportunities to test their understanding of academic concepts as often as they wish without the help

of the teacher. This is particularly useful to the students who need extra opportunities to enhance their sense of control over their learning (Nicol & Macfarlane-Dick, 2006).

From an SRL perspective, KQs provide three types of formative feedback: a) immediate feedback on content knowledge and skills b) expected performance (how to perform) through teacher's feedback and class discussions and c) encouragement for good performance through its reward system; e.g., immediate scores, leaderboard and badges. Figure 1 below shows how the seven principles of feedback practice and defining the teacher's role and students' responsibilities can guide the whole assessment process while administering KQs and maximize students' self-regulated learning.

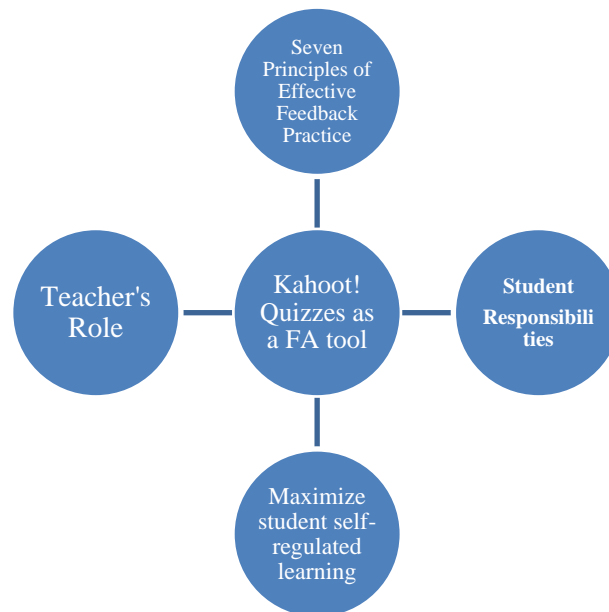


Figure 1. Seven principles of effective feedback and the FA frame

Figure 1 shows how the seven principles of effective feedback can provide the FA frame to promote students' SRL. Since our primary focus is to investigate the benefits of using KQs to provide students' with timely feedback that could, in turn, contribute to the development of their SRL, The proposed model integrates Zimmerman's (2002) three-phase model and the seven principles of effective feedback (Nicol & Macfarlane-Dick, 2006) to define the teacher's role and students' responsibilities while using KQs in the classroom. The model can be applied to KQs and/or other similar GSRs in order to promote students' SRL. The next section presents the proposed model, the method, participants, research context and the data collection tools. Section 3 presents the questionnaire results and the qualitative analysis of the focus group discussion. Section 4 concludes the article with recommendations and suggestions for future research.

THE PROPOSED MODEL

Defining the Teacher's Role and Students' Responsibilities while Using KQs

Based on the seven principles of feedback and the meta-cognitive skills necessary for developing students' SRL, the model below defines the teacher's role and students' responsibilities while using KQs in the classroom. Table 1 below describes how KQs can

provide effective feedback and enhance students' meta-cognitive skills during three distinct yet interrelated instructional- FA phases:

- 1) The planning stage—in which teachers and students collaboratively set and plan learning goals and behaviors
- (2) The performance stage— in which they collaboratively track and monitor performance and motivation;
- (3) The evaluation and reflection phase in which teachers and students collaboratively evaluate the learning progress and plan the next steps based on the external and internal feedback generated by Kahoot! (Adapted from Zimmerman, 2002).

Integrating the Seven Principles of Effective Feedback in KQs to Develop Students' SRL

The Planning Stage: Before the Quiz

Principle 1: helps clarify what good performance is (goals, criteria, expected standards);

Principle 2: facilitates the development of self-assessment (reflection) in learning;

Teacher's Role	Students Responsibilities
Explain and share learning outcomes	Plan learning targets
Plan & design KQs	Manage learning behavior

The Performance Stage: During the Quiz

Principle 3: delivers high quality information to students about their learning;

Principle 4: encourages teacher and peer dialogue around learning;

Principle 5: encourages positive motivational beliefs and self-esteem;

Teacher's Role	Students Responsibilities
Track and monitor performance	Actively participate
Give feedback and manage classroom dialogue	Engage in discussions
Encourage & motivate students to meet learning targets	Manage motivational beliefs and self esteem

The Evaluation & Reflection Stage: After the Quiz

Principle 6: provides opportunities to close the gap between current and desired performance;

Principle 7: provides information to teachers that can be used to help shape the teaching.

