

**GAMIFICATION IN EDUCATION: DOES INCORPORATING GAMING ELEMENTS IMPROVE STUDENT ENGAGEMENT?**

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ABSTRACT

It has been shown that gamification is an effective way for enhancing students' interest in learning and creating an incentive for them to do so in a number of school situations. The purpose of this study is to investigate the effectiveness of incorporating gaming elements into an online learning environment, with a specific focus on the subject of computer science education. The platform that has been proposed, in contrast to many other gamification systems, integrates gamified aspects with automated programming evaluation, which is essential for giving feedback that is both prompt and accurate. A survey was administered to 215 undergraduate students in order to evaluate the impact that the tool had on engagement and motivation. According to the findings, the gamified platform had a positive impact on the students' level of involvement in the classroom, their motivation to study, their self-esteem, their capacity to learn from their mistakes, and their confidence in themselves. According to the qualitative comments, the features of the game that were most highly regarded by the students were also disclosed. The findings of this research provide validity to the notion that the use of gamification in educational systems has the potential to increase student engagement. Furthermore, the lessons that were gained here are applicable to domains other than computer science.

Keywords : Education, Gamification , Elements, Student, Engagement

INTRODUCTION

The 21st century is bringing about a worldwide revolution in education institutions, which is being driven by the development of new technologies and the shifting preferences of students over how they study[1]. Increasingly, students are discovering that conventional methods of education, which mostly consist of lectures and are driven by evaluation, are not sufficient to maintain their interest, participation, and depth of learning at a high level. Within the confines of this framework, gamification has emerged as a cutting-edge style of education that is intended to combine the conventional classroom instruction with the ever-evolving needs of today's students.

The term "gamification" refers to the process by which non-game surroundings, such as educational settings, are augmented with game components, such as points, levels, badges, leaderboards, awards, storyline, and real-time feedback. In the field of educational design, gamification refers to the process of incorporating game mechanics and elements that are intended to motivate students into pre-existing academic content. The digital game-based learning approach, on the other hand, makes use of the whole games themselves as part of the educational process[2]. For the purpose of developing learning environments that are more engaging, interactive, and productive for students, the fundamental concept is to make an appeal to both the intrinsic and extrinsic motivations that students possess. According to other theories of motivation, such as the Flow Theory and the Self-Determination Theory, which emphasise the

role of relatedness, competence, and autonomy in maintaining student motivation, this strategy is consistent with those ideas.

By making classes more fascinating and engaging for students, improving their drive to learn, and raising their sense of success, gamification has the potential to change classrooms, according to research. Gamified systems, for instance, often provide rapid feedback and appreciation of accomplishment, which encourages students to continue with activities that are difficult to complete[3]. Furthermore, gamification not only promotes intellectual and social development, but it also stimulates healthy competition and collaboration among classmates, which ultimately results in an engaging environment inside the classroom.

There are still many individuals who are curious about whether or not gamification is effective, whether or not it will be there for a long time, and whether or not it can be used by people of all ages and from all walks of life. Gamification strategies that are poorly developed have the potential to actually demotivate students, and not all gamified learning settings are necessarily good[4]. As a result, it is of the utmost importance to investigate when, how, and to what extent gaming components have an effect on the level of student participation in the classroom.

With the goal of contributing to the current body of knowledge, the objective of this study is to investigate the ways in which gamification might potentially boost involvement from students. The primary objective of this research is to ascertain whether or whether the incorporation of gaming elements into instructional materials results in a substantial increase in the levels of intrinsic motivation, attention, engagement, and emotional investment associated with learning among students[5]. Through the investigation of both the perceived and quantifiable impacts of gamification, the purpose of this research is to provide educators, curriculum designers, and policymakers with evidence-based insights that may be used to improve the effectiveness of certain educational activities.

OBJECTIVES

1. To investigate how adding gaming components affects students' participation in class.
2. To determine which elements of gamification—such as levels, competition, feedback, badges, and points—are most useful for raising student motivation and encouraging active learning.

HYPOTHESIS

Null Hypothesis (H_0):

In a university programming course, the use of a web-based gamified tool had no discernible effect on students' motivation, engagement, or learning results.

