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Project Supervisor Name: **Dr. Luca Piras**

Student's Full Name: **Benedicta Oghenevole Egbikuadje**

Student's ID Number: **M00882153**

Student's Campus Location: **Hendon**

Student's Project Title: **Gamification of E-Learning Apps for Web-Based Mobile App Development Modules**

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DECLARATION

I, **Benedicta Oghenevole Egbikuadje**, hereby certify that all of the work presented in this report and all other related materials are my own. The information derived from the literature has been appropriately cited in the text, and a list of references has been supplied. No section of this dissertation has been presented previously for another degree or diploma at this or another institution.

Signature: Benedicta Egbikuadje

Date: 30-04-2023

ACKNOWLEDGMENT

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Your expertise and experience in the field were helpful in assisting me to overcome the obstacles I encountered during this project. Your willingness to share your knowledge and provide guidance whenever I required it was greatly appreciated, and it contributed significantly to my learning and development.

I am grateful for the opportunity to have worked under your guidance because I have gained so much knowledge. I feel privileged to have had the opportunity to work with such a knowledgeable and encouraging supervisor, and I will be eternally grateful for your guidance.

ABSTRACT

This report analyses the implementation of gamification in web-based mobile app development modules to increase student engagement and participation. The aim of this project is to address the issue of students' disengagement in the theoretical and practical aspects of the module. The incorporation of game elements into educational environments has gained increasing attention as a potential way to boost students' motivation and engagement. Gamification can give learners immediate feedback and reinforcement, thereby improving their sense of accomplishment and motivation to continue studying. This report presents a literature review on gamification in the context of education and learning, highlighting game design concepts such as points, levels or stages, badges, leaderboards, prizes, and progress bars. A mobile e-learning app was designed and implemented with prototyping, incorporating game-like elements to promote better participation and engagement from students. A questionnaire, 10 usability heuristics, and the 8 core drives of the Octalysis framework were used to evaluate the effectiveness of the app. The results of the evaluation show that the incorporation of game elements increased student engagement and participation, resulting in a more enjoyable and effective learning experience. This report demonstrates that gamification can be an effective strategy for increasing student engagement and participation in web-based mobile app development modules and that the design and implementation of gamification strategies must be carefully considered to be effective.

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1 Background of Study

1.1 Introduction

Computing courses are becoming increasingly popular among students due to the high demand for technology-related skills in the workforce. Nevertheless, according to a number of studies, the lack of student participation and engagement in learning in school is one of the greatest challenges teachers confront in schools and universities (HBP editors, 2022). Students enrolled in computing studies and related courses, such as IT and computer science, have demonstrated a significant lack of interest and engagement, particularly in the theoretical aspects of their modules (HBP editors, 2022). In a blog by Harvard Business Publishing Education, students were asked what instructors do that disengages them. The majority of the students were enrolled in computer-related classes.

The teaching methods employed by schools and universities have a significant effect on student engagement (Kember, Ho, and Hong, 2008). Students are more likely to be motivated and interested in learning when teaching methods are effective and engaging. When teaching methods are ineffective or uninteresting, students may lose interest and become disengaged from the learning process. Because the nature of their course or module may naturally be practical, the majority of computer science students concentrate primarily on the practical aspects of their course or module without thoroughly comprehending the theoretical aspects. Students may also believe that the practical aspect of learning is more enjoyable, entertaining, and engaging because they would be gaining hands-on experience as opposed to spending hours in class or listening to lectures attempting to comprehend the theoretical aspect.

The majority of the time, students can learn through various methods, such as reading books, eBooks, articles, and blogs. However, when it comes to computing, students would prefer hands-on experience and a fun experience over reading. Due to the nature of their course or modules, this forces them to spend the majority of their time on practical experimentation without fully understanding the theoretical aspect. I discuss this issue as a student enrolled in a computer science course.

Students must understand that the theoretical and practical aspects of learning are equally important, and to help them understand this, we must find a way to increase their engagement and interest in learning both the theoretical and practical aspects of their modules or courses. This is where the term “gamification” comes into play. Gamification is the application of game design elements and principles to non-gaming contexts in order to enhance engagement, motivation, and learning outcomes (Chou, 2021). In recent years, gamification has been increasingly utilised in education to increase student motivation and engagement (Dicheva *et al.*, 2015). This strategy has the potential to combat the problem of disengagement among computer science students and enhance their learning outcomes.

Studies have demonstrated that gamification can substantially increase student engagement and motivation (Nieto-Escamez and Roldán-Tapia, 2021). It was found that gamification elements such as points, badges, and leaderboards can significantly boost student motivation and engagement (J. Hamari, J. Koivisto and H. Sarsa, 2014). The main reason

for the gamification of education is to make students' learning experiences more fun and stimulating (Richard Blankman, 2022). In addition, Mekler, Brühlmann, and Opwis discovered that gamification can enhance the enjoyment and intrinsic motivation of students in learning (Mekler *et al.*, 2017).

In addition, gamification can provide students with immediate feedback, which is vital to learning. In a study, students reported that the immediate feedback provided by gamification elements such as points and badges helped them comprehend their progress and motivated them to continue learning (Vlachopoulos and Makri, 2017). Feedback is also a powerful instrument for enhancing learning outcomes (Hattie and Timperley, 2007).

In conclusion, gamification has the potential to combat disengagement among computer science students and improve their learning outcomes (Nieto-Escamez and Roldán-Tapia, 2021). By incorporating gamification elements into learning activities, instructors can create an environment that is more engaging, motivating, and collaborative (Dicheva *et al.*, 2015).

In my project proposal and my interim report, I mentioned that the proposed solution I would suggest is a mobile application that incorporates elements of gamification into the learning process. I also mentioned that I decided to use a gamified e-learning app rather than a typical e-learning app since a standard e-learning app would not be adequate to solve this problem, and gamification needs to be used to boost the level of engagement among programming and computing students. Since, gamification has been recognised as a powerful tool for increasing engagement ('THE HISTORY OF GAMIFICATION (FROM THE VERY BEGINNING TO THE PRESENT)', 2019). I also said that the gamified e-learning app would primarily be designed for web-based mobile app development modules. An experiment would be conducted using this application to establish whether or not it is successful at increasing students' interest in the theoretical and practical parts of the material covered in this module.

1.2 Problem Statement

The application of "gamification" is being proposed as a possible solution to the problem of disengagement among computer science students. Students can be motivated to learn and have a better time studying with the help of a gamified e-learning app that contains game components such as points, badges, and leader boards. If there was not just a standard mobile e-learning app but rather a mobile e-learning app that had been incorporated with game elements, then students would experience less boredom, their engagement and participation would be increased in both the theoretical and practical aspects of web-based mobile app development modules, and they would be able to learn more effectively overall. Students would remain engaged in the learning process while also being entertained if educational environments included game features, animation, and transitions. I intend to design and gamify this application and implement it using a prototype in Figma. The gamification of the e-learning app is currently being adopted in an effort to help eliminate the problem of web-based mobile app development students not being involved in the theoretical components of the module in particular, as well as the practical aspects.

1.3 Aims and Objectives

1.3.1 Aims

1. The primary aim is to design a mobile application that will increase student engagement in the learning process among web-based mobile app development module students. The app can make learning more interactive, fascinating, and enjoyable by incorporating game elements such as points, badges, and leader boards.
2. To enhance motivation for students studying web-based mobile application development modules: Gamification can increase pupils' motivation to learn by focusing on the intrinsic motivation provided by games. By providing students with a sense of autonomy, competence, and belonging, the application can boost their motivation to learn and improve their performance.

1.3.2 Objectives

1. Conduct a literature review to identify the significant obstacles that must be surpassed and the factors that need to be considered when designing an e-learning application for programming students.
2. Compile a list of both functional and non-functional requirements for the e-learning application.
3. After compiling a list of both functional and non-functional requirements, the following phase is to analyse them.
4. Design a user-friendly, simple, and straightforward application.
5. Implementation of the application using a prototype.
6. To place the completed design through its testing procedures.
7. To collect user feedback to gain a comprehensive understanding of what they require, as well as to collect additional user feedback after the design has been completed, which will aid in its further development.

2 Literature Review

2.1 Introduction

According to Prateek Gupta (2022), gamification has, throughout the course of the years, gained a large amount of interest as a technique to enhance students' interest in and engagement in schoolwork. This interest has increased as a result of gamification's ability to increase students' interest in and participation in schoolwork. According to Blankman (2022), the term "gamification" can be used to refer to a wide variety of things, including educational games, exciting examinations and challenges, and educational environments that imitate the design of video games.

I did some research on previous works that addressed the topic of using game elements in the classroom. It is common knowledge that a lack of student engagement in the learning process is a major problem for many schools and universities today and that gamification is one of the most effective methods for addressing this issue.

In this section, I will discuss the different aspects of game design that go into gamifying education, as well as the effects that this has on the students who partake in it. Based on my research, in Section 2.4, I will provide a summary of the essential game features that are required for the gamification of education. These are the game elements that I have taken into consideration and included in my own application. My project proposal specified that I would be basing my gamification on the Octalysis framework developed by Yu-kai Chou. As a result, in sub-section 2.5, I conducted an in-depth analysis of the importance of including some of the 8 core drives of the Octalysis framework while gamifying your application.

2.2 Relevant Literatures

A meta-analysis of the use of gamification in education

As every year passes, it is shown that including components of games in educational settings can have a major positive influence on learning results, particularly in terms of enhancing students' motivation and involvement in the educational process. A meta-analysis of 44 studies on the use of gamification in education concluded that the use of gamification enhanced both the motivation of students and their learning results (Hamari, Koivisto, and Sarsa, 2014).

The gamification programmes that included feedback, objectives, and incentives yielded the biggest effect sizes (Hamari, Koivisto, and Sarsa, 2014). Gamification was found to be significantly associated with significant improvements in motivation, learning outcomes, and engagement when compared to non-gamified control situations (Dicheva, Dichev, Agre, and Angelova, 2015).

Classroom Live

"Classroom Live" is a gamified learning software system that was designed and developed from scratch by Adrian A. de Freitas and Michelle M. de Freitas for the sole purpose of determining whether the concepts of gamification in the classroom can be used

at the undergraduate level to increase students' levels of involvement and drive (de Freitas and de Freitas, 2013).

Although the growth of Classroom Live has been primarily driven by feedback from students and teachers, there are several key game design elements that must be taken into account and that have contributed to the whole development process (de Freitas and de Freitas, 2013). Essential game design elements such as levels, points, badges, and a great deal more were included in the instructional setting. After the students had used Classroom Live for a period of three months, a brief survey was administered to them. Students enjoyed using Class-Room Live, and their level of participation grew over the course of the semester (de Freitas and de Freitas, 2013).

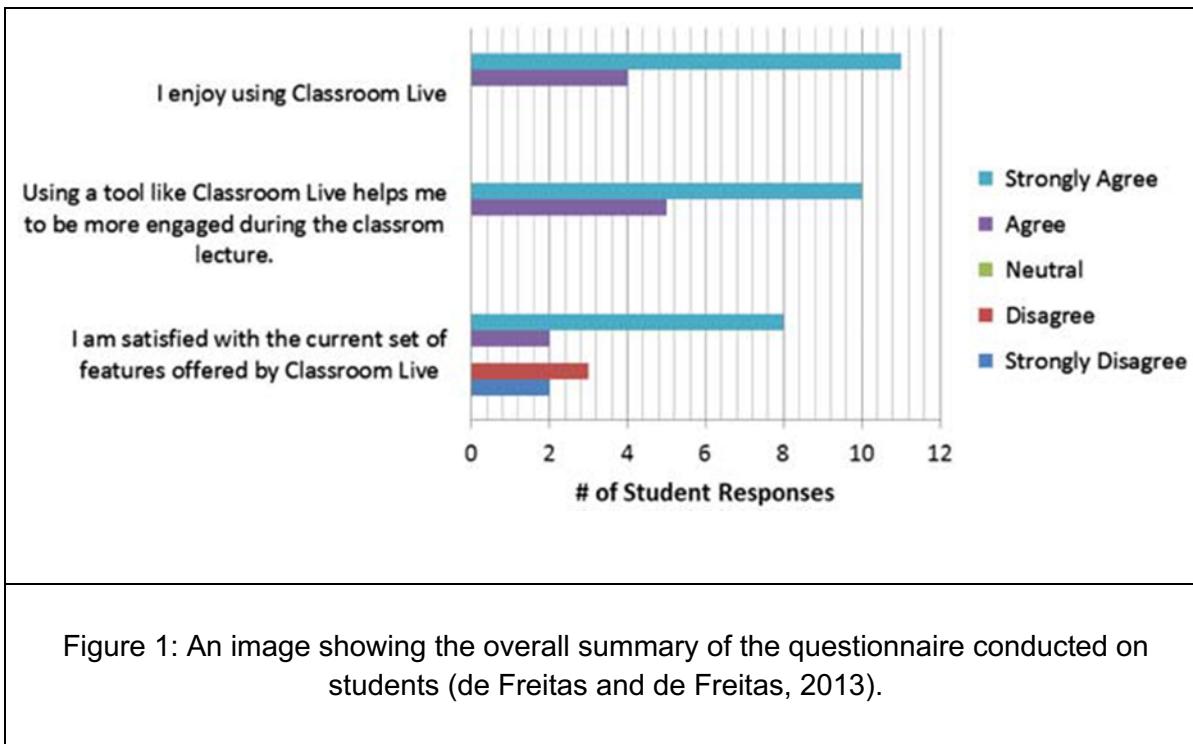


Figure 1: An image showing the overall summary of the questionnaire conducted on students (de Freitas and de Freitas, 2013).

An experiment in the lab to study how gamification affects children

An experiment was conducted in the lab by researchers Robin Brewer, Lisa Anthony, Quincy Brown, and Germaine Irwin to study how gamification affects the behaviour of kids (Brewer et al., June 1, 2013). They used real people as subjects in two distinct experiments to carry out their research. Seven children participated in the initial part of the research in its early stages. They were each shown a screen that was entirely blank, and on that screen, it instructed them as to what motion they should perform. They were instructed to use the tips of their fingers to make six instances of twenty different movements such as numbers, characters, shapes, and symbols on the screen of their device, and once they were finished, they were to press the "Done" button. As a consequence of this early phase, the activities

frequently caused the children to lose interest or become fatigued, and they voiced their desire for the activities to be terminated as soon as possible rather than waiting until later. Overall, only a relatively small percentage of the tasks were successfully accomplished. During the second part of the research project, seven kids who had not been participating before took part. The assignment was exactly the same as the first one that was given to finish the first portion of the research, but this time there were some game elements like points and scoring features added to the assignment. If the participant successfully completes their round, they will be granted 10 points for that round, with a potential total of 1200 points available to them should they complete all six rounds. As a result, in the second phase of the experiment, five out of the six individuals were successful in completing all of the tasks. It is possible to draw the conclusion that the introduction of some game elements not only increased the children's level of involvement with the activities but also their level of motivation to complete the activities. Based on the results of the first and second halves of the task, the percentage of tasks that were successfully completed increased from 73% to 97% (Brewer et al, 2013).

Task	Study	Mean	Min	Max	SD	N
Gesture	1	61%	37%	100%	27%	2/7
	2	95%	67%	100%	13%	6/7
Target	1	85%	39%	100%	26%	5/7
	2	100%	100%	100%	0%	6/6
Overall	1	73%	41%	100%	23%	2/7
	2	97%	84%	100%	7%	5/6

Figure 2: A diagram showing the overall summary of the questionnaire conducted on children (Brewer et al, 2013).

To summarise, the implementation of gamification led to an increase in the level of involvement and motivation exhibited by the children throughout the course of the completion of the tasks.

A STUDY ABOUT THE GAMIFICATION OF EDUCATION

In this study, researchers Siobhan O'Donovan, James Gain, and Patrick Marais studied whether gamification is effective in an educational setting. They stated that in the design of their gamification, they sought to achieve a variety of targets, some of which are the following: to increase pupil contribution and engagement; to enhance attendance in class

and face-to-face participation; and to assist students in developing their understanding and ability to solve problems.

They also went through the three primary qualities that should be included in any design that utilises gamification effectively. These features are as follows: it must have a unique importance to its users; it should be capable of motivating the user into becoming an expert in the particular field; and finally, it should be completely independent by allowing the sensation of having a number of possibilities available to choose from.

They included gamification in their game development course by including a variety of game elements, such as points, progress bars, goals, subgoals, visual elements, a leader board, and many more. They used a questionnaire that was distributed to students in order to analyse the efficacy of gamification. They obtained 34 replies, which accounted for 77.72% of the class total. According to the findings, the use of gamification led to an increase in both the level of engagement shown by the students and their overall performance (Siobhan O'Donovan, James Gain, and Patrick Marais, 2013).

