Enhance Learning Capabilities of Students Using Gamification at University Level

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Abstract. Many students' classes had to be moved online due to the global pandemic of 2020, and many teachers started teaching online without much to no preparation for best practices. The customization of educating children was harmed, and teachers soon found that it was hard to engage and communicate with kids. student involvement is a catalyst for improved student performance and is lower in a virtual environment than in a face-to-face one. Additionally, students are often less motivated in online situations. To increase student involvement in online learning, a variety of teaching strategies were created (e.g., flipped learning model, blended learning, etc.). Recently, many researchers and practitioners have paid considerable attention to gamification. We applied a new approach for the gamification of education is described in two sections serve and conceptual and find the benefits and challenges with the connection between machine learning and gamification at final result and Analysis report is generated. This approach can help motivate students to want to learn.

Keywords: Flipped class, E-Learning, blended learning, Online learning, Gamification.

1   Introduction

The significance of human-computer interaction has grown dramatically in recent years due to the rapid advancement of technology. One of the finest ways to enhance this relationship is through gamification. The increasing use and appeal of video games piqued the interest of educational researchers in the games. Video games are useful, interactive activities that present players with a range of obstacles and goals. In order to complete the game's levels or become an expert player, this engages the player in an active learning process. As more educational institutions shift to using online teaching techniques, courses, and resources for their students, gamification—the blending of game principles and designs with learning content—becomes more and more popular. as seen in figure 1. By offering students a top-notch and engaging learning environment, games can serve as a bridge between students and educational institutions, fostering a greater level of participation on their portals.

Fig. 1. Gamification E-learning(source: https://raccoongang.com)

These days, every company and institution works to improve the student learning program and interaction strategy, which is becoming more and more important in today's world [1]. Innovative technology for creating, modeling, and implementing learning schemes and innovations was never easily accessible a few years ago [2]. The future generation will be easier to learn and better educated if such a novel approach to teaching is implemented in every school. Teachers will face many challenges when implementing such cutting-edge technology in the classroom, so it is imperative that plans for future changes in this area be made now. [1]. In the sphere of education, there needs to be some connection made between the younger generation and students and these kinds of learning devices. [3]. because pupils' social intelligence can frequently be hampered by such cutting-edge learning technologies. Programs that promote student participation and interaction in the classroom ought to receive more attention. [4]. Examining these learning applications in this educational field can serve as a focal point for education in the future, allowing students to express their artistic abilities and improving their learning. Analyzing educational applications in this area can serve as a focal point for education in the future. The environment is far more like a game, but the lessons do not necessitate changing how the classroom is gamified. Gamification aims to inspire and include students in the learning process. By allowing students to participate as players and select their own avatars, gamification raises student engagement they help them in education area.

I.1   Nature of Gamification

As per [5], gamification employs methods based on games, aesthetics, and game philosophy to engage people, promote actions, enhance learning abilities, tackle problems, and so on. The use of game ideas, mechanics, and elements in non-gaming contexts is known as gamification. Using game principles increases performance and engagement in both formal and casual contexts. A few key features of games are crucial for gamification in the classroom [6]. University students will have a more distinct, intriguing, and illuminating knowledge of gamification in e-learning since they are more familiar with technology and new terms used in the field of education [7].

The remaining section of this paper is organized as follows: Section 2 describes related research in this field, Section 3 gives brief description of methodology in which we

work on Model Based on Surveys, Gamification Mechanism, Benefits and Challenges in Connection with Machine Learning and Gamification. Section 4 discusses the result and analysis of Survey based models and Conceptual-Based Models and Experimental results have been analyzed Section 5 conclusions and future scope is reported.