Alternative Hypothesis (H_1):

By including game features like awards, leaderboards, prizes, and automated evaluation, a web-based gamified tool dramatically improves learning results, student motivation, and engagement in a university programming course[6].

MATERIAL AND METHOD

This research used a mixed-method approach to find out whether gamification makes students more engaged in their learning. Focussing on undergraduates taking a programming course at a public institution in Spain, the major data gathering approach included quantitative and qualitative methods. The study's sample size was 215 individuals, drawn from three different computer engineering degree programs[7]. To guarantee representation across various academic paths, stratified random selection was used. A web-based platform that was specifically built for the course was used to gamify it by adding game features including points, badges, leaderboards, and automatic feedback systems. All pupils were given free access to the tool without any limitations on how they may use it in order to encourage equitable participation. An online survey was sent to students from March to May 2023 in order to gauge their level of involvement and enthusiasm. Motivational elements like attendance, study habits, confidence, competitiveness, and resilience in the face of failure were measured using Likert-scale questions (1 to 5) in the survey. The students' responses to an open-ended inquiry on the platform's features that they liked most provided rich qualitative data[8]. R statistical software (version 4.1.1) was used for data analysis, and all replies were kept anonymous and private. The percentage of those that took the survey was 52.5%. In order to verify the survey results and achieve triangulation in the findings, informal interviews were also carried out with teachers and students. The research attempted to record genuine student experiences throughout the early stages of the platform's introduction, despite the lack of a conventional control group[9]. Future study should use comparative experimental designs to address this restriction and draw more strong results.

Web-Based Tool

For the purpose of determining whether or whether the incorporation of game elements into educational settings encourages student involvement, this study used a web-based gamification platform that was successfully integrated into a university-level programming course. There are elements of the game that are included into the learning process. These elements include points, badges, achievements, leaderboards, and awards[10]. These elements were incorporated into the program in order to increase participation and provide reward. Students were able to easily complete their projects, monitor their progress, and work together with their peers because to the platform's intuitive design, which made tasks as easy as possible. Elements that were significant were:

- **Points and Levels:** As they completed programming exercises and reached milestones, students earned experience points and redeemable points. A feeling of accomplishment and challenge was enhanced as one progressed through levels, granting access to more difficult activities[11].
- **Badges and Achievements:** The distribution of badges and accomplishments was initiated by certain acts, including finishing a series of chores. Setting goals and maintaining effort were both promoted by these visual incentives.
- **Leaderboards:** To keep students motivated and not discourage those who weren't in the top ten, a global top-10 and a personal ranking view were implemented. The result was the introduction of social comparison and healthy competition as motivators for participation[12].

- **Store and Incentives:** Academic benefits, such additional points on final grades, and profile customisation may be obtained with redeemable points. Enhanced intrinsic motivation and tailored educational opportunities were the results of this.
- **Testing and Feedback:** Coding duties included both open and closed unit testing. Code contributions and failures were immediately reviewed, allowing for iterative problem-solving and skill reinforcement..

Not only did the system contain real-time automated assessment, but it also encouraged self-directed learning via the use of trial and error that led to progress[13]. Through the use of questionnaires and casual chats, we were able to collect qualitative and quantitative data about the engagement and motivation of the students. The purpose of this study was to record real-life student interactions using gamified learning environments in order to establish whether or not these settings had a positive impact on the level of student engagement and the results of their learning opportunities[14].

RESULT

The purpose of the questionnaire that we distributed was to ascertain the extent to which gamification elements influenced the level of involvement that students had in a programming course[15]. There is a display of the findings below. Quantitative and qualitative data were analysed by the researchers in order to determine how the various components of the game influenced the level of enthusiasm and engagement shown by the pupils.