(A) Improved Understanding: "The gamification improved my understanding of the course material"							
1. Strongly Disagree 0	2. Disagree 4	3 Neutral 5	4. Agree 15	5. Strongly Agree 10	Mean 3,91	Std Dev 0,97	
(B) Improved Engagement: "The gamification increased my engagement with the course"							
1. Strongly Disagree 0	2. Disagree 2	3 Neutral 2	4. Agree 13	5. Strongly Agree 17	Mean 4,32	Std Dev 0,84	
(C) Higher Mark: "I obtained a higher mark for this course because of the gamification"							
1. Strongly Disagree 1	2. Disagree 1	3 Neutral 11	4. Agree 15	5. Strongly Agree 6	Mean 3,71	Std Dev 0,91	
(D) Improved by Story and Theme: "The story and theme (Order of Curmudgeons) improved the gamification"							
1. Strongly Disagree 1	2. Disagree 2	3 Neutral 11	4. Agree 16	5. Strongly Agree 4	Mean 3,59	Std Dev 0,89	
(E) Incentives Order (1 - Best, 6 - Worst): "Order these gamification elements (from most to least effective) in motivating you during the course."							
Leader-board Mean 1,68	Steam Points Std Dev 0,65	Ranks 2,06	Progress Bars 1,16	End Prize 4,24	Badges 1,30	4,35	4,53
(F) Steam Rewards Order (1 - Best, 4 - Worst): "Order the steam point rewards from best to worst."							
Extensions Mean 1,13	Puzzle Clue Std Dev 0,55	Class Reward 2,66	Quiz Do-over 0,87	2,94	3,28	0,80	0,81
(G) Learning Order (1 - Best, 5 - Worst): "Order these gamification elements (from most to least effective) in contributing to your learning."							
Quizzes Mean 1,81	Lecture Attendance Std Dev 0,91	In-class Exercises 1,28	Puzzles 2,19	Game Story 2,52	3,69	4,73	0,96
Game Story 0,71							0,58

Figure 3: A diagram showing the overall summary of the questionnaire conducted on students (Siobhan O'Donovan, James Gain and Patrick Marais, 2013).

COURSERA

Andrew Ng and Daphne Koller, both computer science lecturers at Stanford University, founded Coursera in 2012, a gamified educational platform that allows students to obtain an Ivy League education from home (Coursera). Coursera is an e-learning platform that provides students worldwide with access to the best education available at the world's leading universities. Students can register for Coursera and pay a fee to enrol in one of the

online classes provided by participating universities. Coursera has partnered with reputable educational institutions to provide students around the globe with the highest quality education (Coursera) and to provide individuals from all walks of life and all regions of the globe with the opportunity to transform their lives through education. Aside from all these factors, the gamification of this educational platform has been a tremendous success as a result of Coursea's incorporation of the core drives of Yu-kai Chou's Octalysis framework.

These core drives include Core Drive 2, which represents development and accomplishment. This core drive offers students the opportunity to earn a degree online (unlike many gamified eLearning platforms, such as Udemy) (Jun Loayza, 2023).

In addition, Coursea implemented Core Drive 5, which stands for social influence and relatedness; these enable students to engage and communicate with instructors throughout the duration of a course (Jun Loayza, 2023). Although the application that I intend to design would be similar to Coursera, and Coursera also offers a course for learning how to develop mobile applications, Coursera has some drawbacks that I intend to avoid when I design my own application. The content of the Coursera course centres mainly on academic and professional skills (Andy Thompson, 2022).

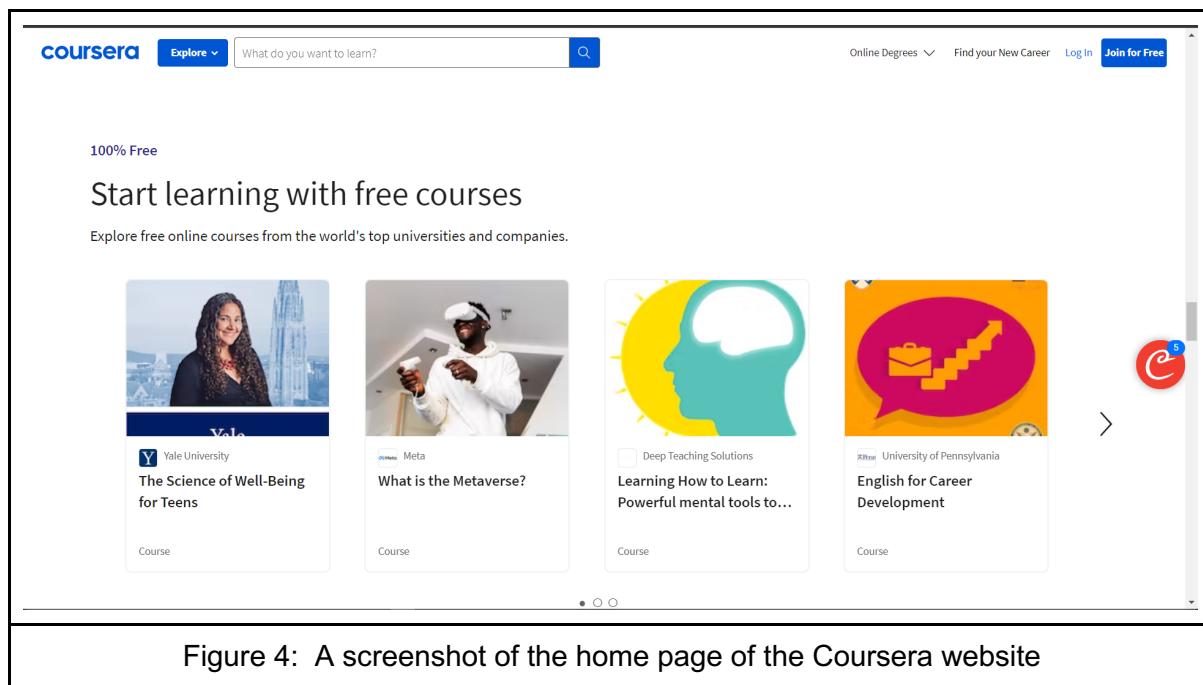


Figure 4: A screenshot of the home page of the Coursera website

DUOLINGO

Luis von Ahn and Severin Hacker are the brains behind the gamified language-learning programme known as Duolingo. The users of the online language-learning software or platform known as Duolingo are able to gain knowledge in more than 30 languages, some of which include French, Spanish, English, and Korean (Lottie O'Conor's research, 2014). Duolingo is ranked first when it comes to the process of learning a language and has over 500 million members all over the world (CNET). Duolingo has included elements of gamification into each and every lesson, such as in-lesson grading, streak counts, and hearts (Lottie O'Conor, 2014). Despite this, however, Duolingo has not done a very good job of making learning languages enormously entertaining and straightforward (Jun Loayza,

2023). The gamification of Duolingo was a success since they integrated gaming elements based on the octalysis framework by Yu-kai Chou (Jun Loayza, 2023).

They incorporated a number of the core drives that are included in the Octalysis framework, such as Core Drive 1, which stands for "Epic Meaning and Calling." They made use of this core drive by making it possible for people of any origin to use Duolingo without cost in order to become proficient in many languages (Jun Loayza, 2023).

Another one of the core drives they used is Core Drive 2, which stands for "Development and Accomplishment." They took advantage of this by employing progress indicators such as daily goals and streaks. These help the players feel more productive and accomplished, which in turn encourages them to return to the game on a more regular basis (Jun Loayza, 2023).

Another one of the core drives they used was Core Drive 4, which stands for "Ownership and Possession." They accomplished this core drive by developing their own currency, which they called lingots. Players can use Lingots to purchase power-ups like "streak freeze" and also buy apparel for their avatar (Jun Loayza, 2023).

Another one of their core drives they used is Core Drive 5, which stands for "Social Influence and Relatedness." They took advantage of this by integrating their very own social language learning clubs into the app, which encouraged gamers to pick up new abilities from one another (Jun Loayza, 2023). Even though this was a brilliant concept with potential benefits, it was poorly executed, and as a result, club members did not engage in much conversation (Jun Loayza, 2023).

Another one of their core drives they used is Core Drive 6, which stands for "Scarcity and Impatience." They used this one by giving humans a limited number of lives (Jun Loayza, 2023). A user needs lives in order to continue playing and learning, and if they run out of lives, they are required to wait until they regain them before they are permitted to learn anything new, similar to how it is in certain games (Jun Loayza, 2023). If a user runs out of lives, they cannot continue playing and learning until they regain them.

Another one of their core drives they used is Core Drive 8, which stands for "loss and avoidance." They made use of this core drive by allowing users and gamers to lose a life if they missed a lesson (Jun Loayza, 2023).

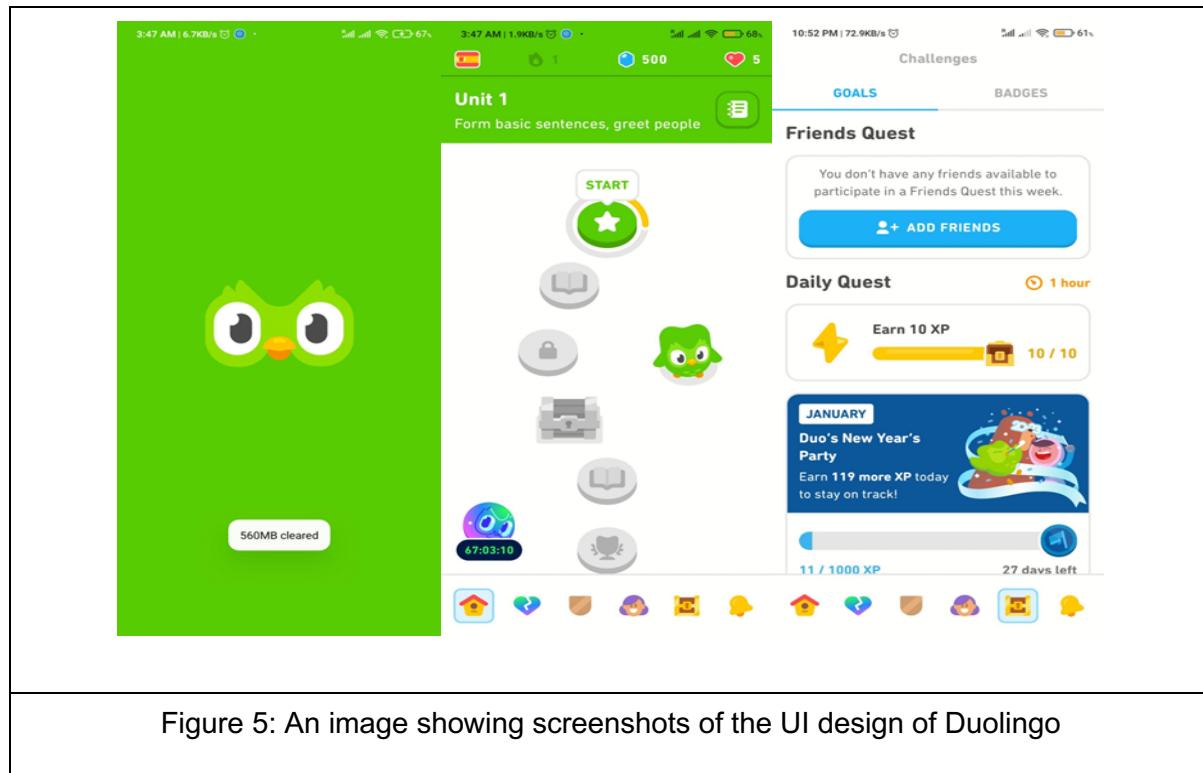


Figure 5: An image showing screenshots of the UI design of Duolingo

The most significant part of my project has been conducting a literature analysis on Duolingo. This is due to the fact that Duolingo is an application that is effectively gamified, which I have personally used and found to be enjoyable to use while also keeping me fully engaged. They have also incorporated many of the 8 core drives of the octalysis framework, which I also intend to incorporate in my own gamified e-learning app. And the most important thing I have learned from both research and using the Duolingo app is that learning a language on this app feels more like playing a game, which makes it more fun and motivating because I know that at the end of each level, I will receive a trophy, or if I fail a lesson, I will lose a life.

GAMIFICATION IN EDUCATION

In an article entitled "GAMIFICATION IN EDUCATION: LEARN COMPUTER PROGRAMMING WITH FUN," researchers Balraj Kumar and Parul Khurana analysed programming students' interest in learning. In this article, the researchers characterise teaching a programming course as an overwhelming challenge. The probability of success is influenced by a number of variables, including the level of educational expertise possessed by the instructor, their level of programming experience, and the teaching style employed in the classroom setting. It was mentioned that gamification, which can be used to increase class engagement, can be implemented in order to enhance the current educational system. Using the concept of gamification, a game design was proposed that includes game elements such as stages, levels, scores, and rewards to stimulate and increase students' learning interests. The intended use of this design was in educational environments. In addition, as the students advanced through the gamified learning process, they acquired multiple levels of expertise to strive for and attain, namely beginner, intermediate, advanced, and expert. It was also stated that the goal of gamifying education is not achieved until the

goal of making learning enjoyable and entertaining is incorporated into the game. This is because the purpose of gamifying education is to make learning more enjoyable and engaging (Balraj Kumar and Parul Khurana, 2012).

KHAN ACADEMY

Khan Academy is an online educational resource that was established by Sal Khan in 2008 and is run as a non-profit organisation (Khan Academy, 2022). When Sal Khan set out to design and develop this gamified educational platform for non-profit use, one of his primary goals was to design and develop a collection of online tools that would assist teachers in instructing students in a variety of subject areas, including mathematics, science, computer programming, grammar, and a great deal more (Khan Academy, 2022). The primary mission of Khan Academy is to "make education available to anyone, anywhere in the world, completely free of charge" (Khan Academy, 2022).

Khan Academy has, over the course of its existence, accomplished a number of remarkable results. One of these results is that each and every one of the students who have completed at least 60% of their grade-level mathematics on Khan Academy has gone through 1.8 times their own expected score on the NWEA MAP Test, which is a well-known standardised examination.

This demonstrates that the educational platform's efforts to incorporate gaming elements were successful. The reason for this is that they have incorporated some of the core drives of the Octalysis framework into the platform. Specifically, they used Core Drive 1, which stands for "Epic meaning and Calling," they used this by sending teachers and volunteers on quests to accomplish a mission, and they also used Core Drive 5, which stands for "Social influence and Relatedness," to give their interns worldwide recognition (Jun Loayza, 2023)—two of the Octalysis framework's core drives. Because of this, Khan Academy has been able to do so much and become so successful (Jun Loayza, 2023). Now the question is, "What would make my application different from KhanAcademy?" The app I intend to design is not wildly different from Khan Academy; the main difference is that my app will be focused on teaching the theoretical and practical aspects of web-based mobile application development, while Khan Academy covers a wide range of topics that do not include my focus area.

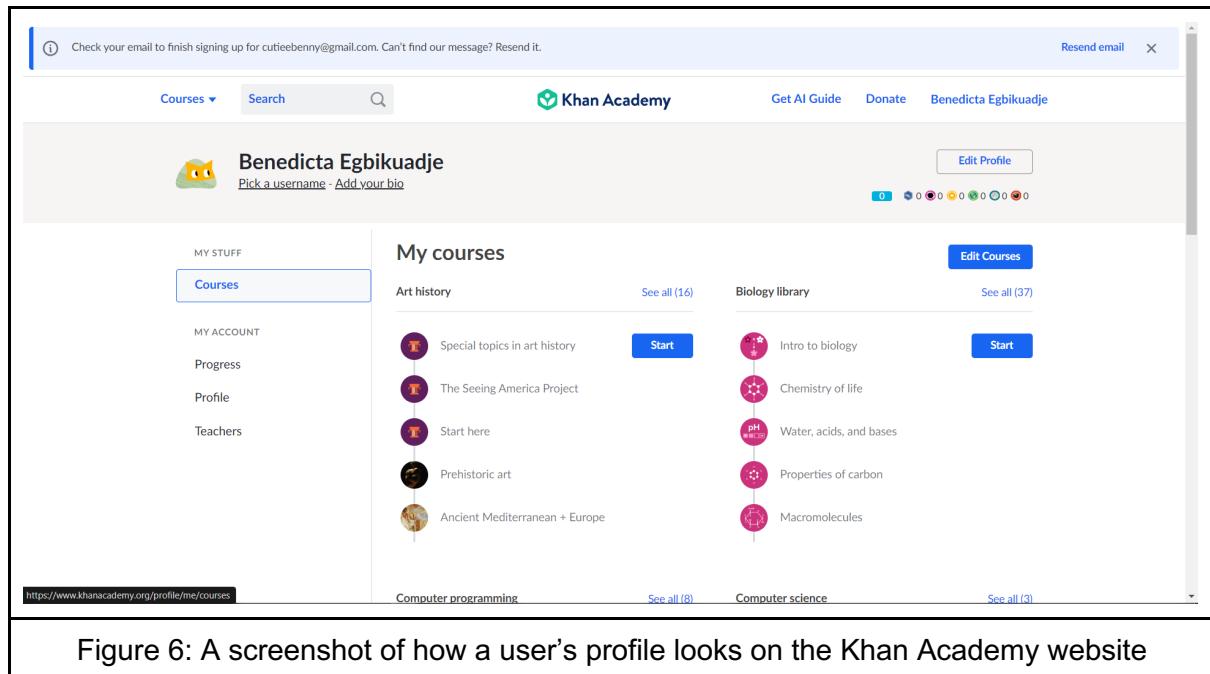


Figure 6: A screenshot of how a user's profile looks on the Khan Academy website

UDEMY

Udemy is a global platform for teaching and learning that was founded in 2010 by Eren Bali, Gagan Biyani, and Oktay Cglar (Mallika Rangaiah, 2020). This educational app is gamified and serves as a learning platform for user-generated content (Mallika Rangaiah, 2020). It is a platform that enables professors and other educators to design, publish, and sell their own online courses on any topic of their choice to students (Jun Loayza, 2023). Students can learn from anywhere in the world and have access to all courses, including those in languages, fashion, coding, and much more, because any educator or teacher from anywhere in the world is able to upload a course (Mallika Rangaiah, 2020).

