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GAMIFICATION IN COMPUTER SCIENCE COURSES: A LITERATURE REVIEW

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Abstract

The complicated, boring problems in computer science learning make them lack motivation during the COVID-19 pandemic. The further exciting and appealing educational setting is the more significant learners' participation in the learning challenge. A traditional setting was not appealing too much, creating a dull environment that has no learning motivation. Gamification is often used as an instrument for motivating learners and increasing their commitment. A study analyzes several previous research types in this field to assess gamification's effect on higher education students in a computer science course. The results conclude that gamification enhances the interest and encouragement of the learners. Also, it improves computer science curriculum training and knowledge of a complicated topic, providing learners with optional barriers. While they are beneficial, pedagogical games may have drawbacks that impact either emotionally and physically learners. The most popular gamification elements used during computer science classes were badges, leaderboards, score, level, and feedback. They were the most commonly known feature of the game in learning computer science. Implementing components of gamification in education is a resource that can motivate learners in computer science education. Gamification can give positive outcomes for students' achievement and the teaching and learning process framework, which teachers increasingly accept. Further research is required to determine if this transforms into an effect on finished performance and governs particular group impacts. Students' academic achievement and results in the computer science curriculum must develop a broader amount of knowledge on the utility through gamification.

Keywords: gamification; higher education; computer science course; elements of gamification; motivation.

Introduction

One of the most challenging problems of today's society is the adverse effects of the COVID-19 pandemic on education. Health authorities took various measures to control this pandemic. One of the measures they have been taken is to allocate lockdown. Most schools have been closed worldwide, and as an urgent result, learning and teaching have been switched online. Therefore, it can be easily said that there are many negative effects of this pandemic on education. In many studies conducted during the pandemic process, it was determined that educators experienced challenges in teaching methods, choosing the appropriate online tools, ensuring interaction, and motivating students in e-learning (Hasan and Bao, 2020; Kyrkjebø, 2020).

For this reason, there are many studies in the literature regarding the interaction of gamification applications with e-learning environments and increase student motivation. A concept named "gamification" has been given particular heed to the rapid growth of multiple

applications together with video game attitudes (Kayımbaşıoğlu and Hacı, 2016). Gamification is the un-gambling mechanism in terms of gaming-design elements and game theories (Al-Azawi, 2016). It may also be described as a range of actions and mechanisms while using or implementing the game sections' properties to overcome problems (Kiryakova et al., 2014). Gamification typically utilizes game design parts to enhance users experience operational effectiveness, movement, training, crowdsourcing, recruiting and assessment of staff, the convenience of use, program efficiency, regular exercise, violations of traffic, public apathy, etc. (Robson et al., 2015).

A research review shows that several gamification study results believe it has significant impacts on participants, promoting such behaviors in a consumer (Butler, 2014). A game turn in other realistic and scholarly areas, and that process will continue. Gamers willingly use their capability to resolve various games' issues and improve self-abilities, including the sedulity, imagination, and versatility in extended games (Seaborn and Fels, 2015). The gamification seeks to employ using the game's meditative force to address real-world issues (Nicholson, 2013). Because of the multitude of benefits from this definition, this is not hard to believe that companies of multiple dimensions, while in various sectors, focused on using the game theory (Hamari and Koivisto, 2015). Also obtained considerable power throughout the production of goods, telecommunications, and procedures and gambling in companies via a mighty scale, is rising (Nicholson, 2015).

Gamification alludes to technology, which aims to encourage fundamental motives towards various behaviors, usually through game-characteristic programming (Hamari et al., 2015). Standard gamification elements involve accomplishments, points, reviews, leader boards, specific objectives, and narrative, for instance (Chen and Pu, 2014). Gamification was extended to just about all areas of society (Iosup and Epema, 2014).

