IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 7.12 ⁜ Vol. 10, Issue 1, January 2023

DOI: 10.17148/IARJSET.2023.10116

GAMIFIED LEARNING FOR TEACHING PROGRAMMING CONCEPTS

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Abstract: Gamified learning is a teaching method that uses game-like elements and mechanics to engage learners and motivate them to learn. It is based on the idea that people are more likely to learn when they are motivated and when learning is presented in a fun and engaging way. Online games are a popular form of gamified learning, as they can be accessed from any device with an internet connection and can offer a high level of interactivity and engagement.

Keywords: Gamified learning, Learning Management System (LMS), programming, understanding

I. INTRODUCTION

Online games for learning can take many forms, including educational games, simulations, and virtual worlds. These games often incorporate elements like points, badges, levels, challenges, and feedback to encourage learners to participate and compete. They may also include features like customizable avatars, social interactions, and real-time feedback to create a more immersive and interactive learning experience.

There are many benefits to using online games for learning, including:
Increased engagement and motivation: Online games can make learning more enjoyable and engaging, which can lead to higher levels of motivation and participation.

Improved retention and transfer of knowledge: Online games can help learners to better retain and apply what they have learned, as they often involve actively applying knowledge in order to progress or complete challenges.

Enhanced problem-solving skills and critical thinking: Online games often involve solving problems and making decisions, which can help learners to develop their critical thinking and problem-solving skills.

Customized learning experiences: Online games can be customized to suit the needs and preferences of individual learners, making them an effective way to meet the diverse learning needs of students.

Following are the exact ways how Games can actually be implemented as a learning tool: Game mechanics: Game mechanics are the elements and rules that define how a game works and how players interact with it. In gamified learning, game mechanics are used to motivate and engage learners, and can include elements like points, badges, levels, challenges, and feedback.

Game-based learning: Game-based learning is a type of gamified learning that involves using games as the primary means of instruction. In game-based learning, the game itself is the focus of the learning experience, and the learning objectives are embedded within the game.

Game-based assessment: Game-based assessment is a type of assessment that uses games or game-like elements to assess learners' knowledge and skills. This can involve using games to assess learners' performance on specific tasks or to measure their progress over time.

Gamification: Gamification is the process of applying game-like elements and mechanics to non-game contexts in order to engage and motivate people. In gamified learning, gamification is used to make learning more engaging and interactive, and to create a sense of progress and accomplishment for learners.

Learning management systems (LMS): A learning management system (LMS) is a software platform that is used to manage and deliver e-learning courses and programs. Many LMSs have built-in gamification features, such as points, badges, and leader boards, that can be used to gamify learning.

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II. RELATED WORK

In this section, we review works that make use of gamification in education and how it affects learning and engagement in the e-learning environment by researchers. It was reported on gamification in education[1]. A systematic review . showed that in the field of medical education and education in general, the majority of studies were conducted in the USA and Canada. Spain had had the highest number of studies on the use of gamification in collaborative learning. Study is a scientometrics, systematic, and co-occurrence analysis of systematic review and meta-analysis articles in the field of gamified education. Motivation, learning and engagement are the one of the most important concepts studied in articles. It was studied effectively in gamification strategy[2] to support self-directed learning in an online learning environment. Online learning has a lot of potential to transform the learning process in higher education.

As attending online classes is economical for learners and does not have to be physically present in class. Educators should equip learners with ample resources to perform and practise self-directed learning. The growth of online learning via the expansion of information and communication technology (ICT) provides flexibility and self-directed learning among learners suiting their learning methods. In 'Effects of a gamified learning environment on students' achievement, motivations, and satisfaction', It was reported[3] that gamification is a relatively new learning strategy that is being increasingly used in education because of its potential to increase learners' motivation and improve their achievements. The view is that the whole learning experience is improved when using gamification, which has been found to stimulate and improve learners' engagement, motivation, social influence, and academic performance. The main goal of the study was to examine the effects of a gamified learning environment on students' achievement, motivation, and satisfaction. In 'Effects of a gamified learning environment on students' achievement, motivations, and satisfaction', It was reported[3] that gamification is a relatively new learning strategy that is being increasingly used in education because of its potential to increase learners' motivation and improve their achievements. The view is that the whole learning experience is improved when using gamification, which has been found to stimulate and improve learners' engagement, motivation, social influence, and academic performance. The main goal of the study was to examine the effects of a gamified learning environment on students' achievement, motivation, and satisfaction.

