Jumble vs. Quiz – Evaluation of Two Different Types of Games in Kahoot!

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Abstract: This article presents the results from a study evaluating two types of games in the game-based learning platform Kahoot!: Quiz and Jumble. When playing the Quiz game, the goal for the students is to choose one out of four answers as quickly as possible, and the score is awarded for a correct answer and how fast the answer is given. When playing the Jumble game, the goal is to arrange four answers in a correct sequence, and the score is awarded for a correct sequence and the amount of time used to answer. The quasi-experiment was carried out in a software architecture course at the Norwegian University of Science and Technology with 59 participants. The experiment took place at the end of five 45-minute lectures on Software Quality attributes, where the two games were used to summarize the topic. Both the Quiz and the Jumble games were created in the same fashion where the goal was to map given statements to named software quality attributes. First, the students played through half of the summary questions using the Quiz game, and then they played through the remaining half using the Jumble game. The students were observed during both games and answered a survey after they had played both games (53 complete responses). The results presented are based on observations and a survey that includes both qualitative and quantitative data. The focus of the survey was on which of the two games the students perceived as most entertaining, most engaging, most motivating, required most concentration, and from which one they learned the most. They were also asked to give comments related to the experience. The results of the study show that both games were perceived to be equally fun, motivating, and provide the same perceived learning effect. However, the Jumble game was perceived to be more engaging and demanded higher concentration from the students. Several suggestions were also provided on how to improve the Jumble game.

Keywords: Game-based learning, Formative assessment, Kahoot!, Game types, Evaluation, Student perceptions.

1. Introduction

One of the significant challenges in teaching is to keep the students' attention, engagement, concentration, and motivation through a lecture. The main goal for a teacher is to enable the students to learn as much as possible within the allocated time. For many in higher education, the default teaching approach is to do presentations using slides in combination student interaction through vocal questions and discussions. For larger classes, a major challenge is that much of the lecturing is a one-way communication with little student interaction, resulting in students losing attention, interest, concentration, and motivation. Studies have shown that the human attention span is not more than 20 minutes, but it is possible to restart the attention clock by, e.g., using a student response system (SRS) (Caldwell, 2007). SRSs have been around since the sixties (Judson, 2002), and have been used for teaching a variety of subjects since the early seventies (Bessler and Nisbet, 1971, Casanova, 1971). The first SRSs required specialized hardware where the students gave their responses through devices similar to TV-remotes called clickers, key-pads, handsets, or zappers (Caldwell, 2007). Today SRSs are mostly web-based where students give their responses using their own digital devices using SRS platforms such as Socrative (Coca and Slisko, 2013), Quizlet (Gruenstein et al., 2009), Poll Everywhere (Sellar, 2011), iClicker (Lucas, 2009), and Learning Catalytics (Schell et al., 2013). Game-based student response system (GSRS) is a variant that was introduced through the release of the game-based learning platform Kahoot! (Wang, 2015). The main difference between an SRS and a GSRS, is a design based on theories on intrinsically motivation instruction for making things fun to learn such as the principles *challenge* (goals with uncertain outcomes), *fantasy* (captivate through intrinsic or extrinsic fantasy), and *curiosity* (sensor curiosity through graphics and sound, and cognitive curiosity) (Malone, 1980). The fantasy in Kahoot! is that the classroom is transformed into a game show where the teacher is the game show host, and the students are the contenders. As in a game show, the contenders will be awarded points, there will be a ranking through a public scoreboard, there are music and audio effects, and the questions and answers are presented through graphics, video, and animations. During the game, the players will compete to research the top-five scoreboard and get feedback on their progress. At the end of the game, winners will be presented and announced.

In the current version of Kahoot!, it is possible to create three types of kahoots (games): Quizzes, Jumbles, and Surveys, as shown in Figure 1. In our study, the two types of games Quiz and Jumble are evaluated. The Survey

was left out as it is not a game but a polling tool. The Quiz and the Jumble, are to some extent, very similar in terms of looks and experience, but they are different in the way the students give their answers. For the Quiz game, the students touch the color and shape that corresponds to the answer on the projected screen she or he believes the correct one. As long as the answer is correct, the faster the student gives the answer, the more points she or he will get. In the Jumble game, the students have to arrange four answers in the correct order by dragging and dropping four colored boxes with symbols (K!rew, 2016). When the student is happy with the arrangement, the answer is submitted by touching a button. Similarly, to the Quiz game, the score is computed based on the time used. However, in contrast to the Quiz game, all four colored boxes with symbols must be arranged correctly to be awarded points. Our initial hypothesis was that the Jumble game would require students to think more carefully before giving their answer, and this study investigates how this difference affects the students' enjoyment, motivation, concentration, engagement, and perceived learning.

