Integration of Game-Based Software Tools into Higher Education

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Abstract. Technology is increasingly being used in all areas and is greatly involved in modern education. This paper aims to examine the impact of using game-based software tools on student engagement and motivation during class. The goal of using game-based software tools is not to replace the work of teachers, but to support the active involvement of students in the topics currently under study. The results of previous research on the use of a game-based software tool and the results obtained using the same tool in an online learning environment are compared.

Keywords: Game-based technology · Software tools · Higher education

1 Introduction

The rapid increase in the availability and accessibility of interactive technologies has contributed to the adoption of games in science and higher education to encourage learning and research. Students can experiment with different technologies to support their learning, and that is the reason why they enjoy using mobile and web applications [1].

According to research on the dynamics of attention span during class, students' attention is increased during the first ten minutes of the class, and it decreases after that. One way to solve this problem and get students' attention is to change the environment during class [2]. Another way is to incorporate game-based software that helps the stimulation of dopamine, which plays a key role in student motivation, influence, and learning. Game-based student response systems (GSRS) should increase students' engagement. In universities, maintaining students' attention and engagement in information technology classes can be difficult, as teaching is often teacher-centered, with limited student involvement and interaction between them. Lectures become monotonous, and students tend to engage in non-task related activities [3]. It is expected that integrating game-based software tools in teaching with the purpose of testing knowledge and repeating study material will increase their engagement and learning. Under the social norms prescribed by the lecture environment, students rarely ask public questions and prefer to remain anonymous [3], thereby reducing student engagement. However, the use of game-based

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software tools allows students to remain anonymous while interacting with the teacher and other students [4].

The use of gamification in education enhances student response systems (SRS), with promising results [4]. SRS is often used to screen multiple-choice questions to offer students the ability to interactively respond to quizzes as part of a formal grading regime. There is a noticeable difference between student response systems such as iClicker and Poll Everywhere and more modern student response systems such as Kahoot! [5]. The use of GSRS in the form of gamification requires participants to activate prior knowledge and evaluate their reactions while playing and learning. GSRS should increase student attention, motivation, engagement, and enjoyment beyond traditional methods. In this way, GSRS systems should overall improve teaching, but also at the individual level should motivate students who do not normally participate in discussions, and GSRS systems are useful teaching tools in fostering learning personalization [4]. Based on these assumptions, this paper will present the results of an exploration of the use of a GSRS tool in teaching at the Faculty of Technical Sciences, University of Novi Sad, Serbia.

Kahoot!, as a game-based learning platform, is a free tool used in various fields. This platform has more than 30 million users worldwide [6]. Kahoot! was created in 2015. by Jamie Brooker and Johan Brand as a system that allows users to create different types of games, such as quizzes, polls, and discussions in which participants compete against each other. It is a system that can work at a classroom level, and the idea is that more students or even the whole class should participate. Kahoot! supports assessments, productive formative assessments, and student reflection [7]. In the beginning, the teacher registers on this system, and afterward, he can select a large number of predefined games that can be easily adapted to his needs or can even create his own game entirely. The creation process is straightforward and easy. After that, students participate in a competition based on the created game, at the same time, each on their device. During the game, the best and fastest answers to each question are revealed, as well as the overall results at the end of the session [8].

This paper aims to investigate the impact of a tool based on the game Kahoot! on the activity, motivation, and learning of students in the online learning environment and to compare the obtained results with previous research [9] conducted in the laboratory environment. A survey was used as a research method and the obtained results are presented in this paper.

The remainder of the paper is organized as follows. Section 2 presents background and related work in this field. Section 3 describes the methodology used in the research. Section 4 the obtained results are presented and compared with the previous research [9]. and Sect. 5 concludes the paper and suggests future research.

