Advances in Gamification in Education

Reza Hajari
School of Electrical Engineering and Computer Science
University of Ottawa
Ottawa, Canada
e-mail: rhaja050@uottawa.ca

Won-Sook Lee
School of Electrical Engineering and Computer Science
University of Ottawa
Ottawa, Canada
e-mail: wslee@uottawa.ca

***Abstract*—Gamification in education is not a new idea and has been investigated in the academic research field in the past years. In this paper, the latest advances of this topic have been discussed. The adaptive gamification approach has been one of the main topics in gamification in education lately and many different approaches have been proposed to achieve the best possible outcome. These approaches will be mentioned, and a comparison between them will follow, to identify which one has been the most effective yet. Also, the idea of adding narration to gamification in education, will be discussed as well. After this survey, it is clear that research in this area has not been matured yet, and there are many aspects of gamification in education that need more attention, to improve the state of it in the education criteria, and thus making it more viable.**

Keywords-Gamification; Education; Adaptive; Framework.

I. INTRODUCTION

Online education has got more attention in the year 2020 and 2021 due to the COVID-19 pandemic. In these hard times it is even harder to get students engaged to their studies. The lack of interaction between the teacher and their students, makes it harder to hold any classes as exciting as they have been in the school. There are many ways to enhance the quality of online education or e-learning. There have been multiple tools and technologies that have been introduced to overcome such challenges. One of these tools is called gamification. Gamification is using game elements in non-game environments to enhance and improve the engagement of learners to the study material by making it more interesting [1]. In this paper we will discuss recent publications around the topic of gamification that are related to E-Learning.

In Section 2, different usages of gamification are discussed, and how gamification can be helpful within the e-learning environment is mentioned. In Section 3, the design of gamification, specifically for education contexts, is explained. The similarities with video games are also discussed briefly in the same section. In Section 4, two different adaptive approaches for gamification in education are mentioned [4], and a comparison has been done among various applications, which employed these approaches based on their contexts. In Section 5, a novel software design model for adaptive gamification in education has been explained. Section 6 will discuss the effectiveness of a gamification application, in Higher Education Institutions, that was used among 24 Business class students. At the end in Section 7, the idea of using narrative for gamification in education has been discussed.

II. USAGE OF GAMIFICATION

The idea of gamification has been around us for a long time. Gamification is tied in with giving different forms of rewards to make an action more enjoyable and satisfactory than it is in a normal fashion. Even giving ranks, achievements and labels in different criteria such as military or offices are considered as some forms of gamification. Deterding et al. [1] have defined gamification as “the use of game elements and game design techniques in non-game contexts”. After the advent of the Internet in the last two decades, many online businesses, websites, mobile applications, etc. have tried to employ game elements into their business models to improve user activities and motivations. These elements include leaderboards, badges, points, rankings, levels, etc. In the past few years, various startup teams and design companies have offered gamification design or software-as-a-service packages for other businesses [2]. In the year 2020, gamification market share rose up to US$ 9.1 billion and is set to grow up to US$ 30.7 billion in the year 2025 [3]. This shows a significant opportunity for the industry to adapt as quickly as possible to take the most advantage of the situation. A study from Markets and Markets back in 2016 had predicted the estimate for 2020 gamification growth to be set at US$ 11 billion [2]. This shows that at the moment gamification has not been properly used to its full potential.

Gamification can be employed by a wide variety of systems that involve with education or motivation toward improving the user engagement or final user experience. This method is not just for the digital era. Gamified elements have been around us for a long time. Any type of reward can be a form of gamification when the reward has not been the purpose of the system; for instance, when parents set rewards for their children if they do the assigned chores, or when an employee gets promoted in an organization and gets a new title. In general gamification could be defined as using gameful elements in the design approach of a system in different contexts by simulating familiar experiences from games that supports various behaviors and processes [17].

Modern gamification gained its popularity from early 2010s. It has been a topic of interest in academia and industry for many years now. The technological advancements throughout the recent years, have enabled more e-learning environments for the purpose of education that share some technical aspects in relation to video games to make learning experiences more immersive and engaging [2].

