

# Gamified Environmental Education Platform for Schools and Colleges

Avish Gadekar<sup>1</sup>, Abhinav Naidu<sup>2</sup>, Shreya Chaya<sup>3</sup>

<sup>1,2,3</sup>Research Student, Bachelor of Computer Application,  
JSPM University, Pune, India

**Abstract:** *It is very important to engage students in sustainable behavior through environmental education, but the concept is still being taught primarily theoretically in a lot of schools and colleges. It results in lack of involvement and interest on the side of the learners, which hampers their learning process and makes it hard for students to see a direct relation between theoretical classes and practical experience. Therefore, we suggest using a gamified system for teaching environmental education, which involves quizzes, challenges, badges, eco-points, and leaderboards. Our proposed system relies on React as a frontend library, Flask as backend services, and SQLite database to achieve our goals based on the client-server architecture, which includes authentications, learning, quiz, challenge, gamification, and analytics modules. Our approach to evaluation consists of engagement analysis, improved performance, and feedback from teachers. Our solution supports NEP 2020 and SDGs (quality education and climate action).*

**Keywords:** Gamification, Environmental Education, Sustainability, Game-Based Learning, Eco-Points, Student Engagement, NEP 2020, SDGs

## I. INTRODUCTION

There are many environmental problems emerging worldwide during the recent years. Some of the environmental problems are pollution, climate change, global warming, and deforestation, which are causing impact on humans and eco-systems. There is a need to aware peoples about the environment through sustainable actions. Environmental education is a crucial part of raising awareness among peoples to maintain and protect nature. Schools and college play their role in environmental education of the students. The traditional environmental education method is based on lessons and other theoretical aspects, with little involvement in practical work. Students get bored of the classroom teaching method due to lack of motivation and practical aspects. Most students learn environmental aspects in order to complete the curriculum and not implement in practice. Thus there is a gap between environmental knowledge and environmental action. Due to advances in technology, there are new forms of learning methods. Assistance provided by computer and internet in learning processes has taken place of traditional methods of learning. Gamification is one of the favorite tools used to encourage students to learn through entertainment. Gamification consists of points, badges, rewards, levels, and leaderboards. Through these aspects the learning method will be funny and interesting to students. Several proposed research projects gamification-based platform for environmental learning at school and college levels. The proposed platform strives to deliver environmental education through the means of quiz games, eco challenges, and other environmental activity based tasks. The users will be rewarded with eco points and badges on the basis of their successful completion of learning tasks and environmental challenges. In addition, the system emphasizes real life environmental practices like recycling and trees plantations activities. The platform uses dashboards and analytic tools for the purpose of monitoring the learning processes. The platform has been deployed using react, flask, and Sqlite for frontend, backend, and database respectively. Therefore, this proposal suggests a new way