Over the past ten years, gamification has grown significantly, and educational institutions are now conducting research on how to incorporate it into the classroom as they begin to see its potential. Similar to this, gamification has seen significant success in the market for casual language learning thanks to mobile programmes like Duolingo and Babbel uses gamification to increase the fun of learning a new language. Similar to learning a new foreign language, learning a new programming language can be difficult for pupils. As a result, the authors created a proof-of-concept application that incorporates the gamification ideas seen in the aforementioned language learning apps, and they intend to test it this autumn in a course on basic programming at our university. In the proof-of-concept, features like awards, experience points, and leader-boards are implemented.

Gamification features aimed at encouraging participation of students in the study of fundamental ideas in algorithms, data structures, and pointers. We did extensive research on Moodle and how to integrate gamification plugins into the system. The HotPotatoes, Games, LevelUp, and Badges plugins were used and set up. It produced the lessons in the Moodle environment after defining the lessons about the specific ideas of algorithms. Then it added a number of games, including snakes and ladders, cryptex, crosswords, and hangman. Utilizing LevelUp, we aimed to gamify the students' learning experience by allowing them to earn experience points to level up in their courses.

Gamification in education is one of the burgeoning disciplines since it makes learning more enjoyable and makes information retention easier. Gamification and learning go hand in hand very well. Both of these are passive activities that demand engagement and inspiration throughout the entire gamification process. The differences between children and adults do not exist. They both want to enjoy their education. This essay describes a novel teaching strategy. Adults are being taught programming fundamentals through the use of gamification.

There are many different game kinds that are utilised in education, such as game-based learning (GBL), a form of game-playing with predetermined learning objectives. Gamification and game-based learning are not the same thing. Gamification is the incorporation of game principles into learning, whereas game-based learning is utilising a game as a learning tool. Gamification, the use of games to improve enjoyment and participation in all facets of our life, is exclusively employed in education.

Content Gamification is the application of game elements, game mechanics and game thinking to alter content to make it more game-like. So, beside game elements, there is a change to the content such as providing a story, challenge,curiosity, mystery and characters to content, to engage the learner [6].

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Researchers outlined two types of academic motivation—intrinsic and extrinsic motivation. Intrinsic motivation occurs when students engage in learning “For it’s own sake” and they enjoy it. Some examples are: altruism, competition, cooperation, sense of belonging, and love or aggression. Extrinsic motivation occurs when something or someone pushes the student to make an action, for example: classifications, levels, points, badges, awards, missions. The process of modifying content to make it more resemble a game involves using game mechanics, game elements, and game thinking. In order to interest the student, there is a change to the material in addition to the game aspects, such as adding a plot, challenge, intrigue, mystery, and characters [6]. Extrinsic and intrinsic motivation were identified by researchers as the two main categories of academic motivation. When pupils like learning "for its own sake," they are intrinsically motivated to do so. Altruism, rivalry, teamwork, a sense of belonging, and love or violence are a few examples. When something or someone forces a student to act, such as through classifications, levels, points, badges, awards, or missions, this is known as extrinsic motivation.

The Covid-19 Pandemic has had a significant impact on educational institutions at all levels, including pupils in kindergarten, primary school, secondary school, and even universities. The education sector must be shut down in order to stop the transmission of the coronavirus and lower the epidemic. To enable sufficient social separation, practically all teaching has quickly migrated to distant learning (Johnson et al., 2020). It was challenging to plan empirical research that investigated the usage of gamified tools because of the COVID-19 outbreak's fast development, and most instructors were making great efforts to switch from in-person lectures to online lectures via videoconferencing tools (Nieto-Escamez and Roldan-Tapia, 2021). Present-day lecturers need to pay attention to the growing issue of students who are losing interest in and motivation for their classes.

Many institutions have started using gamification concepts or apps to improve students' learning experiences, but it's crucial to find the best technique to guarantee that the students are effectively learning through gamification. (2013) Stott and Neustaedter Gamification has a favourable effect on subsequent behaviours like participation and academic achievement to raise students educational level, especially over the short term. (Nekuchaev, Ponomarev, and Golubovski, 1998). The previous researcher also addressed the necessity for educators to create new teaching tactics in order to increase students' enthusiasm and commitment in online classes. Gamification is one method that educators have become interested in recently as they have been researching.

Kahoot is a student response system that draws students in with pre-planned or impromptu tests, conversations, and surveys in the style of games. The quiz can be accessed by students from any device with a web browser, including an iPad, mobile device, or laptop, and they don't require a Kahoot account to do so. To design the quiz, the instructor will nevertheless require a login. It is quick and simple to create surveys, debates, and quizzes. (2015) Dellos The Kahoot application is simple to use and has gained popularity for encouraging student collaboration to win. The fact that this application is both web-based and free, as well as being compatible with mobile devices, is its largest benefit.