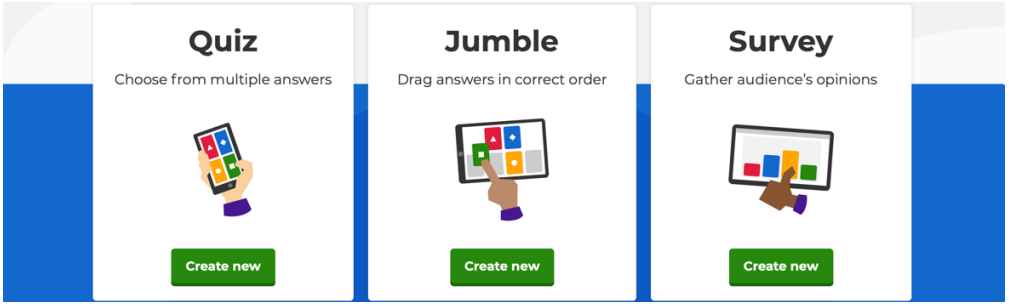

Figure 1: The Three Types of Games in Kahoot!

2. Material and Method

This section presents the research approach, research goal, research questions, and the context of the study.

2.1 Research Questions and Research Approach

The goal of our study was to investigate the effect of the two types of games Quiz and Jumble in Kahoot! used in a software architecture course at the Norwegian University of Science and Technology. The Goal, Question Metrics (GQM) research approach was used (Basili, 1992) where the research goal first is defined (conceptual level), a set of research questions are defined correspondingly (operational level), and finally a set of metrics to answer the defined research questions are described (quantitative level).

2.1.1 Research Goal and Research Questions

Using the GQL template (Basili, 1992), the research goal of our study was defined:

The purpose of this study was *to investigate students' perception of the two games Quiz and Jumble in Kahoot!* for *teaching software quality attributes* from the point of view of *a student* in the context of *software architecture course at a university*.

Specifically, we wanted to investigate how the two games affected the students' perceived enjoyment, engagement, motivation, concentration, and learning. Kahoot! has been used extensively for in every lecture in the software architecture course over several years, but only the Quiz game. In this study, we wanted to investigate the effect of using the Jumble game. Based on our research goal, the following research questions were defined:

- RQ1: What game in Kahoot! (Quiz vs. Jumble) was perceived to be the most fun?
- RQ2: What game in Kahoot! (Quiz vs. Jumble) was perceived to be the most engaging?
- RQ3: What game in Kahoot! (Quiz vs. Jumble) was perceived to be most motivating?
- RQ4: What game in Kahoot! (Quiz vs. Jumble) was perceived to require most concentration?
- RQ5: From which game in Kahoot! (Quiz vs. Jumble) did the students perceive they learned the most?

To give answers to the research questions above, a combination of data sources was used (metrics):

- *Observations* from the lecture
- *Survey* with close- and open-ended questions conducted after the students had played both games
- *Course evaluation* at the end of the semester with two open-ended questions: What has been good, and What can be improved?

2.1.2 Procedures

This study was carried out as a part of five 45-minute lectures taught in one week on Software Quality Attributes. It was organized as one single and a double 45-minute lecture on presenting the content, followed by a double lecture where the first 30 minutes continued presenting the content, and the remaining 60 minutes were used for the quasi-experiment (see Figure 2). The quasi-experiment started with an introduction and motivation to the study. The students then played through the first review quiz in Kahoot! using the Quiz game, followed by a 15 minutes break, and then played through the second review game using Jumble. The students were then asked to do a survey when they came home from school. The students were very familiar to the Quiz Game in Kahoot! but had not played the Jumble game before. The user experience of the two different games is very similar in terms of look and feel, including count-down timer, scoring, graphics, and music. The main difference between the games is the way the students give their answers.

