Using Digital Tools for Gamification in Schools

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Abstract - Gamification in education represents the application of game design elements and game principles in teaching with the aim of increasing student motivation and engagement. Although it is important to motivate students in classroom teaching, it is even more important in online or hybrid teaching models that are increasingly being implemented nowadays due to the COVID-19 pandemic situation. Gamification can be used in education at different levels, from primary and secondary schools to universities. The analysis of literature on the use of gamification in Croatian education showed that it is more present in university education and less in primary and secondary schools. Nevertheless, experience shows that games and many digital tools are used in schools for the purpose of gamification, although there is a gap in the literature on this topic. The research presented in this paper is a work-inprogress on the use of gamification in education. The paper gives an overview of digital tools used for gamification in schools to increase students' motivation and the quality of teaching. Systematic research on gamification should be continued in order to propose appropriate pedagogicaltechnological frameworks that facilitate the application of gamification in schools.

Keywords - gamification in education, digital tools, game design elements for education, students' motivation

I. INTRODUCTION

In the context of the Croatian educational system, modernization of teaching is mentioned as one of the main goals in the national subject curricula [1]. In the guidelines of the curricula, it is proposed to replace traditional teaching methods with modern pedagogical approaches, that include student-centred teaching and involve interaction with students. In this process it is very important to motivate and engage students to achieve learning outcomes as successfully as possible.

Hoverer, for today's students, it is often emphasized that they belong to the so-called "digital generations" or "Z-generations" because they grow up with new digital technologies such as computers and the Internet, smartphones, video games [2]. Characteristic for them is that they process information quickly, like to do several tasks at the same time and play games. These characteristics should be considered in the educational process, using, among other modern approaches and digital technologies, those based on Game Based Learning (GBL), serious games, and gamification [3, 4].

Although it is important to motivate students in faceto-face classes, it is even more important in online or hybrid teaching models, which are becoming more common these days due to the COVID-19 pandemic situation [5]. Although gamification can be used in education at different levels, from primary and secondary schools to universities and lifelong learning programs, the analysis of literature on the use of gamification in Croatian education showed that it is more present in university education and less in primary and secondary schools. Nevertheless, experience shows that games and many digital tools are used in schools for the purpose of gamification, although there is a gap in the literature on this topic. The application of gamification in schools can be seen in the examples presented by teachers on some events such as the CUC - Carnet User conferences or professional conferences organized by the Croatian Education and Teacher Training Agency (ETTA).

This paper aims to fill the gap in the literature by identifying the tools that could be used for gamification by school teachers in Croatia. Section 2 gives background regarding basic GBL and gamification concepts with a focus on game design elements suitable for gamification. Section 3 provides an overview of related work exploring gamification, especially in the context of Croatian education. Section 4 presents some commonly used digital tools used for gamification in schools and section 5 brings conclusions.

II. BACKGROUND

A. Basic Concepts

Very often in the literature, descriptions such as gamification, serious game, game-based learning, gameinspired design or simulations and games are mixed. It is important to understand that these are not synonyms, although the difference is very small [3, 4]. All these terms are related to games and fun in education and are directly related to attempt to increase motivation and improve student engagement.

Game-based learning (GBL) is an approach that involves the use of digital games [6]. Digital games increase students' motivation to learn and thus increase their opportunities to achieve desired learning outcomes by playing games or even creating their own games while using simple principles and game characters within learning activities. Using GBL, learning occurs through playing and developing games while fostering critical thinking and problem-solving skills.

Serious games can be defined as interactive, competitive, or training lessons with defined learning outcomes that allow students to have fun while gaining knowledge. They differ from all other games because their goal is not just fun, but they contain a clearly defined educational component. In well-designed educational games, the learning content is hidden and students play the game regardless of which part relates to learning and which to the educational content presented in the game [3].

The term gamification was coined in 2002 by the British programmer Nick Pelling. but it did not become popular until 2010 [10]. Gamification is the application of certain game design elements and principles to non-game contexts. The purpose of gamification is to engage participants through game-based elements such as avatars, badges, virtual points, levels, etc. [7, 8]. The main difference between gamification and serious game is that gamification does not require a complete design of the digital game which is an advantage from a financial point of view. Even simple digital tools like LMS, quiz tools, etc. can be used for easy implementation of gamification [9].

B. Gamification in Education

Gamification in education represents the application of game design elements and game principles in the classroom with the aim of increasing student motivation and engagement [7, 8]. Simply put, gamification uses game-based mechanics, aesthetics, and playful thinking to engage students, promote learning, and solve problems [8, 11]. Besides education, gamification has also become popular in the workplace, as gamification provides immediate feedback that can improve employee motivation and the ability to fix problems faster than before [10].

In theory, the use of gamification in education can improve student engagement by transforming tasks into games that motivate students through rewards for success, and it can induce desirable behaviour change. In practice, gamification has now shown significant results in creating more accessible and cost-effective materials for e-learning compared to digital games [7].