1. Questionnaire Findings

A survey was conducted with the intention of eliciting the opinions of students on the influence that gamification has on their level of involvement, engagement, and overall learning experience while they are in the classroom. The data indicate that there is a generally positive attitude towards the use of gamification in educational settings. As can be seen in Figure 1, the vast majority of students (52.21 percent, to be precise) believed that the gamified platform enhanced their motivation to attend class. This gives more proof that enhanced student participation was achieved with the implementation of game elements such as leaderboards, badges, and points[16]. Despite the fact that the platform was effective for the vast majority of students, it did not resonate with each and every one of them (12.39%). Following this trend, the data that follow (data 2-5) reveal that students are more interested with the content of the course, that they regularly complete tasks, and that they experience a larger sense of pressure to succeed. The vast majority of students said that the gamification strategy transformed their educational setting into one that was more engaging and optimistic.

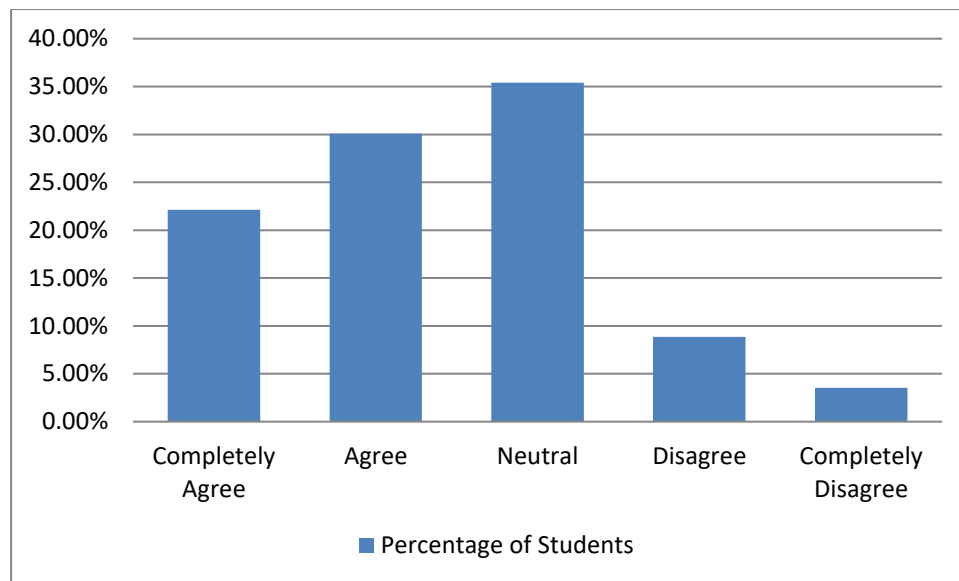


Figure 1. Students' drive to show up to class

Figure 2 shows that most participants (86.72%) thought the gamification platform made them want to study more, perhaps because of the points system[17]. This points to the importance of game-based components in enhancing learning outcomes and promoting academic engagement.

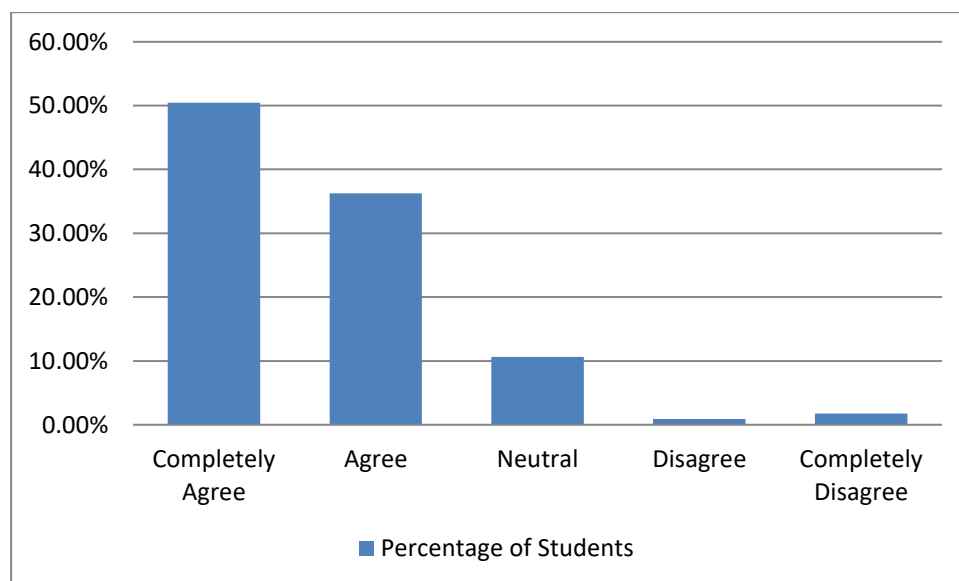


Figure 2. Student study motivation, based on replies.

