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A literature review on the influence of Kahoot! On learning outcomes, interaction, and collaboration

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Abstract

Initially developed in 2012, Kahoot! is a game-based student response system aiming to transform the class into a game show. However, some people have doubts about effectiveness of Kahoot! as an educational game. Therefore, based on past studies, this study explored the influence of Kahoot! on learning outcomes and collaboration including curricular interaction and extracurricular collaboration. The results of this study showed that Kahoot, if appropriately used, could improve learning outcomes. At the same time, Boller's summaries about educational games could not fully define what were needed in the games designed for learning to some extent. It was also concluded that Kahoot! could enhance curricular interaction between students and teachers as well as extracurricular collaboration between or among students. Kahoot! has a bright prospect in both regular and flipped classes, while there are still challenges of Kahoot! use. Lastly, suggestions for future research limitations of this study were discussed as well.

Keywords Kahoot! · Learning outcomes · Curricular interaction · Extracurricular collaboration

1 Introduction

The start of the twenty-first century has witnessed significant development of the Internet, contributing to the prevalence of social software (Azodi & Lotfi, 2020). With the development of education, almost all learning is blended to some extent. Blended learning is a group of integrated lessons, activities, assessments, and resources that

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support individual learning objectives or goals and create learning experiences (Hofmann, 2018). Nowadays classroom is not only a place but also an experience for learning. Facing the trend of blended learning, instructors tend to use game designs in pedagogical practices. This phenomenon is gamification (Zarzycka-Piskorz, 2016).

Gamification as a very trendy word refers to the use of game design elements in non-game contexts (Deterding et al., 2011; Holbrey, 2020). It aims to motivate learners' participation and engagement and in turn, improve their learning outcomes (Okaz, 2015). As education has been requiring the integration of innovative technology, there has been a tendency towards the integration of game elements in class (Murawski et al., 2019; Yu, 2019a). There are various gamified applications such as Socrative, Quizizz, and iSpring Learn LMS, aiming to improve learners' performance and engagement (Zainuddin et al., 2020).

Among the various educational games, Kahoot! (The exclamation mark belongs to the term.) has recently gained much popularity. Kahoot! is a game-based student response system (GSRS) transforming the classroom into a game show (see Fig. 1). It was initially developed in 2012, based on Lecture Quiz research project launched at the Norweigan University of Science and Technology in 2006 (Wang et al., 2007), and was published in 2013 (Murawski et al., 2019; Plump & LaRosa, 2017; Wang & Tahir, 2020). During the process of developing Kahoot!, it was concluded that Lecture Quiz with entertaining learning activities managed to increase learners' motivation, engagement, and perceived learning (Wu et al., 2011).

Overall, Kahoot! aims to enhance learning outcomes by encouraging curricular interaction between learners and instructors in various courses (Wang & Tahir, 2020). However, researchers have long debated the value and impact of this game-based system. Some people dismiss game designs for gamification as frivolous because games do not belong to learning environment and lack seriousness. On the contrary, other people believe the use of game designs is beneficial for learning. Therefore, it is necessary to explain why and how games work in learning to prove that Kahoot! is a laudable tool in learning.

The study conducted by Chung, Shen, and Qiu (2019) suggested that performance expectation was the most important factor influencing learners' acceptance of

Fig. 1 How learners give their answers in Kahoot!. (https://getkahoot.com/how-it-works)

gamification as an educational tool. In other words, whether the game designs could improve learners' learning performance determined learners' and instructors' attitude to gamification.

However, gamified approaches did not show significant improvement in learning outcomes, although gamified approaches did contribute to significant improvement in learners' motivation, engagement, enjoyment, and concentration (Wang et al., 2016). Furthermore, although Kahoot! have a positive effect on learning performance, there were still a few studies where Kahoot! did not result in improved learning outcomes (Wang & Tahir, 2020).

Thus, it was reasonable to discuss whether game designs are associated with improvement of learning outcomes. Since Kahoot! as a GSRS required collective learning including submission and feedback of information, this game design did contain interaction for sustainability of classes (Pertegal-Felices et al., 2020). Therefore, we discussed whether interactional designs in Kahoot! was positively associated with learning outcomes.

2 Material and methods

We carried out this literature review and researched information by using the approaches of identifying inclusion and exclusion criteria, searching for relevant studies, and extracting data for main citations. The following contents will describe each approach.

2.1 Identification of inclusion and exclusion criteria

The identification of inclusion and exclusion criteria was beneficial for identification of a large number of relevant articles. The study carried out by Wang and Tahir (2020) provided the theoretical supports and valid references for inclusion and exclusion criteria for our literature review.

Based on the criteria in the study carried out by Wang and Tahir (2020), the inclusion criteria in our study were: 1) The article is published in an international peer-reviewed journal or conference. 2) The article refers to Kahoot! or gamification in the title or abstract. The exclusion criteria in our study were: 1) The article is not accessible through university services or memberships. 2) The article is only accessible behind a paywall.

2.2 Search for relevant studies

We researched online databases including Web of Science, SSCI, Central and Eastern European Online Library, and SAGE Journals for relevant studies. We also checked references in found studies for additional studies. The following keywords guided the search: Kahoot!, gamification, interaction, learning, learning outcomes, fun, and enjoyment.

During this stage, we checked titles and abstracts of the articles. If an article fulfilled the inclusion and exclusion criteria, we paid attention to the contents of the article. We collected 112 articles in total. It is worth mentioning that the included research resources are limited to our ability. There may be other publications out of our reach.

2.3 Data extraction for main citations

At this stage, we further exact data from the 112 publications for main citations for our study. The criteria for selecting previous studies as the main citation of this were as follows. 1) The paper included had to be published in journals or collections. 2) The paper had to focus explicitly or implicitly on the correlation between the use of gamification including Kahoot! and learning or fun in playing games or gamified designs. 3) The paper had to provide a sufficient description of data and data analysis from which the results were concluded. Having generalizing and summarizing the 112 publications, we found 26 publications as the main citations (See Table 1).

3 Research questions

Based on past studies, we analyzed value of Kahoot! by discussing the effects of this game design on learning outcomes. But researchers had long debated the essential elements in gamified approaches and there were quite a few elements according to studies. Since Kahoot! as one of the designs in gamification reflected both learners' response to questions and feedback to learners' performance, such reciprocal actions constituted interaction. We hence chose interaction as the central issue and first discussed whether interaction in gamification had positive effects on learning outcomes. Therefore, we raised the following research question.

RO1: Is interaction in gamification positively associated with learning outcomes?

Only when interaction in gamification could positively influence learning outcomes could we further discussed the impacts of Kahoot! on learning outcomes. This response system aimed to create game shows in which instructors and learners were involved. Additionally, the system also needed to provide gamified formative assessment and feedback to evaluate learners' performance. Thus, there were various forms of interaction in pedagogical practices. For that reason, we discussed whether interaction with various forms in Kahoot! could improve learners' learning outcomes. Thus, we raised the second research question.

RO2: Is interaction in Kahoot! positively associated with learning outcomes?

Apart from the previous research questions, we discussed the effects of designs for gamification including Kahoot! on different age groups, the use of Kahoot! in flipped class, and potential challenges in the use of Kahoot! in pedagogical practices.