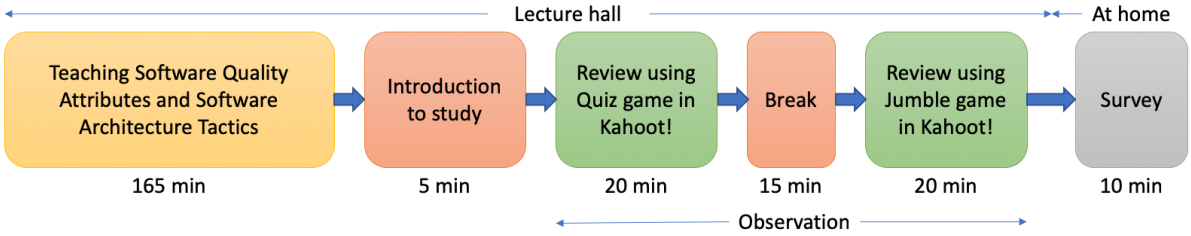

Figure 2: Overview of the Procedures of the Study

2.2 Teaching Software Architecture Using Jumble and Quiz Games in Kahoot!

Our study was conducted in a software architecture course for 3rd and 4th-year students. This course is taught through typically as 3 x 45-minute lectures per week using a combination of slides, blackboard, kahoots (quizzes in Kahoot!) and in-class problems. The course also consists of two exercises and a sizeable graded group project where the students will go through all the main topics of the course (Wang, 2011). Kahoot! is used in every 45-minute lecture, and a total of 27 kahoots are used in a semester. All the kahoots used in lectures are multiple-choice quizzes, where the student should identify which of the four alternatives is correct.

One of the main topics in the software architecture course is quality attributes. Specifically, the students learn how to specify quality requirements and what architectural design decisions (called architectural tactics) they have to make to achieve quality in areas like availability, interoperability, modifiability, performance, security, testability, and usability. The topic of quality attributes is taught over 5 x 45-minute lectures, which are summarized at the end with a long Kahoot where the students have to map descriptions of architectural tactics to a quality attribute. Examples of such mappings could be that the description *"Improve algorithms to decrease latency"* should be associated to *performance* and that the description *"Introduce an explicit interface to a module"* should be associated to *modifiability*. In previous years, the students have only reviewed quality attributes through one long Quiz game.

2.2.1 Quiz Game

The Quiz kahoot consisted of 27 questions where the students had to read 27 descriptions of architectural tactics and map them to one of four quality attributes such as availability, performance, security, or usability. The students had 20 seconds to give their answers per question. As this was a repetition, not much was said by the teacher between the questions. The whole game took less than 20 minutes, and at the end of the game, the top three students were awarded a prize (box of chocolate or candy). Figure 3 shows how the questions were asked in the Quiz game where the projected screen is shown to the left and the student's screen on the right. In the center of the projected screen, the instructions are shown as a picture that was made in PowerPoint. At the top of the screen, the description of the architectural tactic is presented, while at the bottom of the screen, the four answer alternatives in the form of quality attributes are shown. The students were asked to read the description at the top of the screen and then decide on which of the four quality attributes the description match.