Figure 3 shows that 75.22 percent of the students felt that the platform's point system increased their self-esteem[18]. This shows how gamified prizes boost students' confidence and interest in studying while simultaneously motivating them.

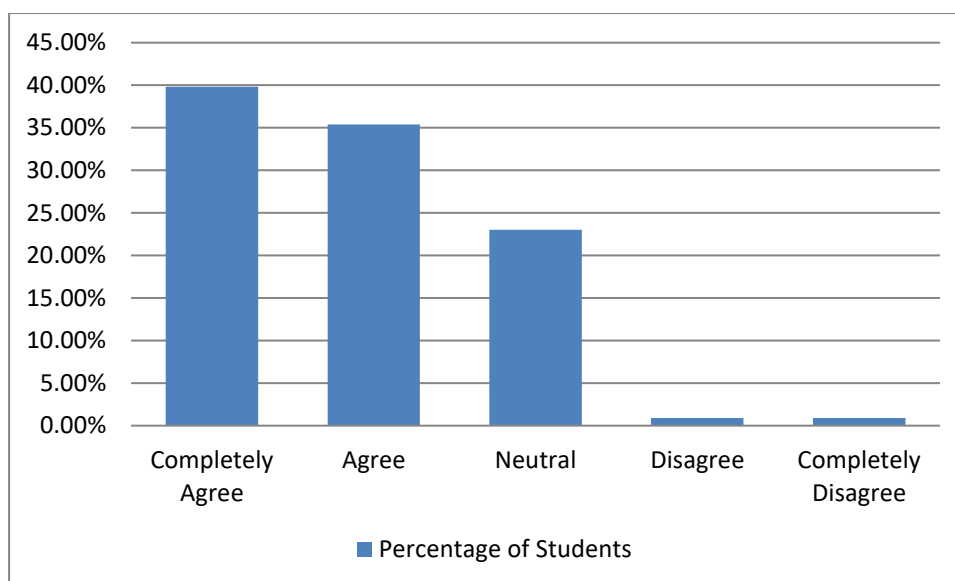


Figure 3. Feedback from students on the impact of points on self-confidence

More than half of the students (53%) felt that the leaderboard's competitive atmosphere increased their motivation, as seen in Figure 4[19]. The results show that competition may be a powerful motivator in gamified educational environments, even if some people were neutral (31.86%).

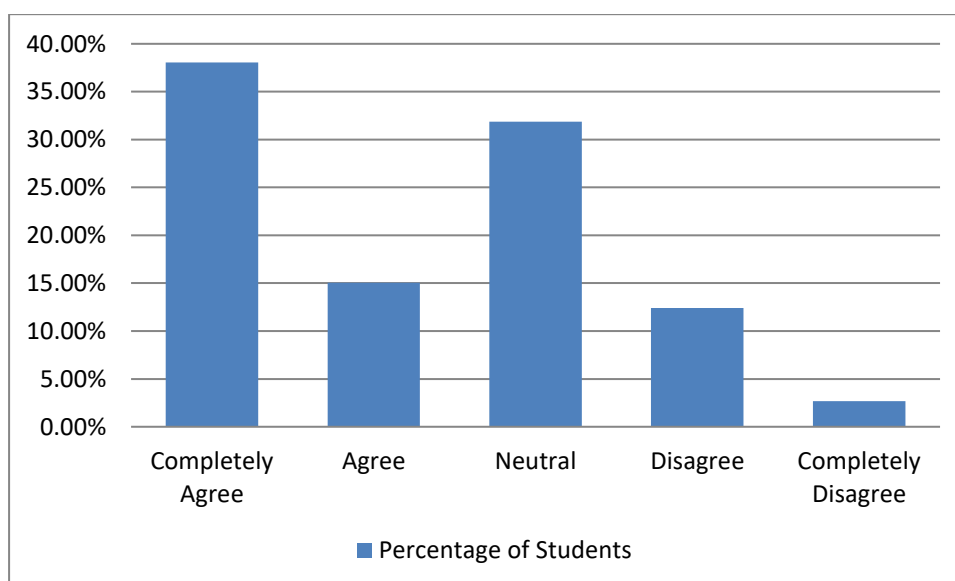


Figure 4. How the leaderboard motivates pupils, from their viewpoint.