Studies on gamification report that the main benefit of gamification is to increase learner motivation, awareness, and engagement [12, 13]. These elements have been mentioned in other studies in relation to a negative aspect of traditional learning, where students reported that traditional learning can be boring for students or does not motivate them as well as modern learning methods. For this reason, gamification could have a great future, especially after the pandemic when students and teachers will be familiar with digital tools and used to e-learning.

Gamification often uses some elements of game design to increase participant motivation and engagement. Gamification used in education could use the following features to achieve excellent learning outcomes: users as students, tasks that users perform and work towards defined goals, points as a result of performing tasks, levels that allow users to progress from simpler to more complex tasks depending on their knowledge, badges as rewards for completed tasks, and ranking users according to their progress [7, 11].

C. Common Game Design Elements in Gamification

Digital badges are virtual medals awarded as a sign of success, a token for reaching some levels, or an acknowledgement for achieving goals. The goal of digital badges is to encourage users to be more engaged and successful at completing activities. To win a digital badge, the user must know what conditions are required [14]. From the teacher's point of view, earned digital badge can be a proof of the achieved result, while from the student's point of view, earned digital badge can be a positive feedback [14]. Some studies claimed that more than 90% of students reported that using the badge system in their daily study routine motivated them and helped them stay focused during class [15]. Studies also suggest that badges are "symbols of recognition". To explain, badges provide a sense of accomplishment during classroom activities. A sense of accomplishment is important for this topic because children often lack motivation to continue learning.

Similarly, in [16] the authors reported on the incorporation of game elements such as avatars, badges and rewards into everyday e-learning in various subjects. For example, avatars are commonly used in schools, but not many studies have been presented on this topic. Avatars are graphical representations of a player that users create on their own. With the avatar created, users present themselves to other users in communities. The results of the study show that students' interests are increased after using avatars compared to their interests before using avatars.

Points are a classic element in almost any game to provide feedback. Depending on the points scored, users can see opportunities to progress and improve [7]. Using points along with a progress bar as part of the feedback system can be a powerful tool to improve children's productivity and increase interest in the lesson [17].

The use of leaderboards is another way to motivate learners [7]. Leaderboards are used to create a competitive atmosphere in the class by displaying the names of the top 5 or top 10 learners, for example.

Storyline or narrative is an excellent tool to help students achieve an ideal interest curve and stay motivated during the learning process. The storyline relates to the native in the game and helps illustrate the applicability of concepts to real life [7].

III. REVIEW OF RESEARCH ON GAMIFICATION IN CROATIA

Globally, gamification has become extremely popular as a scientific term after 2011. There are numerous papers describing case studies as well as reviews on gamification [7, 8, 18]. The focus of the review presented in this paper is on the situation in Croatia. Therefore, it has been investigated whether there is any research on gamification in schools described in the journals or conference proceedings.

The analysis of the literature on the use of gamification in Croatian education showed that it is more present in higher education and less in primary and secondary schools. For example, in [19] the authors

describe the research study on the implementation of gamification using digital badges in the Moodle for course in the university computer science program. Gamification in an ICT course and a business course at a higher education institution using quizzes created by the Kahoot! tool is described in [20].

One of the first papers mentioning gamification in a Croatian high school is [21]. The authors described the use of gamification elements such as adding points to assignments and tests, awarding students with badges, organizing class tournaments using leaderboards, and integrating educational games in the classroom. The authors in [22] describe the use of gamification as a tool to teach high school students how to program.

Of the other studies related to Croatian schools, the one described in [13] stands out as the most complete. This study is part of the SCOLLAm project, where a custom mobile learning platform was developed and deployed in lower elementary schools to create interactive mathematics lessons with gamified "the Math Widget" for solving the four main arithmetic operations on tablet computers. The results of the study show that gamification contributed to increased levels of student achievement in mathematics learning.

It is worth mentioning the review paper [23] which is one of the more comprehensive studies on the implementation of gamification in Croatian schools. The research surveyed teachers about the use of gamification in their teaching activities as well as about their attitudes towards gamification in general. The results reported that only about one third of the participants were familiarized with gamification and most of them never participated in any kind of in-service training on gamification. The authors highlighted a large gap in the Croatian education system, where teachers report lack of knowledge when talking about gamification, lack of time and lack of interest in improving teaching methods. Some teachers also reported that gamification is too complicated to be integrated into the traditional teaching style in Croatian schools. This topic needs to be deeply researched, as all these reasons could be a result of misunderstanding the concept of gamification and the lack of education at the national level.

IV. DIGITAL TOOLS FOR GAMIFICATION USED IN CROATIAN SCHOOLS

As presented, Croatian teachers mostly lack motivation and knowledge to introduce gamification in the classroom and only a small number of teachers have understood the gamification concept [23].



Figure 1. Loomen – quiz and its statistics



Figure 2. Kahoot! Quiz screen on mobile phone and desktop computer

However, teachers in Croatia are familiar with digital tools that enable implementation of gamification so they just need to be motivated and educated to use these tools for that purpose as well.