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III. Design of Gamification in Education

In the first stages of introducing gamification concept to the industry and education, the reward-based version of the system was widely being employed in the application design. In this method the application would use different rewards based on suitable game elements to improve the engagement of its users to the system. This type of gamification is effective as long as the system is willing to give more rewards. Plus, there must be users in the system who are still willing to earn them. There are two obvious problems with this methods:

1. The system should always give more and new rewards.

2. The users might get tired, and will be less motivated toward achieving more rewards.

Zichermann and Cunningham have mentioned in their book, "Gamification by Design" [26], that if you start giving a user a reward, you must keep them in the reward loop forever.

Traditional gamification which is mainly based on giving rewards to the users, could be harmful, if the goal is to create a long lasting behavior [28]. These types of rewards can replace the natural motivation which they are trying to increase. This means that if the external rewards are no longer provided to the users, then they have little to no intrinsic motivation to do the tasks. So, a better way of implementing gamification is required to increase the intrinsic stimulus and help the users with their tasks.

System designers should come up with more innovative ways of using game design elements to make motivation throughout the system rather than just giving external rewards. This matter has been done in video game design as well in the past years. Video game designers, especially online multiplayer game designers, are now facing similar difficulties. They have to encourage players to play their games for a long period of time. Some video games even last for decades and players still enjoy them. They should include internal motivation regarding the tasks which are available in the game to be done by the players. However, there are quite a noticeable number of AAA high budget video games that would lose their player-base rather quickly and prematurely due to bad game design. Most of these games suffer from bad game design elements that would not fulfill the players' demand, or would bore them after a short period of time compared to what the designers were hoping for.

The importance of a thorough game element design also applies to the system designers who are willing to employ gamification elements for their system. Specifically in education, this is a serious problem to solve since improving students' engagement is very complicated and it comes in many forms. So, a single element design might not work the same way for all of the students. Here we come to two different ways of gamifying a system: Static adaptation and Dynamic adaptation [4].

- In static adaptation, the system first categorizes the user into different learner profiles. Then the system adapts by changing the game elements for each distinct learner profile. This way, the system assures that each user will get suitable gamified elements for their own type, that they know they are more interested in.

  The learner profiles are commonly chosen from different versions of player types. There are various classifications available to choose from, for instance Hexad player types [5], Bartle Player types [6] and Brainhex player satisfaction model [7].

- In dynamic adaptation, not only is the system taking into account what learner profile the user belongs into, but also adapts the system to each user different behavior and activity within the system. This adaptation can be done by either customizing the gamification element pool for each user from all the available elements, or by changing the functionality of a particular game element to further match the players' preferences. Dynamic adaptation can also be done beside the static adaptation, and use the learner profile to improve the system.

IV. Adaptive Approach in Gamification in Education

There have been many research attempts done in regards to static and dynamic adaptation in gamification in education over the past few years. In static adaptation, the player type will determine the profile for learner rather than his/her personality. These player types have been introduced to show why players are motivated to play games. For instance, in the Hexad Scale, "Socializers" are players who are willing to interact with other players and to create social connections, while "Achievers" are those who want to tackle difficult tasks to prove themselves [5].

In the literature review provided by Hallifax et al. [4] it has been stated that there are two different categories of research that have been done in the adaptive gamification design: first, papers that have put their findings and recommendations based on the literature surveys, and second, the group that have based their results on user feedback and analysis. Most of the first category of papers have linked the gamification elements to the player types that we mentioned above, prior to this section. The following papers have used this method: [8] and [9]. On the other hand, the second category have used different non adaptive gamification tools or have based their study based on a user review and survey system. These surveys measured the participants' preference, according to their interaction with the system. The following papers have followed this method: [10]-[12].

The result of all these different approaches can be concluded in the longevity of the studies. The authors of [4] have grouped the studies in two categories of short studies and long studies.

Short studies are studies that lasted less than two weeks. Two papers include in this category [13] and [14], which both have used a dynamic adaptation approach. All of the studies of this kind have reported positive results after the studies were done. The research in [13] has shown that the number of errors the learners made during two different sessions of adaptive gamification system decreased, when the personalized system was employed. The authors of [14] have tested two different adaptive situations. For the first situation, the time, that was given to learners to answer questions, changed according to how

fast they answered prior questions. For the second situation, the target score was changing based on the group performance. For both situations the authors reported an improvement in the learners' performance, and they did more tasks compared to a situation with no gamification involved.