Figure 5 shows that 72.56 percent of students said that they were more motivated to find and solve issues when they encountered code errors or failed assessments[20]. This exemplifies the way gamified feedback methods encourage more participation and in-depth understanding of the subject matter.

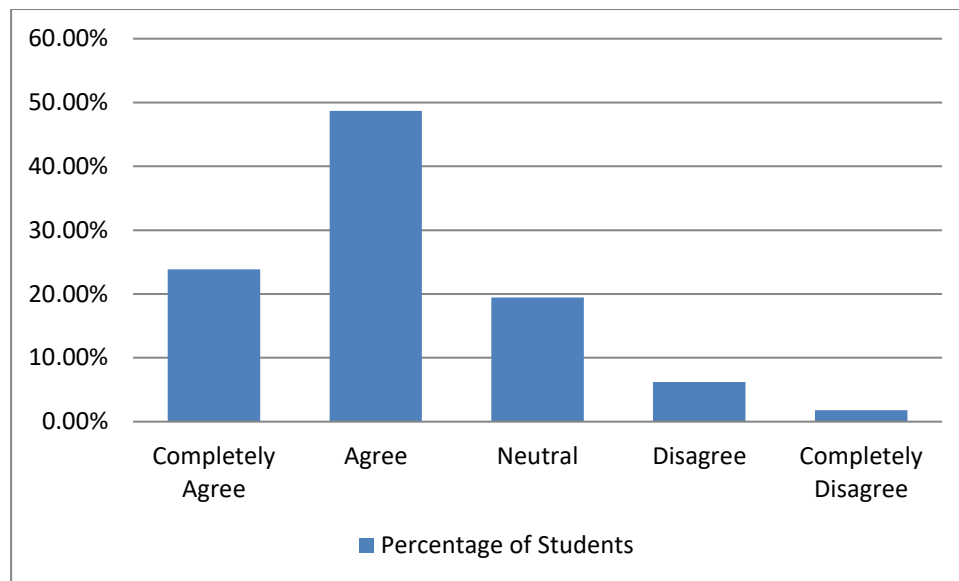


Figure 5. Students said mistakes and failing examinations motivated them.

The study results provide light on how gamification affects computer science students' interest and performance[21]. Most students said the gamified technique boosted engagement, motivation, and enjoyment with learning, while others said it failed. Gamification may enhance education, but it must be tweaked to fit various learners and keep everyone involved (see Table 1).

Table 1. Survey statistics on the gamification platform

Item	Mean	Median	Mode	SD
The use of the tool has motivated me to attend class.	3.58	4.0	3	1.04
I was more motivated to study and therefore obtain more points.	4.33	5.0	5	0.84
Achieving points improved my self-confidence.	4.12	4.0	5	0.86
The competitive environment of the leaderboard enhances my motivation.	3.73	4.0	5	1.17
When my code does not pass the tests, I feel motivated to look for errors and fix them.	3.87	4.0	4	0.91

One-sample t-tests determined whether gamification significantly enhanced participation. All five null hypotheses ($p < 0.05$) were rejected for class attendance, study motivation, self-confidence, leaderboard competitiveness, and error rectification[22]. Based on Table 2, the gamified tool dramatically increased student motivation and engagement in learning.