2 Background and Related Work

Dominiques et al. [10] used an e-learning platform to find out how the use of gamification influences students' motivation to participate actively in teaching. A special software add-on has been created for the platform used in the course as an introduction to information and communication technologies, and this add-on allows the use of

game elements such as trophies and medals, which students receive after completing a specific assignment. Qualitative analysis of the results revealed that gamification has a great emotional and social impact on students, both because of the reward system and the competition part because students were immediately ranked according to the results obtained and could be seen by all, thus knowing their progress in relation to others. However, such results were not shown for all students. Some students did not find it amusing to compete with classmates and did not like the fact that everyone could see their results.

On the other hand, the quantitative analysis shows that the cognitive impact of gamification on students has not proved very significant. Students who participated in the research performed better on practical assignments than on written ones, compared to those who took the course regularly. Also, at first, they had great motivation to actively participate in teaching, but it decreased over time.

Giannetto et al. [11] tried to reduce the motivation problem by using the QizBox web application in teaching. They designed a reward system based on experience points, where participants can complete one of 5 roles based on their engagement in teaching. These roles are Social, Smart, Researcher, Mentor, and Diligent. Particularly interesting is the role of the Mentor, which students get when they help their classmates with specific difficulties by answering questions in a community forum and encouraging their work. For each role, students receive a corresponding trophy and are thus encouraged to advance to the next level of the role. This paper did not evaluate the results, only set up an implementation framework.

Song et al. [12] wanted to show whether learning object-oriented programming is more effective through the use of play. They claim that good game design is key to maintaining the fundamental goal of gamification, which is learning. The user interface is very important to keep students' attention, so it must be clear and straightforward. It is essential to have a good story in the game to keep the user occupied and interested in what is next. In this case, the game Ztech de Object - Oriented is used, in which the story of object-oriented concepts extends throughout the levels. The main player in the game is a student, which is why this is a role play, where the character is being upgraded to the highest level. The results of the survey, where the students expressed their opinion about the game, show that this way of learning is better than the traditional ones, but they think that a better reward system should be introduced.

In order to engage students and enable them to learn programming actively, Mathrani et al. [13] used the educational LightBot game. In this game, players are tasked with controlling a robot that needs to light up all the blue tiles in the walking area, and they do this with a set of commands that represent basic programming concepts. The game has four stages, and each stage has six levels with a gradual increase in weight. The survey itself was applied to two groups of students, the first of whom had no programming knowledge, while the second had recently completed one programming course. The results show that students of both groups enjoyed the game and felt that through the game, some concepts of programming - functions, procedures, conditions - were mastered more effectively. With the students of the first group, this game created a positive attitude about learning programming, but some thought it would be better if they first completed a traditional programming course and then only played the game. The

students of the second group achieved better results in the past phases but also stated that they would prefer to have various tasks. Overall responses indicated that the first group had shown greater enthusiasm than the second group. This consequence was explained by stating that the students of the second group were already familiar with these concepts and that they were preoccupied with the obligations in other courses. This conclusion provides room for further consideration.

Based on this research, it is assumed that game-based software tools help students learn. Therefore, further in the course of this paper, the results obtained in a student-led survey on the impact of a game-based software tool - Kahoot! to student learning in higher education.

3 Methodology

This research aimed to examine the satisfaction and impact of using software tools – Kahoot! to students who used it in teaching based on the following research questions:

RQ(1): Does Kahoot! influence student motivation?
RQ(2): To what extent does Kahoot! affect student engagement and learning?
RQ(3): Have students accepted the use of game-based software tools in learning?
RQ(4): Does Kahoot! have a better impact on the online learning environment?

An electronic survey was conducted through December 2019–January 2020 at the end of the first semester on students using Kahoot! during class, and the results are presented in [9]. The extended electronic survey was conducted once again in June 2020 at the end of the second semester. Compared to the previous research [9], Kahoot! was used exclusively in an online learning environment. The reason is that in the second semester, all forms of lectures were performed remotely, because of the Covid19. Previous research shows that students easily accept the online learning environment [14]. The goal of this paper is to test if Kahoot! is more accepted in the online learning environment. The survey consisted of ten questions, where the first two questions classified students based on their gender and study year. The remaining eight questions regarded the impact of the Kahoot! tool in their work, engagement, motivation, and learning. Participants in the survey were students of the Faculty of Technical Sciences who used a game-based software tool – Kahoot!. This tool is used in such a way that teachers prepared questions for students and used them to repeat the material during class, while students answered questions and competed among themselves. At the end of the semester, students who were involved in the courses in which Kahoot! has been used, completed the survey. A total of 184 responses was collected.