Teacher's Role	Students Responsibilities
Adapt and scaffold instruction	Self- assess and reflect on quiz results

Plan the next assessment	Celebrate success/ keep trying Monitor learning progress and plan the next step.
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Table 1 shows the FA model used to enhance students' meta-cognitive and SRL skills in the experiment.

RESEARCH METHOD AND CLASSROOM PROCEDURE

Based on the proposed model mentioned above, the following procedure was followed during the experiment:

Before the quiz (The Planning Phase)

- 1- Learning outcomes were simplified and shared with students in the beginning of each topic so students can set learning goals. Students were also encouraged to write their learning goals in a journal so they can use the data provided by Kahoot! in self-assessment at the end of the topic.
- 2- To enhance the self- regulation capability of students, the course instructor used the individual mode in creating the quizzes. Other forms of FAs (e.g. assignments and class discussions) were also used alternatively with Kahoot! to provide a variety of FA methods.

During the quiz (The Performance Phase)

- 3- KQs were designed to assess the learning outcomes of the two courses. They were administered at the end of each topic to get feedback on students' grasp of the academic content and to encourage students to reflect on their learning progress.
- 4- Though Kahoot! allows students to stay anonymous or use nicknames, they were encouraged to use their names so the course instructor could provide individualized support after the quiz. The quizzes were not graded; so, students had no problem using their real names to get the extra support.
- 5- The quiz was projected on the main screen and done by all the students present in a simultaneous but individual way. Students needed to select the appropriate answer using their mobiles. To add extra challenge to the game, the time assigned to answer was 30 seconds (see section 1.2).
- 6- After each question, a scoreboard showed the names and scores of the top five students to the whole class and students received individual feedback on their devices.
- 7- A distribution chart of how the students answered was shown between questions; which gave the course instructor immediate feedback on class performance and the chance to discuss students' answers and the results of the quiz. This also allowed students to track their learning progress in comparison with their peers.
- 8- At the end of the game, the winner was announced. The leaderboard and virtual rewards available in Kahoot! helped students to celebrate their success. Its

gamification features (e.g. the use of colorful graphics and music) also increased students' engagement and fun.

After the Quiz (The Evaluation and Reflection Phase)

- 9- Once the game was over, Kahoot! offered performance reports in the form of excel sheets and data that showed details about students' achievement.
- 10- Based on the data, the course instructor could decide whether learning outcomes were achieved or some remedial work needed to be done and to who.
- 11- Students also had access to their individual results, which allowed them to assess themselves and decide what to do next. They were also able to repeat the quiz whenever they wished.

Participants and Research Context

Participants in this study (n= 70) were fourth- year students (all females) who major in translation in the undergraduate level in the English department, in King Abdul Aziz University (Rabigh branch). The two linguistics courses were elective courses that students need to successfully complete to qualify for a graduate degree in the English language (translation track). The courses were taught during the summer course that lasted for a period of 8 weeks. The reason behind choosing the two elective courses and the timing was the relatively big number of students who joined these elective courses, 35 students in each course (normal class size is 10-13) and the fact that one of the researchers was the instructor. During the first week of the course, the instructor introduced Kahoot! application and asked the students to download the application on their smart phones. Since it was the first time for students to use Kahoot!, they were given a quick overview of the application and some training in the beginning of the course. Then, the aim and procedure of the experiment was explained. The frequency of using Kahoot! was once every fortnight (i.e. 4 quizzes in each course) in which the instructor used multiple choice / true & false questions to check concept understanding and skill mastery. After each question, results were displayed on the big screen which allowed the instructor to discuss the results and/ or re-explain if necessary. The quizzes were not graded so students could be motivated and not stressed about their answers.