Table 2. Student motivation hypothesis testing summary.[23]

Item (Null Hypothesis)	p-Value
The use of the tool does not motivate students to attend class.	1.475415×10^{-8}
The students are not more motivated to study and to obtain more points.	1.026765×10^{-32}
Achieving points does not improve the students' self-confidence.	1.592054×10^{-26}
The competitive environment of the leaderboard does not enhance the students' motivation.	5.371024×10^{-10}
The students do not feel motivated to look for errors and fix them when their code does not pass the tests.	8.823050×10^{-18}

2. Open-Ended Feedback: Motivation Dimension

The open-ended inquiry "Which part did you like the most?" helped students understand their motivators. There were several choices, but nearly half of the respondents prioritised exams/hidden tests (13.7%), points (12.8%), final grade rewards (12%), and practical activities (11.1%)[24]. All of these indicate that youngsters choose challenging, rewarding, and practical activities. Usability and enjoyment were important, but not the driving drivers. Fewer than 5% considered code evaluation, simplicity, and pleasure irrelevant. The store/rewards system, leaderboards, and learning experience show the importance of internal and extrinsic motivators, with affects of 5-9%. In conclusion, gamified system designers must combine organised tasks with a variety of engagement strategies to meet a broad range of learner preferences[25].

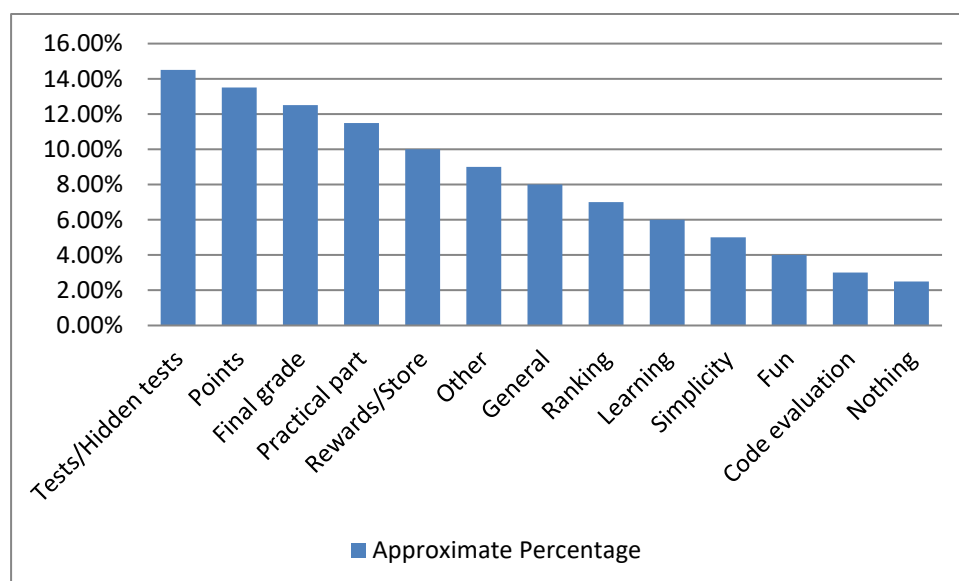


Figure 6. Students' top motivating themes.**3. Qualitative Insights from Student Comments and Interviews**

Students' motivation might be better understood with the use of both quantitative data and qualitative comments[26]. Students' open-ended comments revealed the following gamification elements that they enjoyed the most:

- "The hidden tests that guarantee all potential cases are taken into account."
- "The progression system: achievements, points, etc."
- "Being inspired by the system of rewards."
- "We were motivated to surpass other university degrees by the leaderboard."

Structured tasks (like secret tests), recognition (like points and awards), tangible prizes, and peer competitiveness (like leaderboards) are highlighted as motivating factors in these remarks. A personal ranking system promoted both challenge and inclusion, reducing the possible negative influence of the leaderboard on lower-ranked students while yet encouraging competitive drive.

4. Interview Findings

Informal talks with students, gamification experts, and instructors validated these findings. Teachers noticed student involvement grow and expressed interest in expanding the tool's usage. Gamification experts say the technology works in many educational contexts[27]. Students liked the competitive nature of cross-degree rating, which motivated them. Gamification enhanced interest, motivation, and participation, according to expert interviews and student feedback. Competition and support should be balanced, however.