4 Results

This section describes the results from the review. Having reviewed and analyzed the previous studies, we first analyzed the effects of interaction in gamification on learning outcomes. Only when interaction in gamification could positively affect learning

Table 1 Foci and major findings of main citations in this study

No.	Authors	Foci	Major Findings
1	Aktekin et al. (2018).	Kahoot used in anatomy.	Kahoot! aims to create interaction through quizzes in the atmosphere of games.
2	Aljezawi and Albashtawy (2015).	Contrast between traditional and gamified approaches.	Gamified approaches can make classes more interesting and improve learners' internal skills of dealing with information.
3	Blume (2020).	Performance and attitudes in game-based learning.	Positive attitudes toward game-based learning do not necessarily mean active engagement in educational games.
4	Boller (2012).	Necessary elements of educational games.	Educational games should contain motivation, relevant practices, timely feedback, and training for retrieval of knowledge.
5	Coleman and Money (2020).	Student-centred digital game-based learning.	Although educational games are student-centred, educational games still requires learners' appropriate use.
6	Ding et al. (2017).	Motivation and engagement increased by educational games.	Badges, thumps-ups, progress bars, and avatars are motivational enough to increase learners' engagement in learning.
7	Graham (2015).	Quiz designs in Kahoot!.	Instructors should take teachability and practicability into consideration in questions designs in Kahoot!.
8	Hernandez-Ramos and Belmonte (2020).	Assessment of the use of Kahoot!.	Kahoot! can create a fast and straightforward classroom response system (CRS) and promote innovative methodologies.
9	Holbrey (2020).	The game-based approach with Kahoot! as a kind of blended learning.	Kahoot! contains competitive incentives such as points, leader boards and trophies, to enable learners' active participation and interactive learning.
10	Hwang and Chen (2017).	Designs of educational games to enhance motivation, critical thinking and problem solving.	Educational games can increase learners' engagement in field observation, comparison, data sharing, and other learning activities.
11	Kim, Rothrock, and Freivalds (2018).	The influence of gamification on learners' satisfaction.	The gamified and collaborative elements and evaluative components can increase learners' satisfaction.
12	Nakamura and Csikszentmihalyi (2001).	The theory of Flow based on relation between challenges and skills	Learners should experience the states of Control, Flow, and Arousal to achieve enjoyment from learning experience.

Table 1 (continued)

No.	Authors	Foci	Major Findings
			Flow is an intermediate state. Learners should initially go through the states from Control to Arousal and then go back to Control.
13	Pechenkina et al. (2017).	The influence of educational games in mobile devices on engagement, retention, and learning outcomes.	Educational games can improve engagement, retention, and academic achievements. Those three elements correlate positively with each other.
14	Plump and LaRosa (2017).	Kahoot! for engagement and active learning.	Instructors can use Kahoot! as a supplemental teaching tool, and learners can improve their short-term memory recall and meta-cognitive abilities.
15	Susanti (2017).	Curricular and extracurricular activities provided by Kahoot!	Various activities in Kahoot! Can improve collaborative spirit, task interdependence, social interaction, and engegement.
16	Vieira and Corrêa da Sliva (2014).	Description and analysis of enjoyment and fun	General designs for gamification requires the goal of winning and manipulatable parts. Those elements can facilitate interacting, monitoring, and controlling.
17	Wang (2015).	Effects and challenges of game-based learning.	Educational games can inspire instructors to create contents and encourage learners to participate in class interactions. But overemphasis on learning results is the challenge of game-based learning.
18	Wang et al. (2007).	Lecture quiz on which educational games are based.	Kahoot! was based on Lecture Quiz research. Kahoot! developed into a game-based student response system (GSRS) transforming the classroom into a game show.
19	Wang and Tahir (2020).	The effect of using Kahoot! for learning.	Kahoot! can enhance learning outcomes by increasing curricular interaction between learners and instructors and extracurricular encouraging collaboration.
20	Wang et al. (2007).	The influence of educational games on learners' perceptions.	Collaborative games for learning can improve learners' disciplinary knowledge.
21	Wu et al. (2011).	Improvement of lecture quiz to develop educational games.	Lecture Quiz with entertaining learning activities can increase learners' motivation, engagement, and perceived learning.
22	Woodard and Mabry (2018).	Discussion based on immediate feedback of Kahoot!.	

Table 1 (continued)

No.	Authors	Foci	Major Findings
			Kahoot! with instructors' guidance offers reviewing materials with baselines on prior knowledge and encourages further thinking.
23	Yu (2019a).	Serious games in education.	Serious games are applicable to pedagogical practices. But there should be adaptation of game designs to meet needs from different disciplines.
24	Yu et al. (2020).	The effect of educational games on learning outcomes, motivation, engagement, and satisfaction.	Educational games are beneficial to academic achievements, problem-solving abilities, critical thinking abilities, learning efficiency, and performances.
25	Zainuddin et al. (2020).	The influence of gamified quizzes on learning and engagement	Gamified quizzes can significantly improve learners' performance and engagement.
26	Zarzycka-Piskorz (2016).	Gamified teaching and learning with use of Kahoot!	Kahoot! can motivate learners' participation and involvement in class and make the atmosphere of classes more interesting.

outcomes could we further investigate whether interaction in Kahoot! was positively associated with learning outcomes.

4.1 Is interaction in gamification positively associated with learning outcomes?

Gamification reflects the use of games. Games are systems with rules that offer possibilities of actions so that players can attempt to control their outcomes (Fullerton, 2008; Groh, 2012). Considering games, fun might first come to individuals' mind because games should be naturally fun, otherwise it will be meaningless to play games (Sweetser & Wyeth, 2005). Therefore, we first analyzed interaction from the perspective of fun in games.

4.1.1 Attention in interaction from the perspective of games

Games usually require some interface to proceed and also require players' active participation in tasks to reach particular goals. Even if an individual might have fun by watching others playing games, perception of the outcomes obtained by others account for this individuals' funny experience (Vieira & Corrêa da Sliva, 2014). Therefore, interaction with a task, an object, or other people play an important role in fostering individuals' funny experience.

Interaction stands for a mutual or reciprocal process allowing no less than two entities to communicate with or react to each other (Wagner, 1994). Interaction indicates how individuals experience the world. The world is a dynamic and stochastic environment with much uncertainty. For that reason, humans emphasize the ability of perceiving, reasoning, and acting upon changes for an effective subsistence, accounting for dynamic feature of interaction (Valiant, 1995).

Interaction calls for individuals' perception and action. Effective perception and action depend on more appealing properties with novelty. No matter out of biological needs or internalized social needs, individuals can consciously evaluate and act upon new information through the nervous system (Csikszentmihalyi, 1991). For that reason, attention is an important factor influencing the quality of information processing (Csikszentmihalyi, 1991).

However, humans have limited capacity to process information consciously so they will not receive all information once for all. They will divide the original information into several patterns according to their internal sensed data (Csikszentmihalyi, 1991). They can thereafter autonomously use patterns almost without detailed reasoning (Csikszentmihalyi, 1991). Therefore, individuals' nervous system helps individuals to understand and summarize patterns they encounter.