Long studies are the studies that lasted more than three weeks. These types of studies have reported more mixed results. In the seven papers that the authors reviewed in this literature review, four papers concluded with generally positive results. The authors of [15] studied learners that used an online tool for one month. Learners were equipped with either random assigned game elements, or tailored game elements based on their motivation type. The latter resulted in considerable differences in engagement, motivation and quiz results, compared to the randomly game element assigned learners. The authors of [16] divided learners in three groups. First group was given their game elements based on their Brainhex player type; Second group was given counter-adapted game elements, and the last group got their game elements randomly assigned to them. The study took three weeks to complete. This study shows that learners with adapted game elements spent more time using the tool than learners with the counter adapter ones. The authors of [17] also concluded a positive impact in their study. Learners with adapted game elements correlating to their learning style, had a higher task completion rate than the other who had random elements assigned to them. This was further proven with the self-reported questionnaire, after the study was done. Last paper in this group [18] had positive results as well. The impact of their adaptation tool was measured via a learner's questionnaire, after using their adaptive learning tool, which reported an enhancement in emotional and behavioral engagement. For this study, some university students were divided into different groups according to their Hexad profiles. They used the learning tool for 14 weeks and each group received their own designated game elements. However, the results of the study deemed not significant, due to the small sample size by the authors.

The remaining three studies [19]-[21] had more mixed results. The authors of [20] employed three structured learning sessions over a three-week period, each would last for 45 minutes. Tasks were given to middle school students, who used the tool as part of their normal lesson process. Students with counter-adaptive game elements reported to be finding the assigned game elements more fun and useful than the other students with adapted elements or random ones. Same authors studied a similar test [19], this time with adults who voluntarily used the adaptive learning tool. This study was also in a span of three weeks. They could not find any significant differences among the learners afterward.

To conclude, it has been shown that shorter studies show more positive impacts in adaptive gamification than longer studies. However, the reason is not entirely clear. One conclusion that can be assumed from these studies, is that the novelty effect of gamification elements might wear off after a particular amount of time. Hamari et al. [22] found the significance of novelty effect as well. The other problem is that adaptive systems change over time based on the user preference and activities, therefore, researchers might need to do even longer studies to come up with more substantial results. Another factor, could be different or irrelevant metrics that these studies used to measure the impact of gamification, since some papers report contradictory conclusions in the similar environments, for instance [19] and [16]. The research in [17] showed an increase in motivation in all of the learners, however, the authors of [19] reported motivation increase only for one specific group of learners known as the more invested learners. A brief summary of the conclusion of this section can be found in table I.

TABLE I. STUDIES RESULT TABLE BASED ON DURATION (SHORT OR LONG), ADAPTIVITY TYPE (STATIC OR DYNAMIC), PROFILE (PLAYER TYPE OR PERSONALITY), ACTIVITY (PERFORMANCE OR BEHAVIORS) AND EFFECTIVENESS (POSITIVE OR MITIGATED)

Paper	**Results**				
	Duration	***Type***	***Profile***	***Activity***	***Effectiveness***
[13]	Short	Dynamic	-	Performance	Positive
[14]	Short	Dynamic	-	Performance	Positive
[15]	Long	Static	Personality	-	Positive
[16]	Long	Static	Player Type	-	Positive
[17]	Long	Static	Personality	-	Positive
[18]	Long	Static	Player Type	-	Positive
[19]	Long	Static	Player Type	-	Mitigated
[20]	Long	Static	Player Type	-	Mitigated
[21]	Long	Dynamic	-	Behaviors	Mitigated

V. ADAPTIVE GAMIFICATION MODEL IN E-LEARNING

Design of gamification systems in education has mostly followed the same practice in a significant number of developed systems. This is due to the fact that gamification systems are software, and there are clear and established development processes to how implement a software properly, for a long time in the industry now. However, gamification is very unique in a number of aspects, compared to a typical software. These aspects have to be examined and considered, while designing a new system for a learning environment. Kamunya et al. [24] have introduced an "Adaptive Gamification Model for E-Learning" that tries to solve this exact problem.

the authors of [24] have employed the Design Science Research Methodology (DSRM) to develop their proposed model. To develop this model, they have reviewed 15 different adaptive gamification studies.