It was hypothesized that the immediate feedback provided by KQs and identifying the teacher- students' roles and responsibilities during the FA process will help promote their SRL. During the last week, the questionnaire link was shared with students to fill in class. Finally, the other researcher conducted the focus group discussion to get a more valid feedback on the impact of Kahoot! on students' SRL.

Data Collection Tools: The Questionnaire and the Focus Group Discussion

The questionnaire was adapted from a previous study by (Bullón et al., 2018) and more questions were added to get students' feedback on the effectiveness of KQs in developing students' SRL along three main dimensions:

- A) Its feedback & learning benefits (acquiring academic knowledge and skills and getting feedback on the learning process)

Q: How do you value the use of Kahoot! as a tool that increases your knowledge of the subject?

Q: How do you value the use of Kahoot! as a tool that gives you immediate feedback on your learning progress?

B) Its meta-cognitive benefits (enhancing students' goal setting, self- monitoring, self- assessment and reflection)

Q: How do you rate the use of Kahoot! as a tool that clarifies the learning goals that need to be achieved?

Q: How do you assess your performance in Kahoot! tests in class?

Q: How do you see Kahoot! as a tool that helps you compare your performance with other students in class?

Q: How do you assess Kahoot! as a tool that helps you reflect on your learning progress?

Q: How do you value the use of Kahoot! as a tool that encourages you to keep trying & plan your next step?

C) Its learning environment benefits (concentration, motivation, engagement, competition and fun)

Q: How do you value the use of Kahoot! as a tool that keeps you focused and motivated?

Q: How do you value the use of Kahoot! as a tool that keeps you engaged in the subject matter?

Q: How do you value the use of Kahoot! as adding fun to the test?

The questionnaire used a five-point Likert scale that rated KQs from very favorably, neutral to very unfavorably. Then, the results were statistically analyzed to get the mean, standard deviation and rank of each dimension (see Table 1 below). The focus group discussion was mainly used to collect qualitative data on students' perceptions of KQs as a tool to promote their SRL. Students were asked to a) tell the main benefits and/ or shortcomings of KQs and the proposed FA process and b) explain the rationale behind their ratings. The group discussions were recorded and grouped under each questionnaire heading. They were assured that their responses will be used only for research purposes. Sixty four out of 70 students agreed to answer the questionnaire and 35 students participated in the group discussion.

RESULTS AND DISCUSSION

The results presented in Table 1 below show the students' ratings of KQs as a tool to enhance SRL. As shown in Table 1, there was not much statistical variation amongst the three dimensions. Therefore, special focus was paid to the percentages given to each question as they showed more variation and triggered more reflection during the focus group discussion.

Table 1. Comparison between the mean and ranking of the three dimensions

Dimensions	Mean	Rank
(A) feedback & learning benefits	4.6	1
(B) meta-cognitive benefits	4.5	2
(C) learning environment benefits	4.6	1

As shown in Table (1), the mean was very close in all three dimensions; still, Kahoot! feedback and learning environment benefits occupied first rank. Tables 2-4 are divided into three main columns: the questions under each dimension, the scale, percentages of students' ratings, the statistical analysis and ranking of each question. According to students' ratings, the percentages were consistently positive in all areas and very favorable & favorable ratings ranged between (87.6% -96.9%). The aspects that received the highest favorable rating were in order: Kahoot! fun features (96.9%), learning benefits (95.4%), self- assessment (95.4%), immediacy of feedback (93.3%), self-reflection (95.3%), goal- setting (92.2%), motivation (92.2%), perseverance and planning (90.7%), engagement (89.1%) and competition (87.6%). Though the three SRL dimensions were closely related, for the sake of the analysis, the next sections will handle students' ratings of each dimension separately.

