GAMIFICATION IN COMPUTER SCIENCE

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Annotation

Gamification may be regarded as a learning process in which learners solve problems and overcome challenges in game-based settings. It has been a motivational tool because it emphasizes competition rather than cooperation and sharing. Competitive mechanism has the greatest impact on enhancing students' thinking skills and learning motivation. The commercial success of gamification coupled with its simplicity of deployment makes gamification a popular subject in academic community. This paper provides an overview on gamification in computer science.

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INTRODUCTION

Games are part of our daily living. Playing games brings lots of fun and entertainment to the participants. Different aspects of gaming are shown in Figure 1 [1]. Games designers should structure their designs to create emotions through the mechanics of the game, emotions that encourage players to continue playing the game. Serious game can be suited to help students understand introductory computer programs and coding. The reasoning strategy game is most effective on students' academic achievement, while the puzzle game is most effective on students' motivation.

The world of education practice is changing. The traditional setting is no longer appealing, creating a dull environment that has no learning motivation. A common concern among educators is learners' motivation, engagement, and performance. Students' participation, engagement, and motivation are of great importance in their learning process. The use of game design techniques in education offers the potential to make learning more motivating, more engaging, and more enjoyable for students. Gamification refers to the application of game design elements in non-gaming environments. It is used in many fields such as business,

healthcare, ecommerce, education, and the military. It has gained a lot of interest in recent years as an effective means of engaging existing users and attract new users to web sites. It has been identified as a promising technique to improve students' engagement which could have a positive impact on learning.

Teachers are required to choose the appropriate gamification form in conjunction with the teaching objectives of the lesson. Gamification is used as an instrument for motivating learners and increasing their engagement. Engagement has been identified as a valuable indicator of students' academic achievement. Gamification is implemented across all industries including education. Many educators have tried to efficiently apply game elements to increase student motivation and accomplishment in the classroom. Although games and gamification have a lot in common, they are not exactly the same [2]. The two terms are different and are dependent on the primary role of the application. In recent years, there has been a growing interest in using games as an educational tool to help students learn. An increasing number of teachers have been utilizing serious games in programming courses. They claim that serious game-based learning could improve students' motivation, learning interest, and learning achievement [3].

WHAT IS GAMIFICATION?

The word "gamification" was coined in 2002 by Nick Pelling, a British inventor, but it did not gain popularity until 2010. The idea of gamification came from the fact that the gaming industry was the first to master human-focused design and we are now learning from games. Gamification is not a new concept, but it is deeply rooted in marketing endeavors, such as points cards, grades, and degrees, and workplace productivity [4]. Researchers became interested in gamification because the concept could be implemented in different ways to motivate people. Gamification has become hugely popular in all walks of life, including education. The concept of gamification is illustrated in Figure 2 [5].

The gamification can be viewed in two ways: (1) adopting the act of playing a video game into everyday use, (2) the act of using game elements to make non-games more enjoyable. It is applied in education, business, sports, marketing, and finance. It is currently one of the largest trends in education. Traditional education has been found to be ineffective in motivating and engaging many students. Gamification is cutting-edge approach which is producing positive results in every region of the world.

Everyone loves games. Gamification just takes advantage of that innate desire. It can make practice fun. It can make the routine less droll. Online games have become bolder and more diverse. Gamification involves the introduction of gameplay to a traditionally non-game environment. Its goal is to encourage user engagement.

Here are the typical elements of gameplay [6].

➢ Points - representing progress and accomplishment – often used to obtain rewards

➢ Badges- similar representation to points, often also representing a status

➢ Leader-boards - participant ranking

➢ Performance graphs - to measure individual user's performance over time

➢ Meaningful stories - narrative/context the user exists within

➢ Avatars - a visual representation of a user

➢ Teammates - others engaging in the game

GAMIFICATION COMPUTER SCIENCE

Gamification refers to the use of game design elements in non-game settings to engage participants and encourage desired behaviors. Students are motivated to improve, and engaged through rewards such as tangible material rewards and intangible feelings of victory. Gamification is widely used to enhance learner engagement and motivation. It has been used in many ways to motivate individuals to wholly participate in some specific activities. The rapid development of web technologies and the proliferation of digital devices such as tablets, smartphones, and laptops have greatly facilitated the use of digital games in education.