Use gamification through education becomes a strategy to inspire students to understand in learning milieu by using computer game development and game components (Tejada-Castro et al., 2018). Learners are now digital citizens, so they provide a digital identity (Su and Cheng, 2015). They have grown up using emerging technology and have specific learning patterns, a new mindset towards the process of learning, and great learning and teaching requirements (Tsai et al., 2016). Low student participation and loss of learning enthusiasm are the key challenges faced by school teachers, students, and academic researchers (Hu, 2019). Teachers face real problems and have to address critical issues connected to adapting learning to learners' wants, expectations, and requirements (López and Flores, 2018). Teachers must use various strategies and techniques to teach that encourage students to have been active entrant with high incentives and dedication for their learning (Turan et al., 2016). Current educational modes of thought and patterns strengthened the use of ICT, build preconditions in use with new methods and strategies to incorporate learning. One such phenomenon is the gamification of coaching (Kiryakova et al., 2014). Technology can boost learning through many mechanisms, like offering instant feedback to learners, making additional tools available, or enabling them to exercise their skills at their speed and evaluate their information (Sanchez et al., 2020). Training and learning in the education sector are the most apparent benefit of Gamification (Varannai et al., 2017).

Gamification introduced in higher education has grown during the last decades; it is among the most common college departments (Hamari and Koivisto, 2015). In the literature, computer science courses in higher education have problems with high attrition levels, there are many topics on view, and challenging subjects, often, students consider computer science teaching challenging, content description tedium (Butler and Ahmed, 2016), as well as a

lakelet of avail and incentive (Khaleel et al., 2017). Due to such a software disillusionment that derives from a supposed student's challenges and a shortage of motivation towards student learning (Ortiz et al., 2017). There is a strong connection in both the student's engagement and participation throughout a class. Thus, improved academic success in computer science and coding topics will contribute to increased participation and likely success (Abdool et al., 2017).

Today education evolves with innovations, current and traditional teaching styles (Azmi et al., 2016). Technologies in Use studying-based Personal computers, tablets, laptops, and smartphones (Sanmugam et al., 2016), are used to inspire individuals and promote positive actions towards different persons and groups (Hamari and Koivisto, 2015). Gamification creation indicates that technologies and gaming designing can also be applied in motivation-enhancing activities (Hamari et al., 2015). Because many young people involved in playing games environments (ESA, 2014), although computer games are technological objects, gameplay provides a possibly fruitful way is increasing learner participation and commitment toward Computer Science learning (Mejias et al., 2015).

Games be a component of a student's life shown to be successful, like enhancing encouragement and supporting the student, particularly during the education process (Maia and Graeml, 2015). Gamification does positively impact educational outcomes and behavior towards the course because of its dynamism (Yildirim, 2017). However, it has effectively improved background involvement and interest (Dicheva et al., 2014). Another explanation gameplay system is useful for Computer Science education is because efficient educational strategies are standard through playable demo development (Li et al., 2013). Games represent essential learning precepts that teachers should imitate (Ibanez et al., 2014).

Since games 'educate' notions via designing goals and involving issue-solving, concentrating emphasis on core elements of gaming issues, and structuring issues such that participants draw on past conceptions (Gari, 2019). Designing for issue-solving and simplifying knowledge to draw on previous experience effectively maps the analytical thought techniques (Costello and Lambert, 2019). Gamification could also be applied in computer science with any topic through development, like data structure (Hakulinen and Auvinen, 2014), cloud services (Epema and Iosup, 2014), programming course (Fotaris et al., 2016), 3D computer animation (Villagrasa and Duran, 2013), pure computing (De-Marcos et al., 2016), network node (Zhamanov and Sakhiyeva, 2015), web browsing, database (Domínguez et al., 2013), and AI algorithms (Grivokostopoulou et al., 2016). Using gamification is a way to resolve the problems of actively integrating video games through the classroom (Hanus and Fox, 2015). Gamification's influence upon learners' learning is among the positive effectuation because of its drive; it has a beneficial impact among learners, particularly in education (Ortiz et al., 2017).