Udemy implemented some of the core drives of the Octalysis framework by Yu-kai Chou into their platform. These core drives entail the following: Core Drive 2, which stands for "Development and Accomplishment," was used by adding a progress bar to show how far students have come in their education and to motivate them to complete the course (Jun Loayza, 2023). Additionally, you will find a trophy at the end of each course as payment for successfully completing it (Jun Loayza, 2023).

"Empowerment of Creativity and Feedback," which is Core Drive 3, is another one Udemy's made use of by allowing anyone, wherever they are in the world, to create and host their own online course (Jun Loayza, 2023). Additionally, they would have the flexibility to build an excellent course using their expertise in video editing and any topic they wished.

Core Drive 4, which stands for "Ownership and Possession," was also used by Udemy. This was made use of by providing teachers and professors with a way to earn passive revenue via the platform (Jun Loayza, 2023).

Positive effects were attained as a result of the Octalysis Framework's adoption of Udemy's gamification. Even if the programme I plan to create is not much different from Udemy, I still want to make sure that it does not have any of the drawbacks that Udemy users have to put up with, like Coursera's course content, which is mainly concerned with academic and professional development (Edukatico).

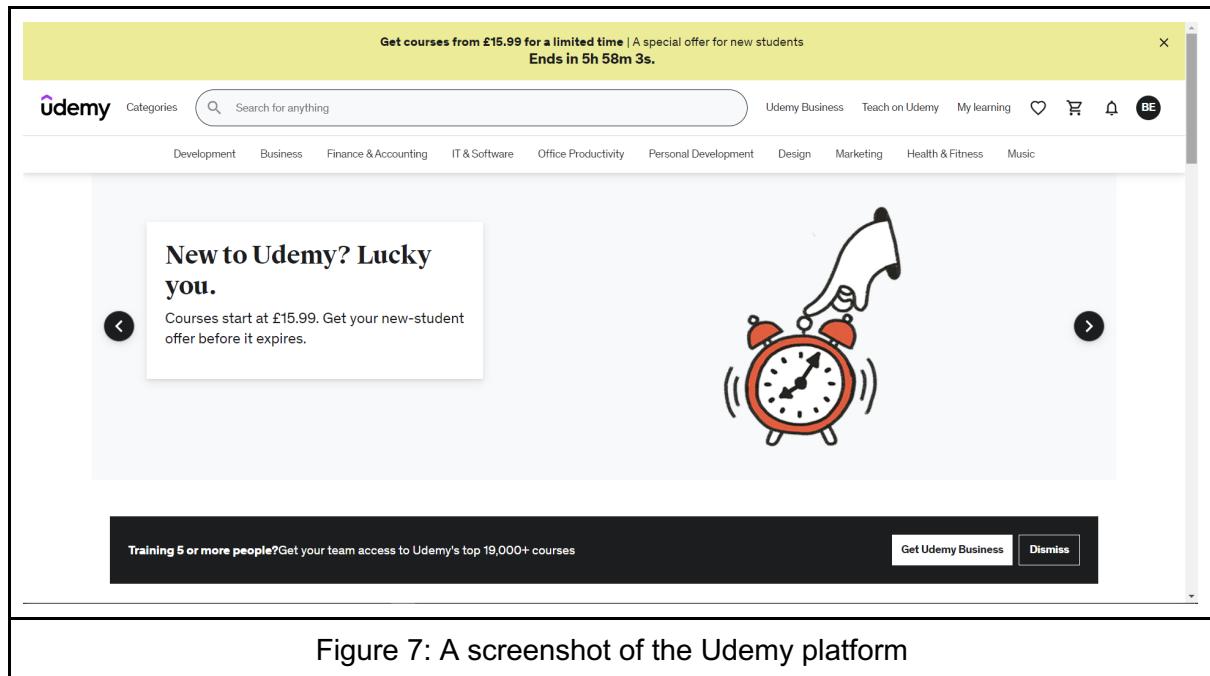


Figure 7: A screenshot of the Udemy platform

There are a variety of ways that gamification could enhance learning. Gamification, for instance, can give students immediate feedback and reinforcement, boosting their sense of accomplishment and motivation to keep studying. Additionally, gamification can provide students with a sense of control and ownership over their educational experiences, which can be especially important for extremely self-directed students (Clark, 2015). However, it is important to note that not all gamification strategies are equally advantageous. To ensure that gamification tactics are successful and do not have unintended consequences, they must be carefully devised and put into practice. Gamification, for instance, may cause students to place a greater emphasis on points and prizes than on their intrinsic motivations (Clark, 2015). Additionally, not all learners may benefit from gamification equally, so it is important to take individual variances in learner motivations and preferences into account (Hamari et al., 2014).

2.3 Conclusion

My literature review discusses the concept of gamification and its positive impact on student motivation and engagement in educational settings. Incorporating game mechanics into education can enhance learning outcomes, engagement, and motivation, as evidenced by the studies presented in the preceding section. It includes specific examples of gamified learning software, such as Classroom Live, Coursera, and Duolingo, and explains how these platforms have been effective at increasing student engagement and motivation. It also provides examples of successful gamified platforms, such as Coursera, Duolingo, Khan Academy, and Udemy, and how they implemented several core drives from Yu-kai Chou's octalysis framework to motivate and engage their users. In addition, it describes an experiment conducted by Brewer et al. that demonstrated the addition of game elements

such as points and scoring increased children's level of engagement and motivation to complete tasks.

The literature review also emphasises the elements that make gamification effective, including the incorporation of unique features that motivate users to become experts in the field, the enhancement of user engagement and participation, and the provision of a sense of autonomy in decision-making. It describes the findings of the research conducted by Siobhan O'Donovan, James Gain, and Patrick Marais, which demonstrated that gamification increased student engagement and performance. It discusses the concept of gamification in education and how it can be utilised to improve the current educational system. The article "GAMIFICATION IN EDUCATION: LEARN COMPUTER PROGRAMMING WITH FUN" suggests that gamification can be used to stimulate and increase students' learning interests by incorporating game elements such as stages, levels, scores, and rewards. To accomplish the goal of gamifying education, the importance of making learning enjoyable and entertaining is emphasised.

In conclusion, the research has demonstrated that gamification can be an effective educational strategy for enhancing learning outcomes and student motivation. Despite this, it is essential to conduct a thorough analysis of the design and implementation of gamification strategies to ensure their effectiveness and avoid unintended outcomes.

2.4 Important Game Design Elements for Education

Six primary **game design elements** that are widely used in the **gamification of education** have been discovered based on my research and literature review of other similar existing systems and publications.

- **Points:** In educational applications, they can be used for a variety of things. When students correctly respond to questions, they can be used to recognise their development. It provides a way for users to give feedback and track their own personal development. Different apps have different point systems that can be applied in different ways and for different things. For instance, after finishing a task or lesson, the Khan Academy and Duolingo applications provide you with points.
- **Badges** are a way to provide users with a badge of accomplishment for successfully completing a task. It is a technique for sustaining user competition and motivation. On Duolingo, for instance, you can earn a badge each month by completing the monthly challenge. How inspiring! You can obtain badges by finishing a task on Khan Academy. Users are motivated to work hard by the possibility of receiving a badge (Siobhan O'Donovan, James Gain, and Patrick Marais, 2013).
- **Progress bars:** According to Siobhan O'Donovan, James Gain, and Patrick Marais (2013), they provide additional motivation and encourage users to finish activities. It can also serve as a motivator to complete the activity at hand, a tool for users to track and monitor their progress, and a reminder of how far they have come and what they have accomplished. Khan Academy, for example, allows you to track your progress and how far you have gone, whereas Duolingo shows your progress together with your current level and progress in a circular progress bar right on the main screen.
- **Levels and stages:** Gamification depend on motivation. Therefore, it makes sense that a user would become more driven when they could see themselves advancing through levels and rising higher, and that they would feel threatened and competitive if they were not, especially if the app they were using included a leader board. A successful gamification method that can easily motivate users and students is the use of levels and stages. For instance, you can see both your progress and the level you are currently on Duolingo, as I indicated previously when I was discussing the progress bar on the main screen. Khan Academy, on the other hand, is not nearly as enjoyable as Duolingo, but it too provides several levels for users and learners while they are learning a specific subject or course.
- **Leader boards** are essentially lists of the individuals with the highest scores. They are crucial in encouraging users to complete a particular task, activity, or course, and they also raise user engagement. Leader boards list students according to performance; this motivates and engages students as well as app users to work harder to climb the leader board. In educational app contexts, rating systems similar to those frequently found in video games can also serve as a means of

encouragement (Siobhan O'Donovan, James Gain, and Patrick Marais, 2013). For instance, on Duolingo, you must complete at least 10 lessons before you can access the leader boards and be graded, whereas there are not any leader boards on Khan Academy.

- **Prizes and Rewards:** It has been found that using prizes and rewards as a form of motivation in order to encourage youngsters and students is an effective approach to engaging them (Balraj Kumar and Parul Khurana, 2012).

2.5 The Octalysis Framework for Gamification and Behavioural Design

During the literature review and research, I came to the realisation that eighty percent of the educational platforms whose gamification was successful in enhancing users' engagement and participation in learning as well as making learning more enjoyable for users had incorporated at least two or more of the octalysis framework's eight core drives. This was one of the more interesting discoveries that I made during the course of my research. For example, Duolingo, Khan Academy, Udemy, Coursera, TEDEd, Tinycards, Blinkist, and many more

The Octalysis Framework, created by Yu-Kai Chou, is a gamification design framework with a human perspective that outlines the eight core drivers for human motivation (Chou, 2021).

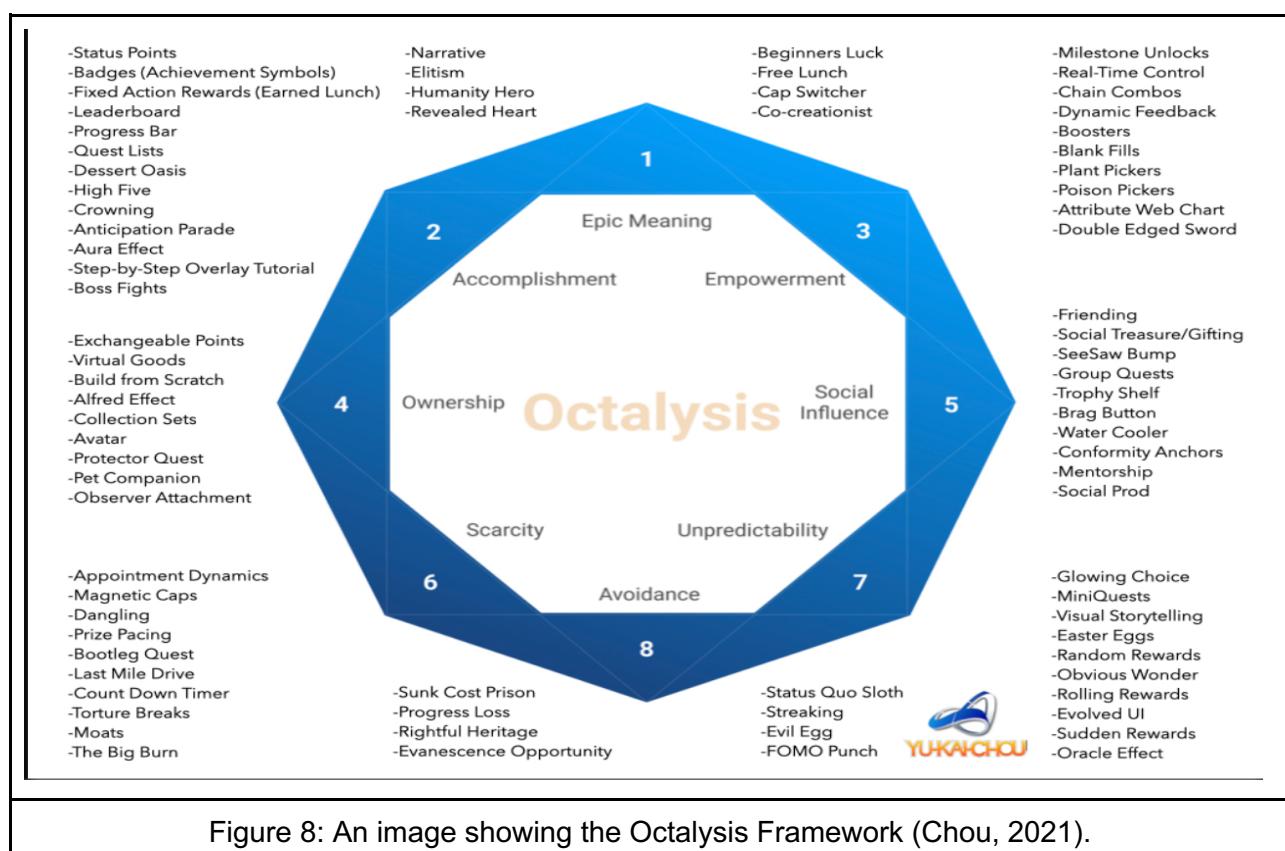


Figure 8: An image showing the Octalysis Framework (Chou, 2021).

The gamification framework known as Octalysis is created in the shape of an octagon, as can be seen in the image that is located above, and there are eight core drives that represent each side.

❖ **Epic Meaning and Calling**

This is the first core drive, which encourages users to look for a greater purpose or significance in their lives that goes beyond their own personal objectives and goals (Virtanen, 2021). Khan Academy, for example, utilised this core drive to encourage teachers and volunteers by assigning them quests to fulfil in order to give them a sense of purpose.

❖ **Development and Accomplishment**

This is the second core drive. We are naturally motivated to take on obstacles in order to achieve a desired goal (Virtanen, 2021). This core drive encourages users to work harder in order to improve their skills and observe their progress (Virtanen, 2021). Udemy, for example, employs a progress bar to show students how far they have progressed in their courses.

❖ **Empowerment of Creativity and Feedback**

This is the third core drive. This core drive explains why users look for opportunities to expand their knowledge and develop their talents. This impulse allows users to enjoy playing since they can become lost in the experience of doing something they find enjoyable (Virtanen, 2021). Feedback is a vital part of the creative process since it encourages us to try out new approaches to expressing ourselves (Virtanen, 2021). Udemy, for example, incorporates this core drive by allowing anyone from any part of the world to develop and publish their own course.

❖ **Ownership and Possession**

This is the fourth core drive. This core driver comes into play when users perceive they possess and own something. This gets to their inner desire to be proud of their possessions and acquire more possessions (Virtanen, 2021). Duolingo, for example, incorporated this core drive by developing its own currency known as Lingots, which users can use to buy power-ups such as streak freeze as well as apparel for their avatar.

❖ **Social Influence and Relatedness**

This is the fifth core drive. This core drive is related to our natural desire to seek mentors, gain praise from other people, and find friendship. This core drive also capitalises on consumers' competitive desire and relative social standing (Virtanen, 2021). Relatedness refers to users' desire to establish relationships with social groups and people with whom they share common interests (Virtanen, 2021). Coursea, for example, incorporated this core drive by enabling students to engage and speak with lecturers throughout their course.

❖ **Scarcity and Impatience**

This is the sixth core drive. Every single one of us has experienced something similar. It is in our nature to want things that are out of our reach. This is the core drive that makes individuals want something just because it is unique, exclusive, or difficult to attain right away (Virtanen, 2021). Duolingo, for example, incorporated this core drive by providing players with limited lives. A user requires lives in order to

continue playing and learning, and if they run out of lives, they must wait until they regain them before they can learn anything new, similar to how it is in some games.

❖ **Unpredictability and Curiosity**

This is the seventh core drive. We are naturally inclined to find excitement in unclear circumstances. When we are confronted with unusual and unanticipated feelings, the reward centre in our brain becomes activated. This helps to explain why we enjoy being surprised and why we are always looking for new experiences (Virtanen, 2021).

❖ **Loss and Avoidance**

This is the eighth and last core drive. This core drive is the natural resistance we have to giving up things that we have laboured hard to acquire. It also explains why users want to minimise potential losses or risks whenever and wherever they may find a way to do so (Virtanen, 2021). Duolingo, for example, incorporated this core drive by allowing users to lose a life after failing a lesson.

In conclusion, the eight core drives of gamification—Epic Meaning and Calling, Development and Accomplishment, Creative Expression and Feedback, Ownership and Possession, Social Influence and Relatedness, Scarcity and Impatience, Unpredictability and Curiosity, and Loss and Avoidance—explain the psychological reasons why people participate more in gamified activities.

To apply this when designing my gamified educational e-learning app for web-based mobile app development modules, I have incorporated some of these essential core drives into the design of my app to increase student engagement and motivation. The app also includes social features such as forums and chat rooms to encourage collaboration and develop relationships (social influence and relatedness).

