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Testing framework for investigating learning outcome from quiz game

A Study From Macedonia and Norway

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Abstract—**This electronic document is a "live" template and already defines the components of your paper [title, text, heads, etc.]** *The quiz-game Kahoot! is a Norwegian developed quiz game that is used in all countries in the world. At the Inland University of Applied Sciences, Kahoot! has been played in several classes and in different ways. This paper will present research at the elementary level both in Macedonia and in Norway. The research is based on an adapted version of the Education Games Evaluation Framework. The adaption is mainly due to it not being a computer game, but a quiz game.*

The framework for testing the learning outcome from games is based on factors that influence on students Quality of Experience, while playing the game, game's ease of use, usefulness, educational value of the game, adoption of the game to the curricula, and teachers' opinion concerning using the game in the learning process. The purpose of the educational games evaluation framework guideline is to identify different parameters that influence on qualitative integration of educational games in the classroom and investigate their interconnections. The parameters refer to students' attitudes, opinions and interactions during the game. Game's ease of use is a factor that determines students' motivation for using the game for learning. We also took into account the use of a game for achieving educational goals (not only as an assessment method). In that way we tried to make a correlation between entertainment and educational value of a game. The evaluation guideline provides the way to create questionnaires for educational games evaluation. This evaluation framework guideline was used to evaluate several educational games available on market (e.g. ScottieGo) and prototypes (e,g, ZookKemon Go).

For the quiz game the adjustments have been to reduce the number of questions regarding the specific gaming questions and rather add questions that are directed directly towards the quiz game.

The pupils at the elementary school have played Kahoot! both in Macedonia and in Norway in order to support the learning outcome from the lectures. The teachers use it as a way of both breaking up the lectures, and to test the pupils.

The learning from the quiz game has been discussed. There is an ongoing investigation regarding Kahoot! supporting deep or surface learning. The preliminary results are pointing towards surface learning rather than deep learning. However, the activity of performing a quiz game can have a value in itself. It breaks up the lecture and used as an indicator of what the pupils have learned, it can be perceived as both fun and educational by the pupils.

A quiz game can thus be used to boost reflection processes. The pupils will have little time to reflect, but they will still have to recall what they think is the answer. These reflections can also contribute towards the learning outcome.

For this paper, we have focused on if the pupils perceive playing the quiz game as fun. We have asked if they have had fun competing, if they have had fun playing it with their class mates, if they are motivated to learn when using the quiz game, if they learn something from the gaming and if they would like to continue playing the quiz game in class. Keeping in mind that these are pupils in elementary school, we suggest that these questions from the quantitative survey would provide us with data that would answer our questions: "do pupils find it fun to play (quiz) games in class?" and "does the gaming contribute to a perceived learning outcome".

Keywords— Quiz game learning; games for learning; kahooting; game evaluation framework

I. INTRODUCTION

Using games for supporting learning outcome is being increasingly popular. Many games have been developed to suit

that particular purpose. But what is the impact of each game? How well does it support the learning outcome?

In order to test different games that are used in education, the Evaluation Framework has been developed. The evaluation framework identifies factors that influence students' quality of experience during use of educational games in the learning process. These factors are complex variables that can be treated from two different perspectives: game related (first streamline) and student related (second streamline). First perspective provides guidelines for analyzing the gameplay, while second perspective provides insight towards the educational value of the game (See Figure 1).

The main idea of evolutional framework is that achieved quality of experience is in positive relation with the achieved quality of learning. Evaluation of an educational game should always start from the: game rating, alignment of the educational goal with the game, and educational goal complexity. These can be evaluated by creating the questions with Likert scale answers than, the students' appreciation of the game should be analyzed using student surveys consisting of Likert Scale questionnaires. The students' appreciation of the game consists of students' motive to play the game, how easy and understandable is the gameplay, and what is the students' attitude toward the game. It is important to note, that different factors such are: cultural background, age, knowledge in certain area, can influence the student's appreciation. Thus, demographic questions should be included in the surveys as well.

Game rating (popularity of the game) is the necessary element for a game to be adopted by the students. It influences games' ease of use, students' motivation and attitudes. The more popular game is, the easier is to find the gameplay explanations and instructions, both on internet and by asking the other students. The larger game community increases students' motivation to achieve good results in the game. The popular games are perceived as more appreciated among students, which increase the positive attitude regarding the game itself. Game rating influences on forming positive attitudes toward playing it in educational context.
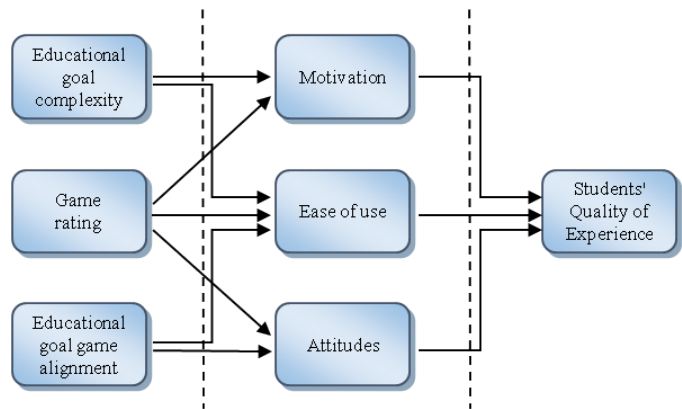