4 Results and Discussion

The obtained results show that the respondents are students coming from different study years of Information System Engineering [15] at the Faculty of Technical Sciences. The learning environment for students in this field is very important and is constantly working to improve the learning experience in laboratories and the online learning environment

[15]. Most of the respondents are in the second year of study (35%), the first year (26%), third-year students (14%), students fourth year (18%), and minority are from master studies (7%). All respondents used Kahoot! during classes (Fig. 1).

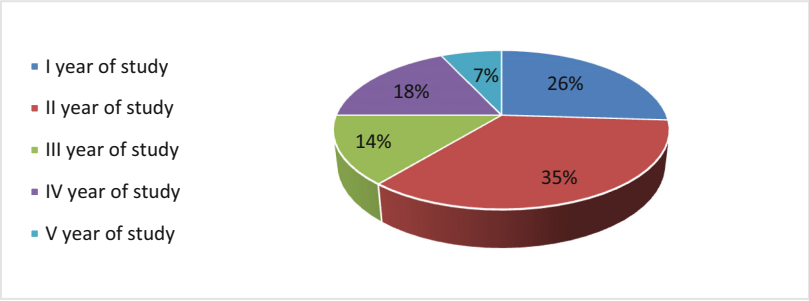

Fig. 1. Demographic characteristics of the respondents by the year of study (source: author's survey)

The first thing investigated among the respondents was if Kahoot! helped them to repeat the coursework. Most of the respondents answered that the use of Kahoot! helped them to repeat the material (92.2%), while far fewer (5.5%) expressed that Kahoot! did not facilitate the repetition of the material during the course. The rest of the respondents did not express their position on this issue.

Next, the question of interest is the extent to which students consider Kahoot! encouraged them in active involvement in teaching. Most respondents said that they felt that using such a tool encouraged them to be actively involved in teaching (91.9%). The rest of the respondents said they generally disagreed with the fact that Kahoot! had an impact on their involvement in teaching. These student responses agree with the assumption that the inclusion of GSRS tools in teaching encourages the active involvement of students in teaching and the topic currently addressed [4].

The concept of this tool also involves competition between the students when it comes to answering the questions posed by the teacher, fostered positive competition, and whether it affected their learning motivation. Most of the students answered that the use of Kahoot! tools encouraged positive competition (87.4%), while the rest of the respondents did not express their views on this issue. When it comes to assessing the influence of this tool and the competition between students on their motivation, the respondents in the majority estimate that Kahoot! positively influenced their motivation (89.7%), while the rest of the students (10.3%) expressed their disagreement with this statement.

The next group of questions relates to the general view on the inclusion of gamification in learning and studies. First, the question of interest is whether students consider Kahoot! and tools similar to it should be included in other subjects in studies – most respondents said they agreed with this statement (62.7%), while a minority, but still a large percentage of students, said that such a tool should not be included in all subjects in studies (25.6%). The rest of the students did not have an opinion on this issue.

Asked if students felt that including gamification in learning facilitated their learning, the respondents answered, in the majority, that such tools did affect facilitated learning (41.6%), while a certain number of students (52.5%) said that gamification did not affect facilitated learning. The remaining number of students did not express their views on this question. Such difference in responses was expected, given that gamification-based tools should support learning and facilitate the repetition of teaching materials, and have no impact on student learning alone [8]. Also, when asked whether engaging with gamification in learning reduces the time they need to learn, students in the minority respond affirmatively (42.4%), while most students (57.6%) say that gamification does not affect the time they need to master some material.