Due to humans' limited capacity of information processing, information and predictability should be in a moderate degree to make fun experience. Because the world is constantly changing, individuals should constantly seek information and summarize patterns. Facing environments with much uncertainty, they should correspondingly trigger more patterns to deal with new information, producing funny experience (Csikszentmihalyi, 1991; Koster, 2010). Unchanged information give rise to high predictability. Once individuals have summarized the predictable patterns, they will have no more interest in the particular area than before. Individuals need not to pay much attention since there are predictable repetitive

tasks. However, excessive information with totally no predictability probably leads to incomprehension (Schmidhuber, 2010). For example, noise conveying too much information will overload individuals' capacity of information processing. Without proper conceptual models, individuals fail to pay attention and are confused about the information. So improper amount of information without predictability ends up making boring and undesirable experiences.

In short, interaction is an essential element for fun in playing games. With the help of attention mechanism, individuals can filter which piece of information is worth exploring, understanding, and summarizing for patterns. Therefore, attention is beneficial for individuals' information processing and participation in interaction.

4.1.2 Competitiveness and flexibility from the perspective of challenge and skill level

Apart from attention, there are still other factors influencing interaction. Since players have desire for fun and enjoyment, Nakamura and Csikszentmihalyi (2001) carried out two-dimensional model of the Flow state and analyzed the optimal states of fun and enjoyment (see Fig. 2). In this model, challenge level stands for competitiveness while skill level reflects players' current mastery of knowledge. Flow stands for the optional situation of competitiveness and feasibility of gamified approaches.

From the perspective of the relation between challenge and skill level, challenge should neither overmatch nor underutilize players' skill level. Players' perceived action capacities should match the perceived action opportunities (Nakamura & Csikszentmihalyi, 2001). Excessively high or low levels or challenge or skill give rise to a series of negative or non-helpful feelings such as anxiety, worry, apathy, boredom, and relaxation (Nakamura & Csikszentmihalyi, 2001).

But a player's ideal state is not static. Enjoyment in interactivity requires both challenge and skill level above players' average level. As a player is skilled enough to deal with the current challenges, this player is in a state of Control with high challenges and higher skills. Then, the experience can motivate the individual to seek

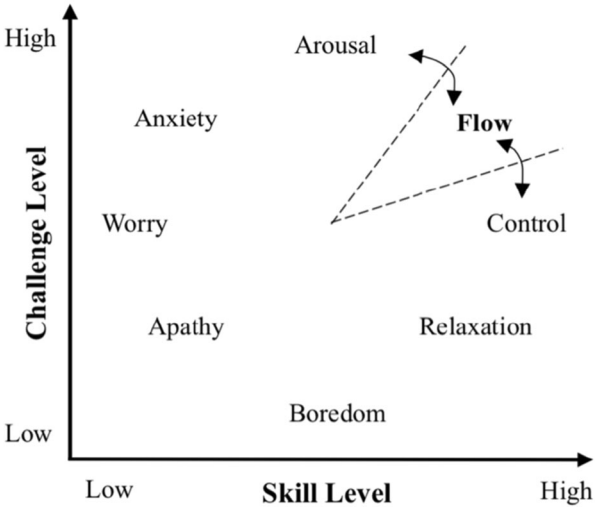

Fig. 2 Two-dimensional model of the Flow state (Nakamura & Csikszentmihalyi, 2001)

more challenges, accounting for the state of Arousal. After mastering the skills, the individual achieve enjoyment and go back to the state of Control (Nakamura & Csikszentmihalyi, 2001).

In short, the two-dimensional model suggests that challenge level matching players' average skill level is another essential factor in enjoyment in interaction. Challenge level guarantee competitiveness in game designs. Besides, optional states include Control, Flow, and Arousal, indicating flexible setting of challenge level. Therefore, optimal situation of interaction requires both competitiveness and flexibility.

4.1.3 Immersion from the perspective of interactivity in gamification

Since competitiveness and flexibility account for players' enjoyment in interaction, we further analyzed whether interaction in gamification should meet the previous demands. Vieira and Corrêa da Sliva (2014) classified playful activities according to different degrees of interactivity (see Fig. 3).

When it comes to unidimensional analysis, needs of challenge make up more possibilities of interaction such as objective-oriented interactions (gaming) and human communicative interactions (playing). The former reflects the fixed goals of winning so that individuals should overcome challenges from activities. The latter indicates the recreational activities without necessity of winning (Vieira & Corrêa da Sliva, 2014).

The researchers also took the second dimension of Whole-Parts into consideration. If one activity or object is an inseparable whole, this activity or object is close to Whole. By contrast, separable activities consisting of many parts or playful designs belong to the category of Part.

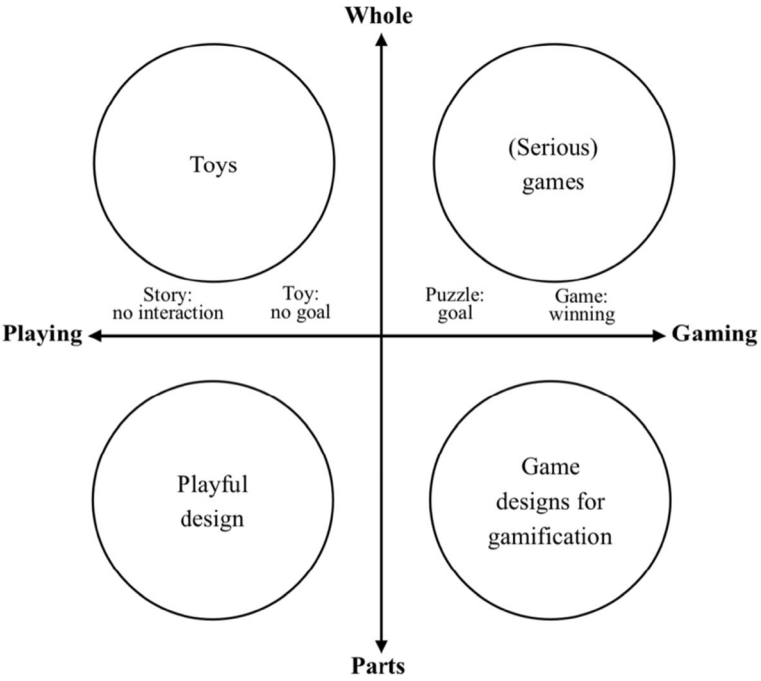

Fig. 3 Two-dimensional model of interactivity in different playful activities

The results reveal that gamification requires fixed goal of winning and flexible elements of designs. Thus, in the aspect of interactivity, interaction in gamification requires both competitiveness and flexibility.

Competitiveness and flexibility contribute to immersion, another important element in interaction (Brown & Cairns, 2004). Immersion refers to the feeling of total involvement in the environment of an interactive system with reduction of self-awareness or even the distortion in time perception (Jennett et al., 2008). Researchers described immersion as the result of the use of schemata (Douglas & Hargadon, 2000). Schemata stand for conceptual models based on individuals' previous interactions. Completely absorbed in a particular environment, an individual tries to fit the fantasy and achieve enjoyment from the recognition of novel patterns full of unpredictable elements (Douglas & Hargadon, 2000).

In the context with gamified approaches, researchers defined immersion as a sense of involvement along with individuals' interactions with the games without barriers, difficulties to immersion (Vieira & Corrêa da Sliva, 2014). To facilitate enjoyment in interaction, holders of games should remove or resolve those difficulties to immersion as many as possible. But removal of all barriers does not necessarily guarantee enjoyment (Vieira & Corrêa da Sliva, 2014).