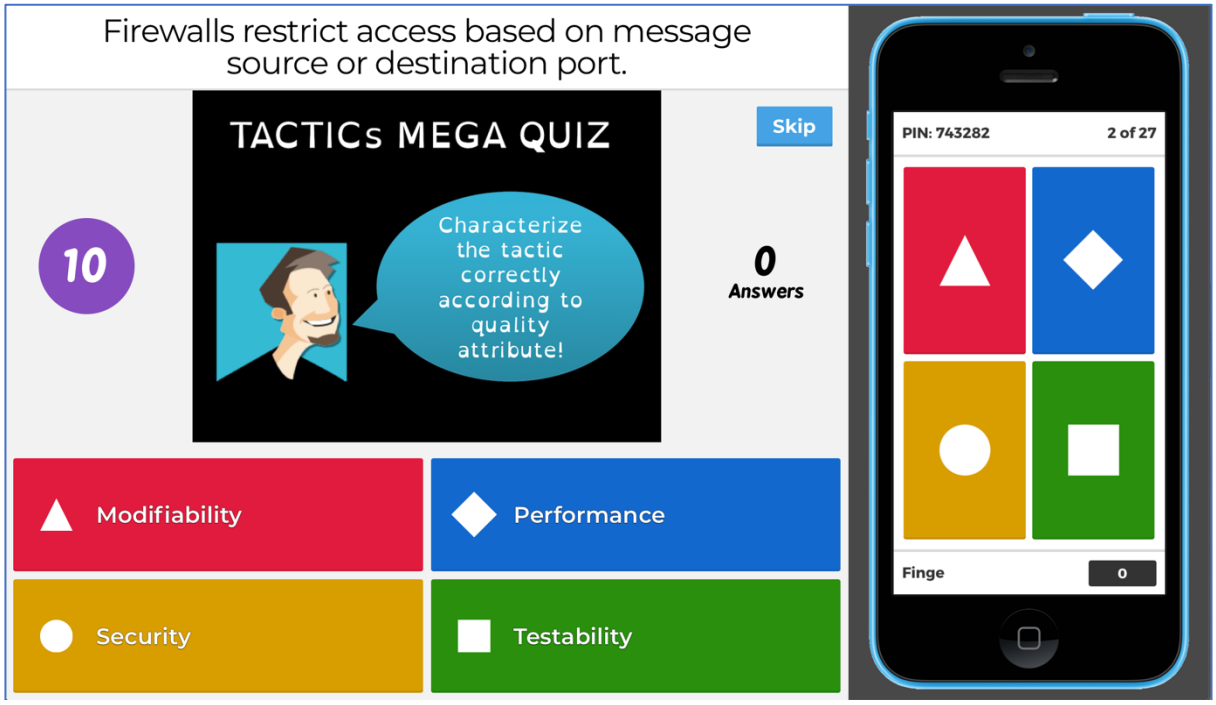

Figure 3: Screenshot from the Quiz game in Kahoot!

2.2.2 Jumble Game

The goal of the Jumble game is mostly the same as the Quiz game, but here the students have to match four descriptions of architectural tactics to four quality attributes. This game requires more effort to give an answer as the student has to arrange four answer alternatives in the correct order before submitting the answer. The Jumble game had twelve questions where nine gave the students 60 seconds to answer, while for three, they had 90 seconds. The three questions with longer answering time had more text to read.

Similarly, to the Quiz game, the Jumble game took around 20 minutes to play through all questions. At the end of the game, the three top players were awarded a prize (box of chocolate or candy). Figure 4 shows how questions were asked in the Jumble game (projected screen to the left and student's screen to the right). The instructions on what to do were shown at the top of the projected screen, while four enumerated descriptions of architectural tactics were shown at the center of the screen. PowerPoint was used to create the four enumerated descriptions of tactics, exported as a PNG-image and then imported to the Jumble game. The lower part of the projected screen shows the four quality attributes that should be mapped to the four descriptions in the correct order. The student screen to the right shows how the user can drag and drop the four color-bars with symbols that represent the four quality attributes on the project screen. For this particular question, the student has guessed that description number three is related to performance, and description number four is related to availability. When all color-bars are organized, the student can click on the circle button to submit the answer.