## **II. RELATEDWORK**

A review of related work in educational technology reveals that the process of gamification is becoming increasingly significant in terms of enhancing student engagement and performance. Numerous works have been carried out with respect to the gamification techniques within education systems. Gamification is currently extensively adopted to engage and entertain the students during the learning process. Techniques like points, badges, rewards, levels, and leader boards have helped boost the motivation of students and make them more actively participate in the learning process. Several research prove that gamification makes students more knowledgeable by increasing their interest and participation in the learning process. In this regard, Hamari et al. described the importance of gamification as being helpful for boosting user engagement and learning outcomes. Similarly, Dishevel et al. investigated the impact of gamification on educational systems where they observed that students' interest increases while participating in the gamified processes of learning. Gamification not only encourages the participants to become interested in the process but also enhances the interaction among the participants. As per Sailor et al., reward-based systems enhance the performance of the learners and generate feelings of success using badges and achievements systems. The conventional teaching approach largely involves theoretical and book-oriented education which often hampers students' involvement and practical knowledge. It was found out that students gain knowledge better by participating actively in various activities and exercises. Active participation helps to understand things better and remember them permanently. Online learning allows flexibility and easy access for learners, and they can learn via any place and any device. Nowadays, students have become more tech-savvy, and multimedia materials like animations, videos, quizzes, and tasks improve learning process. Also, according to the researches performed by UNESCO, it is necessary to pay attention to digital education systems. It was found that game-based learning develops students' skills to solve problems, analyse the situation, and make decisions effectively. Environmental education is highly relevant nowadays due to many problems occurring, for example, pollution, climate changes, and global warming. There is no doubt that educational establishments should promote environment protection and raise awareness of students in environmental issues. But traditional teaching method does not include practical aspects of education and often remains purely theoretical. Students get acquainted with environmental issues just for passing exams. This leads to a disconnect between environmental awareness and sustainable behaviour. Researchers suggest a need for pragmatic and action-oriented approaches to environmental education to enhance student participation and behaviour. Current environmental education platforms offer awareness-related information but lack gamification and motivation-based mechanisms. Many current solutions do not incorporate rewards, badges, leader boards, and activity logging capabilities. Instructors face challenges in assessing the academic performance and participation levels of their students in various environmental activities. Research studies prove that students find themselves motivated during learning activities with competition, achievements, and rewards. Leader boards and eco-point systems generate a feeling of accomplishment and enhance learner participation. Practical environmental actions such as recycling and tree plantation programs help students adopt sustainable practices. Researchers advocate for the incorporation of technological components into environmental education for better academic performance and sustainable behaviour. Web-based technologies support flexible, scalable, and adaptive educational platforms with performance monitoring capabilities. However, many current platforms still fail to integrate gamification, activity logging, and environmental education on one platform. The research aims to address these issues through the development of a Gamified Environmental Education Platform.

## **III. METHODOLOGY**

This research proposal follows a scientific methodology to build the Gamified Environmental Education platform for school and college students. The methodology involves integrating both environmental education and gamification approaches to increase the learning outcomes and engagement of the students. Requirement analysis and problem identification form the first step of the development cycle, where we study carefully the limitations of the existing environmental education system.



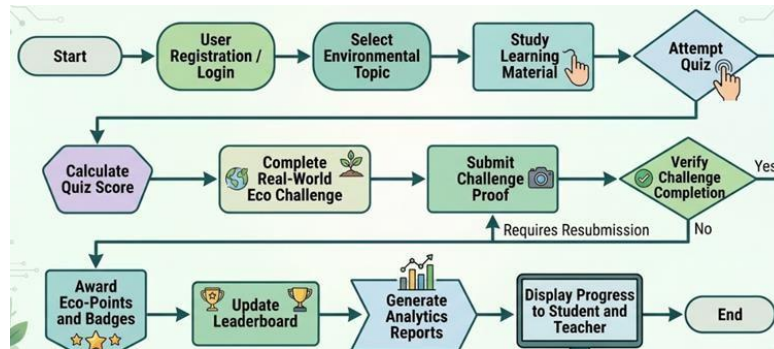


Figure1. Work flow of Gamified Environmental Education platform

These will assist in determining the necessary features and capabilities of the platform. The suggested platform employs a modular and user-friendly design. Methodology consists of several stages such as planning, design, development, testing, and evaluation.

Stage one revolves around the identification of environmental education problems and user expectations. Stage two entails the development of a system design and database design. The frontend of the platform will be designed using React framework. React offers an interactive front-end for both users and teachers.

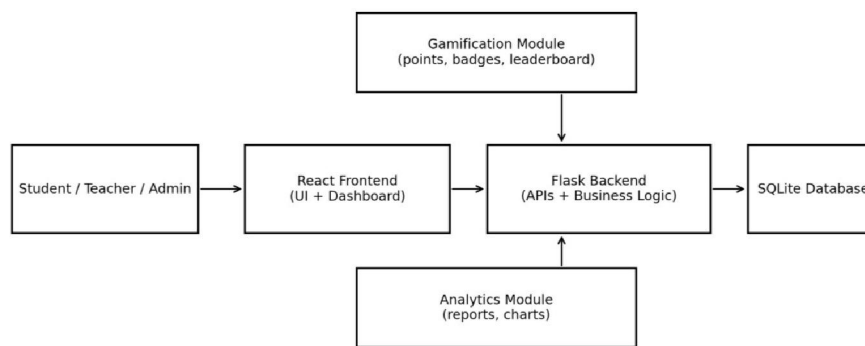


Figure 2. System architecture of the platform.