Several earlier research pieces contribute to Gamification in higher education Computer Science (CS) courses: Gamification plays a constructive role in CS education. There is another result to the class that seldom hires PCs either technologies (Yildirim, 2017). Learners who regularly watch video games became inspired, yet learners who occasionally utilize software also had strong gamification performance (Varannai et al., 2017). Adopting gamification through education could be a resource which might inspire and attract students and produce their success through studying CS more successful and appealing (Butler and Ahmed, 2016). Gamification may be one of the approaches to rising CS learning issues in university education (Sanmugam et al., 2016). Throughout (Ibanez et al., 2014), researchers recognize motivation as a critical variable required to decide learners will understand useful

computer sciences, and gamification may perform a significant factor in enhancing commitment. The stated drawback is that specific anti-plagiarism methods must be established, too, as a program could require fraud. According to Uskov and Sekar (2014), gamification is an increasingly expanding phenomenon and, relying upon through the academic questionnaire, notes that 90 percent of learners loved gamification strategies being introduced throughout computer science classes. Many types of research, such as (Abdool et al., 2016; Azmi et al., 2017; Ortiz et al., 2017) also receive positive outcomes after implementing gamification throughout the software engineering courses, computer programs, and forcing the use of such techniques in colleges and universities. Besides, gamification applications to increase students' motivation in the pandemic process and improve interaction with the learning process become essential (Suppan et al., 2020). This research examines gamification effects for students throughout the higher education computer science course by reviewing the existing articles.

By finding the answers to the following research questions, the effects of gamification for students in the higher education computer science courses are illustrated:

Q1: What are the advantages of gamification in computer science education?

Q2: What are the disadvantages of gamification in computer science education?

Q3: What are the most gamification elements commonly used in computer science courses?

Q4: Does the introduction of gamification elements into computer science courses improve student's motivation?

Methodology

A literature review was carried out to achieve the aim of the study. It is an academic article that discusses scientific understanding through empirical results and theoretical and methodological approaches to a specific subject. They are secondary sources that will not mention any original or new research (Oztemel and Gursev, 2020). In this study, the term gamification in computer science education is used as an initial search criterion; this paper's review is limited to work published in the journals earlier during 2014 as the start of gamification in computer science education search 2020. The choice to restrict the analysis to this time is focusing on the question regarding the relevance. The search will carry out using the following preferred electronic sources to obtain a global perspective. It is preferable because most of the papers connected to the university library, through the library, the largest and most popular online databases, and search engines are available:

IEEE Xplore publishing many conferences and journals, Web of science, science direct, SpringerLink, and Scopus to provide a detailed explanation of the research results on Gamification in Computer Science Education; all data are collected using the following keywords; "Gamification," "Gamification in education," "Gamification in computer science education," "Gamification elements used in computer science education." The initial resources were chosen via papers relevant to the topic, checked the study's abstracts, and determined if the information was pertinent to the parameters.

Resource assessment was based on:

- Inclusion Criteria

1. The findings were submitted between 2014 and 2020 to get the most current research articles.
2. The paper is written in English.
3. The paper discusses some fracture of gamification.
4. The papers are related to gamification in the field of computer science education.
5. Papers available in full text.

- Excluding Criteria

1. Duplicate articles.
2. Non- English articles

Results

This literature review research looks towards discovering the effects of gamification for students in the higher education computer science course; the following subsection provides descriptions of the review results.

The Advantages of Gamification in Computer Science Education

Gamification was implemented in the area of computer science as well as in physical classes and online classes. Gamification is a modern technology that will enhance the educational experience, which has a significant influence on how computer science training is taught and learned (Begosso et al., 2018). Gamification enhances the interest and encouragement of the learners (Ortiz Rojas et al., 2017). Also, it improves computer science curriculum training and knowledge of a complicated topic (Hakulinen, 2015). Here are several of the advantages of gamification:

- Mental evolution: Games can give learners the ability to understanding another computer science (Borna and Rad, 2018).
- Gamification raises the level of dedication and encouragement in the classes that the learners want specifically. As gamification is incorporated into computer science classes, learners are likely to become increasingly active throughout the topics that become taking are studying (Dichev and Dicheva, 2017). Gamification offers numerous possibilities to create Computer Science training more interesting and exciting by presenting a particular thing in new ways. Also, gamification may promote increasingly successful engagement throughout the education environment (Butler and Ahmed, 2016). It can be challenging to accomplish in a typical lecture setting (Zahedi, 2019). Internet connectivity already provides learners with access to such a wide variety of tools for conducting a study across different contexts, improving participation (Iancu, 2019).
- Gamification accelerated job speed for learners; owing to learning abilities, nobody trains the same style (Borna and Rad, 2018). Gamification offers fantastic ways to make education increasingly accessible to those who have specific needs. Moreover, technology will create many resources for learners suffering or disabilities (Morreale et al., 2019).