Furthermore, immersion is a mutidimensional phenomenon (Vieira & Corrêa da Sliva, 2014). Individuals' distinctive preferences and moods affect their manners of experience games. Different characteristics of games account for various perceptions. Different external factors such as peer influence, game reviews, and sociocultural references influence the outcomes more or less (Mäyrä & Ermi, 2011).

In short, interaction in gamification claims competitive and flexible contents accounting for players' immersion. In educational contexts, game designs can hence inspire learners to reach goals and hence facilitate instructors' control of classes.

4.1.4 Feedback from the perspective of person-to-person interaction and HCI

With the development of technology, interaction has extended the range from person-to-person interaction to Human-Computer Interaction (HCI). HCI means interaction between humans and man-made products based on a feedback cyclic system. A participant first act with particular goals which the platform will recognize. Then the platform evaluates the individuals' actions and offers the feedback for the individual. After that the platform compares the results with the initial goals and judge whether it is necessary to restart the cycle (Dubberly et al., 2009). So HCI allows participants to interact with objects.

HCI requires participants' physical or cognitive signals of possibilities of actions and uses of objects, named affordance (Norman, 2002). Influenced by the previous signals, participants can establish conceptual models according to previous similar experiences about interactions, physical or logical constrains, and social or cultural conventions (Norman, 1999; Norman, 2002).

However, person-to-person interaction is still an important constituent in interaction. It still requires participants to share a common communicative response or feedback so that they can work for particular goals. Different degrees to which one affects others' results lead to different group behaviors in interactions such as competition, cooperation, and coordination (Dubberly et al., 2009; Garcia & Sichman, 2003).

In short, no matter how greatly technology in interaction develops, interaction still calls for feedback from participants or computer systems. For that reason, feedback is one of the influential factors in interaction in gamification. Thus far, we have reviewed interaction in gamification from the perspective of fun in playing games. We have also taken development of technology into consideration. In summary, the influential factors in interaction in gamification include attention, competitiveness, flexibility, immersion, and feedback.

4.1.5 Association between influential factors in interaction in gamification and element required for learning

As education has been requiring the integration of innovative technology, there has been a tendency towards the integration of game elements in class (Murawski et al., 2019). To prove game designs as laudable tools in learning, Boller (2012) summarized four-dimensional criteria for games designed for learning (See Table 2). In other words, such elements in game designs are positively associated with learning. Since interaction

Table 2 Elements in game designs positively associated with learning (Boller, 2012)

Elements in game designs positively associated with learning		Influential factors in interaction in gamification congruent with such elements
Motivation	Fun as the primary feature of game	Attention
	Clear and well-defined goals for better performance	Competitiveness
	Competitive elements such as points, badges, and leaderboards (PBLs) for recognition of achievement	
	Escalating difficulty levels when learners keep going	Flexibility
	Flow for immersion in problem-solving, strategizing, or collaborating	Immersion
Specific, timely, and continuous feedback	Continual and immediate feedback ensuring learners to adjust and recalibrate to refine performance	Feedback
	Rewards for good performance or diligence and punishment for poor performance or idleness	
Relevant practice	Designs of quiz-style practices in a simulation of real-world contexts or real-world challenges	Immersion
	Game rules and game resources with which the entire "play" is the practice	Flexibility
Ability to retrieve skill or knowledge when learners need it	Repetitive contents with escalating difficulty level for mastery of skill or knowledge	
	Replication of real-world contexts without real-world risks for quicker retrieval of information	Immersion

in gamification contains some influential factors, we could match the factors with elements summarized by Boller to see whether interaction in gamification is positively associated with learning.

As for attention, game designs for gamification aim to creates funny experience for players. If a game design is fun enough to stimulate potential participants' interest, they are likely to spare time for play so that they are eager to join in interaction. In other words, attention is the prerequisite for interaction and association between interaction and learning.

Regarding competitiveness, interaction in gamification claims well-defined goals which is the required element associated with learning. Inspiring items such as points, badges, and leaderboards (PBLs) can further motivate participants to make good performance. Those items aiming to keep competitiveness in interactivity in gamification are usually widely accepted elements on the gamified online discussion platforms to increase learners' engagement in learning (Ding et al., 2017).

Considering flexibility associated with learning, gamified approaches should contain adjustable designs to meet participants' need and match participants' skill level. Platforms can adapt level of difficulty according to participants' performance, which can contribute to participants' further improvement in mastery knowledge or skill. Additionally, rules can guarantee feasibility of designs so that hosts can control the proceeding of games. For instance, as participants make progress, hosts can create repetitive tasks for participants' retrieval of knowledge or skills.

Based on interactivity of competitiveness and flexibility, immersion in interaction is consistent with the problem-solving collaborative tasks or quiz-style practices. Besides, simulation of real-world contexts can further consolidate participants' timely recognition and use of particular knowledge or skills. Thus, immersion is also positive associated with learning.

Last but not least, feedback is an important indicator of improved learning through games. Feedbacks include praising and alerting contents. If participants manage to make progress, systems of games can provide participants with badges, thumps-ups, progress bars, and avatars as rewards motivating them to further improve skills. By contrast, systems can show reasons of failure encouraging them to try again (Prensky, 2001). Thus, feedback as an accurate evaluation can provide participants with opportunities to adjust and refine their performance.

In summary, by matching factors in interaction with elements for learning, interaction in gamification is positively associated with learning, because all the five influential factors have positive association with learning. In other words, interaction in game designs for gamification is beneficial for learning outcomes. Thus far, this thesis has analyzed the positive association between interaction in gamification and learning outcomes. The following sections will address whether interaction in Kahoot! can improve learning outcomes.

4.2 Is interaction in Kahoot! Positively associated with learning outcomes?

Having discussed the positive correlation between interaction in gamification and learning outcomes, we analyzed interaction in Kahoot! according to the previous influential factors and judged whether interaction in this GSRS could positively affect learning outcomes.

4.2.1 Attention: Energetic music and vivid colors

Nowadays traditional lectures have presented significant challenges, so the use of synchronous online learning in traditional enables learners' active participation and interactive learning (Holbrey, 2020). Compared with traditional teaching, getting knowledge from playing Kahoot! can significantly improve learners' attendance, participation, motivation, attention, and satisfaction (Hung, 2017b). Even compared with other game designs such as Quizizz, Socrative, and Google forms, playing Kahoot! can contribute to learners' higher concentration, engagement, enjoyment, perceived learning, motivation, and satisfaction (Chaiyo & Nokham, 2017; Dolezal et al., 2018). Therefore, Kahoot! manages to attract users to finish learning tasks.

Plump and LaRosa (2017) summarized the advantages of using Kahoot! in the classroom (see Table 3). Kahoot! has various colorful, vivid, and appealing items so that learners are eager to pay attention to learning to win the competition. Among the advantages, music and colors are so attractive that they can contribute to learners' excitement and energy. Questions in this system are flashcards. While answering questions, learners will hear count-down tick and background music adjusted to how much time they have to answer (Wang & Tahir, 2020). As for colors, Kahoot! shows each question along with four or less alternatives in different colors with associated graphical symbols (Wang & Tahir, 2020). Learners should give their answers by choosing the color and symbol they believe corresponds to the correct answer (Wang et al., 2016). Thus, with interest in learning stimulated, learners need not face the tedious contents.