Incorporating these core drives into the design of a gamified e-learning application can create a more engaging and motivating experience for students, resulting in enhanced learning outcomes and educational outcomes.

3 Requirements Specification

The requirement specification provides a precise and unambiguous description of what the software system must be able to do and how it must act under specific circumstances. The requirements specification is crucial because it serves as the foundation for all subsequent software development tasks, including design, coding, testing, and maintenance (Easterbrook Steve, 2000).

3.1 Functional requirements

- Registration and authentication of users: Users should be able to register for an account, log in, and access their profile.
- Course content management: The design should contain a list of web-based mobile application development courses, including topics, lessons, and exercises.
- User progress monitoring: The design should monitor the user's progression through the course material and provide performance feedback.
- Elements of gamification: The design should include game-like elements, such as badges, levels, points, and leader boards, to incentivize learning.
- Video presentations of lectures and tutorials: The app ought to include video presentations of lectures and lessons on how to develop web-based mobile applications.
- Quizzes and evaluations that are interactive: The design should include interactive quizzes and evaluations to evaluate user knowledge and provide immediate feedback.
- Social learning features: The design should include social learning features, such as discussion forums, that enable users to collaborate and learn from one another.

3.2 Non-functional requirements

- Performance: The design should load quickly and have very little lag or delay in its reaction times in order to provide a seamless experience for the user.
- Scalability is important, as the software needs to be able to accommodate a large number of users and simply scale up as the user base expands.
- Compatibility: The design ought to be compatible with a wide variety of mobile devices and operating systems, including Apple's iOS as well as Google's Android.
- Usability: The design should have a straightforward and simple user interface, making it simple for users to move through the app and locate the information they require.
- Gamification: The design should be intended to engage users and motivate them to learn, and gamification components such as achievements, leaderboards, and prizes should be incorporated into the app's design.

4. Methodologies for Research

4.1 Questionnaires

It is essential for researchers to make use of questionnaires since these instruments make it possible for them to collect massive volumes of data from a diverse group of people in a relatively short period of time (Trochim, 2007). They are versatile tools that can be utilised to study a wide range of research issues and can be applied to either small or large sample sizes. In addition, there is no expense associated with surveys, and they can easily be reproduced in order to give comparisons between groups (Trochim, 2007). And based on the literature reviews that I carried out, I found that questionnaires and surveys were useful methods for testing whether or not the gamification of education promotes student involvement in the learning process. Dicheva et al. found that employing surveys to collect data on student preferences can help educators adjust gamified learning experiences to students' particular needs and interests (Dicheva et al., 2015). Students are more likely to be interested in and devoted to activities that match their interests, which can lead to higher engagement and motivation.

I carried out two questionnaires. The first questionnaire was designed to collect information about potential user requirements for the design of the gamified e-learning app for the web-based mobile app development module. This information would be helpful to me when designing the app. The second questionnaire was designed to collect information about potential user feedback on the design of the gamified e-learning app for the web-based mobile app development module.

Qualtrics was used in the creation of the questionnaires. The questionnaires consisted of a series of questions that were administered to participants who were anonymous to me in order to collect data regarding the participants' opinions, views, habits, and other characteristics. The questionnaire, along with an offer to participate, was distributed over social media, and participants were asked to complete it online while maintaining their anonymity.

The first questionnaire was made up of eight questions, most of which were centred on subjects that users desired to see included in the app. These questions were circulated to individuals in the study who ranged in age from 18 to 25.

Below are the questions asked in the first questionnaire and the number of responses.

Questions	Number of responses
Are you a computing student or doing anything related to computing?	13
Does the course you are studying include practical experiments?	13
What would you love to see in eLearning apps? Videos, game elements, etc	13
Do you usually engage yourself in the theoretical aspects of your course as much as the practical parts? If no, please elaborate.	12
Are you familiar with the term "Gamification"?	13

As a computing student or anything related, do you usually try to fully understand the theoretical aspects of your module before engaging yourself in the practical parts?	13
What eLearning apps have you used before?	13
Would you agree that a gamified e-learning app (with transitions, animations, and game elements) would increase your engagement and interest in both theoretical and practical aspects of your course?	13

The second questionnaire was made up of eight questions, most of which were centred on whether or not “users felt more engaged while using this app” and what improvements could be made. These questions were circulated to individuals in the study who ranged in age from 18 to 25.

Below are the questions asked in the second questionnaire and the number of responses.

Questions	Number of responses
Would you agree that the user interface design is user friendly and easy to interact with and move through?	10
Did you feel engaged and entertained while learning with this app?	10
Did you encounter any issues while using the app?	10
When you encountered an issue while using the app, how long did it take for you to recover from it?	10
Would you agree that the use of transitions and game elements made this app more fun?	10
Would you agree that this app has helped you learn both the theoretical and practical aspects of web-based mobile app development modules?	10
What was the most exciting / engaging activity you encountered while using the app?	10
What improvements / changes would you love to see in this app?	10

4.2 Evaluative Analysis of Potential User Requirements

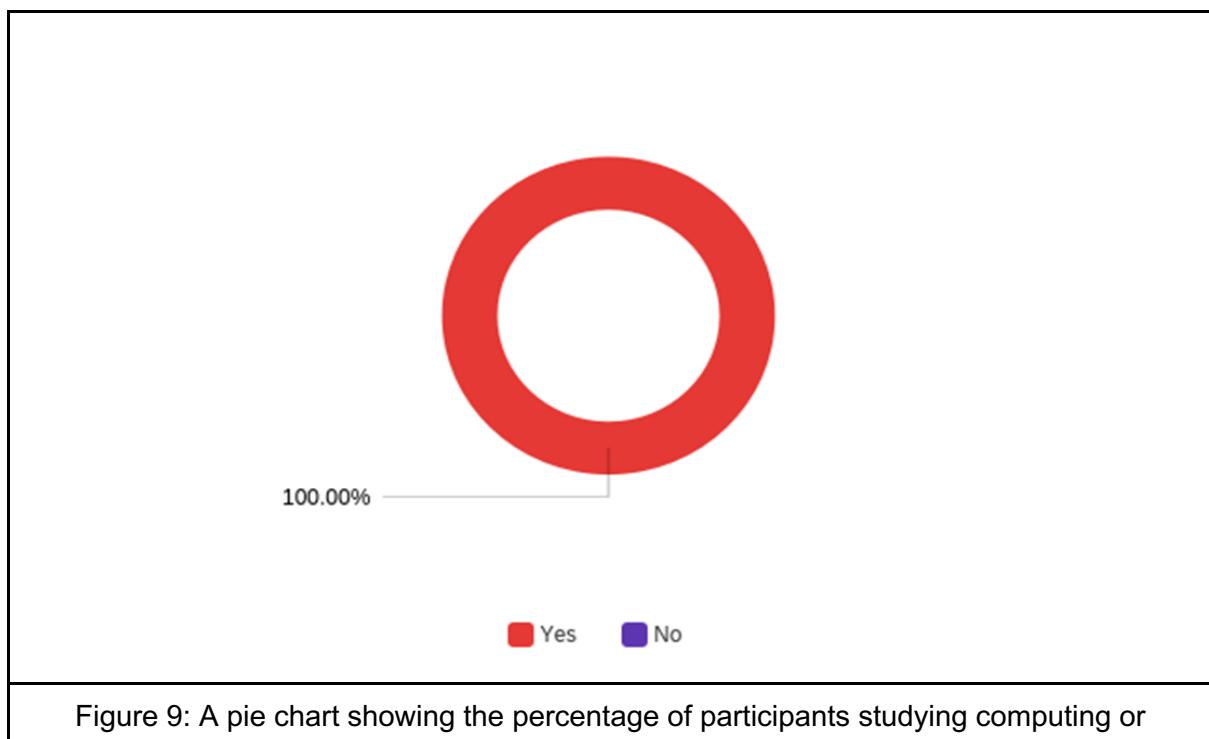
I conducted a thorough analysis of the responses I received from both questionnaires. The first questionnaire, which I shared via social media to ensure participants remained anonymous using an invitation document, included the questionnaire link. This questionnaire helped me while I was designing the application. For the second questionnaire, which I also shared via social media to ensure participants remained anonymous, I used an invitation

document that consisted of the Figma link, where my design of the gamified app was done for users to first test it out, and the questionnaire link, where they answered the questionnaire based on their experience. This is how my evaluation and testing were conducted anonymously. This questionnaire was distributed to people between the ages of 18 and 25.

4.2.1 Evaluative Analysis of the First Questionnaire

Q1: Are you a computing student or doing anything related to computing?

#	Answer	%	Count
1	Yes	100.00%	13
2	No	0.00%	0
	Total	100%	13



anything related

This question was posed with the purpose of determining the background of the participant and gaining an understanding of their level of experience with computing. The information that is gathered from this question can be utilised to analyse the replies that were provided by the participant and to develop conclusions based on their level of comprehension of the field of computers. As shown in the pie chart above, every participant who took part in this questionnaire was either a computing student or studying something more related, making answering the other questions easier from their own perspective.

Q2: Does the course you are studying include practical experiments?

#	Answer	%	Count
1	Yes	92.31%	12
2	No	7.69%	1
	Total	100%	13

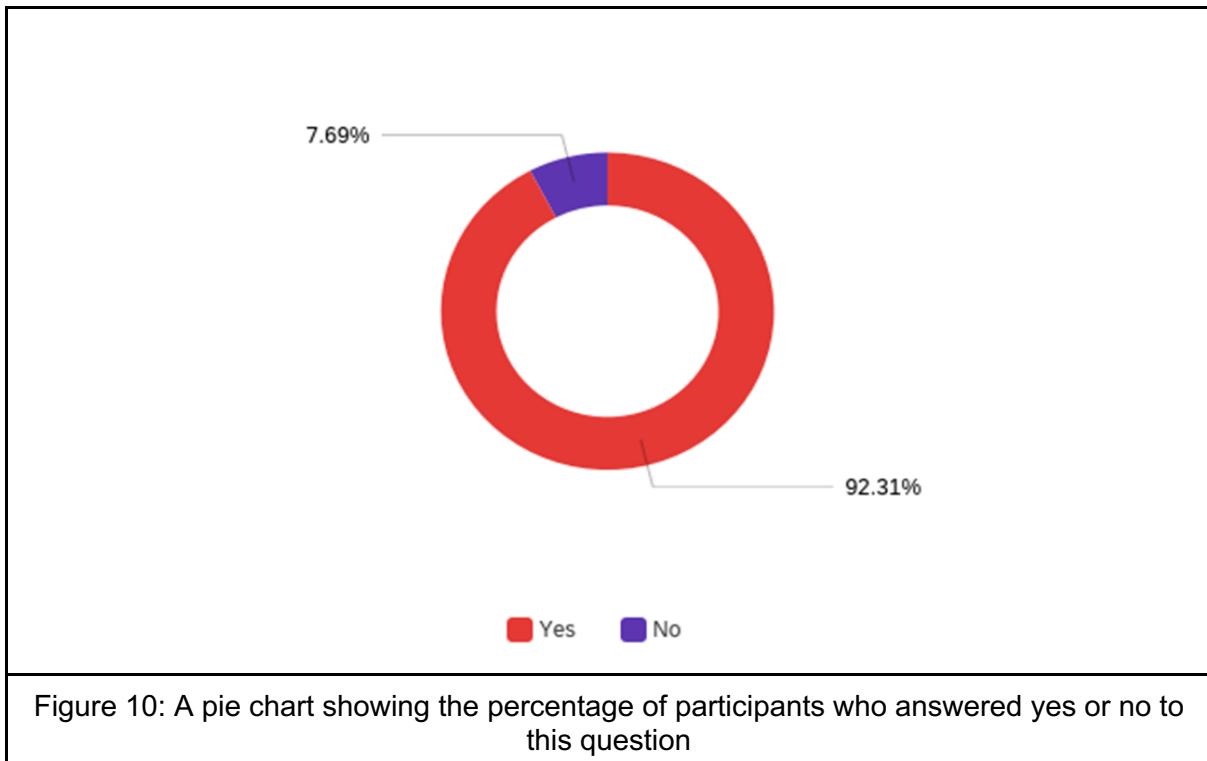


Figure 10: A pie chart showing the percentage of participants who answered yes or no to this question

The purpose of this question was to determine the participant's level of practical experience in the computer sector. This assisted me in analysing how much practical experience participants have in the subject as well as how that experience related to their responses to certain questions. As shown in the pie chart and table above, 92.31% of the participants who took part in this questionnaire answered yes, 92.31% of them in the courses they are studying include practical experiments, while 7.69% in the courses have no practical experiments.

Q3: What would you love to see in eLearning apps? Videos, game elements, etc.

#	Answer	%	Count
1	Video's	23.08%	3
2	Game elements	53.85%	7
3	Transitions	0.00%	0
4	Animations	23.08%	3

	Total	100%	13
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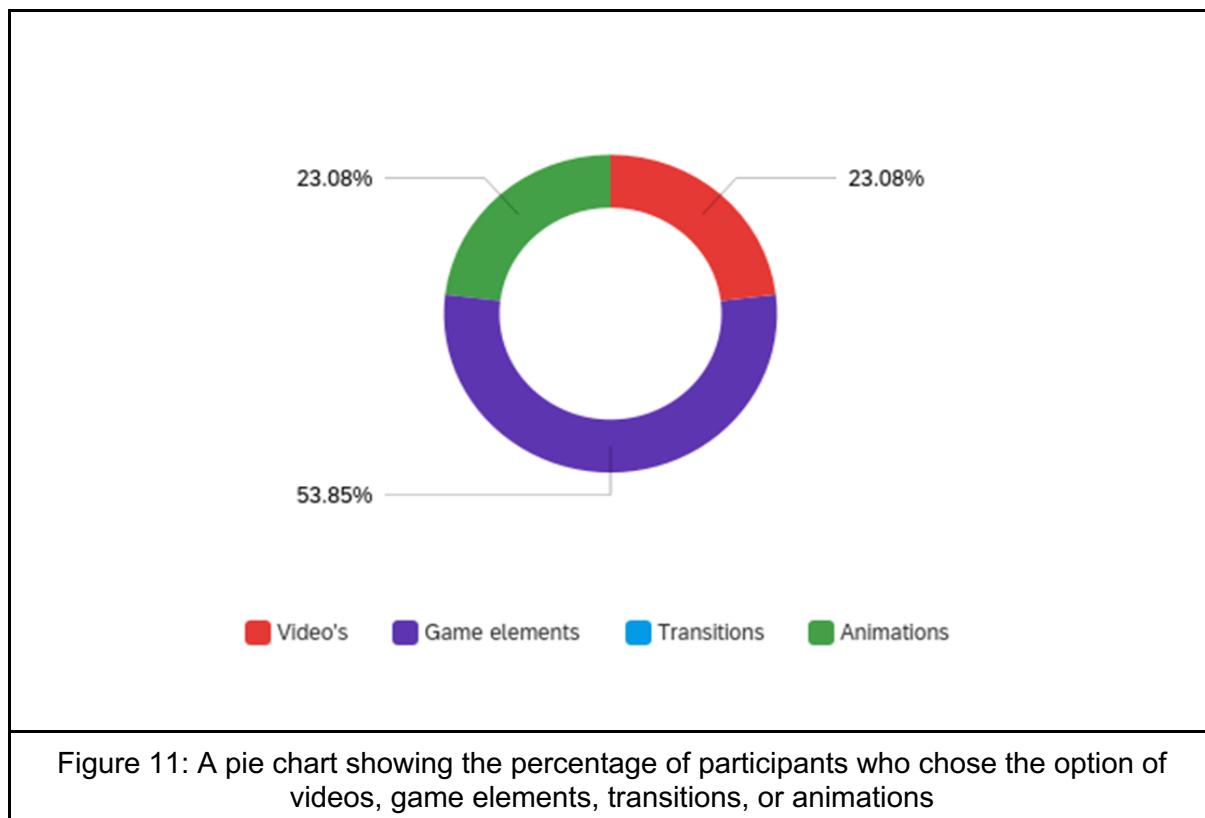


Figure 11: A pie chart showing the percentage of participants who chose the option of videos, game elements, transitions, or animations

In order to have a better understanding of the preferences of the participants in relation to e-learning apps, this question was asked. When participants were asked what they would want to see in an e-learning app, the answer that received the highest percentage of votes was 53.85% based on the answers that they gave in the questionnaire, which was the game's elements. This is displayed in the pie chart above. In addition, as can be seen in the table, three of the participants noted animation, three of the participants pointed out videos, and seven of the participants said they would like to see gaming elements included in the app. Because of this, I now have a better idea of the components that should be included in my own e-learning application for the learning of web-based mobile app development modules.

Q4: Do you usually engage yourself in the theoretical aspects of your course as much as the practical parts? If no, please elaborate.

Do you usually engage yourself in the theoretical aspects of your course as much as the practical parts? If no pls elaborate

Yes

Yes

Yes

No, I am usually less engaged in the theoretical aspects of my course, depending on the type of theory. For example, during lectures, if the tutor would explain the theory of a subject for a long time, I would find the topic really boring, but if the explanations showed videos, animations, or some sort of visual representation, I would be engaged and learn about that topic quickly.

Yes, I have no choice, as it is essential for learning.