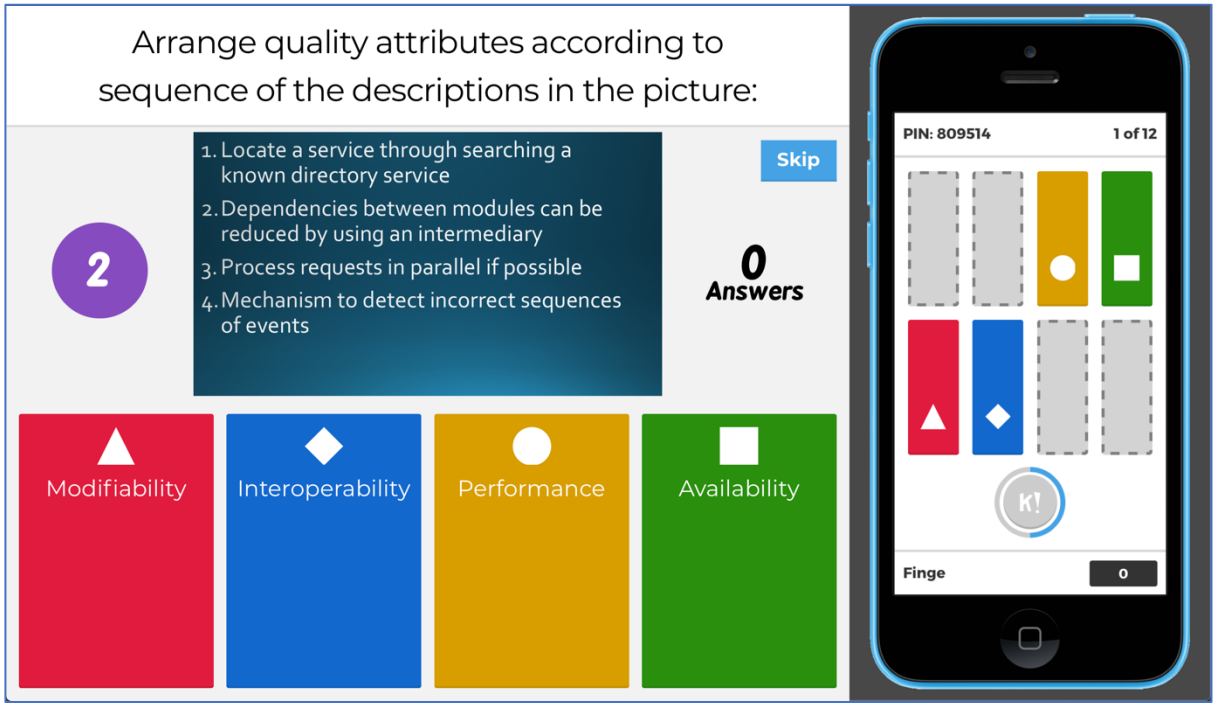

Figure 4: Screenshot from the Jumble game in Kahoot!

3. Results

This section presents the results of the survey on the two types of games and observations made. The survey had 53 respondents, where 17% were female vs. 83% were male students.

3.1 Results from Close-ended Questions

Table 1 shows the results of which game type the students thought was the most fun, engaging, motivating demanded most concentration and which one they learned the most.

Table 1: Results from the survey on two types of games in Kahoot!

		Female		Male		Total	
#	**Statement**	**Quiz**	**Jumble**	**Quiz**	**Jumble**	**Quiz**	**Jumble**
1	Most fun	5 (56%)	4 (44%)	21 (48%)	23 (52%)	26 (49%)	27 (51%)
2	Most engaging	1 (11%)	8 (89%)	12 (27%)	32 (73%)	13 (25%)	40 (75%)
3	Most motivating	4 (44%)	5 (56%)	23 (52%)	21 (48%)	27 (51%)	26 (49%)
4	Most concentration	0 (0%)	9 (100%)	1 (2%)	42 (98%)	1 (2%)	52 (98%)
5	Learned most	3 (33%)	6 (67%)	20 (45%)	24 (55%)	23 (43%)	30 (57%)

The results showed that there were no significant differences related to the games being fun or motivating. However, the students perceived Jumble to be most engaging (75% for Jumble vs. 25% for Quiz) and demanded the most concentration (98% for Jumble vs. 2% for Quiz). There is a weak tendency that the students perceived that they learned more from Jumble (57%) than from Quiz (43%). In terms of gender differences, there is a tendency that female students perceived Jumble as more engaging than male students (89% vs. 75%), and that they thought they learned more from Jumble (67%) compared to male students (55%). However, due to the low count of female students in our study, it is not possible to conclude.

To test for statistically significant differences, binomial probabilities with the assumption that both games would be perceived to have similar characteristics were calculated. The test calculated the probability (P-value) for k or more out of 53 subjects would prefer one game mode over the other `(n=53, p=0.5, q=0.5, mean=26.5, var=13.25, stdev= 3.6401)`. Table 2 shows the binomial probabilities for choosing the Quiz game for statements 1 to 5. The results show a P-value of less than 0.05 for statements 2 and 4.

Table 2: Binominal probabilities for preferring one game over the other for statements 1-5

#	Statement	n	K	P
1	Most fun	53	26	0.500000
2	Most engaging	53	13	**0.000179**
3	Most motivating	53	27	0.500000
4	Most concentration	53	1	**<0.000001**
5	Learned most	53	23	0.206108