- Gamification allows learners to develop an activity plan as well as to select the top-ranked activities and also to earn further marks first. It makes students feeling recognized enough for their most robust efforts (Zahedi, 2019).
- Learners tried to cope stronger: human contact among learners by talking, listening, and effectively debating ideas arises while learners become presented with a question, proposing answers, supporting one another in the event of challenges (Rahman, 2018**;** Elshiekh and Butgerit, 2017).
- Improvement of behaviors; Learners may acquire unhealthy habits throughout computer programming, like stealing and sometimes hack (Butler and Ahmed, 2016). Pedagogical games will direct learners in their career and academic growth to understand certain behaviors. Many results may be accomplished through gaming but are not specifically applicable to computer science education: movement abilities, behavioral and mental results, and physiological outcomes (Borna and Rad, 2018).
- Learners liked playing the game: learners are supposed to appreciate gamification lessons increasingly. It offers various feelings, including inquisitiveness to anger, happiness, and beneficial psychological experiences, just like hope or confidence (Ibanez et al., 2014). It focuses on learners' passion, unrelenting motivation, which students love and are fantastic about (Permana et al., 2018).
- Gamification offers an excellent opportunity for timid learners to show themselves, so both learners mark themselves overtly. It provides learners with optional barriers and allows them to use their abilities and participate in the course. It changes a standard guidance process within computer science classes (Morreale et al., 2019).
- Students can lose and attempt again without any adverse consequences. It reduces a lack of motivation among learners and improves learning chances (Ortiz Rojas et al., 2017).
- Direct feedback to learners that they could focus through different choices and questions relevant to the curriculum content and provide direct feedback, guidance is immediate (Zahedi, 2019). Throughout the learners' viewpoint, assessments and tasks and many other tasks offer various concentrations/manner of input while the participants realize what they learn or everything they want to understand (Elshiekh and Butgerit, 2017).

Digital education engagement gamification is correlated via various training theories-successful education, issue-oriented trying to learn, public studying, Theories of functionalism, and collective training. It will also improve morale yet often promote learners' development to define negative and positive positions (Iancu, 2019).

In the digital classroom, gamification is about making education an enjoyable activity (Rahman, 2018**)**. Through this direction, students gain valuable abilities to the actual world and develop information (Buckley & Doyle, 2016). Gamification in computer science education includes benefits: it encourages functionality, it slowly participates in the process of learning – that provides a range of exercises and assignments that evoke attention, direct feedback as well as prize, it stimulates imagination, develops rational thought and issue solution, builds abilities for use (Ortiz Rojas et al., 2017; Butler and Ahmed, 2016; Elshiekh and Butgerit, 2017).

It will provide educators with the materials required to guide and inspire their learners to turn the process of training towards a positive one (Zahedi, 2019). Gamification has the power to help enhance teaching. Educators may utilize various applications to improve conventional teaching methods and make sure learners are most involved (Ibanez et al.,

2014). Virtual teaching methods, automated testing, and online evaluations will help educators save a great deal of time. The precious time is used to work towards learners with learning disabilities (Frącz, 2015).

Disadvantages of Gamification in Computer Science Education

The use of gamification in learning Computer Science has demonstrated beneficial effects. Many research types showed that the gamification dimension would inspire and involve the learner during computer science education. Through academics, successfully applied gamification to boost a learner's awareness, the interest, and ability of a learner with gamification computer programming training have been enhanced. While they are beneficial, pedagogical games may have drawbacks that impact either emotionally and physically learners (Mejias et al., 2015).