Fig. 1. Educational Games Evaluation framework

Educational goal complexity influence game's ease of use and students' motivation. Easer educational goal can be implemented with simpler rules. On the other hand, easy challenges are demotivating for the students playing the game. Competitiveness in game influenced on students' motivation for playing it over and over again in order to achieve better results. Educational goal complexity should determine the number of levels in the game and how they should be passed. Namely, for each level of learning outcomes should be appropriate level of the game which will motivate students for playing it. This can be implemented by indicating different degrees of success which could be achieved while mastering a given level.

Game alignment with the educational goals is related with students' attitude towards the game and the game ease of use. The proper game alignment with educational goals can provide new views on educational goals and increase the student attitude towards the game. Students think that it will help them to learn on more interesting and stimulating way that is very familiar to them. At the same time, the educational goals can provide hints for gameplay, making it easier to use. This would contribute to the easier achievements of the learning outcomes.

Students' motivation is one of the most important factors in the process of creating educational game. If the game is too challenging, the player will be frustrated, and if it's too simple, the player will lose interest. In either case, players are very likely to become disengaged and quit the game play. That's why educational goals must fit clearly in the game.

Students' motivation towards playing games and using game in the educational process leads to their positive attitude toward use of similar games in the learning as new teaching approach. Motivation towards using educational games and students' attitudes toward this new teaching method directly, together with how easy is the gameplay influences student's achieved quality of experience.

The focus of our investigations has been on looking at gender differences with regards to having fun, how they perceive the competitive aspect, and how they perceive playing Kahoot! contributes to the learning outcome.

II. THEORETICAL BACKGROUND

Children (in general) like to play, and learn and develop during play [1]. A child's play can be important for developing social skills. The social interaction with other children will help the child to e.g. understand social "rules". During play, children learn from each other, but may also construct learning from their previous experiences in social interaction.

There are several studies on games and learning. The term "serious games" was coined by Ben Sawyer [2] and indicated that games could be developed for a more "serious" purpose than "just for fun". James Paul Gee has presented research on several topics regarding learning from games. He claims that games can aid in the process of literacy [3], and in more general; how one can learn from video games [4].

Learning from peers and from peers with a broader background, can support the social learning process. This is described by Lev Vygotsky [5]. His description of "the zone of proximal development" addresses how it is possible to expand ones learning and development in a social context with peer with different knowledge backgrounds.

Learning in a social context means being somewhat active oneself. Student activity is also promoted in today's classroom. With the emergence of Flipped Classroom, the students are encouraged to be active and make use of their own experiences. Flipped Classroom is defined as either a class that utilizes practices, problem solving and video lectures, or group based/open ended problem solving, video lectures, closed ended quizzes and practice exercises [6, 7]. John Dewey claimed that it is important to connect new learning to previous experiences [8, 9].

To get a better understanding of how one can learn from experiences, David A. Kolb introduced the experiential learning cycle [10]. An experience requires reflection that explains what happened. The next phase is to conclude on what learning there is to take from this experiences and then planning a new experience, utilizing the lessons learned from the previous experience (see Figure 2).

Reflection is thus considered to be an important bridge between knowledge and learning. Reflection processes can be facilitated in different ways. Donald Schön argues that one can reflect during and after an action or experience and that, reflection can be on different levels [11]. It is possible to reflect in an action but also on an action, as Schön explains about how one can reflect in action on action. Reflecting after an action is in the military described as After Action Review [12, 13]. This After Action Review does, however, only include the two phases after the "Experience" in Kolb's cycle.

III. METHOD OF INQUIRY

For our investigations; to explore how students perceived Kahoot!, the Evaluation Framework was adapted to suit the quiz game. The adapted version was developed into a quest using the tool Questback in order to collect and analyse the data.
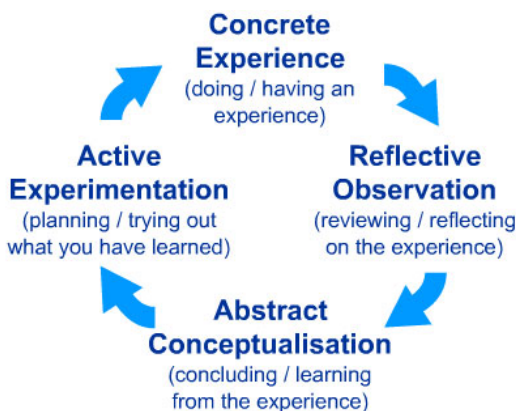

Fig. 2. The experiential learning cycle - retrieved from https://www.simplypsychology.org/learning-kolb.html

This quantitative research method allows us to compare the answers from the two different countries. Since our focus have been learning from fun and in a social setting, it was important to establish how well they liked to play the quiz game in their classes. In this setting, their class was their social environment.

