

Technological Aspects of Gamification: Criteria for the Selection of Digital Tools and Platforms

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Abstract: This work-in-progress paper describes research conducted as part of the ongoing project "Enhancing Motivation for Learning Through Gamification", whose main aim is to develop a pedagogical-technological gamification framework to help high school teachers design and implement gamification activities. The research will be conducted using the Design-Based Research (DBR) methodology. Currently, the project is focussing on researching the technological aspects of the gamification framework. This paper proposes criteria to consider when selecting digital tools and platforms for gamification and presents the results of analysing selected tools. The main contribution of the paper lies in its own categorisation of the gamification criteria based on the MDA framework, in which the gamification categories are described according to Mechanics, Dynamics and Aesthetics. As an example of the application of the categorisation, the analysis of the gamification tool Kahoot! is described in detail.

Keywords: Gamification in education, Digital tools and platforms for gamification, MDA framework, Gamification framework

1. Introduction

Gamification in education is the application of game design elements and game principles in the classroom with the aim of increasing students' motivation, interest and engagement so that they learn more effectively (Dichev and Dicheva, 2017; Osatuyi et al, 2018). It differs from the application of game-based learning because it is sufficient to include only some elements of the game such as virtual points, badges, leaderboards, avatars and use accessible digital tools and platforms for teachers such as LMS and quiz tools (Vrcelj et al, 2021).

Despite the potential for the implementation of gamification at different levels of education, a review of the existing literature shows that it is more commonly used in higher education institutions than in schools (Vrcelj et al, 2023). The first step in encouraging teachers in schools to design and implement gamification activities is to help them select appropriate digital tools for gamification.

This paper describes research in this direction conducted as part of the project "Enhancing Motivation for Learning Through Gamification". The main aim of the project is to develop a pedagogical-technological framework for gamification to help high school teachers design gamification. The research is conducted using the DBR methodology. The first DBR phase, the analysis, was carried out in preliminary studies in 2023 (Vrcelj et al, 2023). In the current research phase, the design of solutions for the analyzed problem, the first step is to develop the technological aspect of the framework.

This paper proposes criteria to consider when selecting digital tools and platforms for gamification as a prerequisite for the development of the future pedagogical-technological gamification framework for secondary education.

2. Related Work

Although technological gamification frameworks have been developed for different domains, it is evident that there is still a lack of frameworks that would be suitable for secondary education and that the frameworks are intended for gamification designers rather than teachers, as they do not sufficiently address pedagogical aspects that would complement the technological aspects of gamification. Furthermore, the existing frameworks (Toda, et al, 2020; Mora, et al, 2017; Bernik, 2021) are too extensive and therefore too complicated for secondary school teachers.

It should be emphasised that frameworks for digital games were developed before the gamification frameworks, one of which is the most famous and widely used MDA framework (Hunicke et al, 2004). MDA is an acronym that refers to three framework elements: Mechanics, Dynamics and Aesthetics. This model helps game designers to focus on the fundamental elements of the game to create a satisfying experience for players and can also be successfully applied to gamification (Kusuma et al, 2018).

The MDA framework served as a starting point for creating the technological part of our own framework, the fundamental feature of which is that the elements describing gamification were chosen to be applicable to teachers in schools, as they might find complicated and detailed systems demotivating. The MDA framework was chosen because it adapts well to education and the learning process and can be used effectively to motivate students (Kusuma et al, 2018; Pratama and Kusuma, 2022; Angelia et al, 2020).

3. Categorisation of Gamification Criteria

When selecting the criteria for the categories, their suitability for schools was considered. We used the literature review and the results of a preliminary study conducted as a systematic literature review (Vrclj et al, 2023) to propose our categorisation (Table 1).

Table 1: Categorisation of gamification criteria

Mechanics	
Points	Users can collect numerical points that are automatically awarded for achievements.
Badges	Virtual medals awarded to the user as a sign of success, or for achieving goals.
Leaderboards	Ranking of users based on the results achieved, mostly points accumulated.
Levels	Completing a certain number of tasks, users are allowed to move up to the next level.
Progress bar	It shows the user's progress and guides them through the system.
Dynamics	
Prizes/rewards	Additional virtual rewards or recognition can be awarded for user achievements.
Feedback	Quick feedback on the user's current engagement.
Adaptation	The system changes depending on the user's actions and data.
Puzzle	Solving additional games, puzzles, etc.
Quiz system	Solving quizzes with different types of questions, usually multiple choice.
Synchronous use	The use of gamification in the classroom, e.g. during the teacher's presentation.
Asynchronous use	Gamification during the user's independent learning.
Aesthetics	
Avatar	The participant can choose his own character and/or nickname.
Live reactions	The participant can react (e.g. like) with emoticons, pictures, or stickers.
Challenge	An element whose aim is to encourage the user to perform tasks.
Competition	Competition with other users using gamification elements.
Cooperation	Cooperation with other users in teams and possibility to select a team.
Storyline/narrative	Creating a fictional narrative.
Fantasy	Using sound, dynamic graphics, a 3D virtual world and/or AI to create a fantasy.
Other	
Reports	The teacher has access to student data on participation in gamified activities.
Lessons	Lessons can be created as presentations and training materials.
Classes	The teacher can create virtual classes and enrol their students.
AI tools	Availability of AI tools to create questions, check errors, etc.