One of the biggest and most popular platforms used for gamification purposes is Moodle [25]. Moodle allows implementation of gamification in all school subjects due to the possibility of creating different activities such as quizzes, crosswords, Level Up! and quiz mentor, which also provide quick feedback in the form of results, badges, progress bars, etc [9].

In Croatia, a system called Loomen [26], based on the Moodle and maintained by the Croatian Academic and Research Network (CARNET), has been developed specifically for the use of e-learning in the national education system. In addition to students, teachers have also been trained on the Loomen platform in recent years, as part of the School for Life project, which provided teachers with the appropriate knowledge for e-learning [24]. Loomen allows students to be tracked as they complete activities on the platform (Fig. 1). Loomen is also a useful tool for gamification as all the important elements such as badges, avatars, rewards, progress bars, storylines can be implemented [9]. Each student can create their own picture or avatar to introduce themselves to the other members of the group. In Loomen, progress is easy to track using the progress bar. The progress bar allows the teacher to provide quick feedback, but also visually represents the students' assignments. Additionally, students can be rewarded with a virtual badge by completing each activity. With the help of various tests and crossword puzzles with a time limit, Loomen can foster a competitive spirit among students.

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Figure 3. MS Forms - Escape Room example

Besides Moodle/Loomen, other digital tools used in Croatian schools also enable the implementation of gamification, such as Izzi Kvizzi [27], Kahoot! [28], Microsoft Forms [30], Mentimeter [32], etc.

Izzi Kvizzi is a new digital platform available online [27]. Izzi Kvizzi was developed in the 2020/2021 school year for students in primary school (grades 1-4) and facilitates an online knowledge competition. On the platform Izzi Kvizzi students from the earliest school age compete for knowledge from all subject areas with appropriate gamification elements as well as games such as memory cards, crosswords, interactive videos, puzzles. By solving the tasks, students collect XP points individually, but also as a class team. The class team with the most XP receives valuable rewards such as T-shirts.

Kahoot! [28] is a digital game-based tool, designed to improve the working atmosphere and to support and encourage the competitive spirit of students at all levels of education. Through the elements of gamification, Kahoot! provides very quick feedback that can be used for formative evaluation to monitor student progress [29]. The tests in Kahoot! encourage a competitive spirit among students as they motivate students to answer the questions correctly in the shortest time possible. The element of rankings is particularly represented, as the fastest answers receive the most points and at the end of each question the order of the questions is changed depending on the number of points obtained. The three best students can especially distinguish themselves on the virtual podium at the end of the quiz (Fig. 2).

Microsoft Forms is a part of the Microsoft Office 365 suite [30] that can be used to create quizzes that are not time-limited. By incorporating creativity into MS Office, it is possible to find elements of gamification by creating quizzes with narrative like Escape Room (Fig. 3). Learning through a game like Escape Room contains many elements of gamification and it encourages students to collaborate, develop critical thinking skills that allow for elements of discovery and exploration in the search for a solution like treasure. Each time students move to the next "room" or higher level, they receive feedback when they have successfully overcome obstacles [31].

Mentimeter [32] is an online digital tool that allows teacher to create interactive presentations with live polls to engage students during lectures. The tool can be used on any smart device. Students follow the presentation from their own devices and automatically see new slides as the lecturer changes the slides. This option is very important for work discipline and engagement in class, especially when the lecturer creates interactive slides for which a student response or contribution is expected. The answers or results are immediately visible graphically to all. The presentation created in Mentimeter can contain different types of questions: open and close types of question such as true/false questions, ranking, scales, Q/A, multiplechoice answers, open-ended questions. All questions can be limited in time, but the fastest student to answer the questions correctly gets the most points, and that student is immediately ranked on the leaderboard. The Mentimeter provides quick feedback, and it is well suited for gamification because of the elements mentioned above [33].

V. CONCLUSION

Globally, 2020/2021 has been challenging year for both teachers and students when it came to implementing online teaching and e-learning. Teachers had to use innovative solutions to motivate and engage their students when using online or hybrid teaching models due to the COVID-19 pandemic situation. One way to increase student motivation and engagement is to use gamification. The aim of this paper was to provide an overview of basic GBL and gamification concepts and to present digital tools that are affordable, easy to use, and suitable for gamification in Croatian schools.

The analysis of the literature on the use of gamification in Croatian education showed that it is more present in university education and less in primary and secondary schools. This could be a result of misunderstanding of the concept of gamification by school teachers. However, the analysed studies were published before the pandemic COVID-19, during which Croatian teachers used e-learning platforms and digital tools more than ever before. During the pandemic, Croatian teachers were trained to use different tools, including those that are suitable for gamification in the classroom. Therefore, it is possible that they changed their attitude towards gamification in general, seeing it as a useful method to motivate students, and that they will continue to use gamification tools in their practice in the future.

However, these statements are not proven so further research is needed. In addition, more systematic research on gamification should be conducted in the future to propose appropriate pedagogical-technological frameworks to facilitate the application of gamification in schools which will be aligned with the guidelines of the new Croatian subject curricula

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