The quest consisted of 14 questions. 4 questions was about background data, such as gender, if they had any previous experience with Kahoot!, and how often (if at all) they played video or mobile games.

The other questions used a form of Likert scale [14, 15] with "smileys" instead of statements. Rensis Likert developed this five (or seven) point scale and tit is used to get respondents to express how much they agree or disagree with a particular statement.

The survey was distributed in both Macedonia and in Norway and $N^1 = 58$ Macedonian students and a total of $N^2 = 44$ Norwegian students replied, all in the age group of 12 to 13 years of age. However, some of the students did not reply with regards to their gender. They are not a part of the respondents from whom we have analysed the answers. The number replies from respondents from Macedonia was thus $N^3 = 46$ and the corresponding number of Norwegian students was $N^4 = 43$.

IV. KAHOOT GAME

Kahoot! is a quiz game (www.getkahoot.com) that is developed at the Norwegian University of Science and Technology. The website allows for sharing own quizzes and download quizzes. It allows for different approaches regarding playing. For instance, one can play in single mode or team mode.

According to their website, Kahoot! is used in all countries in the world and at the end of 2017 they had 70 million monthly users.

The quiz game allows for up to four different answers and it allows for different solutions to correct answers; all four can be right, one of two, three or four may be right, etc. (it requires at least one correct answer). Each question has a time limit with regards to answering. This can be set from 20 seconds to 120 seconds.

The game can be played as a pre-generated quiz or in a classroom with the teacher as a "game master". The students can reply the game by logging on from a pc, iPad or mobile phone. By entering a game pin generated by the quiz game, the "game master" can start the quiz and decide on when to display the next question.

A scoreboard is optional, but many students like to see how well they are doing. The students are given an opportunity to rate the game and learning outcome after playing.

V. RESULTS AND DISCUSSION

Here we present and discuss the results from the two surveys. Of the respondents that replied from Macedonia ($N^3 = 46$) 21 were boys and 25 were girls.

A. Results from the Macedonian boys

All of the (reported) 21 boys play games on PC and mobile phones and only 3 report that they seldom play games on their mobile phones. 18 (of 21) strongly agree on liking playing Kahoot! 17 strongly agree (17) or agree (3) to it being fun to use

Kahoot!. 17 strongly agree and 3 agree to liking playing Kahoot! with their class, and 16 strongly agree and 4 agree to being motivated to learn by using Kahoot! during lessons. This coheres with the theories on social learning and learning in social contexts. Even when student plays as single player, the notions of being a part of a group or community is present.

17 strongly agree and 3 agree on learning from playing Kahoot! (1 disagrees). We have no possibility of uncovering why this one student is not learning, and there could be a number of reasons as to why this one person has answered this. However, the other 20 boys do claim to learn from the Kahoot!. This is an encouraging number and paired with the result from it being fun, this is supported by the theory on games for learning purposes [3, 4].

B. Results from the Macedonian girls

Of the 25 girls 13 had not played Kahoot! before. 2 play games on TV or PC every day and 10 play often. 12 play games on mobile devices every day, 8 play often, and 5 play seldom. 22 strongly agree to liking playing Kahoot!, 3 agree. 20 strongly agree that it is fun to compete using Kahoot!, 3 agree, and 2 are indifferent. 22 strongly agree to liking playing Kahoot! in their class, and 3 agree. 12 strongly agree to being motivated to learn by using Kahoot! during lessons, 7 agree, and 1 is indifferent. 19 strongly agree to learn from playing Kahoot!, 4 agree, and 2 are indifferent.

The girls show similar/comparable results with the boys. They too, confirm it being fun and engaging, and that they learn from this experience.

C. Results from the Norwegian boys

19 of the respondents that had replied to the gender question from Norway were boys. Of these 19, 1 had never played Kahoot! before. Only 3 never play games on TV or PC and 6 never play games on mobile device. 15 (of 19) strongly agree on liking playing Kahoot! and 13 strongly agree (13) or agree (4) to it being fun to use Kahoot!. 13 strongly agree and 6 agree to liking playing Kahoot! with their class. 9 strongly agree and 7 agree to being motivated to learn by using Kahoot! during lessons. 10 strongly agree and 8 agree on learning from playing Kahoot!.

Again, we get confirmation of learning from having fun and playing games in a social context.