For both learners and educators, gamification has a few adverse effects, such as:

- Gamification will create unsanitary competition and unneeded conflict between learners. That may be a detrimental and inappropriate gamification impact via course action (Ortiz Rojas et al., 2017; Schulz et al., 2015).
- The quick-paced and direct feedback gives rise to a participant's term memory question (Baxter et al., 2016). Learners may start anticipating and do not have the same answers across all aspects of academic learning, contributing to disappointment (Furdu, 2017).
- The expense from gamified training varies according to the particular program use, costs for preparation, software costs, and instructors' training costs may arise (Faiella and Ricciardi, 2015). Such expenses are often carried on to the undergraduates via fees and course instructions that need to be bought, increasing the overall number of obstacles to entering the learning environment. Sometimes there are program-associated costs to promote or services that are offered internet or are sponsored in the university atmosphere (Mejias et al., 2015).
- Gamification may trigger poor personality-esteem or bad behavior, particularly if learners lose at a game (Schulz et al., 2015).
- When teachers pick gaming, this has not always seemed obvious how well the game outcomes would be related to the evaluation of a curriculum (Gari, 2019); although many platforms provide an automated method to measure performance, teachers may have to start turning the success of the individual student match through achieving goals. Finding a suitable match between popular products and the course content is often not straightforward (Hakulinen, 2015). Establishing the game to the course takes much proper planning as well as lecturer procurement. Almost all of an occasion's educators would need to watch the simulation first, requiring time to complete until they thoroughly know the game and goals (Haaranen et al., 2014).

Not that all learners who were inspired through gamification of education have not experienced any impact in applying gamification since they have also won full badges or points (Ortiz Rojas et al., 2017). According to Baxter et al. (2016), Participants have variations in either the result for gamification, that most often utilize technology and participants who never use it, such as IT students and students from non-IT. The distinction between IT and non-IT learners becomes non-IT, which is generally driven through necessity and accessibility, while non-IT learners were not. That is because students with IT are similar to whole technologies. The learning environment may not influence the project's degree of

objective quality throughout the game, which might decide whether simple or hard to use, yet learners who regularly play computer games have been more inspired than learners who enjoy playing a computer game. Non-IT learners indeed have a straightforward achievement in applying to gamification.

Most Used Gamification Elements in Computer Science Education

Gamification is often characterized as utilization throughout the non-game background of gamification components, which increases the learners' encouragement and motivation, as it does in computer science education, there are many gamification elements used (Rahman, 2018). Depending on the primary research findings, a most popular feature of gamification used during computer science classes were *badges, leaderboards, score, level* as well as *feedbacks,* and they were the most commonly known feature of the game throughout learning at computer science (Rojas-López and Rincón-Flores, 2018; Koivisto and Hamari, 2014). Badges and Leader boards have become the critical ability to improve training performance (Falkner and Falkner, 2014). Gamification elements that are most commonly seen in computer science training is as follows:

Points: Some researches explored the effect from points showed the good effects throughout computer science education since the point offered immediate feedback and made the participant engaged or inspired with computer science teaching (Sprint and Cook, 2015; Oktaviati and Jaharadak, 2018; Rojas-López and Rincón-Flores, 2018).

Badges: According to Smiderle et al. (2019); Oktaviati and Jaharadak (2018) and Rahman, (2018), badges highlighted good effects that could inspire or include learners during computer science learning; it will inspire learners to provide enjoyable learning experiences and therefore can assess the skill of the individual, learners feel encouraged to complete the assignment and enjoy the extra acknowledgment will gain as they receive the badges. Badges may improve the learner's interest or involvement in studying computer science, but perhaps the main crucial thing has become an effective structure; it will be more straightforward or more challenging for the learner to obtain (Baxter et al., 2016). There will be variations of learning trends among learners with the information stage; learners of poor performance may be most motivated for engaging, whereas learners of higher motivation become provided hon abilities badges (Falkner and Falkner, 2014).

Leaderboards: Depontes et al. (2018) found that for some learners, they get the beneficial effect that offers inspiration, although often students hate the competitive components like the leaderboards incorporated into computer science class. Students would like to carry through the role of trying to achieve the best scoreboard spot. That offers learners the right motivation to actively engage further throughout the events and climb higher (Smiderle et al., 2019).