Lastly, students respond positively to the most common question about their attitude regarding the use of gaming in learning. The majority of students report that the use of gamification in learning has a positive effect on their learning performance and contributes to the easier repetition of the course material (88.8%). In comparison, a significantly smaller number of students (10.8%) stated that the use of such tools does not affect their learning performance, and the rest of the students (0.4%) stated that using such tools had a negative effect on their learning. Graphically presented in Fig. 2.

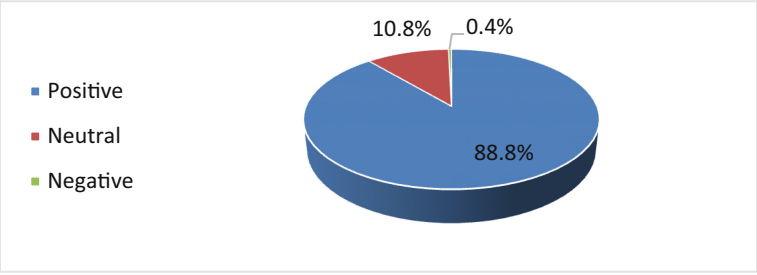

Fig. 2. Effect of using gamification on students learning performance (source: author's survey)

Table 1. Results from previous research [9]

RQ	Survey statement	Agreed	Disagreed
RQ1	Kahoot! encouraged students' active involvement in teaching	78%	22%
RQ1	Kahoot! encourages positive competition among students	83.3%	16.7%
RQ2	Kahoot! helped students' to repeat coursework	87.3%	12.7%
RQ2	Kahoot! facilitates student learning	27%	73%
RQ3	Gamification has a positive effect on students' learning performance	86%	14%

Compared to the results obtained in the previous research, presented in Table 1, it is found that students respond better to the use of Kahoot! in an online learning environment

(RQ4). Each of the survey statements has a higher percentage of agreement within the research conducted in the online learning environment (RQ4). The results of the research are presented in Table 2.

Table 2. Survey results

RQ	Survey statement	Agreed	Disagreed
RQ1	Kahoot! encouraged students' active involvement in teaching	91.9%	8.1%
RQ1	Kahoot! encourages positive competition among students	87%	12.6%
RQ2	Kahoot! helped students' to repeat coursework	92.2%	7.8%
RQ2	Kahoot! facilitates student learning	41.6%	58.4%
RQ3	Gamification has a positive effect on students' learning performance	88.8%	11.2%

5 Conclusion

The rapid development of technology has contributed to significant changes in education, which calls into question the effectiveness of the traditional approach to teaching and the repetition of materials in higher education.

Based on the research conducted, it became clear that students are ready to include a game-based software tool - Kahoot! (RQ3) in the teaching environment and that it positively influences their involvement in a unit that is in the process of repeating material or is currently being processed. Compared to previous research [9], we conclude that students use Kahoot! gives an even better result in terms of online learning (RQ4).

Kahoot!, as an example of a game-based software tool, students have widely recognized as a tool that positively influences their motivation in the process of acquiring new knowledge and repetition of material (RQ1). Also, the fact that such a tool should be used in teaching environments, as well as students' suitability for learning, can be confirmed by analyzing the respondents' answers regarding the inclusion of gamification and in other subjects in studies, where most have confirmed that they believe that game-based software tools should be introduced in most subjects in studies. When it comes to motivation, we must also analyze the competitive concept of such tools. Kahoot! was rated by the respondents as a tool that influences the creation of positive competition between students which also influences students' motivation during the course (RQ1).

On the other hand, when asked whether such a tool influences the facilitated repetition of the learned - the repetition of the material processed in the previous units, most students respond positively, which leads us to the conclusion that the use of such a tool in the repetition of the material, as one of the segments of learning, has a positive impact on students and their results (RQ2). Finally, based on this research, it is concluded that students respond positively to the introduction of Kahoot! tools and tools based on gamification and open access to new technology in teaching.

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