2   Related Research

According to the self-determination theory (SDT), in order for people to grow, they must have autonomy, competence, and relatedness. Students must have these requirements in order to function at their highest level and in good health (Carlos et al. 2018).The motivation that fall on a continuum, with intrinsic motivation on the right and motivation (without intending to act) on the left. With the usage of a gamification system, students may be able to transition from being driven by external factors like points, badges, and a leaderboard to becoming intrinsically motivated to finish the task (Sanchez, Eric, 2017). Requirements listed above can be met by a well-thought-out gamification system, which will raise student motivation. The learning environment of a learner also affects their motivation (Barde et al., 2021). According to (Gee & James, 2005), there are several forms of When a learner is intrinsically motivated, they are driven by the task's significance. An externally motivated learner is driven by the reward or punishment, and when it is taken away, their desire wanes. According to AGT, people can be driven by their convictions or a desire to accomplish particular objectives. When it comes to gamification, the objective could be a place on a scoreboard, an unlocked level, or a badge (Jouneau-Sion, Caroline. et al., 2017). When properly implemented, gamification has the potential to support student achievement in a variety of learning contexts, including online learning. This includes leveraging mastery and performance goals. In order to potentially boost motivation, my study makes advantage of performance goal, which is students' desire to display greater accomplishments on the scoreboard. Its use in health-related activities is a more specialized field (Krach, Shelley et al., 2019), where different game elements, like point-reward schemes, are integrated into kid-friendly physical activities.

3   Methodology

The approach used for the gamification of education is described in this section. There are two stages to this. We implemented first with a survey and later with a conceptual approach.

3.1 Structure of Gamification in Education

Before creating a gaming model for education, a number of important considerations need to be made. Gamification is the process of creating a game's structure accordingto an educational setting, whereas game-based learning allows students to produce content linked to study subjects. Medieval Swansea, Ribbon Hero, Duo Lingo, Brainscape, Knower and Lifesaver, and others are a few examples shown in figure 2.
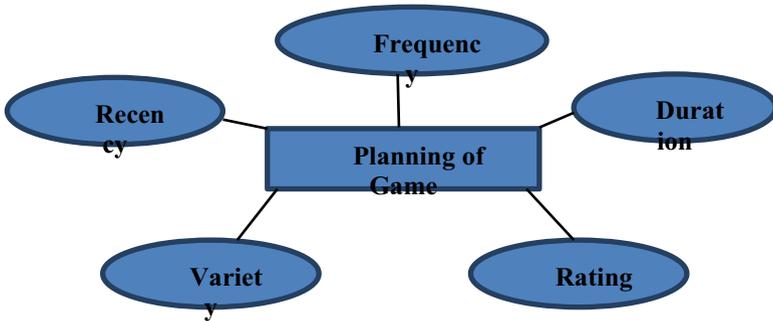
Fig.2. Mechanism of game product

3.2 Model Based on Surveys

Prior to putting the idea into practice, we conducted a study to ascertain the present standing of university students. A survey instrument was created to assess the present comprehension and abilities of 100 pupils. Based on the results of this survey, 10% of students performed at a high level, which is good or above average overall; 69.40% of students performed at an average level, which is average overall; and 20.4% of students performed at a low level, which is below average. Then they were introduced to the idea of gamification. Various exercises, games, and practice sheets were given to students based on their comprehension level.

Additionally, mentors were given to the kids, to whom they may ask any questions they might have. Raising the reading proficiency of the kids who were at low or ordinary levels was the major objective. Figure 3 shows the implementation process. Compared to other game aspects, students considered attending lectures and completing tests to be more engaging. Studying with the study materials was less effective than taking quizzes and receiving fast, direct feedback. Because of the reward system incorporated into the gamification, which kept students' interest in the course and continual attention, the lecture also increased.
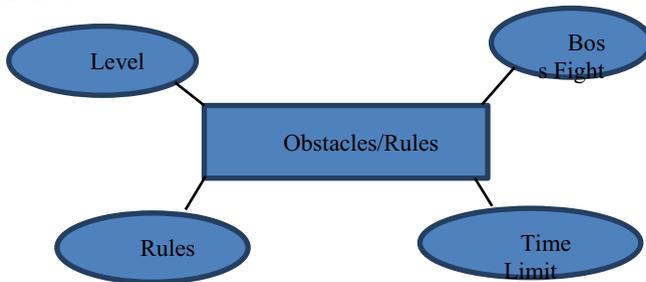