Levels: They positively affect learning computer science, like motivating and engaging learners (Oktaviati and Jaharadak, 2018). Another key would be to maintain sufficient product railings, growth, and series to be effective through gamification, neither frustrating the users but maintaining the students' correct amount. Typically, often grouped through lines, effectiveness, when the student wins certain marks, progresses to another stage (Baxter et al., 2016).

Feedback: It can prevent missing or frustrated learners from being noticed that direct feedback became a crucial feature through gamification, reinforcing the link between right-doing and getting praised for it (López and Flores, 2018).

Cooperative creating group Programming to computer engineering learners, one common goal is to write software programs besides competitive type issues. A series of discussion topics are produced in which an Association for Computing Machinery (ACM) programming competition form of the challenge becomes presented for encouraging the learners (Smiderle et al., 2019). Every person, or team of learners, can add the workable answer as responses to the main subject; learners involved in the issue have to see other learners' ideas, have input and comments, and ideas for other ideas (Sherriff, 2016). It offers learners an excellent means of communicating, cooperating, developing their rate, and, most significantly, gain from one another programming abilities (Rahman, 2018). The learners produced significant participation from those discussion topics; the above gamification element makes it attractive for all the learners to learn on the difficulties of programming competition form and get training from classmates (Elshiekh and Butgerit, 2017).

Based on Oktaviati and Jaharadak (2018) and Begosso et al. (2018) in the computer science curriculum, the most commonly known gamification components are badges that are directly accompanied by both points and leaderboards. Academic achievement impacts on gamification indicate that it is a successful method incorporated into the teaching material. Gamification also has a more in-depth knowledge of learners with their contributions. Also, leaderboards had observed to be the primary motivating, although points seemed further successful than certain gamification elements. Experiments already found that the learner's performance increased significantly since using these gamification elements. Badges, Leaderboards, awards, level, and point seem to be the more factors explored throughout studies (Sprint and Cook, 2015).

Effects of Gamification Elements on Student's Motivations in Computer Science Courses

Motivation is the step to continue the action and even to direct it. Learning motivation may be described as the willingness of the student to encountering (Lister, 2015). Gamification's main goal was to improve motivation and success by structured elements targeting various activities and ability creation. It gives rise to numerous theoretical frameworks, often using motivational templates (Frącz, 2015). The philosophy of self-determination speaks of two main types: internal and external motivation.

The gamification component's implications through teaching students computer science could even enhance engagement and motivation between the learner and the learner who has appreciated doing their job (Borna and Rad, 2018; Buckley and Doyle, 2016). Gamification training is a resource for helping learners, and teachers gain knowledge and make the educational quality more successful and attractive (Zahedi, 2019; Wenzl and Miladinovic, 2018). Using game technology can divert attention to a participant throughout teaching practices, as well as some participants would diminish attempts to learn much more about the component (Morreale et al., 2019). Consequently, this is necessary to ensure that gamification will not make learners negligent when applying rivalry (Butler & Ahmed, 2016). The architecture of assignments and classroom materials there at an appropriate level is essential for learners (Elshiekh and Butgerit, 2017). Several study results have explored the efficacy regarding gamification elements throughout the field of computer science; the elements more often tested in the studies have been: points, rates, badges, and accomplishments, as well as leaderboards that can motivate several fields of computer science (Iancu, 2019; Rahman, 2018; Ibanez et al., 2014; Azmi et al., 2016). Gamification has a beneficial effect on learner motivation (Buckley and Doyle, 2016).

ARCS motivation method, as it is the best method to increase educational process efficacy, encourages externally and internally motivation (Pinter, 2020). Keller created it in 1987 for computer science courses to identify several motivational approaches that would be applied throughout learning (Sherriff, 2016; Čisar et al., 2020; Sprint and Cook, 2015; Lister, 2015) to provide and promote the encouragement of learners can be found through gamification elements such as:

- Gamification elements Provide learners with a feeling of command that helps them identify their objectives and decide how to meet them.
- Describing the goals: learners often understand what to do to gain points and be best put throughout the ranking.
- Use constructive rivalry: it will inspire learners to work better and study more to score higher.
- Providing prizes: Learners earn incentives by placing them on the leaderboard as well as obtaining badges. All who perform more get a reward, and rank higher encouragement is indeed a perfect way to inspire.
- Offer accountability to the learners: what rating would appear, which badges are next, based on whether involved the individual is. The shifted obligation will get the learner motivated.
- Creating exciting lessons: learners are actively interested in attending lessons as they miss leadership roles or earn different badges.
- Keeping expectations high and achievable: each learner becomes informed on creating the right place and the leaderboard by attending and contributing to classroom work.
- Gamification elements Providing feedback: Students receive feedback mostly on points, badges, and location on the leaderboard. The learners can see through themselves if they could do better or try to change it.
- Success track: grades, awards, and leadership positions show the participant's performance throughout actual time.
- Fun is among the factors that encourage computer game participants to enjoy and keep returning for further. Gamification appropriates the concept of fun through computer games to obtain the students' dedication and improve motivation in such a right way. Picking up badges as well as points is something of a game. Competition by game among classmates keeps the whole process enjoyable (Ortiz Rojas et al., 2017).
- Include resources for achievement: the framework presents two strategies to boost a leaderboard role. Next, each learner earns points through course attendance. Much visiting indicates further points.

Based on studies by Begosso et al. (2018), Permana et al. (2018), and Dolgopolovas et al. (2014), gamification plays a significant function in inspiring teachers and students for learning algorithms and coding principles and the main topics of introductory object-oriented programming to engineering and computer science learners, because it is further enticing towards learners and offers more powerful opinions and relationships than conventional strategies. Studies that have carried out experimental data on using gamification elements conclude mostly on the beneficial impact on learners' academic achievement and overall success via immediate results and communication (Butler and Ahmed, 2016). Several

scholars reported promising findings suggesting higher levels of probability and increased comprehension and interaction of learners when gamification technologies are added to the classroom atmosphere (Alsawaier, 2018; Ibanez et al., 2014).

Iosup and Epema (2014) and Lister's (2015) experiments have significantly improved learners' success while using gamification elements. The training efficacy has a good influence; once the gamification elements have been removed from the program, learners' accomplishments decrease, user involvement decreases, and interaction reduces.

According to Haaranen et al. (2014). not all students become motivated by the gamification components or advantage from them. In reality, the amusement elements for gaming can divert the participant from the game's teaching practices and the participant's attempts to analyze information (Lister, 2015) further. Some research results indicate that students are not motivated in certain situations, which reduces their intrinsic motivation (Gari, 2019; Hanus and Fox 2015; Rojas et al., 2017). For this reason, gamification applications can be used instead of a single type of motivating factors.

Discussion

Students have some problems in computer science courses, especially programming language courses. It is not easy to understand. So, there must be a way of encouraging students to practice study and exchange ideas; they need to be motivated. Gamification is used as an instrument for inspiring students and growing their dedication (Elshiekh and Butgerit, 2017; Cadavid and Corcho, 2018). Gamification plays a significant part in learning computer science because it is much more appealing to young learners and offers connections and experiences that are more powerful than conventional methodologies. The gamified learning environment has enhanced learners' involvement and boosted enjoyment, even as learners are required to accomplish a task, increase product preservation, and improve learning morals. Researchers have reported beneficial effects with gamification on academic success (Iancu, 2019; Dichev and Dicheva, 2017; Butler and Ahmed, 2016; Zahedi, 2019; Morreale et al., 2019; Rahman, 2018; Elshiekh and Butgerit, 2017; Borna and Rad, 2018; Permana et al., 2018; Morreale et al., 2018; Ortiz Rojas et al., 2017; Buckley and Doyle, 2016; Elshiekh and Butgerit, 2017; Ibanez et al., 2014; Frącz, 2015).

Gamification also has little negative impacts for both the students as well as the teachers. Studies have highlighted a disadvantage for learners due to Gamification (Ortiz Rojas et al., 2017; Furdu, 2017; Faiella and Ricciardi, 2015; Mejias et al., 2015; Schulz et al., 2015; Gari, 2019; Hakulinen, 2015; Haaranen et al., 2014; Baxter et al. 2016).