KQs Feedback & learning Benefits

Table 2. Students' ratings of (A) KQs feedback and learning benefits

Questionnaire questions	Likert scale	Results			
		Percentages %	Mean	SD	Rank
2- How do you value the use of Kahoot! as a tool that increases your knowledge of the subject?	Very favorably	68.8%	4.6	0.57	1
	Favorably	26.6%			
	Neutral	4.7%			
	Unfavorably	0%			
	Very unfavorably	0%			
3- How do you value the use of Kahoot! as a tool that gives you immediate feedback on your learning progress?	Very favorably	65.6%	4.6	0.58	2
	Favorably	29.7%			
	Neutral	4.7%			
	Unfavorably	0%			
	Very unfavorably	0%			

Students' assessment of Kahoot! feedback and learning benefits received high rating (mean= 4.6, SD= 0.58). As shown in Table 1, students' high rating of KQs for its feedback and learning benefits agreed with previous studies (Wang et al., 2015 & Wang and Lieberoth, 2016) who maintained that the immediate and continuous feedback provided by Kahoot! had significant impact on students' learning. The individualized feedback in these quizzes certainly provided students with the opportunity to "develop an overview of the work, so that they manage and control it" (Black & Wiliam 2006, p.15). The display of the feedback facilitated the development of students' understanding of their level and helped them monitor their own progress (see Spector et al. 2016). The feedback included

the teacher’s immediate explanation of the correct answer, which encouraged them to reflect on how to improve (Roschelle et al., 2007, Looney, 2010). KQs provided teachers and students with these data immediately after the assessment took place, so they did not have to wait for teacher’s marking to get this critical feedback.

KQs Meta-cognitive Benefits

Table 3. students’ rating of (B) KQs metacognitive benefits

Questionnaire questions	Likert scale	Results			
		Percentages %	Mean	SD	Rank
1- How do you assess the use of Kahoot! as a tool that clarifies the learning goals that need to be achieved?	Very favorably	67.2%	4.5	0.75	3
	Favorably	25%			
	Neutral	6.3%			
	Unfavorably	0%			
	Very unfavorably	1.1%			
6- How do you assess your performance in KQs in class?	Very favorably	68.8%	4.6	0.57	1
	Favorably	26.6%			
	Neutral	4.7%			
	Unfavorably	0%			
	Very unfavorably	0%			
8- How do you see Kahoot! as a tool that helps you compare your performance with other students in class?	Very favorably	56.3%	4.4	0.71	4
	Favorably	31.3%			
	Neutral	12.5%			
	Unfavorably	0%			
	Very unfavorably	0%			
9- How do you assess Kahoot! as a tool that helps you reflect on your learning progress?	Very favorably	65.6%	4.6	0.58	2
	Favorably	29.7%			
	Neutral	4.7%			
	Unfavorably	0%			
	Very unfavorably	0%			
10- How do you value the use of Kahoot! as a tool that encourages you to keep trying and plan your next step?	Very favorably	59.4%	4.4	0.71	4
	Favorably	31.3%			
	Neutral	7.8%			
	Unfavorably	1.6%			
	Very unfavorably	0%			

Though Kahoot’s benefits in enhancing students’ meta-cognitive skills received positive rating (Mean= 4.5, SD= 0.57-0.75), 1.6% of students rated Kahoot! as a goal- setting tool very unfavorably. In the group discussion, students said that though KQs assessed their performance in relation to the learning outcomes, they still found it difficult to know what to do next. Similarly, 1.6% of students rated question 10 “how do you value the use of Kahoot! as a tool that encourages you to keep trying and plan your next step?” unfavorably. Though Kahoot! gave students immediate feedback on their performance, they still found it difficult to develop the metacognitive skills necessary for SRL. For some students, the link between the feedback provided by Kahoot!, perseverance and planning

the next step was still missing and needed further coaching and training. Students usually take time and differ in their capability and pace of developing these necessary skills. Bose and Rengel (2009, p. 30) stated that what set self-regulated learners apart from their non-self-regulated peers was the capacity to “generate more internal feedback, responding to external feedback, and increasing efforts to achieve learning goals”, which is key to autonomous learning. Perhaps, the use of KQs in one summer course was not enough to develop the required metacognitive skills for SRL for all students.

However, the aspect that received high positive percentage was how KQs helped students monitor, assess and reflect on their learning in relation to learning outcomes and in comparison with peers. The use of KQs and its immediate scoring system enabled students to assess their knowledge and reflect on their learning. Without instant feedback, self-regulation is almost impossible to happen. Students and teachers received quantitative data in the form of reports that helped them check performance in relation to learning outcomes, so they could decide what concepts were still not fully grasped and what to do next. This certainly helped learners gain a deeper awareness and control over their own performance.