The success of gamification on computer science education is tied to its potential to engage students in learning activities because engagement has been proved as positively correlated with outcomes of student success, including satisfaction, persistence, and academic achievements. Engagement typically has three components [7]:

➢ *Behavioral Engagement:* This is related to participation and can be understood as positive conduct, absence of disruptive behavior, participation in school-related activities.

➢ *Affective Engagement:* This focuses on the willingness to do the work and includes interest in learning activities, enjoyment, and positive attitudes about learning.

➢ *Cognitive Engagement:* This refers to students' investment in learning to achieve deep understanding and expertise. Cognitive engagement is also closely related to strategies students use in order to solve a problem or understand a concept.

Implementing components of gamification in education is a resource that can motivate learners in computer science education. The most popular gamification elements used during computer science classes are badges, leaderboards, score, level, and feedback [8].

GAMIFICATION COMPUTER SCIENCE EXAMPLES

Gamification motivates by adding gamefulness to the learning tasks. It can provide students with a fun and engaging them to learn and apply programming concepts, algorithms, and computer systems. Common applications of gamification in computer science include the following:

➢ *Game-based Learning:* Gamification in learning is an approach that uses mechanics, elements, and techniques of game design in non-game contexts. It mediates student engagement and motivation to action so that they can learn and can solve problems. The learning process that adopts gamification is also known as game-based learning. This entails using educational games as a way of teaching programming concepts, such as coding, algorithms, and data structures

By creating educational games that challenge students to think creatively and solve complex problems, they are able to apply the concepts in a practical and meaningful way [5]. Figure 3 shows gamed-based learning [9].

➢ *Programming:* Programming education refers to teaching basic programming skills that link with algorithms and artificial intelligence applications. Programming has long been regarded as a difficult subject to teach and learn due to the its complexity. Students need innovative approaches to learn programming. There is positive impact of gamification in programming education. The effect of gamification is more pronounced in text-based programming than graphical programming. Novice programmers often struggle with of text-based programming, while the graphical programming is helpful to promote learners' motivation. One can infer that the text code programming requires more help with gamification. In programming education, there are many ways to apply the gamification: using games as teaching tools, games as student works, and games as competition mechanisms. The teachers' action is critical when applying gamification on programming education [3].

BENEFITS

The benefits of gamification in computer science education are many. It has been identified as a promising technique to improve students' engagement in learning. It can help students develop problem-solving and critical-thinking skills. It can foster collaboration and teamwork, which can help them develop their social skills and the ability work effectively with others. It can also be used to introduce students to new programming concepts and technologies in an engaging way. Gamification has a positive impact on students' academic achievement and self-efficacy.

CHALLENGES

In spite of the many benefits of gamification in computer science education, there are also some challenges. For example, it can be difficult to create educational games that strike the right balance between being fun

and educational. While some advocates of gamification may argue that students are more engaged and interested in learning when gamification is used, some see gaming as a way of bribing students. They see students as only learning for the sake of achieving some rewards. Students may not be retaining information [10]. When students perceived rewards as a means of control, it led to a decrease in students' intrinsic motivation and diminishes their actual willingness to learn or participate.

There are many challenges in teaching computer programming: the diversity in students' ability, the time-consuming nature of programming, and the difficulty in motivating students to learn computer programming. The design and deployment of digital games is costly in terms of time, effort, and money. Most of the available gamification courses are poorly designed due to the sudden need to shift from face-to-face environments into online platforms. There is a lack of consensus on the key factors for evaluating educational games. Some recent studies report evidence of academic cheating behaviors. Gamification processes should be carefully designed to prevent, detect, and discourage dishonest student behavior. Failure is an integral part of learning, but in the classroom it tends to be a source of shame and embarrassment. Gamification does not just make failure OK, it also makes it part of the fun.