Most successful gamification elements being utilized in computer science courses have been badges, leaderboards, ranking, level, and feedback. Based on the preliminary investigative research results Rahman (2018)**,** Rojas-López and Rincón-Flores (2018), Koivisto and Hamari (2014), Falkner & Falkner (2014), Sprint & Cook (2015), Oktaviati and Jaharadak (2018), Smiderle et al. (2019), Depontes et al. (2018), Elshiekh and Butgerit (2017), Oktaviati and Jaharadak (2018), Begosso et al. (2018), Sprint and Cook (2015).

Throughout understanding computer science, the gamification elements can boost engagement and motivation between some of the learners and the learner who has liked doing their job. Gamification education is also a way to help learners, and teachers understand how to make ones educational success extra efficient as well as good looking (Lister, 2015; Frącz, 2015; Borna and Rad, 2018; Buckley and Doyle, 2016; Zahedi, 2019; Wenzl and Miladinovic, 2018; Morreale et al., 2019; Elshiekh and Butgerit, 2017; Iancu, 2019; Pinter,

2020; Ibanez et al., 2014; Sprint and Cook, 2015; Butler and Ahmed, 2016; Hakulinen and Auvinen, 2014; Sherriff, 2016; Azmi et al., 2016; Čisar et al., 2020; Begosso et al., 2018; Permana et al., 2018; Dolgopolovas et al., 2014; Alsawaier, 2018; Iosup and Epema, 2014).

Not all learners become motivated through or benefit from the gamification elements (Haaranen et al., 2014; Lister, 2015). Some researches were carried out in which students were not motivated in some instances, reducing one's inherent motivation may harm learners (Gari, 2019; Hanus and Fox 2015; Rojas et al., 2017). Specifies that gamification has become too centered following an external source of motivation because the motivation effects with gamification would not be consistent for individual teaching students.

According to the research results, it is suggested that the students are not motivated enough within specific rules in the classroom and should use motivating practices such as gamification.

Conclusion and Recommendations

Use technologies in education today, and having modern forms for teaching. Gamification becomes a resource for learning to support learners, particularly computer science training. This study reviewed the literature regarding gamification within computer science and software engineering learning classes and their characteristics. Research results showed that incorporating gamification elements in computer science education can positively affect students studying from different perspectives, particularly their successes, participation, and motivation in educational activities. In particular, gamification techniques enhance the enjoyable components and behave as a motivational tool for learners to be much more active in the learning process.

Throughout their experimental studies, only a few researchers found harmful effects on gamification. The most popular gamification elements that were mostly applied in the previous research in computer science learning and teaching processes were points and leaderboards, feedback, and digital badges, resulting in beneficial results between learners about student motivation. Introducing gamification to education can become a resource that can inspire and participate in the learner to practice computer science, to render their success most successful and appealing. Gamification could offer beneficial results to the learners' performance, and it should be increasingly embraced among educators in the learning and teaching system.

This study's limitations are that the review paper examined gamification research just in computer science. During the literature review, the study test revealed that nomenclature besides gamification elements may not always be excellently described or reliable throughout research results. Therefore, there was not even a significant body for evidence-based articles limited with gamification throughout computer science courses, and we have taken our inference in the findings of those studies. A few of the research performed utilized qualitative analyses that were not applied toward a standardized experiment to get further evidence for such results.

By this study, some recommendation needs to be considered for future investigators as follows:

- The study is limited to make conclusions on the effect of gamification on educational achievement and students' academic performance—greater involvement in education. Classroom attendance has been seen as an outcome of gamification and is also significantly

linked to enhanced students' performance. Further research about students' academic achievement and results throughout the computer science curriculum must develop a broader knowledge of utility through gamification.

- Further research is required to determine if this transforms into an effect on finished performance and governs particular group impacts. Research needs to focus on several other gamification components like cooperation; Experience, and explore the system along with the widely utilized elements. Additional work is also required to examine fun, happiness, and attitudes about gamified active learning on the learners.

Abbreviations

CS: Computer Sciences

ICT: Information Communication Technology

IT: Information Technology

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