The backend service is built on Flask framework. Flask is used for API handling, user request handling, authentication, and processing of data. SQLite database management system is implemented for efficient data storage in the database. The database contains user information, quiz information, eco-points, badges, and user activities. The proposed platform is implemented using separate modules for students, teachers, and administrators. Students will be able to register themselves and log in for accessing learning resources and engaging in learning activities. Teachers can upload learning resources and monitor their students' performance. Administrators can manage the complete functionality of the platform. Environmental learning material will be provided using digital modules and multimedia. The quiz is conducted to assess the student's understanding of environmental concepts. Eco-challenge is added to motivate students towards environmental activities. Students can provide proof of their activities like recycling and tree plantation.

The reward system motivates and promotes continuous participation of the players in the system. The platform includes the features of tracking and analysing the player's progress. The teachers can monitor student engagement, quiz scores, and completion percentage of activity. The system generates reports and dashboards to facilitate performance analysis. The user friendly interface will facilitate easy navigation and access. The platform will also be device compatible with laptops and smartphones. Testing of the application and system performance will be carried out to ensure its correct and optimal. functionality. Functional testing will be carried out to test individual modules of the application. Performance testing will be carried out to ensure smooth functioning under all conditions. Usability testing will be done to check user interaction and interface. Data analysis and evaluation of results will be done in this methodology. Students'



engagement and participation rates will be checked for evaluation of the system. Knowledge retention and practical behaviour are also analysed.

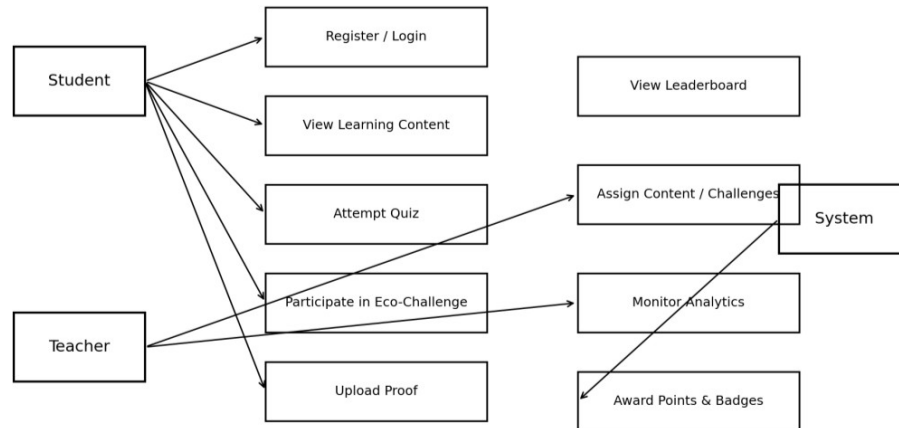


Figure 3. Use case.