The scoreboard system functions similarly to a scoreboard that presents a ranked and sorted list, and it effectively displays students' total performance. Around 70 pupils were subjected to Dr. Carman Neustaedter's application of gamification principles using a scoreboard system. When the course was examined, it was clear that there was some freedom to fail, that progress was being made, and that narrative was being used. (2013) Stott and Neustaedter. Additionally, because they can visually and digitally detect changes in ranking as a result of recent uploads, it demonstrates how certain coursework affects their score. It should be emphasised that employing points is not the sole factor in the scoreboard's efficiency.

The scoreboard helps motivate people because accomplishments are intimately tied to opportunities for the future and prior successes. For instance, students who are only 50 XP behind the students in front of them might be more motivated to work harder for the upcoming assignment if the "B" grade students decide they are happy with their existing grades and solely care about them.

The Covid-19 pandemic has had a catastrophic impact on society, economy, and politics as well as on people's health throughout the world (Arnove, 2020). Universities were harmed by this because several nations closed buildings, forcing instruction to shift nearly immediately to online delivery. Students at all educational levels have been greatly impacted by the sudden changes brought on by the pandemic. To address the academic lag caused by the Covid-19 epidemic, educators must create the best learning environments possible (American Psychological Association [APA], 2020; Daniel, 2020).

According to current educational trends, instructors prefer active learning, which places the student at the centre of the learning process (Tharayil et al., 2018). Therefore, according to a number of studies, active learning transitions pupils

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from memorization to a more fulfilling learning experience (Aji & Khan, 2019). According to Freeman et al. (2014), students who participate in active learning are less likely to fail a class or leave school altogether than those who attend traditional instruction. Students typically earn better grades when teachers refrain from 2021, page 37 of the Australasian Journal of Educational Technology (5). Set clear learning objectives, limit distractions, and give students opportunities to communicate and ask questions in secure areas.

The students in the two undergraduate classes felt that the gamification method encouraged them to show up to class, participate, and complete the assignments during the lockdown brought on by the Covid-19 pandemic. These results are consistent with those of Park et al. (2019) and Morschheuser et al. (2019), who discovered that students thought receiving a benefit after completing a task or activity was a pleasurable experience. In this way, the findings of our study demonstrated how gamification in higher education, when combined with a reward system, can engage and encourage students in a challenging online learning environment. The study also showed that the reward system might increase flow and encourage students to participate in the course.

Games are an integral part of human life, regardless of age or gender, according to several anthropological research studies (Santos-Guevara & Rincon-Flores, 2021; Smiderle et al., 2020; Stefani et al., 2014). Due to the acknowledgement of the student's cognitive abilities, attitudes, and values, as well as the atmosphere of healthy competition created by the reward system, gamification as part of educational strategy can make learning settings into more fun processes.

We also draw attention to a fascinating finding that supports the notion that gamification is interactive.

III. GOALS AND OBJECTIVES

As a learning management system (LMS) that helps students learn JavaScript through games, our goal is to provide a more interactive and engaging way for students to learn programming concepts and skills. By using games as a learning tool, we can provide students with a more dynamic and enjoyable learning experience that is more likely to hold their attention and motivate them to learn. Games can also provide a more interactive and hands-on way for students to practice and apply programming concepts, which can help to solidify their understanding and build their skills.

In addition to providing a more engaging learning experience, our goal as an LMS that helps students learn Java, Python, C++, JavaScript and even fundamental web development languages like HTML and CSS through games is also to improve students' retention and understanding of programming concepts. Games can provide a more interactive and immersive way for students to learn and retain programming concepts, which can improve their overall understanding of the material.

Another goal of ours is to provide a more personalized and adaptive learning experience. By using games to teach programming, we can adapt to the individual needs and abilities of each student, providing a more personalized learning experience that is tailored to their specific needs and goals.

Finally, our goal is to increase student motivation and engagement. Games can provide a sense of accomplishment and progress, which can help to increase student motivation and engagement. By using games to teach programming, we can help to keep students motivated and engaged as they learn.

IV. METHODOLOGY

The system offers a semantic way to deal with student’s learning difficulties.

A. PROPOSED SYSTEM

The proposed system is a Learning Management System(LMS) which is hosted online. This LMS will have a user login which allows for authentication and verification. The users who register to the lms will have access to their progress in the learning flow. When the user logs in, a progress screen with different programming languages is shown. This will have a card representation of the current progress of the user. When user clicks on the particular language card, they will be taken to an interactive graphical game.

Suppose user choses Python as the language they want to learn, then first a set of installation steps will be presented. User can choose to skip this step then the game will start and there will be incentives to start learning from the basic print statement. As the user progresses through, a progress bar will be shown on the top right corner. Users can switch

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between programming languages at any time and the progress will be stored. After completion, a successful completion certificate will be issued.