The previous studies revealed that Kahoot! contained various appealing features beneficial for both learners and instructors. From the standpoint of learners, a majority of learners believed Kahoot! positively affected their motivation, enjoyment, excitement, engagement, learning experiences, and learning efficiency (Alario-Hoyos et al., 2017; Aleksić-Maslać et al., 2018; Antoniou et al., 2016; Asa'd & Gunn, 2018; Bicen & Kocakoyun, 2018; Iruela & Neira, 2018; Ismail & Mohammad, 2017; Leung & Pluskwik, 2018; Licorish et al., 2018; M. A.-A. Ismail & Fakri, 2017; M. Ismail et al., 2018; R. Ismail & Ibrahim, 2018; Youhasan & Sanooz, 2018; Zarzycka-Piskorz, 2016). Since playing Kahoot! allowed learners to answer questions anonymously and

Table 3 Advantages of using Kahoot! in the classroom (Plump & LaRosa, 2017)

• Free
• Easy for instructors to learn
• Simple process for learners (no account registration or downloading of application)
• Compatible with smartphones, tablets, or computers
• Real-time results help instructors provide clarification when needed
• Music and colors add to student excitement and energy
• Increase student engagement
• Instructors can download, review, and save student results
• Learners can take quizzes multiple times
• Instructors can create quizzes, discussion questions, or surveys
• Instructors can adjust the response time

increased learners' motivation and confidence, learners felt more secure, safe, and comfortable in the classroom-friendly atmosphere created by this GSRS (Cutri et al., 2016; Tsymbal, 2018; Youhasan & Raheem, 2019). Additionally, playing Kahoot! could stimulate learners' interest in learning with the attractive inviting user interface and music (Bryant et al., 2018; Çetin, 2018; Plump & LaRosa, 2017). Apart from learners, the use of Kahoot! could also enhance instructors' attention and concentration, contributing to better teaching (Yapıcı & Karakoyun, 2017).

In short, there are quite a few appealing elements including energetic music and vivid colors in Kahoot! aiming to create a user-friendly environment. Such elements can enhance both learners and instructors' participation in curricular interaction. Therefore, interaction in Kahoot! is consistent with the factor of attention positively associated with learning outcomes.

4.2.2 Competitiveness and flexibility: Curricular game competition and various modes

Kahoot! allows instructors to freely edit contents and forms of questions, which requires instructors to design questions concerning the corresponding classes in advance. Thus, challenge level of questions mostly depends on instructors' designs. This part hence concentrates on the motivational and competitive items throughout the process of playing this system. Besides, variety of modes and functions account for high flexibility and feasibility.

Kahoot! aims to transmit a series of quizzes into a curricular game competition. Facing tasks transmitted in Kahoot!, learners will answer questions or vote anonymously. Each question has three sections. The first section includes two pages. The first page just presents questions to let students think or judge for some seconds. Then the second page reveals both questions and choices of answers. While answering questions, students will hear count-down tick and background music adjusted to how much time the students have to answer. After learners' submission, the page will present the distribution of answers and the correct answer(s). Learners will get the corresponding points depending on accuracy and speed (Wang & Tahir, 2020). The points can provide goals or challenges for intrinsic motivation (Malone, 1980). The third section is the scoreboard showing the top five players. Thus, learners will know how far they are behind the players ahead (Wang & Tahir, 2020).

The count-down tick and background music are not distractions from the main contents of questions but the invisible reminders of competition. Both presentation of answer distribution and the scoreboard presenting the top players reflect that learners are contenders in competitive games (Wang, 2015). At the same time, the processes of game competition are not unchangeable. If hosts find some questions unnecessary to answer, they can skip those questions and spare time for the key points in classes. Thus, Kahoot! can guarantee competitiveness in the curricular interaction with some flexible choices for instructors.

However, excessively competitive atmosphere is not beneficial for interaction and learning outcomes. To strike the balance between competitiveness and learners' state in interaction, modes in Kahoot! are flexible enough to present contents in various ways supporting different types of pedagogical practices.

From the standpoint of instructors, there are quite a few choices for question designs. Instructors can design questions in various forms including Quiz questions, True or

False questions, Open-ended questions, Puzzles, Polls, Word clouds, and Slides. Instructors can also set a time limit ranging from 5 to 120 s for each question (Wang & Tahir, 2020).

Regarding learners, apart from the ordinary curricular gaming mode, learners can participate in other extracurricular modes such as "Host Live", "Challenge", and "League Game". Each mode can offer learners the opportunities to cooperate with others with competitiveness in a moderate degree (Wang & Tahir, 2020).

"Host Live" allows learners to become hosts to collaborate with other learners as contenders. The learner host can control games, while other learners can see and answer questions on their devices. Additionally, to simulate the game show better, leaners can also become audiences to mirror or observe other players' performances with AirPlay or Chromecast.

"Challenge" offers learners possibilities to see and answer questions and answers at their own pace and on their device. This mode is similar to self-paced learning and suitable for homework or station work. Only when many learners have submitted answers to the questions can they see presentation of answer distribution.

"League Game" creates a competition between different groups of learners and requires joint efforts made by the learners in particular groups. Learners will unite each other into leagues and receive self-paced challenges for the achievement of their leagues. After playing at their own pace, they can see where their leagues place on the league leaderboard. This mode can motivate leaners to make joint efforts to reach the common goal in a competitive atmosphere.

Since Kahoot! concentrates more on learners' engagement through a competitive gaming experience (Wang & Tahir, 2020), gamified approach with the use of Kahoot! is generally consistent with the demand of competitiveness for better learning outcomes. According to the previous studies, competitive game element was especially effective in vocabulary acquisition with learners' higher motivation and increased engagement (Klimova & Kacetl, 2018). Thus, competitive interactivity in Kahoot! seems to contribute to much efficiency in vocabulary courses.

Even if competitiveness is an indicator of motivation and engagement, the gaming experience should strike a balance between competitiveness and flexibility. Previous studies still revealed doubts about competitive elements in Kahoot! and even adverse effects caused by excessive competitiveness. Too competitive gaming elements would give rise to much anxiety for the learners that will ruin their motivation to learn (Zarzycka-Piskorz, 2016). If instructor had set too limited response time for learners, learners would tend to simply guess the answer just for high score (Bicen & Kocakoyun, 2018; Moutinho & Sá, 2018; Muhridza et al., 2018; Plump & LaRosa, 2017). Besides, stressful atmosphere would lead to learners' fear of losing (Głowacki et al., 2018; Yapıcı & Karakoyun, 2017). In short, poorly designed questions would lead to adverse effects on learning (Smith & Brauer, 2018).

Facing these problems, instructors and learners can select different modes according to pedagogical needs, which indicates designs in Kahoot! are flexible enough to keep competitiveness in a suitable degree. For instance, to avoid learners' unnecessary guessing, instructors can emphasize learners' accuracy of answering questions although learners will get points mainly based on how quickly they give a correct answer (Wang & Tahir, 2020). To reduce learners' fear of losing, learners can play Kahoot! as members in teams rather than as individuals (Abidin & Zaman, 2017; Atherton,

2018; Muhridza et al., 2018). Therefore, generally speaking, interactivity in Kahoot! is competitive and flexible and so positively associated with learning outcomes.