#### IV. RESULT & DISCUSSION

The development of Gamified Environmental Education Platform was done to study its effectiveness in boosting student engagement, environment awareness, and active participation in sustainability practices. Several modules such as quizzes, eco challenges, eco-points, badges, leader boards, analytics, and activity monitoring were used on the proposed platform. The system successfully created an engaging learning platform that is easy to use by students and teachers alike. It enabled students to access environmental education information and participate actively in quizzes and eco-challenges. Activities like recycling, tree planting, and waste management boosted students' participation in environmental practices. Eco-points and rewards motivated students to perform more environmental education activities and remain engaged actively. Leader boards created healthy competition among students and made them stay engaged actively in environment-related activities. The teacher noted that students were interested in environment topics more than in classroom learning. The gamification strategy made students interact better with educational information while improving learning and retention. Multimedia learning materials like quizzes and eco-challenges made students better at remembering environmental concepts. It allowed students to connect environmental theory with sustainable practice. Monitoring of students' progress took place effectively through the use of analytics dashboards and performance reports. Through the use of the reporting system, students' participation levels and their performance in quizzes could be easily detected. The user interface was discovered to be user-friendly and easy to navigate. The use of the React framework facilitated performance on several devices, whereas the Flask framework efficiently performed the tasks requested by the user and processed data. The SQLite database was able to store user information, activity logs, scores, and eco-points. The results of functional testing were positive since all system components were operating perfectly fine. The system worked smoothly when performance testing was done, and usability testing proved that the system is user-friendly. Gamification techniques applied in the proposed system increased student participation and motivation. The research proved that incorporating gamification in environmental education enhances the effectiveness and motivation of the learners. The proposed solution minimized problems associated with traditional environmental education due to interaction, measurability, and activities involved. The modularity of the proposed system makes it adaptable to school settings and colleges.



TABLE I: Test cases

Test Case ID	Test Scenario	Test Description	Input Data	Expected Result	Actual Result	Status
TC01	User Registration	Register new user	Valid user details	User account created successfully	Account created successfully	Pass
TC02	User Login (Valid)	Login with correct credentials	Valid email & password	Login successful, dashboard displayed	Login successful	Pass
TC03	User Login (Invalid)	Login with incorrect credentials	Wrong password	Error message displayed	Error message displayed	Pass
TC04	Challenge Viewing	View available challenges	User logged in	List of challenges displayed	Challenges displayed	Pass
TC05	Challenge Completion	Submit completed challenge	Valid submission	Points awarded and status updated	Points updated correctly	Pass
TC06	Quiz Submission	Submit quiz answers	Selected answers	Score calculated and displayed	Score displayed correctly	Pass
TC07	Leaderboard Update	Update leaderboard after points change	Updated points	Rank updated dynamically	Rank updated correctly	Pass
TC08	Badge Assignment	Award badge after milestone	Points threshold reached	Badge assigned	Badge assigned correctly	Pass
TC09	Notification Trigger	Send notification on task completion	Completed task	Notification sent	Notification received	Pass
TC10	Profile Update	Update user profile	New profile data	Profile updated successfully	Profile updated	Pass

## V. CONCLUSION

The suggested gamified learning platform for environmental education is designed to enhance environmental awareness and student engagement in environmental learning activities. The study focused on the effective application of gamification approaches to enhance environmental learning and education. Traditional environmental learning methods are based on theories which do not effectively catch student attention. The new learning system overcomes this challenge by offering eco-quizzes, challenges, rewards, badges, and other features. The suggested platform has helped in building an interactive and active environment for environmental learning and study stages. With the new approach, students have been encouraged

To participate in environmental learning activities as part of the system, reward systems and eco-points helped in enhancing student participation level. The leaderboard facility helped students in feeling competitive in learning. Here, students have been able to retain the knowledge gained from environmental learning activities. Activities have helped students in applying theoretical information in practical environmental activities. Using analytics dashboard, teachers were capable of monitoring the performance and participation of their students. The application made the task of tracking quizzes, activity, and accomplishments much easier. The utilization of React, Flask, and SQLite technologies ensured that the performance of the system was seamless. The user interface was user-friendly, responsive, and easy to navigate for both students and teachers.