Fig. 3. Survey based Model

3.3 Model Based on Concepts

A quantifiable method of determining how increased student motivation affects education is to achieve academic achievements. Instructors may find that a focus on evaluation in different school settings is the most useful metric. Therefore, in addition to developing gamification for an engagement paradigm that combines desired engagement levels with appropriate game attributes and allows us to analyze the effects,

we need to take into account how this works in conjunction with educational goals [8-10]. This is a stance that academics share. The suggested structure for gamifying education for students is depicted in Figure 4. Pupils will gain from a blend of instructional strategies, visual elements, and gamification tactics that will maximize their learning outcomes.
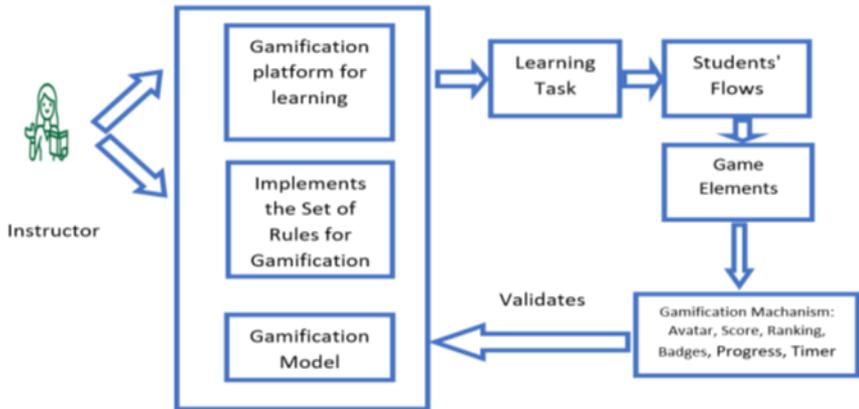

Fig.4. Proposed Framework of Gamification for Student education

3.4 Gamification Mechanism

Avatar: In gamification of education, an avatar represents the student. Pupils must be positioned appropriately. The avatar "student" is selected based on the student's abilities, course content, and intended educational purpose, as opposed to other crucial considerations.

Score: A score is a type of gamification statistic that offers a thorough analysis of a student's performance in all gamification classes together. It suggests that aggressiveness, tact, and everything in between are taken into account.
Ranking: The purpose of a ranking is to let students know where they stand in a gamified lesson. The spotlight helps those at the top, and knowing one's position in relation to peers helps everyone else.

Badges: Badges are virtual awards that indicate accomplishments in completing particular tasks and are awarded by other users. Badges gained a lot of traction in online games after accomplishments were added to the Xbox Live system.
Progress is a metric used in gamification classrooms to inform users of how well pupils are doing in reaching their objectives.

Timer: Using timers in gamified classrooms increases the physical strain, emotional attachment, and excitement levels. Unsurprisingly, they want to use gamification—the incorporation of gaming elements into learning—to boost student engagement. When there are time limits, students concentrate better.

3.5 Benefits and Challenges in Connection with Machine Learning and Gamification

The advantages of gamification for the machine learning community are presented after the advantages of applying machine learning for the gamification community. Lastly, we list some of the difficulties that have been found when combining gamification and machine learning. According to (Barde et al. 2022) machine learning specifically aids in adjusting game features and task difficulty and offers early student profile detection to improve gamification. Only with machine learning may gamified tasks be improved by adjusting game features according on interaction progress and system goals. Stated differently, this facilitates the continuation of user involvement with the platform, often known as engagement, and updates interaction contents to make them more useful and realistic.

One advantage of applying machine learning to gamification jobs is that it automates personalization without requiring operators to do extra effort. This is also documented in (Creery et al., 2018). The user experience has continuously been enhanced by customizing game features according to user choices and capabilities. This is because many of the individual user potentials, limitations, and behaviors are unknown because game features are often planned and built once, before the system is exposed to the natural world. Designing a system that is responsive enough to meet the needs of every user is therefore difficult.

In light of the difficulties, the papers were examined for potential restrictions on the integration of these technologies. Since the researchers typically highlight the positive aspects of their work in their reports, there aren't many difficulties mentioned that although large datasets are an essential prerequisite for machine learning-based gamified platforms, the limitations presented by the small datasets provide a serious barrier (Alsawaier et al., 2018). Most machine learning applications on gamified platforms often aimed to formulate the problem as supervised learning, which necessitates a labeled target variable. However, by employing the limited quantity of data that is accessible, it can be advantageous to think of them as different kinds of machine learning issues, such semi-supervised learning, for instance. when the users are grouped according to their performance.

4   Result and Analysis

Results analysis is also done in two parts since we have adopted two approaches for gamification in education.

4.1 Results of Survey-Based Models

Comparing the outcomes obtained prior to and following the gamification concept's deployment allowed us to assess the concept's efficacy. Fifty pupils were given the

survey questionnaire. This survey was designed to find out how much more engaged and knowledgeable they were about the course, how well they performed, and what they thought of the gamification concept. We discovered that all of our results were above average, or positive, after comparing the two surveys. Students' engagement was increased, and they believed that this approach was more successful than the conventional method at improving their comprehension and learning capacities. The proportion of pupils performing below average rose to 50%. Evaluation reports from students before and after gamification are displayed in Table 1, and the improvement is depicted in Figure 5.