No, the practical aspects are significantly more engaging and simpler to learn. I learn more quickly through hands-on experiments than through reading and comprehension alone.

Yes

Yes, I do.

Yes

Yes, I do.

Yes

Yes

This question was asked to the participant in order to have a better understanding of their preferred method of learning, whether it be theoretical or practical. The information that was acquired from this question was used for the purpose of conducting an analysis of how the participants approach learning and how the method by which they learn affects the content that they comprehend. As can be seen in the table displayed above, ten of the participants (or 83.33% of the participants that answered the question) selected the option to respond

"yes." This demonstrates that students actually do make an effort to understand the theoretical aspect of their course just as much as the practical parts, but let us not forget the small percentage of students who answered "no" and explained why they said "no" by saying, "I am usually less engaged in the theoretical aspects of my course, depending on the type of theory." "For example, during lectures, if the instructor were to explain the theory of a subject for a long time, I would find the topic to be extremely boring." "On the other hand, if the explanations showed videos, animations, or some other kind of visual representation, I would be engaged and learn about that topic quickly." This has demonstrated the fact that students would experience less boredom and a greater sense of engagement in the material if there was a greater focus on videos and animation rather than the discussion of the theoretical aspects of the topic in question. Another participant who said "no" stated that "the practical aspects are significantly more engaging and simpler to learn." Experiments where I can directly apply what I learn are much more effective for me than reading and trying to understand what I read. " According to what I have gathered, this person prefers to gain hands-on experience rather than having to sit still for a number of hours while attempting to comprehend the theory, which is why they spend more time participating in practical experiments as opposed to theoretical learning.

Q5: Are you familiar with the term “Gamification”?

#	Answer	%	Count
1	Yes	84.62%	11
2	Maybe	7.69%	1
3	No	7.69%	1
	Total	100%	13

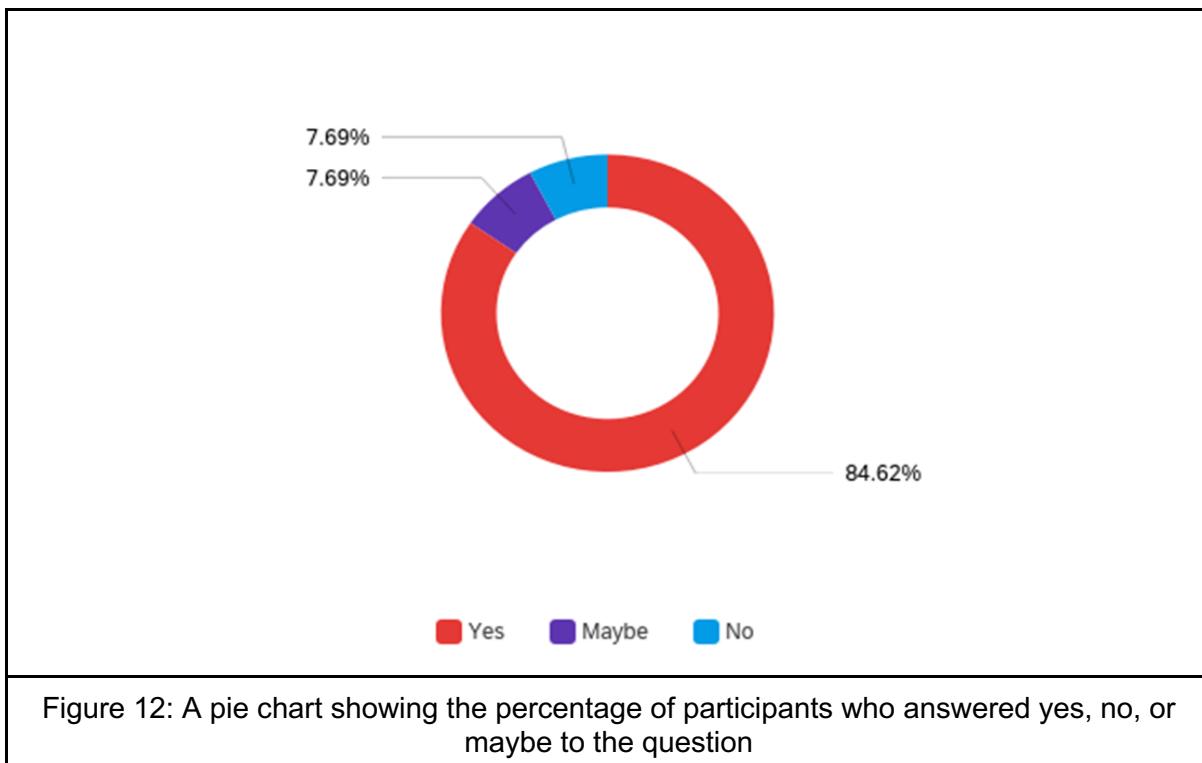


Figure 12: A pie chart showing the percentage of participants who answered yes, no, or maybe to the question

This question was asked with the purpose of determining the extent to which the participants were familiar with the word "Gamification." This was helpful in identifying the participants' degree of expertise in the field as well as how their level of knowledge may have affected their responses to particular questions. According to the table and pie chart above, 84.62% of those who completed the questionnaire were familiar with the term "gamification."

Q6: As a computing student or anything related, do you usually try to fully understand the theoretical aspects of your module before engaging yourself in the practical parts?

#	Answer	%	Count
1	Yes	61.54%	8
2	No	38.46%	5
	Total	100%	13

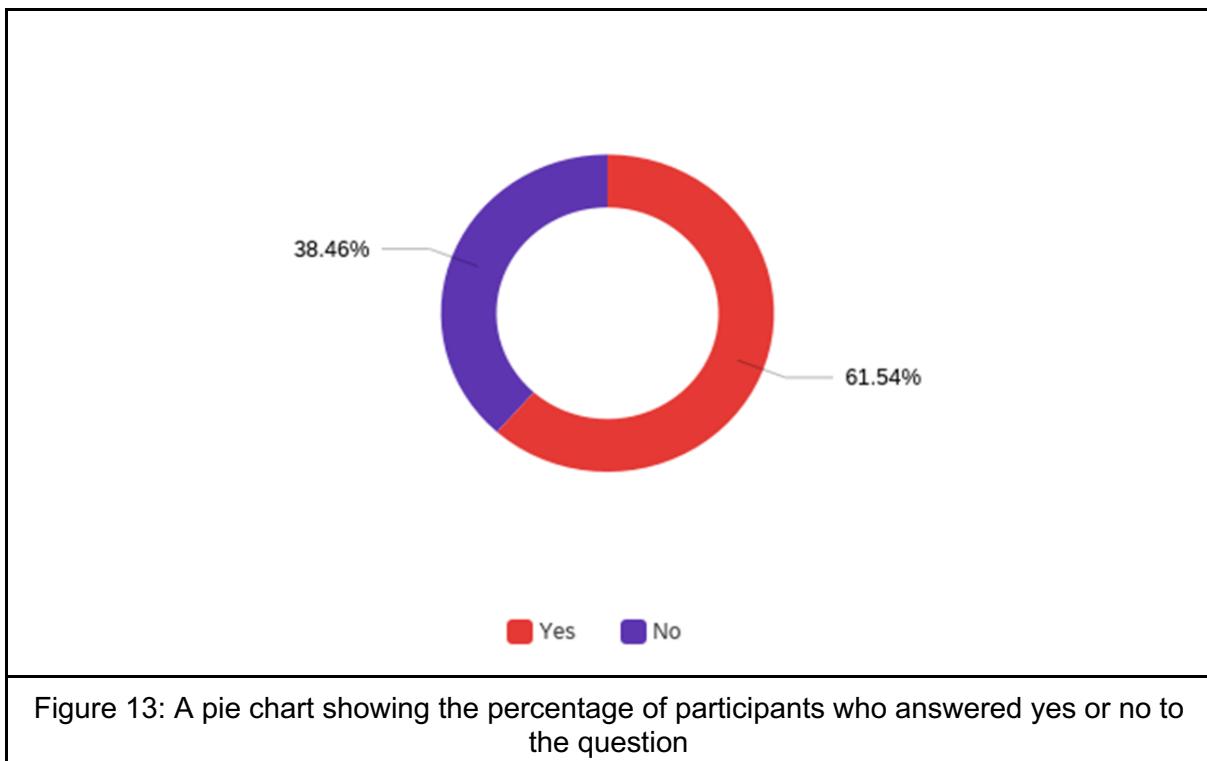


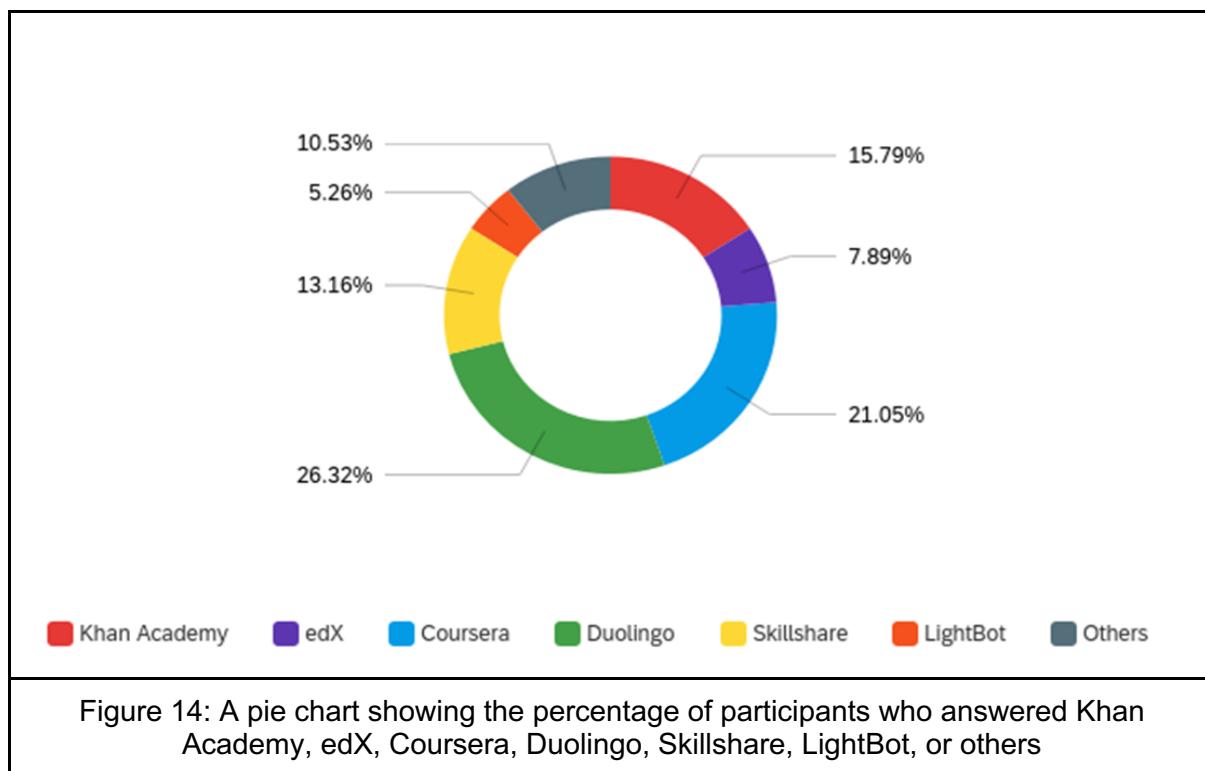
Figure 13: A pie chart showing the percentage of participants who answered yes or no to the question

This question was asked of the participant in order to gain a better understanding of their approach to learning computing. The information that was acquired from this question was used for the purpose of conducting an analysis of how the participants approach learning and how the method by which they learn affects the subject matter that they understand. As can be seen in the table and the pie chart, eight participants responded "yes," representing 61.54% of those who filled out the questionnaire, while just five respondents said "no," representing only 38.52%. As shown by these results, at least 30% of students do not make an effort to fully understand the theoretical underpinnings of their coursework before moving on to the practical aspects of it.

Q7: What eLearning apps have you used before?

#	Answer	%	Count
1	Khan Academy	15.79%	6
2	edX	7.89%	3
3	Coursera	21.05%	8

4	Duolingo	26.32%	10
5	Skillshare	13.16%	5
6	LightBot	5.26%	2
7	Others	10.53%	4
	Total	100%	38



The purpose of this question was to determine the participants' respective levels of familiarity with e-learning app platforms. The information that was acquired from this question was utilised in order to gain an understanding of the extent to which participants were familiar with e-learning apps. According to the data in the table and the pie chart above, 26.32 percent of the participants have used Duolingo, whereas 21.05 percent have also used Coursera. The remaining platforms included Khan Academy (15.79%), Skillshare (13.16%), others (10.53%), edX (7.52%), and LightBot (5.26%). The results reveal that people are already familiar with educational apps.

Q8: Would you agree that a gamified e-learning app (with transitions, animations, and game elements) would increase your engagement and interest in both theoretical and practical aspects of your course?

#	Answer	%	Count
1	Yes	100.00%	13
2	Maybe	0.00%	0
3	No	0.00%	0
	Total	100%	13

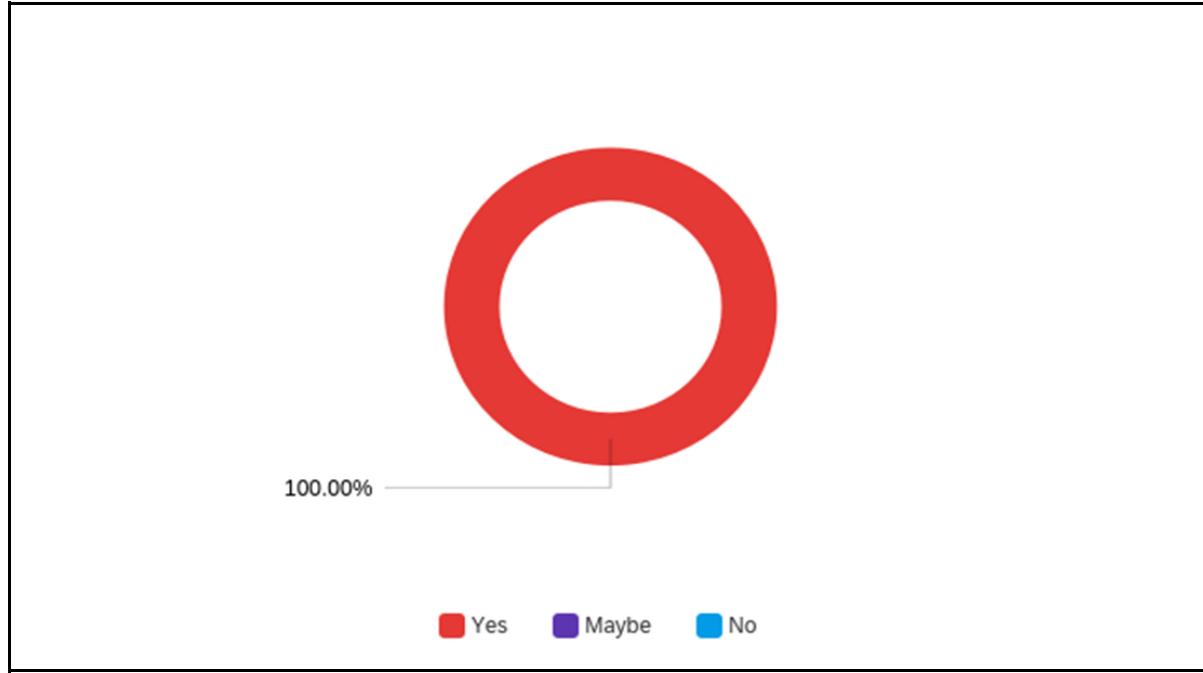


Figure 15: A pie chart showing the percentage of participants who answered yes, maybe, or no to the question

The purpose of this question is to gain an understanding of the participant's viewpoint toward the use of gamification in e-learning applications. The responses to this question were

analysed to determine the preferences and attitudes of the participants with regard to the implementation of gamification in educational settings. To better understand the efficacy of gamification in e-learning apps and to design apps that respond to the tastes of their target audience, this information was helpful when designing my app. As shown in the table and pie chart above, all participants who took this questionnaire answered yes to this question, which brings me to the conclusion that gamification is an important way of increasing students' interest and engagement.

5. Design and Implementation

I have designed the user interfaces that will be used and have created a prototype with the help of Figma. It was necessary for me to employ frames, animation properties, and other such things in order to add transitions. In this section, I will also be showcasing my user interface design and how I have conducted the implementation. I would also show my low fidelity design and initial idea.