DISCUSSION

This study intended to address the question, "Does incorporating gaming elements improve student engagement?" as it explored the impacts of gamification in the classroom. The research was conducted with the desire to answer this question. The research makes it abundantly evident that gamification has a positive impact on the levels of motivation and engagement shown by students[28]. According to the findings of the survey, more than half of the students (52.21 percent) were either in agreement or strongly in agreement that the gamified platform increased their motivation to attend class. This was in response to the initial research question, which asked, "How does the integration of a gamification system impact students' motivation and engagement in a programming course?" Game-based elements significantly boost both interest in learning and attendance, as shown by the fact that a much greater number of students (82.72%) reported feeling motivated to study more diligently in order to gain points.

The results of previous research in the area of gamified learning are consistent with our findings. As an instance, [29] conducted research that shown that the use of game-based, interactive learning on platforms such as Kahoot! resulted in an increase in the level of engagement and recollection of topics among students. [30] also highlighted the significance of gamification in terms of its ability to generate and sustain

situational interest, which is an essential component of long-term engagement. This research lends credence to the conclusions of the studies that came before it, namely that gamification boosts both the internal and external motivation of students, which is essential for them to continue to be interested in their studies throughout the course of their academic careers.

A lot of helpful characteristics were discovered in response to the second research question, which was "Which functionalities of the gamified tool influence students' motivation?" Fifty-three point nine percent of the pupils who were polled said that the leaderboard was either extremely or somewhat motivating. This feature, which generated a healthy feeling of competition among students, motivated students to strive for better performance and higher ranks. This gave students a sense of accomplishment. While this was going on, 75.72 percent of students said that their self-confidence had significantly increased as a result of the points and achievements acquired. As this demonstrates, even very little rewards may have a big psychological influence on the way in which goal-oriented conduct is shaped. In addition, the error-based feedback loop implemented by the tool proved to be beneficial; 72.56 percent of students said that it inspired them to correct their code whenever it failed. There is clear evidence that gamification has the capacity to foster perseverance and iterative learning, both of which are fundamental components of education that is centred on mastery.

Additionally, the qualitative comments provided additional support for these results. Incentives, secret examinations, and practical assessments were all concepts that were met with a great deal of enthusiasm by the students. In addition to being challenging and unique, these components offered a feeling of achievement to the whole experience. Through the incorporation of elements such as self-assessment, incentives, competition, and progress tracking, the gamified platform demonstrated its ability to accommodate a diverse variety of learning styles. Previous study has also shown outcomes that are comparable. Research [31] suggests that items such as leaderboards and badges have the potential to boost academic effort and persistence by encouraging structural competition and trait motivation. There have been a number of additional studies that have shown that gamification methods have the potential to boost performance in a manner that is comparable to that of difficult goal-setting [32].

Limitations and Future Directions

In spite of the fact that the results are encouraging, it is essential to keep in mind that there are certain restrictions. As a first point of consideration, the findings may not be relevant to a more extensive population since the study was conducted with just one institution. Second, since there was no control group, it is impossible to determine whether or not gamification is the sole factor that influences motivation. A third point to consider is that a programming course may not be able to adequately cover gamification in subjects that are not technical or in the humanities. It is recommended that future research include a wide range of academic institutions and areas in order to conduct a more comprehensive evaluation of the efficacy of gamification technology. It may be important to conduct quantitative evaluations of actual performance, such as test scores or code accuracy, in order to get a better understanding of the influence that gamification has on learning outcomes that go beyond engagement. An additional fascinating area of study is the evaluation of how these technologies reduce the workload of educators via the use of automation and student-directed learning.

CONCLUSION

It is demonstrable that the incorporation of gamification elements into the classroom results in increased levels of motivation and engagement among students, particularly in the context of computer science studies. Encourage both intrinsic and extrinsic motivation in students by providing them with elements like as leaderboards, points, successes, and speedy feedback. These aspects enhance the learning experiences of students. The data gives validity to the premise that gamification may be an effective tool in the classroom, rather than just a fleeting craze that is only happening for a short period of time. Because of this, it motivates tenacity, self-assurance, and participation in the process. The findings give persuasive evidence that gamified technologies have to be used in education on a more widespread scale, despite the fact that there are various constraints and restrictions. Gamification is becoming an increasingly popular method for improving learning outcomes and student retention in both online and offline learning contexts. This trend is particularly prevalent in online learning environments.

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