Table 1. Evaluation reports from students before and after gamification

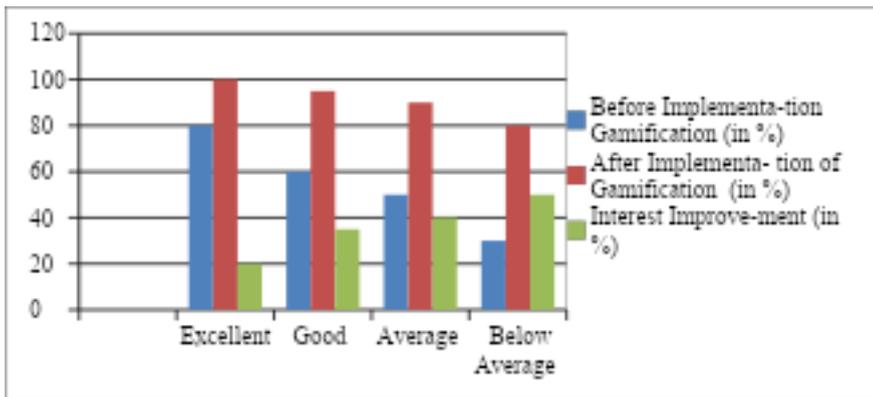| Students Category	Before Implementa-tionGamification (in %)	After Implementa-tion of Gamification (in %)	Interest Improve-ment (in %)
Excellent	80	100	20
Good	60	95	35
Average	50	90	40
Below Average	30	80	50

Fig. 5. The Progress Graph of Improvement

4.2 Results of Conceptual-Based Models

The affinity score of several gamification mechanism components, including "Score," "Avatar," "Ranking," "Badges," "Progress," and "Timer," for student motivation and engagement in the classroom is assessed in this study. The degree of student-teacher engagement in gamified classrooms is indicated by an affinity score, which is a percentage of several interaction characteristics.The initial and end affinity scores for each gamification technique are displayed in Table 2. After calculating the affinity score for each mechanism, it is shown that "Avatar" provides pupils in gamification classrooms with high levels of motivation and dedication.

The accuracy score of the "Hexad"(User Type framework) and "Motive" (refers to the reason that encourage to the user to engage with a activity) profiles in the gamification classroom is displayed in Table 3. Following a random selection of students for the "Hexad" and "motive" profiles, it seems that 16% and 18% of the tasks, respectively, seem beneficial to students in terms of gamification. It indicates which game features are best suited for gamification based on the characteristics of the students.

Table 2. The affinity and Final scores

Gamification Mechanisms	Affinity Score	Final Score
Score	4.85	14.08
Avatar	3.21	22.31
Ranking	0.0	1.13
Badges	0.18	0.68
Progress	1.79	21.30
Timer	6.74	2.27

Table 3. Accuracy Score of Profile in Gamification

Profile	Accuracy score
Hexad	0.16
Motive	0.18

A student's level of motivation and engagement in a given subject through gamification is to be used as a proxy for the relevance vector. Each gamification mechanism's relevance vector is displayed in Table 4. After assessing each mechanism's relevance vector, it has been found that "Avatar" effectively motivates and engages students in specific subjects in gamification classrooms.

Table 4. Relevance Vector of Gamification

Gamification Mechanisms / Relevance Vector	Avatar	Badges	Progress	Ranking	Score	Timer
	0.1529	0.1410	0.0247	0.0	0.073	0.299

Table 5. Comparative and Performance Analysis of Before and after Gamification in (%)

Profile Indicator	Fully Completed Lesson Count	Restarted Quiz Count	Passed Quiz Count	Quiz Count	Question Count
Before Gamification					
Hexad	15.3	37.35	5.99	7.72	11.1
Motive	27.19	13.89	23.14	19.98	15.93
Combine	8.14	17.19	13.54	13.67	10.98
After Gamification					
Hexad	12.31	38.18	4.46	8.44	10.95
Motive	28.6	16.39	29.44	18.26	14.09
Combine	2.14	11.33	11.46	17.58	15.09

In order to enhance students' learning and engagement in gamification classrooms, Table 5 presents a comparative and performance analysis of before and after gamification. It is noted that the 'Hexad' and 'Motive' values, and particularly the Game Elements ratios, differ in order of magnitude. Because some will have a greater influence than others, it will not be able to create a conventional total.