KQs Learning Environment Benefits

Table 4. students' rating of (C) KQs learning environment benefits

Questionnaire questions	Likert scale	Results			
		Percentages %	Mean	SD	Rank
4- How do you value the use of Kahoot! as a tool that keeps you focused and motivated?	Very favorably	67.2%	4.6	0.64	1
	Favorably	25%			
	Neutral	7.8%			
	Unfavorably	0%			
5- How do you value the use of Kahoot! as a tool that keeps you engaged in the subject matter?	Very unfavorably	0%	4.5	0.63	3
	Very favorably	62.5%			
	Favorably	26.6%			
	Neutral	9.4%			
7- How do you value the use of Kahoot! as adding fun to the test?	Unfavorably	1.6%	4.6	0.68	2
	Very unfavorably	0%			
	Very favorably	67.2%			
	Favorably	29.7%			
	Neutral	1.6%			
	Unfavorably	0%			
	Very unfavorably	1.6%			

The questionnaire results also agreed with previous studies that reported Kahoot! benefits in creating a positive learning environment (Mean= 4.6, SD = 0.63-0.68). Its gamified features enhanced their engagement (89.1%), motivation (92.2%) and competition to complete the quizzes (e.g. earning points and competing to be among the top 5 on the leaderboard made the quiz games exciting and motivating). The question that received the highest favorable rating (96.9%) was “How do you value the use of Kahoot! as adding fun to the test?” Surprisingly, the same question received the highest

unfavorable rating (1.6%). Students seem to have mixed perceptions about the gamified features of KQs. For example, while most students found the audio effects, graphical symbols and the time limit exciting and enjoyable (cf. Bicen & Kocakoyun, 2018 & Wang & Lieberoth, 2016), others thought it was very distracting and made the game extremely challenging. 92.2% of students thought that KQs turned classroom assessments into focused and highly motivational learning experiences through class competition and challenge. The results also confirmed the findings of previous studies on SRL that the classroom environment also helped either facilitate or frustrate the development and use of SRL (Bandura 1997; Zimmerman 2002). Göksün and Gürsoy (2019, p. 16) wrote:

Instant feedback capability using game elements such as scores, badges, rankings and rewards in gamification leads to student engagement in learning environment and enforces their behavior to reach targets.

They (2019, p.16) add, “it also allows us to observe the motivation of individuals, to monitor their emotional and metacognitive traits, and to understand their specific behavior”.

Focus Group Discussion

In the group discussion, students said that KQs helped them master the content as well as got them engaged in the quizzes. Sharing the learning outcomes also helped them to get a sense of achievement while answering the quizzes. One of the students said:

A1: “Knowing what I need to learn was more important to me than getting the highest score and the good thing is I achieved both”.

Students also pointed out that the quizzes helped them understand the technical terms used in the two courses through the quiz MCQs and true/ false questions. The immediate feedback they got after answering each question and the discussion of the answers in class helped them gain more insight into the learned topics. Kahoot! also offered them the opportunity to repeat the quiz as often as they wished without the help of the teacher. One of the students said:

A2: “I immediately knew where I stood and I could decide what to do based on the feedback. So, I could choose to repeat the quiz, ask the teacher or simply read the lecture notes again”.

A3: “I could repeat the test whenever I wish and this was a big advantage”.

However, this was not the case for all. Some students pointed out that the test scores helped them assess their knowledge but they still could not decide what to do next with that knowledge. They pointed out that the teacher’s discussion of the answers was the best part of the test because it helped them understand the concepts better. One of the students said:

A4: “Yes, repeating the test was very useful but I still couldn’t tell what I need to do if I still didn’t get it”.

Some of the students’ positive comments on Kahoot! learning and feedback benefits were:

A5: "Answering KQs at the end of the lecture helped me learn better and revise the materials to make sure I got it right.