4.2.3 Immersion: Virtual game show

Challenge level is essential for learners to achieve high engagement or immersion for better learning outcomes (Malone, 1980; Pechenkina et al., 2017; Sweetser & Wyeth, 2005). Kahoot! aims to simulate game show with a series of questions. To imitate relatively game shows or competitions in a virtual online platform, this system has the corresponding rules for instructors and learners to follow.

Instructors first choose playing modes, such as player vs. player or team vs. player, to meet the corresponding demands of classes. Then they will get and display PIN, ID for the particular game, to let learners join. During the game, instructors can also enable or disable a name generator, randomize the order of questions or answers, skip questions, and show PIN. Therefore, instructors can control over the experiences in classes, and learners can stay in the mood for the games. Once instructors click on the "Start" button, the segment of answering questions begins so that learners should be prepared for the sequence of questions (Wang & Tahir, 2020).

Having started to play, instructors and learners can participate in the digital game competitions in different ways. Instructors can use Kahoot! in different stages of pedagogical practices to reach distinctive goals. At the beginning of classes, instructors can use it to initially stimulate students' interest, to assess students roughly, and to prepare students for the classes. This system contains "Blind kahoots" mode introducing new topics the students do not know much before (Castle, 2015). This mode uses questions to stimulate students' curiosity about new knowledge and interest in interaction in lectures (Wang & Tahir, 2020).

During the class, instructors can use Kahoot! at regular intervals to interrupt the lectures and summarize the previous knowledge, which reflects the most common way of using this system (Wang & Tahir, 2020). Regular retrospection guided by teachers can gradually develop students' habits of reviewing knowledge. The anonymity may disperse students' worry about mistakes they may make (Yu et al., 2014).

At the end of classes, Kahoot! displays podium to correlate rewards with active participation in curricular interaction. Even after class, learners can even replay the games, called "Ghost mode". The name of "Ghost" originates from a contrast with live classes joined by students in the flesh (Susanti, 2017). This mode provides learners with opportunities to retrospect classes and correct previous mistakes or potential mistakes (Wang & Tahir, 2020).

In short, no matter in class or out of class, gaming elements with question-based tasks and clear goals can bring learners high participation and immersion in game competitions in a virtual platform. In this case, immersion requires instructors to guide learners and learners to make reactions, accounting for better interactions and better learning performances (Su & Cheng, 2015).

As Kahoot! is one of the GSRSs, it is necessary to mention uses of GSRS. There are various ways of using GSRS in class and out of class (Wang & Tahir, 2020). Instructors can use it at the beginning of a session as a starter or doing a survey (Iona, 2017). Alternatively, with the use of this system, instructors can recapitulate the contents halfway in the session to break up the lecture (Iona, 2017). Moreover, the most

useful usages of this system are for reviewing old and new contents and obtaining baselines on prior knowledge (Woodard & Mabry, 2018). As for evaluation, instructors can also utilize GSRS for formative assessment to practice skills, increase retention, and review knowledge before tests (King, 2017). Thus, results of the previous studies prove that GSRS can keep users' immersion in playing and learning with the comprehensive designs in pedagogical practices. With availability in different stages of pedagogical practices, Kahoot! can hence meet the demand of immersion for interaction positively associated with learning outcomes.

Notably, Kahoot! creates gamified competitions in a virtual online circumstance but not very similar to competitions in real-world contexts. That seems to contradict Boller's arguments, because game designs should simulate real-world challenges (see Table 2). However, virtual elements in Kahoot! can still contribute to curricular and extracurricular interaction based on the atmosphere of games (Aktekin et al., 2018). Thus, generally speaking, Boller's summaries are acceptable and comprehensive, but it seems that simulation of real-world challenges are not the necessary and indispensable requirement.

4.2.4 Feedback: Rewards from person-to-person interaction and HCI

As GSRS, Kahoot! features mutual and interactive activities (Woodard & Mabry, 2018). There are timely feedbacks realized in rewards including points or the verbal signals such as "good" or "excellent". As mentioned previously, interaction includes person-to-person interaction and HCI based on the technological development. Thus, this part focuses on analyses of feedback in interaction in Kahoot! in the aspects of person-to-person interaction and HCI.

The interaction of Kahoot! include both interaction between instructors and learners and HCI (Wang & Tahir, 2020). As for person-to-person interaction, Kahoot! provides instructors with opportunities to create their own questions supporting classes and encourage learners to participate in class interactions, consistent with the communicative needs for learning (Plump & LaRosa, 2017; Wang, 2015). Apart from the regular multiple-choice questions, instructors can use Kahoot! to motivate learners to participate in open-ended discussion or surveys where there are no right or wrong answers. Learners can express their opinions freely and anonymously without peer pressure (Plump & LaRosa, 2017).

As for feedbacks in HCI, Kahoot! provides learners with motivational and gamified elements such as emotes, points, leaderboard, trophies, and verbal signals such as "good" and "excellent" as rewards. Besides, energetic music and adaptive response time also belongs to the feedbacks. Moreover, if learners keep going, there will be limitations of response time in answering questions, indicating another form of feedback for increase in challenge. So Kahoot! is motivational enough to encourage learners to finish question tasks and reach further learning goals.

According to previous studies, Kahoot! can wake up learners from slumber in class and stimulate them to speak out their points of view in class (Susanti, 2017). This game design with timely feedback can help to enhance class participation (Parra-Santos et al., 2018), check learners' understanding, and improve their reading skills (Çetin, 2018). Feedbacks can also reduce instructors' workload (de Sousa, 2018) for their better engagement with a large number of learners (Nkhoma et al., 2018).

In short, Kahoot! is congruent with the demand of feedback for interaction positively associated with learning outcomes. Thus far, interaction in Kahoot! has been consistent with all of the five influential factors including attention, competitive, flexibility, immersion, and feedback. Since those five factors contribute to positive association between interaction in gamification and learning outcomes, interaction in Kahoot! can positively affect learning outcomes. Application of Kahoot! can promote innovative methodologies for the improvement of quality in higher education (Hernandez-Ramos & Belmonte, 2020).

4.2.5 Overall impacts of interaction in Kahoot! On learning outcomes

Overall, Kahoot! can increase learners' interest in lessons, increase their motivation, enhance their understanding of the lessons, and encourage them to achieve more learning goals (Bicen & Kocakoyun, 2018). Social interaction plays an indispensable role in Kahoot! so that this system can turn classrooms into digital games (Sweetser & Wyeth, 2005). For that reason, this system can enhance the interaction among learners (Antoniou et al., 2016; Cutri et al., 2016; Esteves et al., 2017; Hou, 2018; Mustață et al., 2018; Wang et al., 2016). Game show elements such as graphics, points, and music are beneficial for interactive learning environments, contributing to learners' enjoyment, motivation, and concentration (Abidin & Zaman, 2017; Aktekin et al., 2018; Baydas & Cicek, 2019; Bicen & Kocakoyun, 2018; Bryant et al., 2018; Lee et al., 2019; Chaiyo & Nokham, 2017; Cutri et al., 2016; de Sousa, 2018; Głowacki et al., 2018; M. A.-A. Ismail & Fakri, 2017; R. Ismail & Ibrahim, 2018; Jamil et al., 2018; Licorish et al., 2018; Moutinho & Sá, 2018; Susanti, 2017; Tan Ai Lin et al., 2018; Tan & Saucerman, 2017; Taylor & Reynolds, 2018; Turan & Meral, 2018; Wang, 2015; Wang & Lieberoth, 2016; Wang et al., 2016; Wichadee & Pattanapichet, 2018).