5.1 App UI Design

5.1.1 Low Fidelity Design

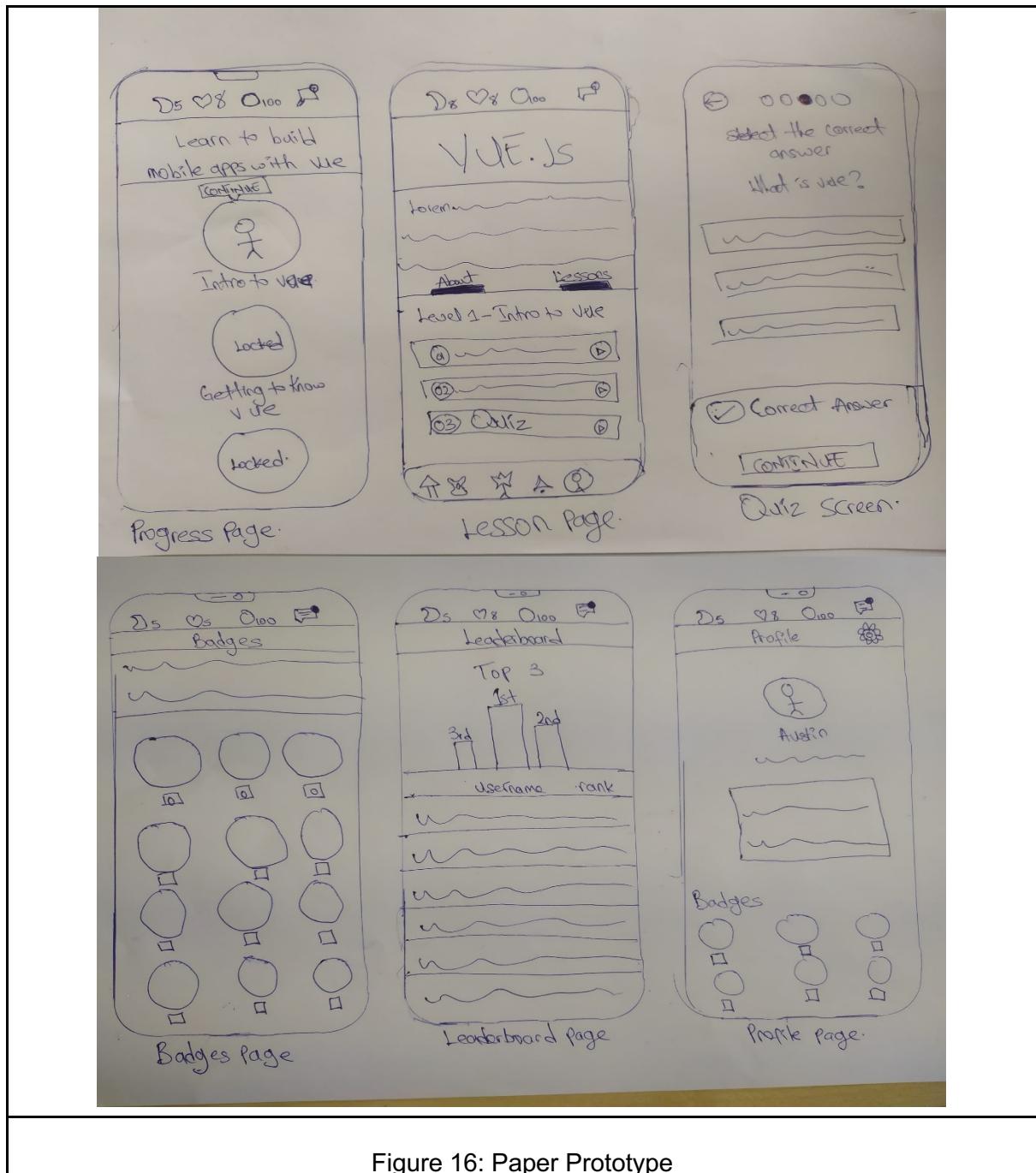


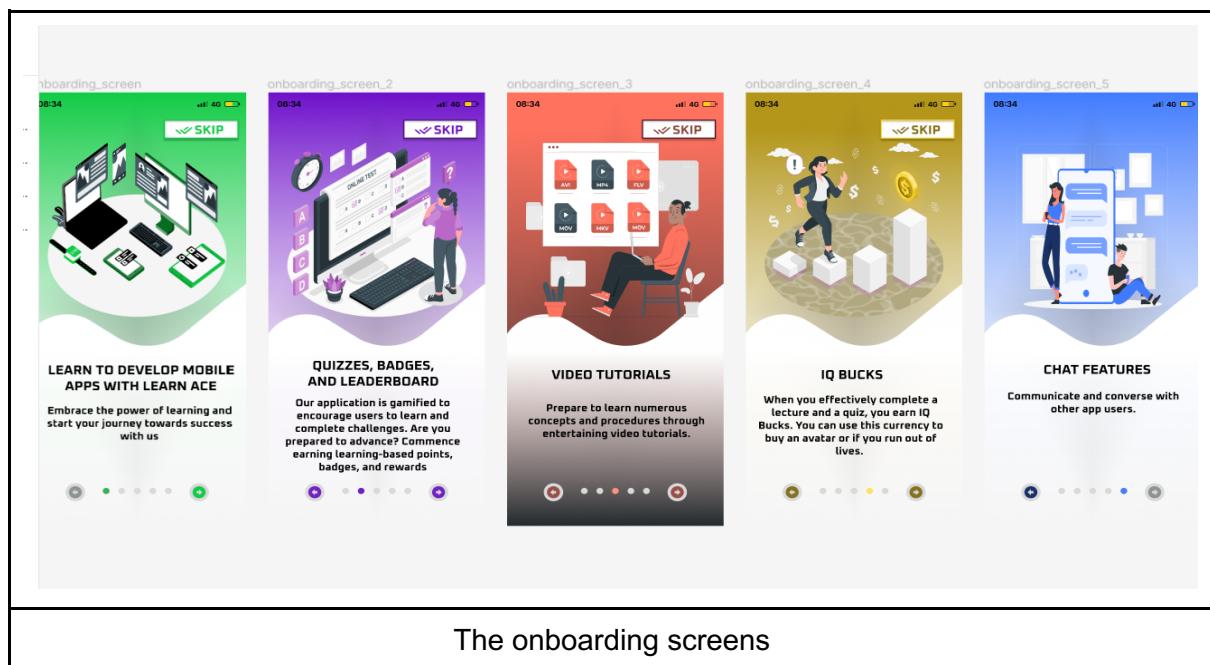
Figure 16: Paper Prototype



Figure 17: A Wireframe showing my initial design

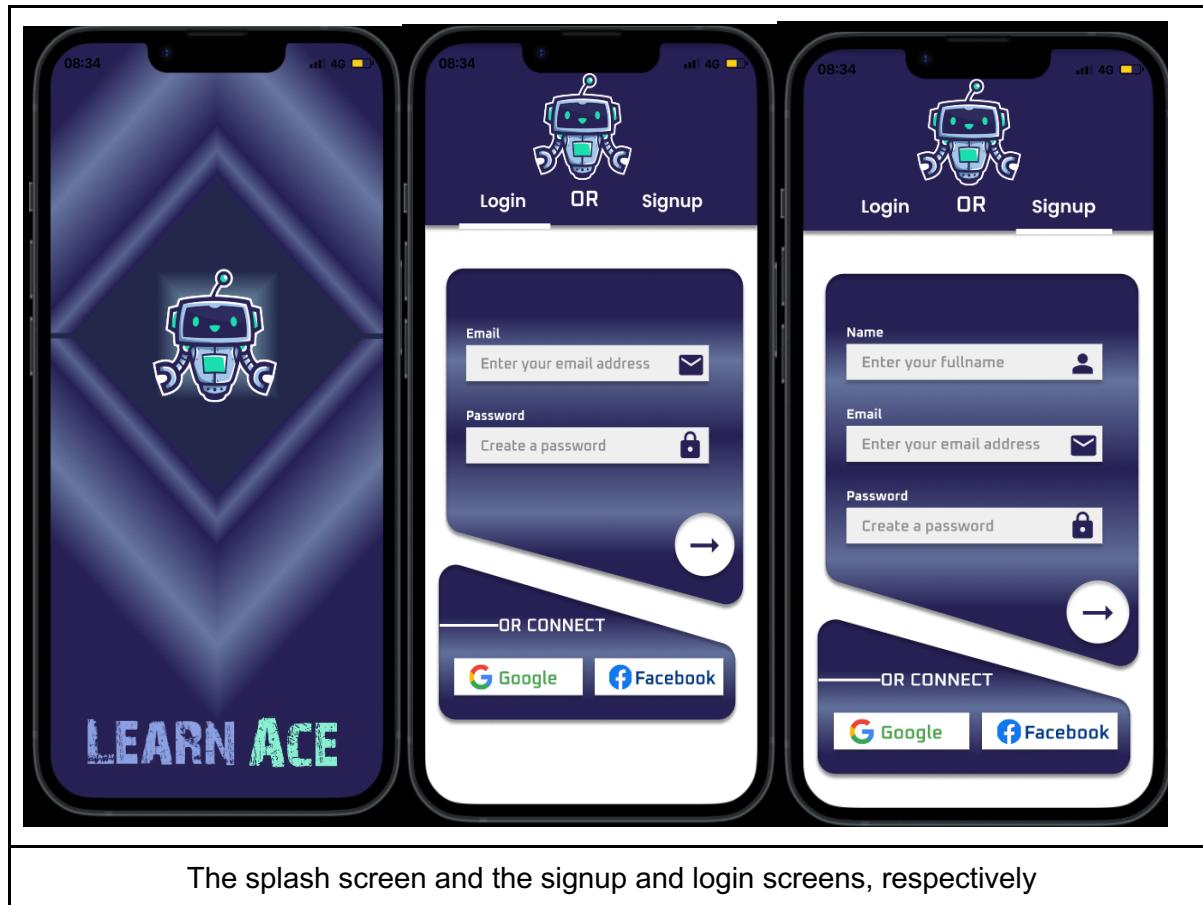
5.1.2 High Fidelity Design

The Onboarding Screens



These are the **onboarding screens** of my design which informs users what to expect of the design and prototype.

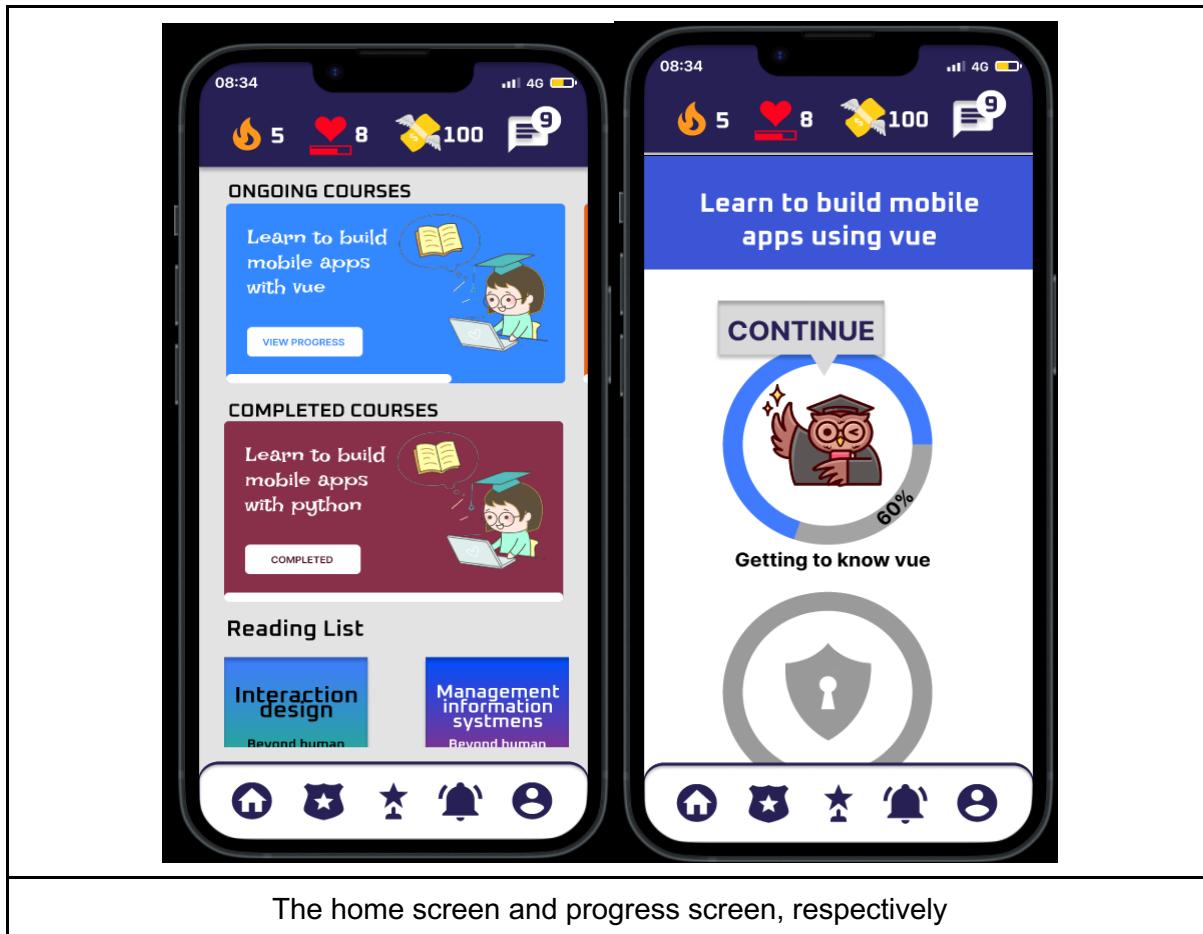
Splash Screen and Signup/Login Screen



The splash screen and the signup and login screens, respectively

After the initial loading screens (the "splash screen" and "onboarding screen") are complete, the login page will be displayed. Users must first log in to the app, or register for an account if they have not previously. However, because it is only a design and prototype, anyone can log in, sign up, and test the prototype.

HOME SCREEN AND PROGRESS SCREEN



The home screen and progress screen, respectively

The [home screen](#) shows the user's current ongoing courses, completed courses, and their reading list.

The level and the amount of progress made by the user are displayed on the [progress screen](#).

One of the octalysis core drives is “Development and Accomplishment,” users would feel more motivated if they could see their progress and how far they have gone. So I have made use of progress bars, as seen in the progress screen, which are circular, to show users how far they have advanced throughout the course.

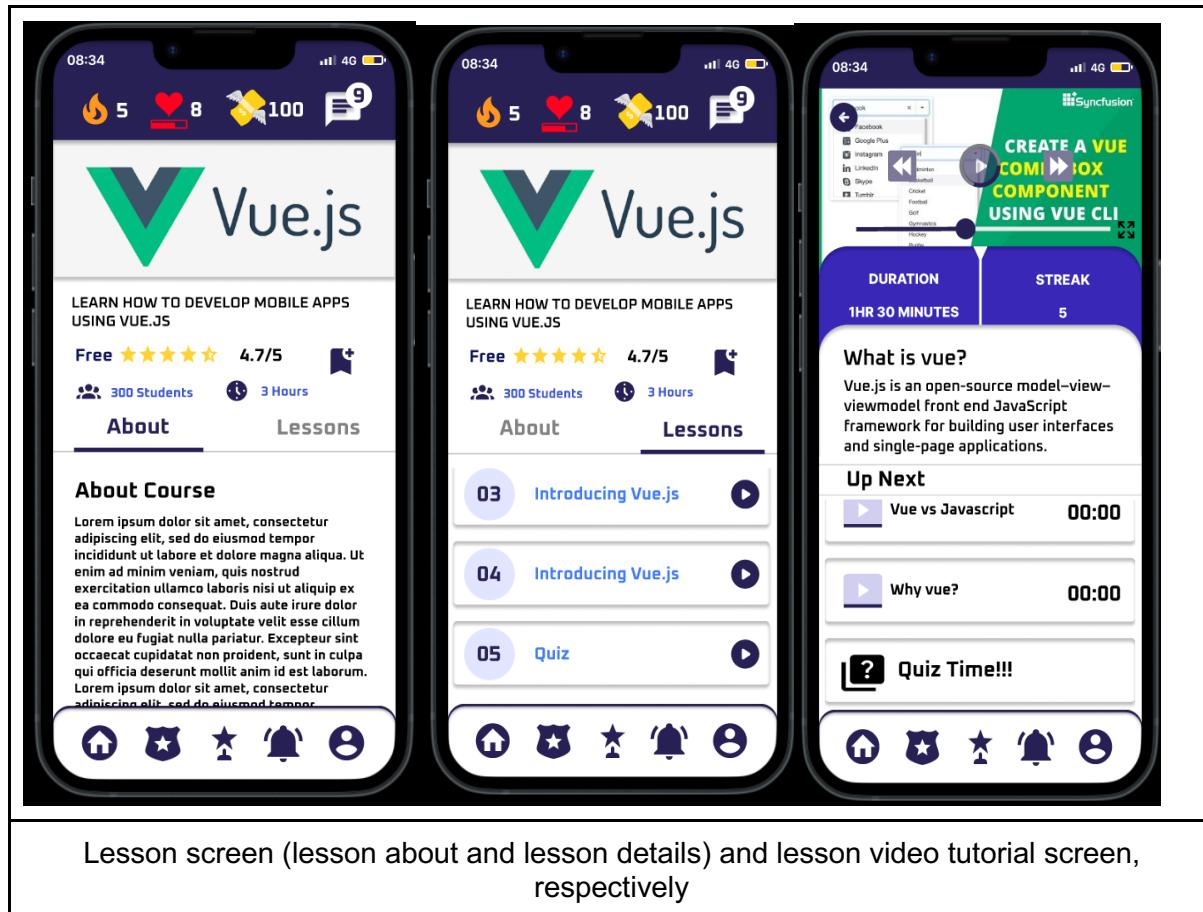
The inclusion of game elements, as seen in the screenshot, is intended to keep people interested and motivated; features like those found in video games, such as progress bars, leader boards, points, and badges, like in video games, there are levels and lives on this progress screen. I will explain more about why I have added each of these game elements as we go further into my design.