3.2 Results from Open-ended Question

A total of 33 comments were submitted to the open-ended question in the survey, where most of them suggested improvements (82%), some were negative comments (9%), and some were positive (9%). The negative comments were related to too short time to submit an answer when playing Jumble, too much waiting time when playing Jumble, and difficulty in reading the text on the projected screen. The positive comments were related both to the Quiz and the Jumble games being fun and engaging, while some preferred Quiz while others preferred Jumble. The suggestions were related to four main areas, where over half of them focused on the lack of feedback on student devices after the correct answer was presented at the projected screen. In the current version of Jumble, the answer the student gave is not shown, which makes it very hard to learn and reflect from the given answer. Almost one-third of the students suggested that the scoring for Jumble should be changed. Currently, the player only gets points if all four answers are in the right place. Many students suggested that it should be possible to be awarded points for partially correct answers. The remaining suggestions for improvements included games where both Quiz and Jumble questions could be combined and user interface improvements. Here are some quotes from the students' comments: "I liked Jumble a lot, but the Quiz is more fun. Maybe you should make both available", "Quiz was a lot more fun", "I did not remember what I answered, and it was not very motivating to only be awarded points for all answered placed correctly", "I really preferred Jumble mode, due to the longer time limits, more complex and engaging questions", and "A mix of both would be perfect".

3.3 Observation

In general, the observations from both types of games were that the students were highly engaged in both games. For the Quiz game, the atmosphere in the lecture hall was cheerful, and most students gave their answers after a few seconds with little thinking. Some students, in their pursuit of making the top-five scoreboard, expressed that they gambled and guessed so that they could answer fast and possible gain more points. The students were highly focused and concentrated during the Jumble game (to a more considerable extent than for the Quiz game). It is evident that this type of game demanded more thinking and concentration as the first answers came after 30 seconds. One negative effect was that the fastest students had to wait for the slower students up to 30 seconds or more before the correct answer and scoring were revealed.

4. Discussion

This section presents a discussion about results, course evaluation, validity, and related works.

4.1 Discussion About the Results

The results from the survey at the end of the experiment showed that the students perceived both the Quiz and Jumble games in Kahoot! to be equally fun, motivating and they were perceived to have the same learning effect. The main difference was related to engagement and concentration. The observations from the study confirm this difference as students were more casual and careless in giving answers playing the Quiz game in contrast to the Jumble game. One explanation for this difference is simply that for the Quiz game, the student only has to touch or click on one of the four colored bars to answer, while for the Jumble they had to drag-and-drop four answers in positions and finally click on a button to submit the answer. This process of arranging the four colored bars in Jumble forces the students to think and reflect before giving their answer. The need for reflection before giving answers was especially crucial for the Jumble game used in this study, where the students had to map four statements to four answers. Another way of using the Jumble game is to ask the students to arrange four answers according to, e.g., to size, age, and ranking. Although such Jumble games will require more thinking than a Quiz game, it will not be as demanding the way it was used in this study.

The main disadvantage with the Jumble game as it is today is the lack of student feedback and the scoring scheme. Many students were frustrated as they needed to get all four answers correctly ordered to get points. It is possible to give points for partially correct answers, but the main disadvantage is that some students will only focus on some of the answers and not consider all of them before submitting an answer.

4.2 Course Evaluation Results

The course evaluation made at the end of the semester did not contain any specific comments related to the use of Quiz vs. Jumble game in Kahoot!. However, the feedback from the students was generally very positive on the extensive use of Kahoot! in the course. Of the 51 comments on what has been good in the course, 23 (45%) mentioned Kahoot!. This positive feedback was related to Kahoot! engaging students, making lectures more interesting, providing good involvement of students in lectures, providing a more positive and fun learning environment, making it easier to pay attention in class, and being a great way of testing knowledge of what students have learned. The only negative comment related to Kahoot! in the course evaluation was that one student said Kahoot! was used too much.

4.3 Threats to Validity

There are some potential threats to the validity of this study. One potential threat is that only the most positive students answered the survey at the end of the experiment. However, in the quasi-experiment, 59 students played the games, whereas 53 students had complete survey responses (90%). Although this study reported some tendencies on gender differences, there were not enough female respondents to make any conclusions. Another potential threat could be that the students in the study knew the Quiz game well but did not know the Jumble game at all. The latter can cause a novelty effect that can cause the students to be more favorable for the Jumble game. However, as described earlier in the article, the user experience in both games is very similar. Also, as the results did not favor Jumble to be more fun and motivating, it seems like this was not the case in our study. One limitation of this study is the way the Jumble game was used. In our study, the students had to map four answers to four descriptions, which makes it more demanding than merely arranging four answers according to, e.g., size, age, or similar. As such, this study is more of an extreme case of the Jumble game, which is more likely to produce a stronger contrasting effect between the Quiz and Jumble game.