Even if there are inevitably adverse effects caused by poorly designed questions, Kahoot! still contains some designs to reduce the negative effects. For example, anonymity in answering questions can reduce learners' stress and make a safer environment to fail (Cutri et al., 2016; Jamil et al., 2018; Jones et al., 2018; Licorish et al., 2018; Mahon et al., 2018). Variety of modes of playing avoid boring learning experiences.

Aiming to create an engaging fun and motivating learning platform, Kahoot! can positively affect learning outcomes, classroom dynamics and reduce student anxiety (Wang & Tahir, 2020). Game designs for gamification can function as devices producing interactions and facilitating cultivation of learners' attitudes, skills, and knowledge in a competitive but friendly atmosphere (Clark et al., 2016). As a system for gamification, Kahoot! can improve learners' engagement, motivation, and learning outcomes (Alonso-Fernández et al., 2020).

Classes highlighting interactive activities can increase instructors' and learners' participation and involvement, improving learners' mastery and the use of knowledge (Yu et al., 2020). Increased interaction is conducive to learning strategies such as collaborative learning and context-aware learning strategies (Liu & Chu, 2010), both instructors' and learners' confidence and self-esteem (Dellos, 2015; Johns, 2015), recognition of learners' knowledge gaps, learners' short-term memory, and long-term retrieval of knowledge (Aljezawi & Albashtawy, 2015).

In traditional lectures without the use of Kahoot!, learners are usually reluctant to interact with instructors because they often feel threatened and uncomfortable (Okaz,

2015). Learners are usually worried about making mistakes in public. Furthermore, traditional lectures are usually teacher-centred (Yu et al., 2014). These phenomena harm interaction and learners' mastery of knowledge.

However, it is unreasonable to discard traditional instruments. We should integrate traditional instruments with other innovative technologies (Mustață et al., 2018). Instructors can make implementation of online instruments be accompanied with the traditional instruments to maximize the efficiency of learning. This combined implementation can consolidate the vast amount of knowledge, improve learners' abilities to apply the knowledge to the practical contexts, and motivate them to undertake the challenging tasks (Mustață et al., 2018). Therefore, instructors can use Kahoot! as a supplement to a traditional teacher-centred lecture setting, increasing engagement by allowing and inspiring learners to demonstrate their knowledge in a fun and exciting way (Jones et al., 2019).

In summary, interaction in Kahoot! positively affects learning outcomes because this system fulfills all the demands from the influential factors for interaction in gamification positively associated with learning outcomes. With appealing elements, designs for balance between competitiveness and flexibility, immersion in digital game shows, and timely feedbacks, Kahoot! is conducive to improvement in interactive learning.

5 Discussion

As previously stated, interactive learning created by Kahoot! can enhance learners' performance. But facing great popularity of game designs in educational contexts, we should notice different effects of such designs on different age groups. Besides, Kahoot! can also function as a supplemental tool in flipped classes, indicating the potential uses of this game design. Furthermore, there are still some challenges related to the uses of Kahoot!.

5.1 Effects of game designs for gamification on different age groups

Aiming to create better learning experience, Kahoot! increases instructors and learners' participation in exciting digital game shows. Notably, as such gamified technologies have attracted an increasing number of users' attention, users in different age groups tend to have different recognitions of the game designs in educational contexts. Therefore, it is necessary to discuss how differently such game designs will affect different age groups and which indicators will lead to such different effects.

Facing gamification, young users tend to have higher intensions to accept gamified products and perceive more enjoyment than the older users (Bittner & Shipper, 2014). With prior gaming experience, younger users can utilize products of gamification more efficiently (Bittner & Shipper, 2014). Generally speaking, young people can accept designs in gamification and enjoy them more easily. Therefore, it seems that developers can pay more attention to gamification targeted toward a specific age group (Bittner & Shipper, 2014).

As for indicators of users' intentions, attitudes, subjective norm, and perceived control influence users' intentions of conventional products, while attitudes and

perceived usefulness affect users' intentions of gamified products (Bittner & Shipper, 2014). Additionally, enjoyment and flow are essential factors in mediating between users' motivational incentives and intentions (Bittner & Shipper, 2014). Thus, developers of gamification should concentrate on enjoyment, flow, and the perceived usefulness to especially improve young users' extrinsic and intrinsic intentions for gamified products (Bittner & Shipper, 2014).

When it comes to the effects of Kahoot! on different ages, both learners and instructors generally show positive attitude to this system (Wang & Tahir, 2020). Instructors tend to pay more attention to the details probably negatively associated with pedagogical practices. For example, instructors find it difficult to apply Kahoot! to all courses (Yilmaz & Karaoglan Yilmaz, 2019). Besides, this system might give rise to unnecessary competition or cheating in learning (Yilmaz & Karaoglan Yilmaz, 2019). The previous phenomena adversely affect instructors' management of classes (Yilmaz & Karaoglan Yilmaz, 2019). Instructors' advice can provide valid reference for further upgrading of designs for gamification.

In short, even if younger people are more likely to use games designs for gamification efficiently than elder people, elder people can pay more attention to current disadvantages of the uses of such designs. Especially in pedagogical practices, instructors focuses more on flaws and restrictions in uses although they are generally positive about the application of such designs including Kahoot!. In addition, users' perception of enjoyment, flow, and usefulness determine their choices of gamification. Developers should focus on those factors for more recognitions for game designs.

5.2 The use of Kahoot! In flipped class

With the development of technologies and education, the use of Kahoot is not limited to regular face-to-face classes. Flipped classes can provide so much freedom for learners that they can conveniently acquire knowledge assisted with instructors and peers on an online technology-enhanced platform (Yu, 2019b; Yu et al., 2020). However, the distractions, such as lower engagement rates or weak extracurricular supervision, will give rise to the limited use of flipped pedagogical approaches (Huang et al., 2019).

Since flipped class requires learners' participation in exercises with timely feedback (Hung, 2017a), instructors can use Kahoot! in flipped classrooms to increase learning (Hung, 2017b). Kahoot! is conducive to the personalized designs and methodologies with the immediate feedback beneficial for cultivation of learners' engagement (Plump & LaRosa, 2017). The immediacy of feedback of Kahoot! provides learners with opportunities to consolidate and extend their knowledge through further discussion. Learners can also improve their short-term memory recall and meta-cognitive abilities (Plump & LaRosa, 2017).

As for extracurricular supervision, various extracurricular activities in Kahoot! can provide learners with the opportunities to supervise each other. Funny game elements in learning can trigger learners' effective engagement, persistence, and motivation to learn (Zarzycka-Piskorz, 2016). Therefore, Kahoot! is conducive to significant changes in the atmosphere of extracurricular supervision motivating learners' participation in learning in flipped class (Zarzycka-Piskorz, 2016). Learners can enjoy such activities on computers or iOS or Android mobile devices, reflecting various resources, strong

capabilities, rich interactions, power support for effective learning, and assessments (Pastore et al., 2005).

In the technological aspect, Kahoot! requires the availability of Wi-Fi, access to mobile devices, instructors' ability to use online technologies, and learners' affinity for online games (Plump & LaRosa, 2017). Sound equipment and facilities account for the increased quality in teaching and efficiency in learning (Zenouzagh, 2020). Nowadays, most universities can meet previous technological demands. Therefore, Kahoot! is suitable for flipped class from the perspectives of curricular participation, extracurricular supervision, and technological requirements.