CONCLUSION

Gamification is the use of game design elements in non-game settings to engage users and encourage desired behaviors. It has been gaining attention recently as a way to make learning more enjoyable and interactive. It has a moderate positive impact on students' academic performance, motivation, and thinking skills. It has the potential to revolutionize the way computer science is taught. Using gamification through education becomes a strategy to inspire students to understand in learning milieu by using computer game development Learners are now digital natives, so they provide a digital identity. Gamification raises the level of dedication and encouragement in the classes [11]. More information about gamification in computer science can be found in book in [12-15].

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AUTHORS

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Janet O. Sadiku holds bachelor degree in Nursing Science in 1980 at the University of Ife, now known as Obafemi Awolowo University, Nigeria and Master's degree from Juliana King University, Houston, TX in December 2022. She has worked as a nurse, educator, and church ministries in Nigeria, United Kingdom, Canada, and United States. She is a co-author of some papers and books.

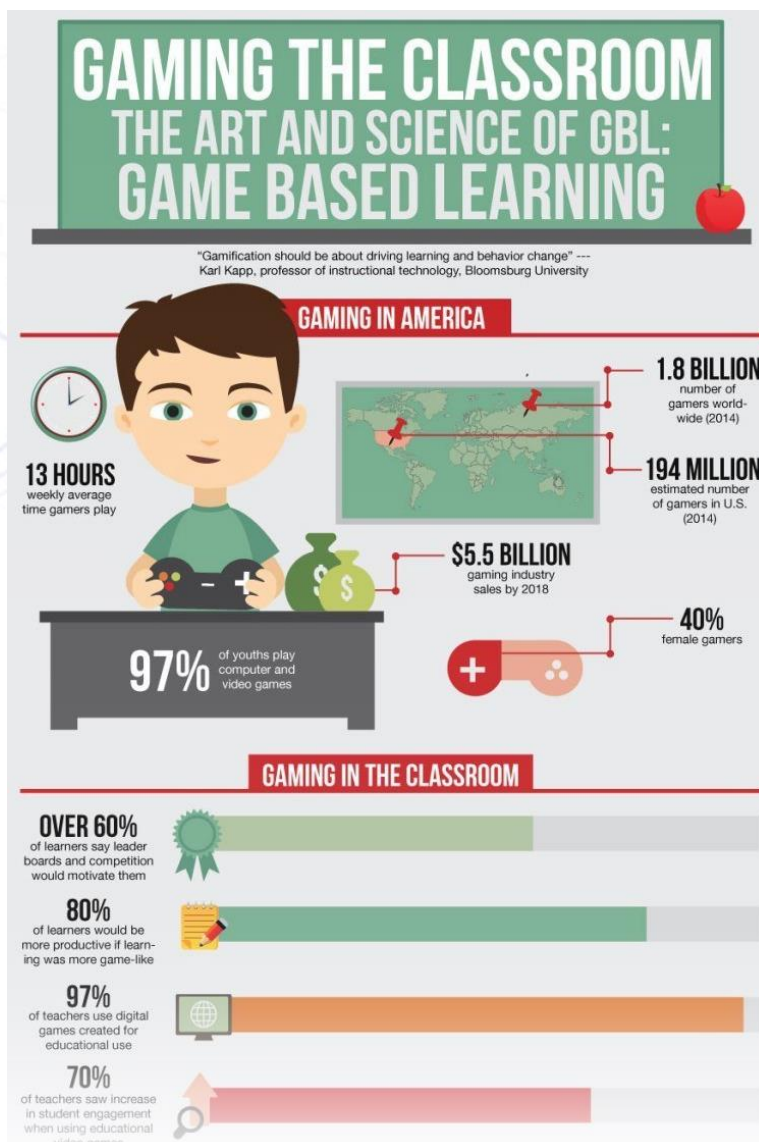Figure 1 Different aspects of gaming [1].

Figure 2 The concept of gamification [5].

Figure 3 Gamed-based learning [9].