Here is a quick review of how the DSRM process works:

A) Problem identification: In the proposed model by [24], the problem can be identified as how an adaptive gamification system can be engaging and how to improve motivation.

B) Objectives of the solution: Development guidelines of the system should be presented in this stage.

C) Design and development: The first artifact of the proposed model would be created here.

D) Demonstration: This stage is to show how the artifact exactly works.

E) Evaluation: The effectiveness of the newly developed artifact will be determined.

F) Communication: The result of the evaluation must be published.

The authors of [24] have also shared their results after an in-depth literature review of adaptive gamification studies from 2013-2019. Nearly 50% of these studies had adaptive proposals of various adaptivity framework, in which the different game elements were to match with a specific learner profile. Only about 33% of the studies had a complete adaptive gamification system and evaluations, which about 60% of them had shown positive impact for their systems.

Finally, the authors of [24] have proposed their gamification framework based on their finding of the literature review. The key components of their model are as follows:

1. Adaptive gamification engine: The engine is responsible for assigning the game elements to learners based on their learner profile or characteristics. This can be either done in static or dynamic adaptation approach.
2. Management of the platform: This module is defined for administrative functions such as role assignment and user addition.
3. Adaptive gamification elements: This part holds all the different gamification elements that the system could offer. They have been grouped in their appropriate category of elements, mechanics and dynamics.
4. Adaptive gamified course: In this module the course will be designed based on the proposed gamification approach.
5. Report: This module is to report the different aspects of the system after implementation. This can include various concerns such as motivation, engagement, effectiveness, efficiency, experience and knowledge.

The conclusion of the research that has been done in [24] is that by employing a proper gamification design framework, a better and more suitable adaptive system could be achieved. Gamification is extremely related to each individuality of any learner, and a competent adaptive system must consider all learners' motivations and different behaviors toward the system. The proposed adaptive gamification framework which is depicted in Fig. 1 has been designed to answer these concerns for future adaptive gamification system designs.

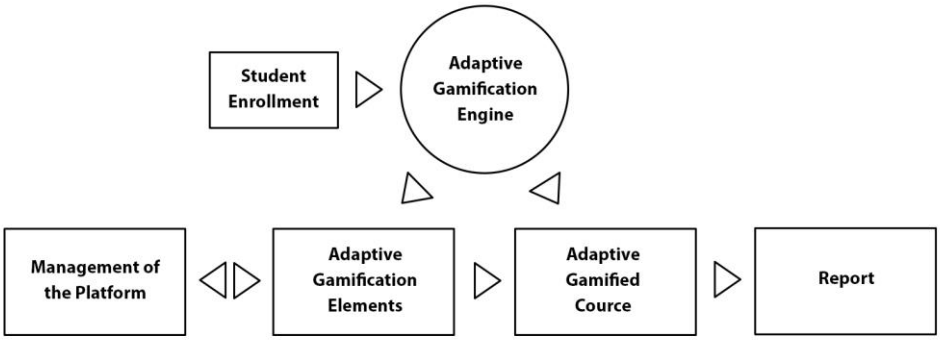

Figure 1. Adaptive Gamification model for E-learning. Adapted from [24]

VI. EFFECTIVENESS OF GAMIFICATION

A comprehensive study has been done by Hiroko Oe et al. [23] on how gamification works in Higher Education Institutions. In this study, the impact of gamification has been examined in a Business class, which consists of interviewing 24 different students in the field. These students were using gamification for their Business lesson in the form of a Massively Multiplayer Online (MMO) game. This game was designed to explore the challenges in the business education at higher education institutions. The game used a virtual economy that lets the participants to make decisions within the community, on one shared server in real time for the set subject [29]. Prior to this study, the positive impact of employing MMO scheme on students' learning process has been discussed, more specifically in business contexts [27]. Therefore, the study in [23] mostly aimed for gathering the students' evaluation of the system, to help improving the development of designing a blended learning system with gamification.

The study of [23] was done during the Covid-19 pandemic so the students were already engaged with Information and Communications Technology-based (ICT) learning. The MMO role-playing game was integrated in the ICT-based learning system, during classes and seminars. There are some advantages

and disadvantages with ICT-based learning systems. On one hand, students could feel less pressured during a class, and participate in more discussions and activities. On the other hand, some students who are not comfortable to engage with class activities, might feel even less motivated to participate in an online environment. Plus, in an online education environment the teacher has less control, due to the nature of the class, and the fact that class presence cannot be the same as in-person classes.