B. JWT AUTHENTICATION

JSON Web Token (JWT) defines a standard for authentication which allows for secure transmission of information with the use of JSON object. The information is digitally signed so it can be verified that it is from a trusted source. JWT is defined in (RFC 7519)

It can be primarily used for Authorization and Information exchange. Here is an example of how you might use JWT authentication in a React application: First, we will need to set up a backend server that is responsible for authenticating users and issuing JWTs. This server will have routes for handling login and registration requests, as well as a route for validating JWTs.

In our React application, we will implement a login form and a way to send login requests to our backend server. We will the Axios library to send HTTP requests to our server.

When a user successfully logs in, your backend server should return a JWT. You can store this JWT in the client-side storage (such as localStorage) so that it can be accessed on subsequent requests. On subsequent requests to your server, you can include the JWT in the Authorization header of the request. For example:

```
fetch('/protected-route', {
  headers: {
    'Authorization': `Bearer ${jwt}`
  }
 });
```

On the server side, you can then use a library like jsonwebtoken to verify the JWT and extract the user's information. If the JWT is valid, you can allow the request to proceed. If it is not valid, you can return an error or redirect the user to the login page.

C. UNITY

Unity is a cross-platform game engine that is widely used for creating 2D and 3D games, as well as other interactive content such as virtual reality (VR) and augmented reality (AR) applications. It provides a range of tools and features for creating and testing games, including a visual editor, scripting API, physics engine, animation tools, and audio support.

Here are the ways we will be using Unity in our project: Prototyping: Unity is often used for rapid prototyping of game mechanics and gameplay ideas. Its visual editor and scripting API make it easy to quickly build and test game prototypes. Building games: Unity is used by game developers to build games for a variety of platforms, including PC, console, mobile, and web. It provides a range of tools for creating game assets (such as 3D models, animations, and audio). We aim to make a game using Unity and then integrating it in our React application.

D. REACT APP

React is a popular JavaScript library for building user interfaces that is well-suited for gamified learning projects. It allows us to create reusable components that can be easily shared and customized. This helps in decreasing the development time. It is designed to be fast and efficient, which is important for a gamified learning project that will require frequent updates to the user interface.

React is designed to be compatible with a wide range of libraries and tools, which means that we can easily integrate it with Unity which is a central tool for our gamified learning project. React is particularly well-suited for building interactive user interfaces, which can be important for creating engaging and immersive gamified learning experiences.

So, overall the user will have to go through user authentication as previously mentioned. And later, an introductory quiz will be done to evaluate user expertise and accordingly games will be displayed to upskill themselves. Leadership board will display user progress as well as they compare their scores with other members playing the same game but they can also keep this score bard according to their preference.

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A. WORKFLOW OF LMS

The LMS starts off with user authentication, then introductory quiz to let user get used to the platform and also to evaluate the levelof expertise they possess. Next steps are installation procedure and actual programming games. The following figure represents the whole workflow of the platform.

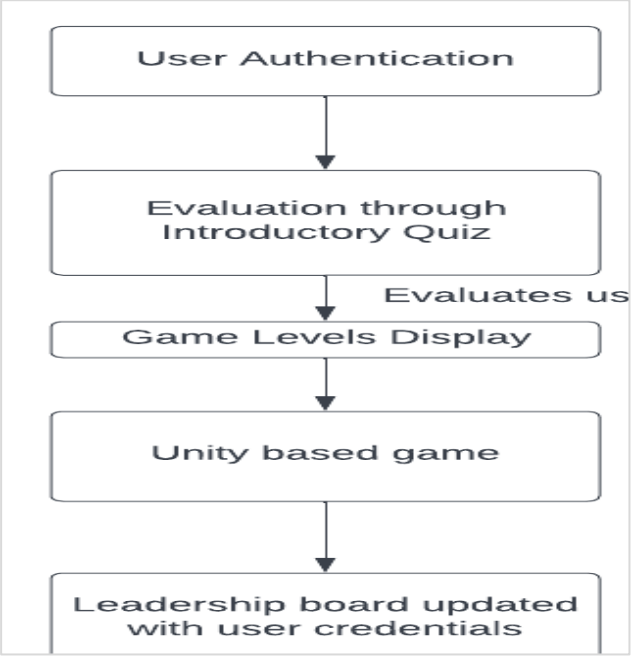

Fig. 1 Workflow of LMS

V. CONCLUSION

A gamified learning platform for programming concepts could be a valuable resource for learners of all ages and experience levels. By incorporating game-like elements such as points, badges, and leaderboards, it has the potential to make learning more engaging and motivating. Interactive, hands-on activities and exercises can also help learners better understand and retain programming concepts.

Such a platform could be used as a supplement to traditional programming courses or as a standalone resource for self-study. Overall, a gamified learning platform has the potential to make learning programming concepts more effective and accessible for a wide range of learners.

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