As for advantages of the use of Kahoot! in flipped class, less monotonous lectures provided by this system can improve students' mood, creativity, and morale (Aljezawi & Albashtawy, 2015). Learners are hence eager to engage themselves in field observation, comparison, data sharing, and other learning activities actively (Hwang & Chen, 2017).

Additionally, as a game design for gamification, Kahoot! can provide high-quality, flexible, portable, and relaxing educational services, increasing interactivity between learners and instructors (Gentry et al., 2019). The improved interactivity can contribute to the motivational learning strategies such as collaborative learning and context-aware learning strategies (Liu & Chu, 2010). Such strategies are beneficial for problem-solving and communicative ability with peers and instructors (Hava et al., 2020).

In short, the elaborate use of Kahoot! in flipped class can significantly improve learners' interactivity with instructors and peers, attendance, participation, speaking skills (Hung, 2017b), and grades (Dolezal et al., 2018).

5.3 Challenges related to the use of Kahoot! In pedagogical practices

Even if Kahoot! has a bright prospect in education, there are still challenges of the uses in pedagogical practices from various perspectives.

Regarding online learning, changeability of online education will give rise to some instructors' and learners' confusion about the use of technologies including Kahoot!. Facing the combined implements of traditional and digital education, instructors are confronted with challenging tasks to balance the validation of learners and the quality of teaching. Facing various learning mode, learners will spend much time on adapting to online learning (Volungeviciene et al., 2018).

Considering technical problems, unreliable internet connections will lead to adverse effects on teaching and learning. Interaction in Kahoot! needs projectors to show questions and answers on the screen and requires learners to choose the graphs matching the answer on the screen on mobile devices, but some learners have difficulty in reading questions and answers on projected screen. Moreover, designs of this system does not allow learners to change answer after submission (Wang & Tahir, 2020).

From the perspective of learners, learners' general positive attitude toward educational game-based learning does not necessarily mean their active engagement in educational games (Blume, 2020). Learners' indulgence in playing games cannot guarantee their engagement or learning outcomes. Besides, learners may pay little attention to multiplayer engagement and social interactions, such as peer respect and superior obedience, in game-based learning (Coleman & Money, 2020). Furthermore, under stressful time-pressure for give answers, learners are afraid of failing quizzes.

(Wang & Tahir, 2020). Once they have given an incorrect answer, they can hardly to catch up (Wang & Tahir, 2020).

In the aspect of instructors, some instructors hold the view that Kahoot! can offer little scholarly merit (Holbrey, 2020; Plump & LaRosa, 2017). Therefore, concentrating on learning results, they refuse to use Kahoot! in case that non-serious atmosphere would lead to learners' slackness (Holbrey, 2020; Plump & LaRosa, 2017). Additionally, some instructors find it challenging to use this system because it is difficult for them to make the ideal situation where all learners can have enough time to answer questions. Otherwise, poor designs of questions will reduce learners' reflection, cause some learners to guess without thinking (Wang & Tahir, 2020) and even result in cheating in competition, unfavorably affecting management of classes (Yilmaz & Karaoglan Yilmaz, 2019).

Kahoot! still has wear out effects on classroom dynamics (Wang, 2015). The positive effects on classroom dynamics will fade when this system becomes familiar to instructors and learners (Wang, 2015). If instructors have used this system for several months, there will be less positive effect on classroom dynamic (Wang & Tahir, 2020).

To relieve the previous problems, programming and ongoing collaboration between users and technologies should regularly improve (Pellegrino & Quellmalz, 2010). Users' feedbacks to developers of such a technology play an important role in improvement of the game design (Sun et al., 2020). Users and developers should also notice that educational games are designed to promote learners' desire or willingness to learn (Volungeviciene et al., 2018).

Despite the previous challenges, Kahoot! is a successful bridge in pedagogical practices. Kahoot! improves the pedagogical experience, enables learning in fun and innovate manner, reinforces personalized learning, and guides learners to achieve deeper levels of thinking (Holbrey, 2020). Interactive environments can inspire learners to actively participate in the classes and make better academic performance (Plump & LaRosa, 2017).

6 Conclusion

This thesis has presented a literature review on whether interaction in Kahoot! is positively associated with learning outcomes. The purpose of this study was to find answers to the following two research questions.

6.1 Major findings

RQ1 concentrated on the effects of interaction in gamification on learning outcomes. Since fun is the essential factor in games, we first analyzed which factors can contribute to enjoyment in interaction in gamification. Based on the theories and models in past studies, we found the five influential factors such as attention, competitiveness, flexibility, immersion, and feedback. Having compared those factors with Boller's summaries about gaming elements positively associated with learning outcomes (See Table 2), we found that all the five factors could match the elements congruent with demands of learning. Therefore, the main conclusion of this question is that interaction in gamification is positively associated with learning outcomes.

RQ2 concentrated on the effects of interaction in Kahoot! on learning outcomes. Since interaction in gamification could positively affect learning outcomes, we could further analyze the effects of interaction in Kahoot! as one of the game designs for gamification. We investigated whether interaction in this game design fulfill the demands from the influential factors summarized in RQ1. The results revealed that interaction in Kahoot! could match all the factors. Energetic music and vivid music were attractive enough to fulfill the demand of attention. Competitive gaming elements and various playing modes helped instructors to strike a balance between competitiveness and flexibility in class. Learners could enjoy immersion in exciting virtual game show. With timely feedbacks such as gamified rewards and verbal signals, this system could evaluate learners' performance and motivate them to reach further learning goals. We found that interaction created by Kahoot! had all the necessary elements positively affecting learning outcomes. Thus, the main conclusion of this question was that interaction in Kahoot! was positively associated with learning outcomes.

Apart from the research questions, we discussed effects of gamification on age groups. We found that younger people could use such designs more efficiently than elder people. But elder people paid more attention to details about flaws in uses. Developers should also emphasize enjoyment, flow, and usefulness of gamification products. Besides, Kahoot! was also applicable to flipped class in the aspects of curricular participation, extracurricular supervision, and technical accessibility. Furthermore, there were still challenges in uses from the perspectives of changeability in online learning, learners' anxiety, instructors' management, and technical problems.

The main conclusion of our literature review is that Kahoot! can positively affect learning outcomes from the perspective of interaction. Interactive tasks can consolidate knowledge, develop good learning habits for learners, and enhance instructors' management of classes.

6.2 Limitations of this study

The major limitation of this study is the coverage of the literature. There were inevitably some studies out of our reach. We would also inevitably miss some studies due to the paywall. Admittedly, studies cited in this review may be insufficient due to the limitation of availability of the resources.

Another limitation of this study lies in a biased selection of articles. We mainly focused on the positive effects of Kahoot! or gamification on learning outcomes. We also paid much attention to the influences of Kahoot! on learning at a general level. The generalization of the results in this study concentrates on pedagogical practices in classrooms or flipped class rather than occupational trainings or other contexts.

It would be greatly appreciated if readers could provide more related studies to extend and diversify the results. Future research could be conducted to determine the effectiveness of Kahoot! in different contexts such as primary education, higher education, and occupational training requiring different learning goals skills.

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