The backend services facilitated the process of receiving user requests, authentication and managing data. Effectively the database was used to manage and save users' info, quizzes results and eco-points. Functional testing established that all modules were working properly without significant bugs. Performance testing established that the system performs well with multiple users. The test of usability also suggests positive results concerning accessibility and simplicity. The



findings have shown that gamification increases learning participation and efficiency in environment. The proposed system minimized the drawbacks of previous methods of teaching environmental education based on classes. The proposed approach enabled interactive, flexible and self-paced studying environments. The development of this project stressed the significance of using technology to develop learning systems. Methods used in the development of this system are in line with the objectives of NEP 2020 and sustainable development goals. The project proved the efficacy of gamified learning systems in spreading environmental awareness. Accordingly, the proposed platform encouraged environmental consciousness and sustainable lifestyles. The modular system architecture makes the system scalable and ideal for educational institutions. An extensible and upgradable system with the help of the modular approach makes the system useful for future uses. Through updates, the system will become more

Complex and useful. This can include implementation of the system in cloud computing, AI-based learning and recommendation systems, IoT-based monitoring systems etc. Therefore, the proposed platform provides a useful solution to the challenges of environmental learning.

#### **ACKNOWLEDGMENT**

It would be appropriate for us to express our sincere gratitude to our project guide for rendering immense help, support, and encouragement in doing this research. We extend our heartiest appreciation to the faculty members of the Department of BCA for encouraging us and helping us during the course of the project. We would like to thank our college management for arranging all the facilities needed for the successful completion of this research project. We are also thankful to our friends and classmates for their helpful suggestions, feedback, and cooperation throughout the project. We sincerely appreciate all the participants for rendering immense help during the testing and evaluating phase of this system. We thank all the developers of React, Flask, and SQLite technologies for providing us valuable resources. We thank various research papers, journals, and websites for making us acquainted with the gamification concept. We express our appreciation to our family members who rendered immense motivation to us, which played a key role in our success. It would be appropriate for us to thank all those people who rendered us help indirectly and directly in the completion of our project.

#### **REFERENCES**

- [1]. Hamari, J., Koivisto, J., and Sarsa, H., "Does Gamification Work? A Literature Review of Empirical Studies on Gamification," IEEE, 2014.
- [2]. Dicheva, D., Dichev, C., Agre, G., and Angelova, G., "Gamification in Education: A Systematic Mapping Study," Educational Technology & Society, 2015.
- [3]. Sailer, M., Hense, J., Mayr, S., and Mandl, H., "How Gamification Motivates: An Experimental Study of the Effects of Specific Game Design Elements," Computers in Human Behavior, 2017.
- [4]. Clark, R. C., and Mayer, R. E., "E-Learning and the Science of Instruction," Wiley Publication, 2016.
- [5]. UNESCO, "Digital Learning and Education Report," United Nations Educational, Scientific and Cultural Organization, 2022.
- [6]. Kapp, K. M., "The Gamification of Learning and Instruction," Pfeiffer Publication, 2012.
- [7]. Domínguez, A., Saenz-de-Navarrete, J., de-Marcos, L., et al., "Gamifying Learning Experiences: Practical Implications and Outcomes," Computers & Education, 2013.
- [8]. Werbach, K., and Hunter, D., "For the Win: How Game Thinking Can Revolutionize Your Business," Wharton Digital Press, 2012.
- [9]. Gee, J. P., "What Video Games Have to Teach Us About Learning and Literacy," Palgrave Macmillan, 2007.
- [10]. Deci, E. L., and Ryan, R. M., "Self-Determination Theory and the Facilitation of Intrinsic Motivation," American Psychologist, 2000.
- [11]. Indian Ministry of Education, "National Education Policy 2020," Government of India, 2020.
- [12]. United Nations, "Sustainable Development Goals Report," United Nations Publication, 2022.



- [13]. Mayer, R. E., "Multimedia Learning," Cambridge University Press, 2009.
- [14]. Siemens, G., "Connectivism: A Learning Theory for the Digital Age," International Journal of Instructional Technology and Distance Learning, 2005.
- [15]. Chen, C. M., and Hsu, S. H., "Personalized Intelligent Mobile Learning System for Supporting Effective English Learning," Educational Technology & Society, 2008.
- [16]. Al-Azawi, R., Al-Faliti, F., and Al-Blushi, M., "Educational Gamification Vs. Game Based Learning: Comparative Study," International Journal of Innovation, Management and Technology, 2.
- [17].