4.4 Related Work

Digital game-based learning has been found to have a positive effect (Prensky and Prensky, 2007), but the effect varies from game to game. Several articles evaluate the use of games and apps in an educational setting (de-Marcos et al., 2016), and how entertainment games can be used in an educational context (Squire, 2003, Gee, 2003). There are also articles that compare the effect of Kahoot! to other games or educational tools such as YouTube and in-class games (Hussein, 2015); Who Wants To Become A Millionaire and Code Academy (Fotaris et al., 2015); Infuse Learning, QuizSocket, Verso, Socrative, and Poll Everywhere (Andrés et al., 2015); paper quiz and Clicker SRS (Wang et al., 2016); and ClassDojo, Classcraft, and Socrative (Bicen and Kocakoyun, 2017). One study presents a quasi-experiment where they compare how the use of Kahoot!, Quizizz, and oral questions and answers (control group) affected engagement and academic achievement (Göksün and Gürsoy, 2019). The pre-service teacher students were organized into three groups where a pre/post-test and a questionnaire were used. The results showed that Kahoot! had a more positive impact on engagement and achievement than the two other groups, but the results were not statistically significant. Quizizz was found to have a less positive impact than the control group and Kahoot!, and this was explained by limited visual feedback and that the questions progressed at an individual pace. A similar study compared Kahoot! to a multiple-choice approach where they found significant better skill development for Kahoot! ($p<.01$) within areas such as teamwork, practical training, leadership, oral communication, ICTs, capacity to produce new ideas and solutions, capacity to learn and act in new situations, business skills, personal study, and independent work (Guardia et al., 2019). However, other skills like the capacity to take decisions, analysis and solving of problems, theoretical training, written communication were not significantly improved.

Some studies examine how Kahoot! can be used in different ways. In a study in Greece, thirty-four university students played first the Quiz, then the Jumble and finally the Challenge (asynchronous play against other players) in Kahoot! to see how it affected participation, engagement, and learning (Douligeris et al., 2018). The students were in general very positive to Kahoot! and enjoyed the Quiz, Jumble, and Challenge. However, the analysis showed that the students were significantly more positive towards the Quiz than the two others. A

study from a middle school in Portugal, examined using Kahoot! for traditional assessment vs. co-creation, where the students created and hosted their own kahoots (de Sousa, 2018). The results showed that the students found it easy to create their own content, but it was hard to choose and write false alternatives. Further, the teacher's role changed to be a facilitator guiding the students towards the goal, and the use of Kahoot! for co-creation lead to increased engagement and interest, promoted dialogue and co-discussions and led to better understanding. A quasi-experiment in Taiwan examined two different approaches for using Kahoot! in a flipped classroom, where one group used Kahoot! as standard, while for the other, the students shared their initial responses before answering and discussed questions after correct answer had been revealed (Hung, 2017). The results revealed that the latter group with pre- and post-question discussions outperformed standard group and scored higher on a more positive learning culture.

An article similar to our study compares two different multiple-choice quiz games wherein one, the students can only give one correct answer, while for the other multiple correct answers (Wang and Hoang, 2017). The results showed that the game where students could submit several correct answers was perceived to be more fun, more motivating, a better social experience, and result in increased learning. A similar study investigates the effect of points and audio in Kahoot! (Wang and Lieberoth, 2016). The study revealed significant differences, whether audio and points are used in game-based learning in the areas of concentration, engagement, enjoyment, and motivation. The most surprising finding was how classroom dynamics was positively affected by the use of audio.

5. Conclusion

This article has presented the results of a quasi-experiment investigating how the two games Quiz and Jumble in Kahoot! affected the students' enjoyment, motivation, engagement, concentration, and perceived learning. The results reveal that the two types of games provide the same level of enjoyment (RQ1), motivation (RQ3), and perceived learning (RQ5). However, the study shows that the Jumble game required significantly more concentration from players (RQ4). This makes sense as the answering process in Jumble is more demanding. Observations support this explanation, as students gave their answer after a few seconds in the Quiz game vs. after 30 seconds for Jumble. The main disadvantage of Jumble was more idle time for the fastest students. The study also showed that the students perceived the Jumble game to be significantly more engaging than the Quiz game (RQ2). This is probably related to the deeper concentration required. The students identified some shortcomings related to the Jumble game, including a lack of feedback on what answer they had given, no scoring for partially correct answers, and no support for mixing Quiz and Jumble questions.

Future research will include experiments on the learning effect of the two different games, as well as how the students' perception changes over time using the two games.

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