The objective is to create two groups of students using the vectors obtained: one containing students who have been assigned a Game Element deemed suitable and the other containing students with a Game Element that is not suitable. Then, we will measure the differences between several chosen indicators (e.g., time spent on the application) to check the vectors' relevance.

Table 6. Growth rate between the group with Profile Indicator (in %)

Profile Indicator	Var MI	Var ME	Var AMOT
Hexad	50.48	84.17	29.9
Motive	30.87	49.17	29.3
Combine	46.71	56.79	13.63

Indeed, the chosen indicators must be more or less linked to the investment of the pupils in the application. Therefore, the idea is to verify that students with an adapted Game Element are more involved than those with an unsuitable Game Element. For each chosen indicator and affinity vector, it is possible to observe the growth rate between the groups with Game Elements deemed to be unsuitable and the groups with Game Elements deemed suitable.

After the gamification, it was found that following the recommendations of the 'motive,' (After motivation student joined) 'Hexad,'(Students Groups) and 'Combined' profiles, the group of students with unadapted game elements completed an average of 28%, 38%, and 11%, respectively more lessons than the group with adapted game elements.
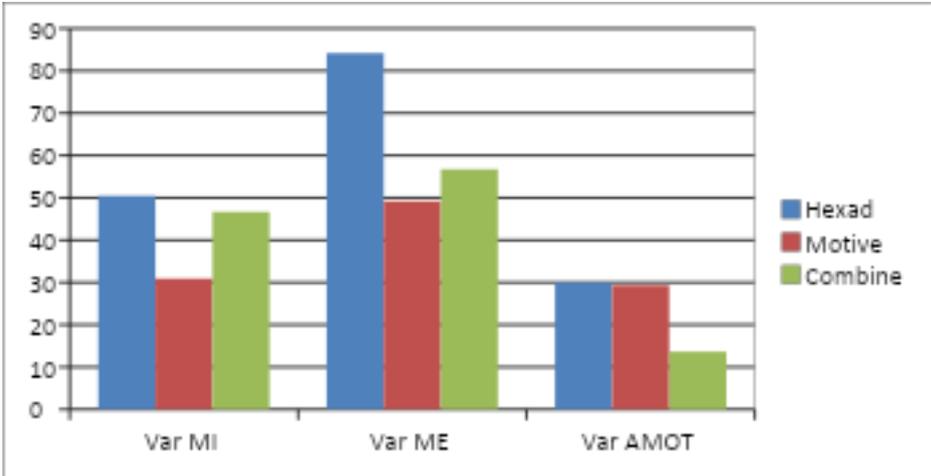
Fig. 6. Bar representation of Growth rate between the group with Profile Indicator (in %)

The group's growth rate using the Profile Indicator is displayed in Table 6. The growth rate between the group with game elements judged inappropriate and the group with appropriate game elements is noted for each affinity vector and selected profile indicator. Depending on the profile indicator, the growth rate may be positivein some circumstances. Students spend longer time in gamified classrooms and are more involved, as seen by the high profile indicator value. Therefore, it seems that profile indicators are important in gamification shown in figure 6.

The 'Combined' profile has been shown to be the most stable when it comes to gamification of student learning and engagement. This profile uses a range of average values. Students who included game aspects into their lessons invested 12% more in the gamification process than those who did not. This is more beneficial for creating effective gamification learning environments. Due to fuzzification, this study demonstrates that the 'Hexad' profile has been discovered to be inconsistent with the outcomes of the other two profiles. For instance, it appears to be unimportant if the growth rate is positive for it and negative for Passed Quiz Count and Fully Completed Lesson Count.