This app was designed to teach users the theoretical and practical aspects of developing mobile apps. The learning process is divided into various levels, like how games have levels, and at the end of a level there is a quiz. Upon successfully passing the quiz, the user earns a badge, and at the end of the course, you will get a special trophy for your efforts. You can use the scroll bar in the progress screen to navigate through the levels.

- The images/icons within the progress bar can be clicked to bring up the lesson screen.

- The "home" icon, when clicked, takes the user back to the home screen.
- The user can access the top scorers by selecting the trophy icon with a star.
- The user's badges will be displayed on the badge screen whenever they click the badge icon.
- If the user clicks the bell icon, all of their notifications will be shown.
- When a user selects the person icon, their personal information will be shown.

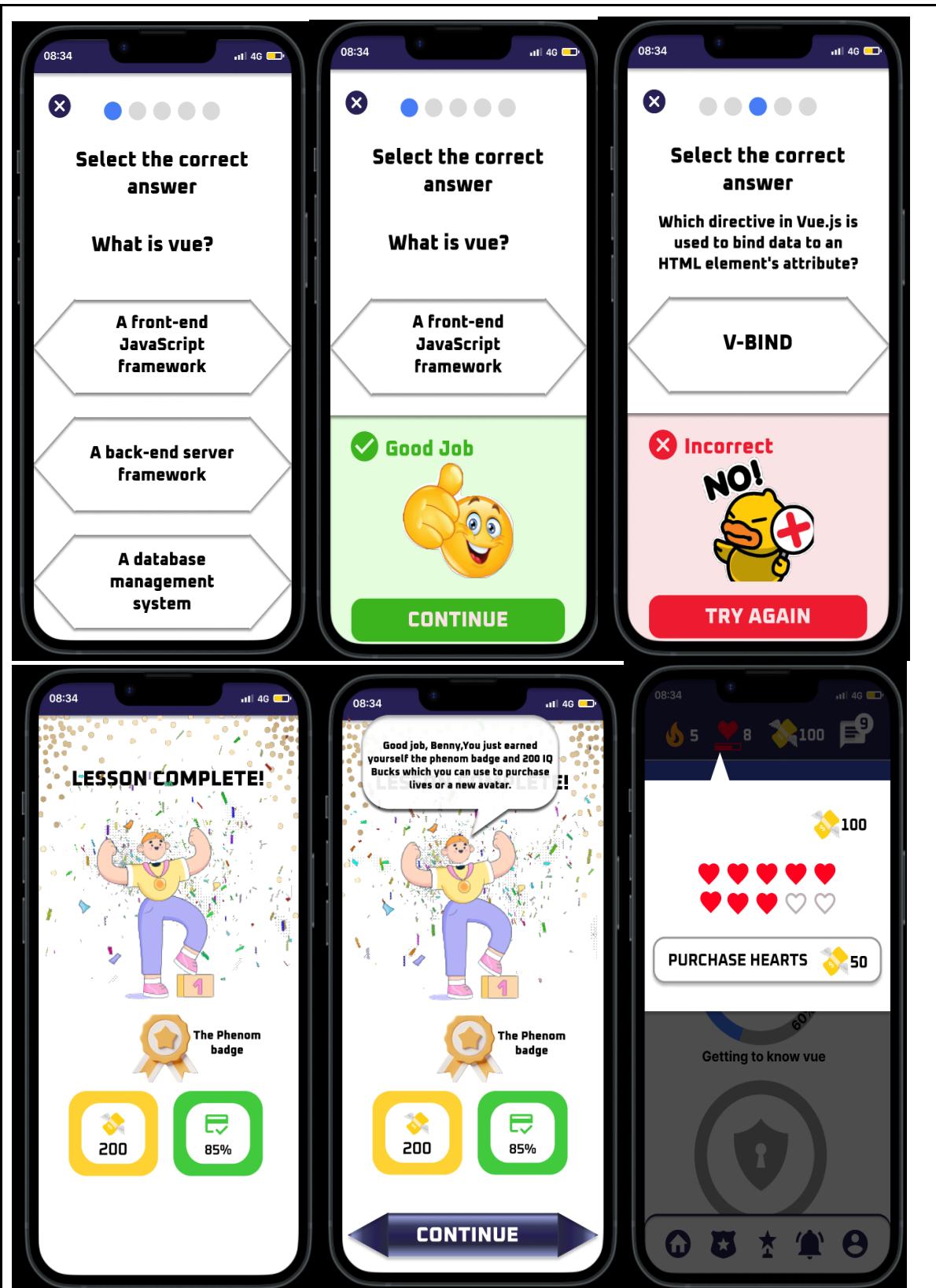
Lesson Screen and Video Tutorial Screen



Lesson screen (lesson about and lesson details) and lesson video tutorial screen, respectively

These are the screens for lessons and video tutorials. Users can access curriculum-specific information and details on the [lesson's screen](#). And for each lesson, videos are played as demonstrated in the [lesson video tutorial screen](#), and at the conclusion of a complete lesson, which is referred to as a "level" in my app, there would be a quiz to evaluate users' understanding and comprehension of the covered material. This lecture screen is also equipped with a scroll bar for navigation. As shown in the [lesson video tutorial screen](#), it shows the user's streak—how many days the user has been consistently attending the lectures and watching the videos. "This is my own way of implementing a way for users to earn points in my design, as points provide a way for users to give feedback and track their own personal development." Users can also see other users' reviews and add their own.

QUIZ SCREEN

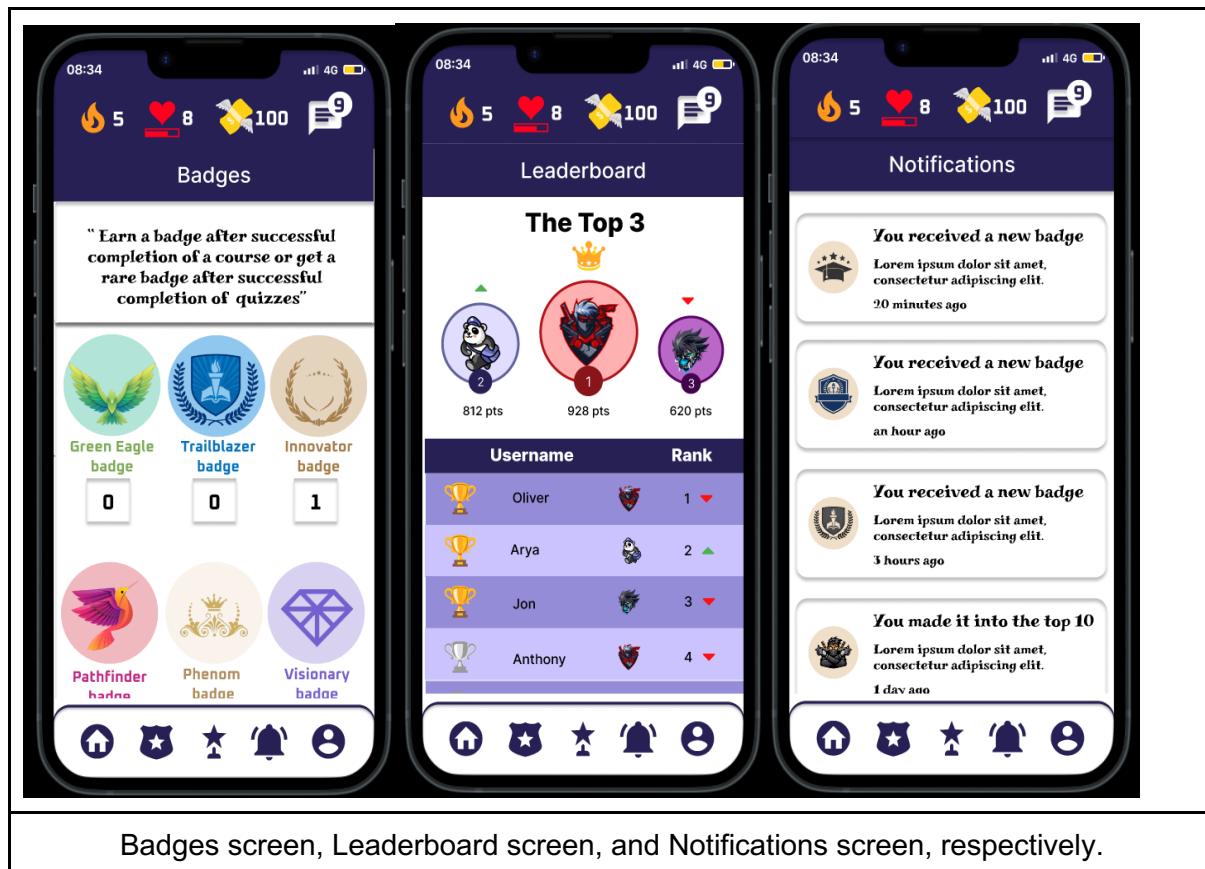


Quiz screen and an open overlay (6th image)

This is the [quiz screen](#). After successful completion of the lesson and video tutorials, a quiz would be made available for users. This is to assess the user's knowledge after attending and watching the lesson video tutorial. As shown in the image above, when the user answers the question correctly, a green overlay pops up telling the user "good job" and showing a button to continue, while when the user picks the wrong answer, a red overlay pops up telling the user "incorrect" and to try again.

Based on my research, one of the ways to encourage users is with interactive quizzes. This is my way of implementing the octalysis' first core drive, "epic meaning and calling," which I have implemented by urging users to keep going or attempting with my overlay pop-up messages, and at the end of a quiz since it is the end of a level, they would receive a badge and 200 IQ bucks (the name I have given my app's own currency). Based on the octalysis fourth core drive, which stands for "ownership and possession," I created my own app currency to give users the freedom and ability to own and possess a thing. When a user completes a quiz, they receive a badge and 200 IQ bucks, and as they progress, the amount of IQ bucks they earn increases. This would increase their motivation and ambition. As depicted in the sixth image above, this currency can be used to purchase lives in the app, as users lose a life whenever they fail a quiz.

Badges screen, Leaderboard screen, and Notifications screen



Badges screen, Leaderboard screen, and Notifications screen, respectively.

The [Badges screen](#) shows all the badges a user can earn within their time of using the app, and under each of the badges is the number the user has earned while using the app, as shown in the image above.

The [leaderboard screen](#) shows the top 10 points earners, their username, and rank, as well as the top 3 right up top on the leaderboard screen, as shown in the image above. This would make users more competitive and therefore more engaged.

The [Notifications screen](#) shows all the users' notifications.

Profile screen

The image displays four screenshots of a mobile application's profile screen, arranged in a 2x2 grid. The top row shows the main profile screen and a detailed view of the profile. The bottom row shows a screen for choosing an avatar and a sign-out confirmation dialog.

Top Left Screenshot (Main Profile Screen):

- Header: 08:34, 4G, battery icon.
- Top bar: Icons for fire (5), heart (8), wings (100), and messages (9).
- Section title: Profile.
- Profile picture: Circular icon of a character with a mask and wings.
- Username: benny
- Full Name: Benedicta Egbikuajde
- Email: benegbiks@gmail.com
- Statistics (in a box):
 - Books Read: 5
 - Badges: 5
 - Videos Watched: 11
 - Quiz Completed: 5
- Badges section: Shows three circular icons representing different achievements.
- Bottom navigation bar: Home, Shield, Star, Bell, and Profile icons.

Top Right Screenshot (Detailed Profile View):

- Header: 08:34, 4G, battery icon.
- Section title: My Profile.
- Profile picture: Circular icon of a character with a mask and wings.
- Profile details: Benedicta Egbikuajde, benegbiks@gmail.com, Change Avatar button.
- Badges section: Shows two icons with counts of 1 each.
- Bottom navigation bar: Help, View Progress, and Sign out buttons.

Bottom Left Screenshot (Choose an Avatar):

- Header: 08:34, 4G, battery icon.
- Section title: Choose an Avatar.
- Grid of 12 icons arranged in 4 rows of 3. The first row has three 'Free' icons. The subsequent rows have icons with '100 IQ Bucks to unlock', '300 IQ Bucks to unlock', and '500 IQ Bucks to unlock' respectively.

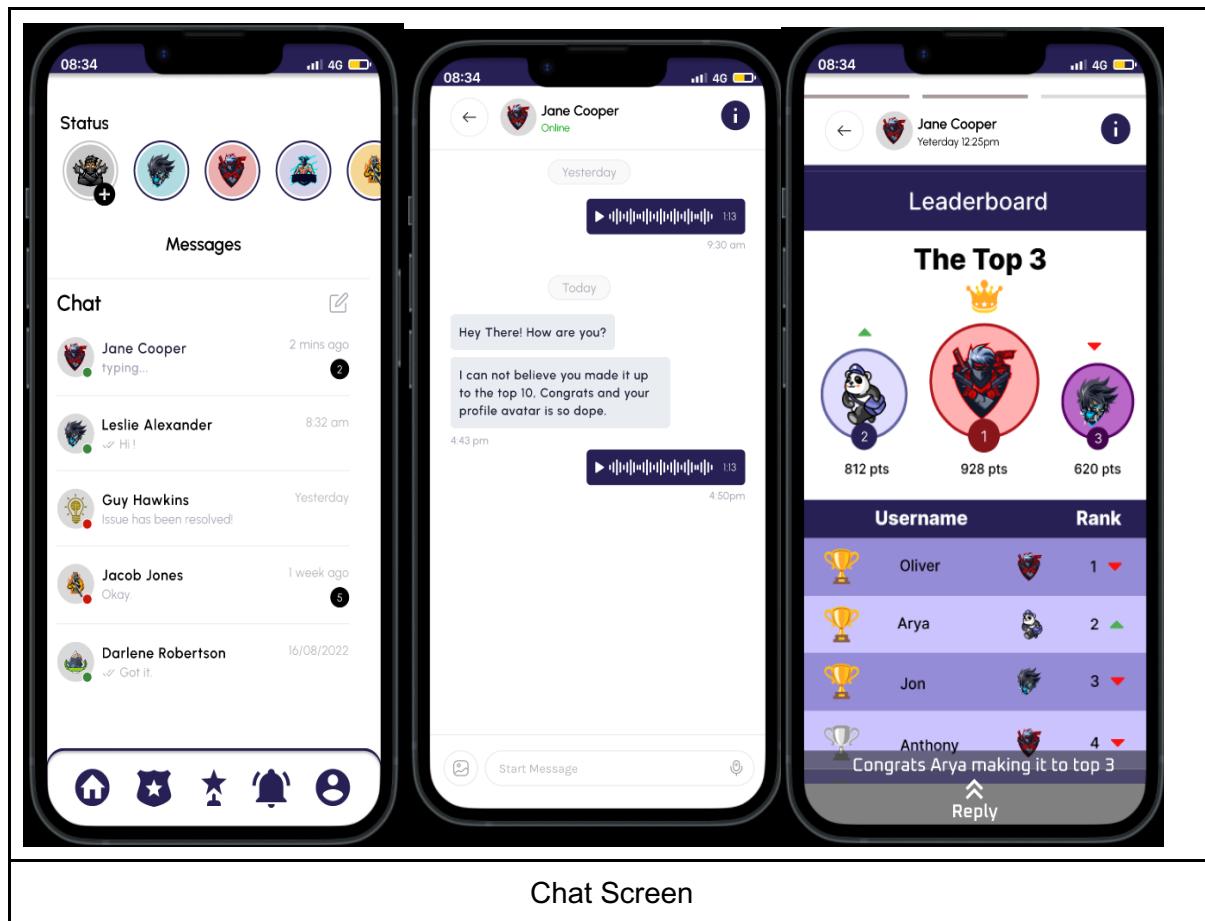
Bottom Right Screenshot (Sign Out Confirmation):

- Header: 08:34, 4G, battery icon.
- Section title: My Profile.
- Profile picture: Circular icon of a character with a mask and wings.
- Profile details: Benedicta Egbikuajde, benegbiks@gmail.com, Change Avatar button.
- Sign Out dialog box:
 - Header: Sign Out.
 - Text: Are you sure you want to sign out? You would have to sign in to access your account.
 - Buttons: Cancel and Sign Out.
- Bottom navigation bar: Help and Sign out buttons.