The conclusion of the study that has been done in [23] can be summarized in a few key points. First and for most, the students share mostly positive feedback about using the gamification system for their business class. They all felt, that it could be a useful tool to make the process more interesting and exciting to get engaged with. However, a number of students said that, although, it seems to be helpful, they were not sure about the assessment of the whole system. They demanded a comprehensive explanation of how can this system help them better than the traditional way of learning this course, so they can focus on what makes the best out of the proposed system. Another issue to consider is that these specific students were already familiar with the MMO game elements and how the game design should work, however, that is not always the case with the target audience for such systems.

Overall, the result of the research in [23] was positive. It suggested that a good design is necessary for any specific group of students and for each individual gamified system. Therefore, the optimal impact of learning could be achieved. A Gamification conceptual framework can be found at the end of the research in [23].

VII. Narrative for Gamification in Education

It is appropriate to compare gamification systems with video games. One can argue, that a gamified system is a type of video game on its own. However, the purpose of designing and using these systems are vastly different. One is mostly used for entertainment purposes, whilst the other is trying to improve and encourage students in their studies to perform their tasks more efficiently and effectively. But the similarities are quite significant, and gamification systems might benefit from more video game components than the researchers and designers thought could be viable in the first place. One of the components that has not been extensively investigated in gamification systems is narrative.

Narrative is often used to drive the story of a video game or a movie. However, Paula T. Palomino et al. [25] have proposed a concept of Narrative for gamification in education. They argue that narrative can also be effective in a learning environment, and improve the learners' engagement. Since there are not a lot of studies around narrative for gamification, the authors have done a literature review for narrative in other medias, including video games. Then, they found the definitions and features, that is similar among the studied subjects, to finally achieve a common ground, that can be used for gamification purposes. In the process they also found out that narrative can also be part of the User Experience, since it shares some of the similar characteristics with it.

The authors of [25] have concluded that narrative can be used for gamification contexts, only if the following features are present in the system:

1. Actor as the user, learner or student.
2. The choice element, which indicates options for progression based on the answer.
3. Interactivity. This means that the system should response to the users' actions.
4. A sequence of events. Progression has to be made in logical chain of user and system actions, and should be quite clear to the user.
5. Space, time and date of the interaction.

If these features are parts of the system, then a narrative approach for the gamification system could help the students to be more involved with the system. There are two different types of narrative, embedded and emergent. These are used to differentiate the terms, narrative and story. Traditional narrative approaches cannot be used directly in the gamification contexts. Based on the user experience component of each system, only the appropriate parts of a narrative should be used to emphasize a particular part of a feature in a gamification system. Each component should be individually tested and studied before implementing any narrative into it.

At the end of the study that has been done in [25], the authors conclude that due to the limited prior research in this field, they could only focus on the theories about narrative. Further study, design and implementation is necessary for a more comprehensive conclusion in this field.

VIII. Conclusion and Future Work

In this paper, recent advances in gamification in education were discussed and a conclusion has been provided for each part. It is obvious, that the idea of gamification in education has been attracting more researchers to study and improve it in various aspects of it. These studies mostly suggest positive impacts for learner engagement and motivation for their proposed and/or tested systems.

The main problem which remains unresolved is that, there are still not enough real life evaluations of such systems to provide robust conclusions about the efficiency and effectiveness of such systems. Although, in the recent years there have been improvements in testing such systems, there are still numerous problems that need attention. These problems include: size of the test audience, the duration of the test, lack of proper assessment for the system, inability to scale the result for different cases and the rapid evolution of the ICT world. These issues make it challenging for researchers and designers to apply older conclusions on the newly designed systems. For the future work, comparing all the gathered data from different literature reviews in adaptive gamification in education, and trying to correlate them with various contexts, other than what there were tested in, are in order. Plus, there are still numerous aspects of gamification in education that have not been discussed in detail in this paper. With a thorough evaluation of the results, based on the available literature review, and a deep analysis on how each

element could be enhanced, the quality and effectiveness of future gamification systems shall be improved significantly.

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