Table 7. Growth Rate for Group Gamification

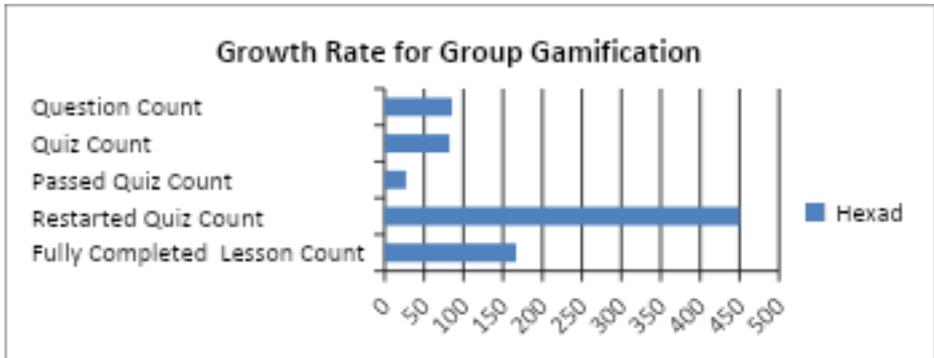| Profile Indicator	Fully Completed Lesson Count	Restarted Quiz Count	Passed Quiz Count	Quiz Count	Question Count
Hexad	166.67	450.0	27.03	82.09	85.28

Fig. 7 Bar representation of Growth Rate for Group Gamification

The growth rate for group gamification is displayed in Table 7. After the gamification, it has been found that the greatest number of students are motivated when the quiz is restarted. An additional 350 students are inspired and involved in gamification if there are 100 pupils in total. After finishing the session, 66% more students engage and participate, according to the Fully Completed session Count.

The Growth Rate for Group Gamification is represented by a bar in Figure 7. It is evident that gamification increases the interaction between students and teachers or instructors and makes students' doubts more apparent. Additionally, it has been noted that the teacher-student interaction has improved.

4.3 Verification of a point that challenges us

Try to confirm in this area that a good recommendation based on the student's profile, rather than a specific game element, is what increases student interest. In fact, it is noted that the gamification mechanisms "Avatar," "Score," and "Timer" are most frequently seen in table 7's recommendations. Whether or not these gamification methods are suggested by profile indicators, we want to make sure that students' involvement and engagement in gamification is not increased in an absolute or general fashion. To accomplish this, divide each vector into two equal-sized student groups, each of which is assigned Game Element G.

 The first group comprises pupils for whom G (in the first slot) was recommended by the vector. Students that the vector did not recommend G to (G not in the TOP-k of recommendations, k > 1) are in the second group. The suggested gamification of Machismo is displayed in Table 8 according to their rating. It has been noted that "avatar" is frequently suggested first. Specifically, regarding the motivation vector: This game element should be present in 257 out of 258 pupils. Either matrices and vectors lack relevance, or it is a great entertaining aspect.

Table 8. Recommendation of Gamification Mechanism

S. No.	Gamification Mechanism						Total
	'Avatar'	'Badges'	'Progress'	'Ranking'	'Score'	'Timer'	
1	141	0	10	8	37	62	258
2	257	0	0	0	1	0	258
3	212	0	0	0	17	29	258

5   Conclusion and Future Scope

Gamification technology has greatly improved human-computer interactions in recent years. However, as machine learning techniques progress, more research is being done on the possible combination of these two technologies. In order to examine every facet of this phenomenon, we conducted a thorough literature analysis in order to research the convergence of gamification and machine learning. To investigate the use of machine learning in gamified applications and vice versa, their interactions, and the advantages and difficulties of integrating these two technologies, we developed five study questions. Consequently, a number of machine learning applications have been found to improve gamification performance. Our results have been divided into three groups: works pertaining to education and learning, gamification task personalization, and attempts to modify behavior. The most frequently used area of focus under these categories is application relating to learning and education. The learning and education sector has long been one of the primary uses of gamification. The issue with gamified chores, though, is that they typically don't hold users' attention over time. The research community has made numerous attempts to use machine learning to address this problem, and a number of solutions have been discovered. Customizing gamified learning platforms is one of the common strategies. There are various ways to do this customisation. One is to record users' interactions with the system in order to learn about their preferences and capabilities, and then modify the gamified activities accordingly. Additionally, it is feasible to identify the learners' impacted states throughout gameplay scenarios and adjust the game experience accordingly.

Additionally, it may be possible to forecast future user behavior and utilize that information to offer recommendations to users as a kind of incentive. Additionally, machine learning can assist a learning system in grouping students according to their performance and ability so that they can receive gamified tasks tailored to their needs. The degree of user interaction with the system must also be assessed and evaluated, which can be done with machine learning and has been demonstrated in numerous research. Providing users with context-specific gamified content is another crucial component of gamified learning platforms.

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