A6: "Accessing the quiz on our mobile devices made it easy to participate and pausing after each question to discuss the answers was great in reinforcing the content in an engaging way".

A7: "The quizzes highlighted the important concepts in the course and helped me to focus on them".

A8: "I found KQs much more engaging than answering questions in class or doing classroom assignments especially that I got the results of the test immediately after I do the quiz".

However, the negative comments were as follows:

A9: "The time limit was very challenging and sometimes I couldn't answer in time; still, I benefitted from the teacher's discussion of the answers".

A10: "I felt so pressured during the game and I didn't like the competition. I'd rather focus on learning the concepts and the right answers to the questions than compete with other students".

Students also liked the fact that the quizzes were not graded. There was no risk involved and they all shared. Using their real names instead of nicknames helped them get individualized feedback and support from the teacher after the quiz. As the course instructor, I could immediately assess students' needs based on their performance in the quizzes. As pointed out in earlier studies, KQs gave "students the freedom to fail without fear" (Lee & Hamer 2011, & Sánchez-Mena et al., 2016). Scores were only displayed on their devices so they could make mistakes without feeling ashamed in front of the class. Reflection and self-assessment were also encouraged because there was always a goal to be achieved whether the learning goals or being the winner of the game. When asked if they liked the application to be used in other subjects, students welcomed the idea provided that the tests were not graded.

As for students' feedback on the classroom environment, students said that though the audio feature in KQs was fun; yet, they wanted to focus more on the questions to get a high score and have their names show on the leaderboard at the end. Some of them pointed out that the time limit of 30 seconds challenged them and reduced the fun aspects of the game. One of the students said:

A.11 "Competition was very tough! I had to focus on the questions to get the answers right if I want to be on the leaderboard".

A.12 "It was fun to see the scores of the top students in the game and compete to score higher."

Finally, some students commented on the steps taken in the assessment process and said that they found the strategies very effective and the procedure applied very consistently. This feedback was extremely important because we firmly believe that using KQs in itself

could not enhance students' self-regulatory skill without the support of an effective FA process. Wang (2008) maintains that if administering FA only involves changing paper-and-pencil test into web-based quizzes, this will not necessarily improve its effectiveness. Only when the technology tool is linked to a clear pedagogical goal; e.g., the development of learner self-regulation, and implemented in relation to a coherent set of principles, will it get the expected results. What is important is not just the mere use of the digital tool as much as the underpinning pedagogy and the instructional design that makes these digital assessment tools effective in the classroom.

CONCLUSION

The aim of the present study was to get students' feedback on the impact of KQs on developing SRL along three dimensions: feedback & learning, meta-cognitive skills and learning environment. The proposed model integrated a set of principles for effective feedback and Zimmerman's (2002) SRL model to describe the teacher's role & students' responsibilities during the FA process. Students' positive ratings of KQs and the whole assessment process showed that both were effective in enhancing the metacognitive skills and the classroom dynamics required for SRL. However, the study showed that without effective FA strategies, teachers and learners will not benefit from the unique features of these digital assessment tools, and consequently SRL skills might not be developed. The effectiveness of KQs / and or other GSRSs mainly depend on the entire learning environment and the assessment model employed in the classroom (see Attwell & Hughes, 2010, p.36). The FA model allowed both students and teacher to share the learning outcomes, monitor students' learning progress toward a desired goal, get effective feedback, and evaluate the learning progress through dialogue and self-assessment. The immediate feedback given after each quiz also allowed them to celebrate success and gain the confidence, self-efficacy, and motivation required for self-regulation. In the 21st century context, these SRL skills are essential for the development of life-long learning.

Though the study is a classroom- based experiment that involved only a small sample of students, it has significant implications for teachers who wish to use digital assessment tools to develop students' SRL skills. It highlights the importance of providing opportunities for students to regulate their learning and reflect on their progress. Recent research shows that self-regulatory processes are teachable and can lead to increases in students' motivation and achievement (Schunk & Zimmerman, 1998). For future research, other SRL variables still need to be further investigated, e.g. how KQs and/ or other digital assessment tools could enhance students' intrinsic/ extrinsic motivation, goal setting and self- reflection.

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