In the proprietary categorisation of gamification criteria, the *Mechanics* refers to specific game elements embedded in gamification tools to drive student behaviour, including common game design elements such as points, levels and leaderboards. The *Dynamics* of gamification describe how the basic elements of mechanics are applied and combined to influence student behaviour, considering the types of interactions that are appropriate for learning. The *Aesthetics* in this categorisation refer to the emotional and motivational aspects, i.e. the experiences that students gain from participating in a gamified system. This includes satisfaction, sense of achievement, social interaction and other emotional aspects. In addition to the three categories formed following the MDA framework, a fourth category, *Other*, was added with other elements that are useful for gamification in education.

4. An Example of Using Categorization

To validate the categorisation, an analysis of popular digital tools and platforms that enable gamification was carried out. The tools selected were those that are successfully used in schools according to literature review (Vrclj et al, 2023): Kahoot!, PeerWise, ClassDojo.

As an example of analysing a gamification tool using the proposed categorisation, this paper focuses on Kahoot!, a popular platform used to test students' knowledge, provide formative assessment or take a break from traditional classroom activities (Wang & Tahir, 2020). Kahoot! enables teachers to create, share and run quizzes (called kahoots) in real time.

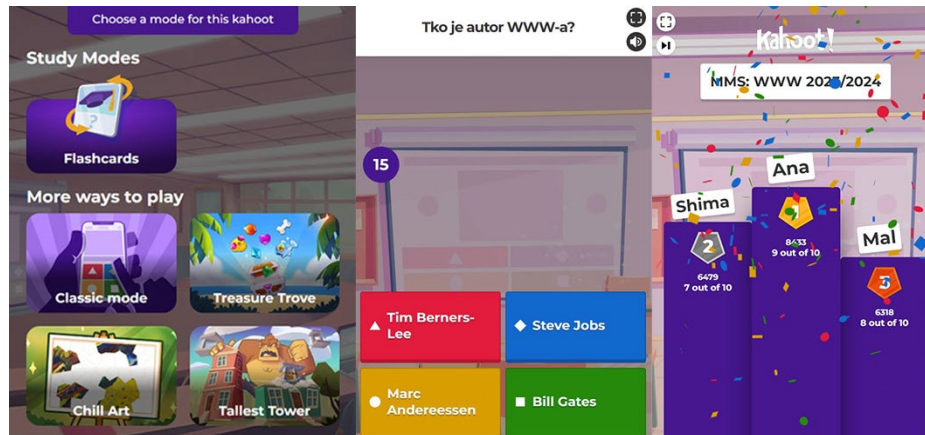


Figure 1: Kahoot! screens for game modes, question answering, and podium

Of the elements in the *Mechanics* category, Kahoot! uses points and leaderboards. Students earn numerical points for answering questions, which are awarded based on accuracy, but also on the speed of the answer. At the end of the quiz, a podium (leaderboard) is displayed with the 3 students who have scored the most points.

In the *Dynamics* category, it is important to point out that the quiz system is the basic way of using Kahoot!. Regarding puzzle, additional games are offered for some subjects. Students receive immediate feedback after answering a question. Synchronous use is the basic type of use, as the quiz questions are solved in class under the guidance of the teacher, but the system also allows asynchronous use (student-paced kahoots). The adaptation element (personalised kahoots) is supported.

All elements of evaluation are represented in the *Aesthetics* category. The student can choose an avatar (theme character), students can react with emojis (live reactions). In addition to the basic challenge of the quiz (answer correctly as quickly as possible), there is also an additional challenge to solve the quizzes independently. When solving the quiz questions, students can compete independently against other students, and teams can compete against other teams. Students can be divided into teams and solve the quizzes together. Achieving a fantasy in Kahoot! is that the classroom is temporarily transformed into a game show where the teacher is the quizmaster of the quiz and the students are the contestants. In addition, imaginative stories have been developed for some of the Kahoot! game modes, for example *Treasure Trove*.

Of the other elements used for gamification, the reports on student results are available to teachers, slides with questions can be created, and the teacher can create courses and join students. There are also AI tools, for example for generating questions.

To summarise, Kahoot fully contained 2 elements in *Mechanics*, 6 in *Dynamics* and 7 in *Aesthetics*. As for the other tools analysed, PeerWise was found to have fully included 3 elements in *Mechanics*, 3 in *Dynamics* and 1 in *Aesthetics*. For ClassDojo, 2 elements are fully included in *Mechanics*, 4 in *Dynamics* and 6 in *Aesthetics*.

We recommend that teachers who want to use digital tools for gamification analyse them based on the elements of all 4 categories. It is particularly important that they select the tools with sufficient implemented elements in the *Aesthetics* category, as student satisfaction when using gamified activities in the classroom will have an impact on learning success.

5. Conclusion and Future Plans

This paper presents a preliminary study on the use of gamification, proposing a categorisation of gamification criteria for the selection of digital tools and platforms based on the MDA framework.

It was validated that the categorisation can be successfully applied to the analysis of gamification tools, such as Kahoot!. This result will play an important role in the subsequent research steps, i.e. in the further development of the technological part of the gamification framework.

In the further course of the research within the project, the categorisation of the gamification criteria as the technological part of the future framework will be expanded to include additional pedagogical aspects related to the successful realisation of learning outcomes and student motivation. Furthermore, we plan to develop our own digital tool for gamification that can be used by teachers in schools, conduct an experimental part of the research consisting of a series of iterative DBR cycles, and analyse the results to create the final version of the gamification framework.

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