D. Results from the Norwegian girls

7 (of 24) have not played Kahoot! before. 12 play games on TV or PC every day and 11 play often. 6 play games on mobile devices every day, 5 play often, and 8 play seldom. 12 strongly agree to liking playing Kahoot!, 7 agree, and 2 disagree. 11 strongly agree that it is fun to compete using Kahoot!, 7 agree, 1 disagree and 1 strongly disagree. 10 strongly agree to liking playing Kahoot! in their class, 7 agree, 1 disagree and 2 strongly disagree. 10 strongly agree to being motivated to learn by using Kahoot! during lessons, 7 agree, 2 disagree and 3 strongly disagree. 9 strongly agree to learn from playing Kahoot!, 11 agree, 1 disagree and 1 strongly disagree.

The results here also contained some discontented persons. Since it is the same persons disagreeing to having learned, to having fun and to enjoy playing Kahoot!, this may also have other explanations. However, it is important to take into consideration that not all students may enjoy or learn from playing a quiz game. One possible explanation is what Peter Senge refer to as "personal mastery" [16], or in this case; lack of personal mastery. If loosing or not feeling that one is able to reply adequately, the lack of mastery can end in an aversion towards the gaming.

E. Results summed up

The Macedonian students seem generally more positive than the Norwegians do. The general impression is that there were very positive results regarding fun, the game supporting learning outcome, that the collaborative as well as the competitive sides to the quiz game supported the learning outcome and that they felt motivated to learn.

We can also state that there is very little difference between the genders. The activity that the game provides seems to be welcomed. Having fun whilst learning supports the experienced learning outcome. Even if there is a few of the students that are negative towards the experience, most of the students seem to have obtained personal mastery. They seem to be motivated to learn from playing the quiz game.

What this study does not provide sufficient data for is whether or not the learning can be considered deep or if it is only surface learning.

Investigations from Norway claim that it is only supporting surface learning, and that deep learning cannot be established [17].

F. The Game Evaluation Framework

Based on the game evaluation framework it is possible to sum the results into the following table.

The educational goal complexity refers to how many or how difficult the goals for the game are for the game in question. For this quiz game, it was about testing learning from classes, e.g. in geography or history. At least one answer is correct and it can be a combination of remembering when seeing the right answer(s) or remembering what is the correct answer(s).

TABLE I. EVALUATING KAHOOT! USING THE GAME EVALUATION FRAMEWORK

Educational goal complexity	Motivation	
Testing knowledge acquisition of different topics from class	High	
Game rating	Ease of use	Students quality of experience
High	Kahoot! is easy to use	High quality of experience High perceived learning outcome
Educational goal alignment	Attitudes	
High	Positive	

Regarding game rating, the students rate the quiz game very high. They enjoy the gaming and the activity of gaming.

The educational goal alignment is also rated as high. They seem to find it appropriate with regards to the purpose; testing learning outcome from classes.

They are motivated to use the game, motivated from using the game, as they experience personal mastery when they achieve points and ratings. The students claim that Kahoot! is easy to use, they can use either a computer, iPad/Smart-Board, or mobile phone to log on to the game. They enter a game pin and then they are good to go. Their attitudes towards the game and the gaming are very positive.

This means that they have a high quality of experience and a high perceived outcome.

VI. CONCLUSION

We found that all of the students enjoyed playing games, both in Macedonia and in Norway. The Macedonian students were, however, slightly more satisfied with using the game for learning purposes. All of the students claim to have learned from playing Kahoot! Also most of them enjoy playing with their school mates. This confirms that students want to play (quiz) games and that they welcome the activity as something motivating and fun.

There were few differences in girls and boys in both countries. Most of the students, with exception from some of the Norwegian students find that the gaming supports their experiences learning outcome. It also makes them motivated to learn more. They rate the social aspect of the gaming high, which means that they enjoy and find the competitive and collaborative side of the gaming supporting their learning process.

Testing out the Game Evaluation Framework has been interesting, as the framework originally is developed for other types of games. It does, however, confirm our findings and it also provide us with valuable insight on the learning outcome and how the goal alignment and goal complexity with regards to education correspond towards the ease of use and motivation. This determines how well the students rate the games regarding quality of experience and learning outcome.

A. Further Research

The framework could be further tested to see if different ways of using Kahoot!, e.g. team mode, and see if this will have an impact on the outcome.

The data presented in this paper is only a part of the existing material, as we here wanted to look at gender differences. It is thus possible to look for further findings in the total material.

It would also be interesting to do investigations in other countries where they have used Kahoot!. This would provide us with a wider array of data. Also, a larger number of respondents both in Macedonia and in Norway could be desirable.

The framework is developed to do research on the student perspective. However, the teacher aspect is also interesting. How do the teachers perceive games and/or quiz games to support the learning outcome and the motivation to learn.

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