Profile Screen

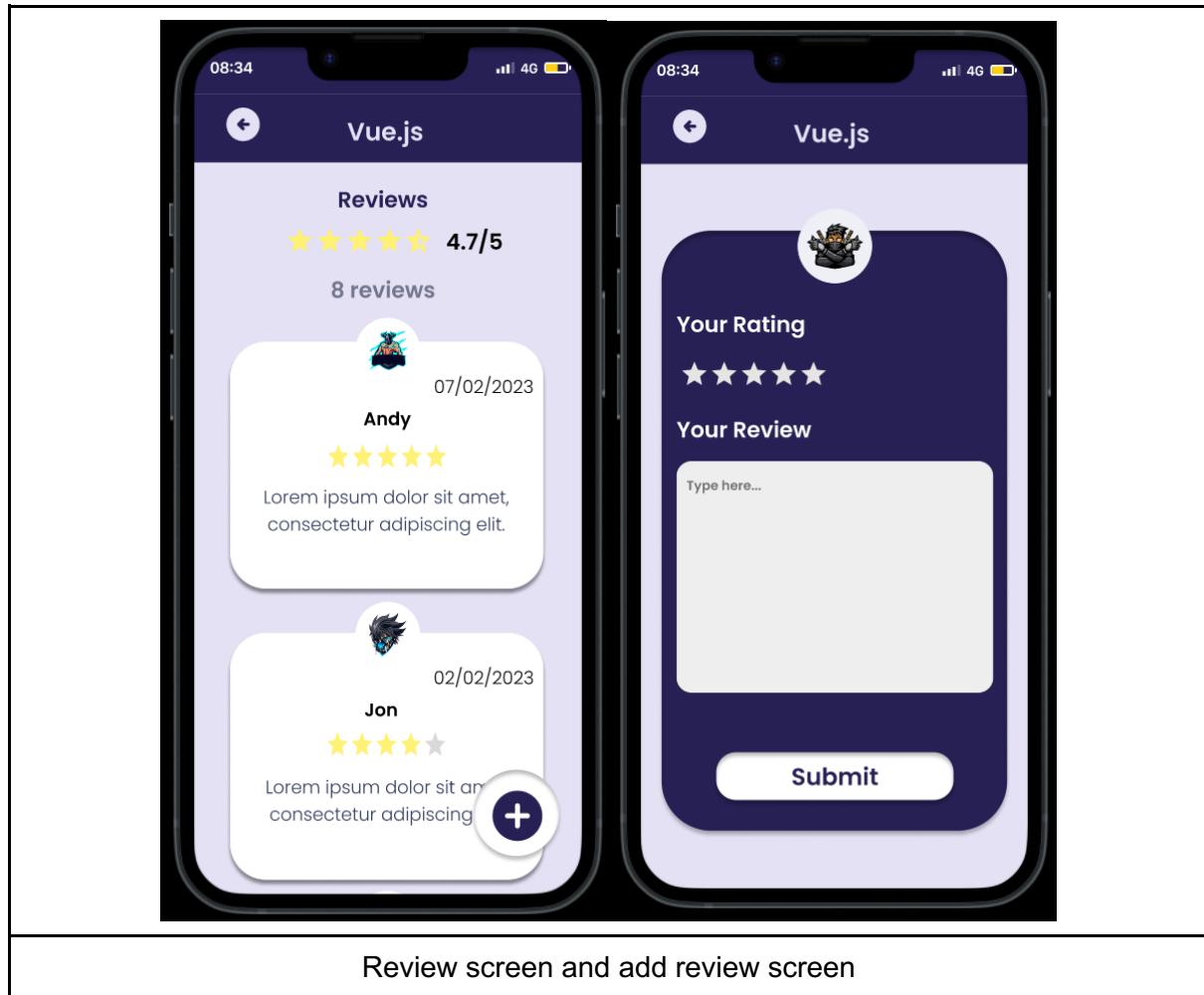
This is the profile screen. This is where users can find their personal information books they have read, videos they have watched, badges they have earned, and the number of quizzes they have completed. By clicking the setting icon on the profile screen, users would see a sidebar, and in the sidebar, there is a button to change their avatar and sign out, as shown in the above image. Clicking the "change avatar" button takes the user to another screen to choose an avatar. Users can purchase an avatar with the use of their "IQ Bucks" or pick a free avatar as shown above and clicking the "sign-out" button pops up a sign-out overlay message asking users to confirm if they want to sign out, as shown in the above image.

Chat screen



This is where users can chat with other users of the app and their lecturers. They can also view their various statuses and see updates, as shown in the third image above. Based on the octalysis framework's fifth core drive, which stands for "social influence and relatedness," I have implemented this chat feature in my design to allow users of the app to chat, communicate, and build relationships with other users and their lecturers.

Review screen



As I said before, users can view other users' reviews on the [lecture screen](#). They can view their reviews by clicking on the stars, which takes them to the [review screen](#) as shown above. They can also add their own review.

Based on my design and prototype of the “gamification of an e-learning app for web-based mobile app development module,” I would now check if I have implemented my gamification based on the [octalysis framework](#) as I stated in my project proposal.

The eight core drives of the Octalysis Framework	Has this been implemented into your design?
Epic meaning and calling	Yes, I have implemented this core drive by adding an interactive quiz at the end of a level, after which the user earns a badge.
Development and	Yes, I have implemented this core drive by adding a

Accomplishment	progress bar in my design to show users how much progress they have made.
Empowerment of creativity and feedback	Yes. I have implemented this core drive by allowing users to see a score after taking a quiz and if they pass the quiz, they earn a badge.
Ownership and Possession	Yes, I have implemented this core drive by adding the app's own currency to my design, which users can use to purchase lives or buy a new avatar. Users also earn a badge after successful completion of a level and a special trophy after completing a whole course.
Social Influence and Relatedness	Yes, I have implemented this core drive by including a chat feature in my design, which allows users to communicate with other users and lecturers.
Scarcity and impatience	Yes, I have implemented this core drive by adding lives into my design. Every time a user fails a question in a quiz, they lose a life. Users must have enough to continue learning.
Unpredictability and Curiosity	No.
Loss and Avoidance	Yes, I have implemented this core drive by adding lives into my design. Every time a user fails a quiz, they lose a life and earn no badges.

Note: Since I have only done a design and a prototype, some of the features and game elements I have included in my design may not like it would work in an actual app.

5.2 Implementation

The implementation was done on Figma through prototyping. I used Figma to do the following:

- I used Figma to create interactive screens by connecting multiple frames using hotspots or clickable elements. This allowed me to evaluate the usability of your design by simulating user flows.
- Using Figma, I added animations and transitions to my prototype to make it more engaging and real. I created basic animations using Figma's integrated animation tools.
- I used Figma to evaluate my prototype directly in the app and shared it with others for feedback and testing.

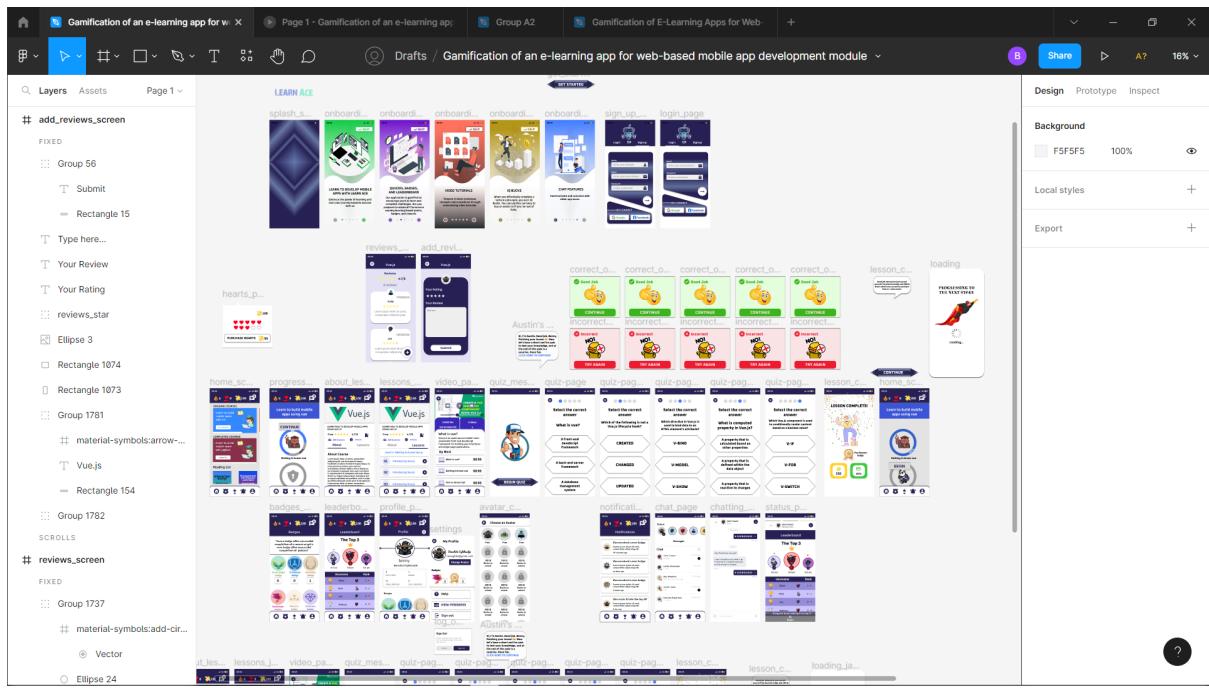


Figure 18: A screenshot showing my user interface design

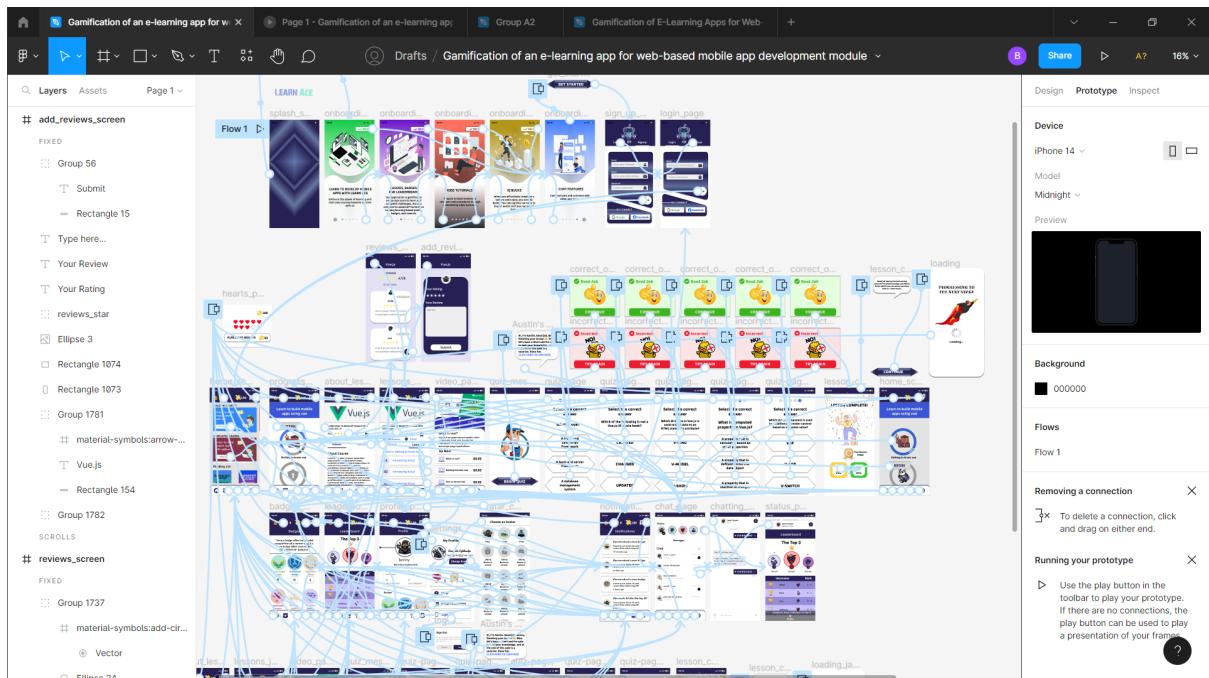


Figure 19: A screenshot showing how I have done my implementation and my prototype

The link to view my design and prototype: -

<https://www.figma.com/file/SZT3FCyizpYcVdvAUSjeNh/Gamification-of-an-e-learning-app-for-web-based-mobile-app-development-module?type=design&node-id=0%3A1&t=DYJRx2kNh8JkPmO4-1>

The link to view just the prototype: -

<https://www.figma.com/proto/SZT3FCyizpYcVdvAUSjeNh/Gamification-of-an-e-learning-app-for-web-based-mobile-app-development-module?page-id=0%3A1&type=design&node-id=1-1574&viewport=201%2C-381%2C0.27&scaling=scale-down&starting-point-node-id=1%3A1574>

6. Evaluation

In this section, I will demonstrate how I tested and evaluated the user interface and user experience.

6.1 UI and UX testing

This was done in an anonymous manner via an invitation document that I sent out to distribute the second questionnaire, which contained both the questionnaire URL and a link to the data visualisation tool Figma. Before answering the questions, participants would first test out the prototype. Because it is a simple, quick, and cheap approach to testing and evaluating user interfaces and user experiences, I chose to use it.

6.2 Evaluative Analysis of Potential User Feedback on the App

As mentioned in sub-section 4.2, I conducted two questionnaires, and for the second questionnaire, I shared it via social media to ensure participants remained anonymous, I used an invitation document that consisted of the Figma link, where my design of the gamified app was done for users to first test it out, and the questionnaire link, where they answered the questionnaire based on their experience while using the app. This is how my evaluation and testing were conducted anonymously.

6.2.1 Evaluative Analysis of the Second Questionnaire

Q1: Would you agree the user interface design is user friendly and easy to interact with and move through?

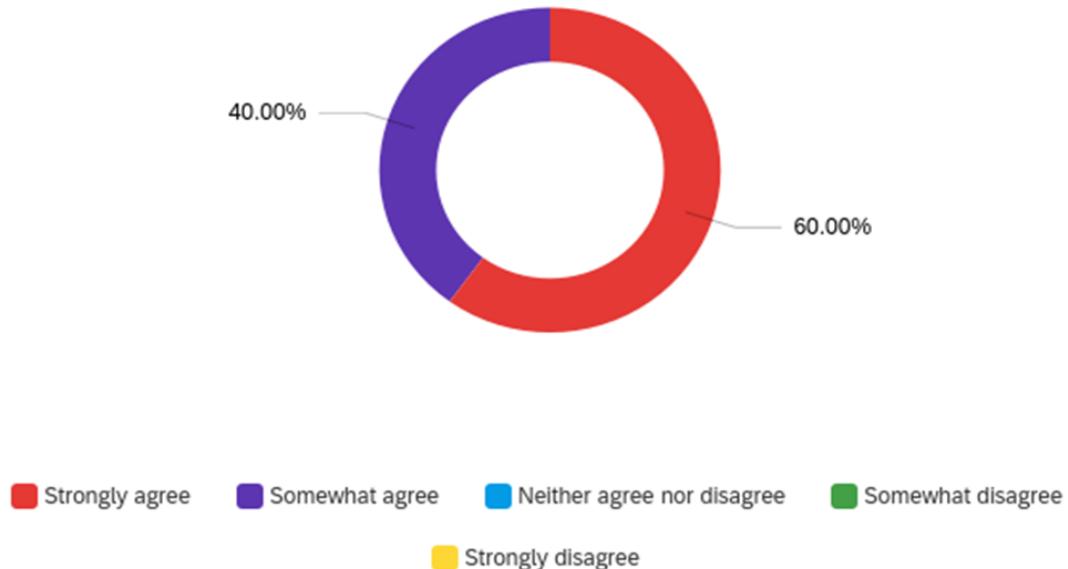


Figure 20: A pie chart showing the percentage of participants answer to the question

The purpose of this question is to determine how satisfied the user is with the design and interface of the app as a whole. The information that was gathered can be utilised to improve the app's usability and user experience by identifying areas that require improvement and using that information to make those improvements. Based on the responses from the questionnaire, 60% of the participants strongly agreed that the design was user friendly and 40% of the other participants somewhat agreed, as shown in the pie chart above. This shows that the design was easy for users to navigate through.

Q2: Did you feel engaged and entertained while learning with this app?

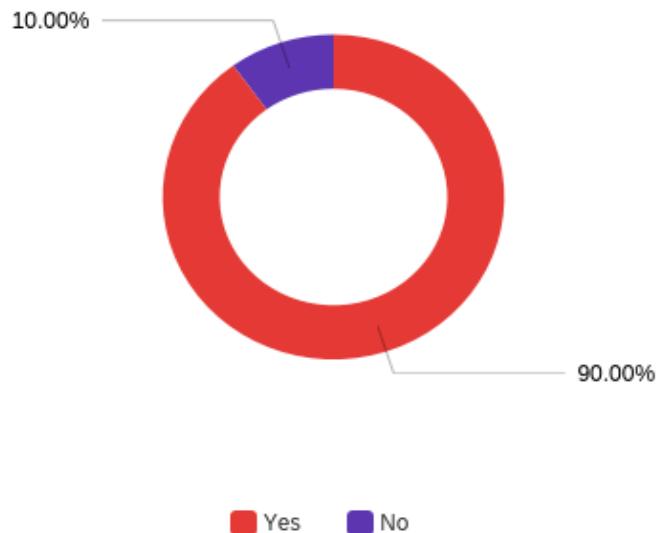


Figure 21: A pie chart showing the percentage of participants answer to the question

The purpose of this question is to determine the extent to which the user is engaged with the content provided by the app. It is of the utmost importance to guarantee that the user will continue to be engaged in, and driven by, the learning process. The user's feedback can be reviewed to determine how successfully the app engages the user and to pinpoint areas that require further development. The result of the questionnaire as seen in the pie chart signified that 90% of participants felt engaged.

Q3: Did you encounter any issues while using the app?

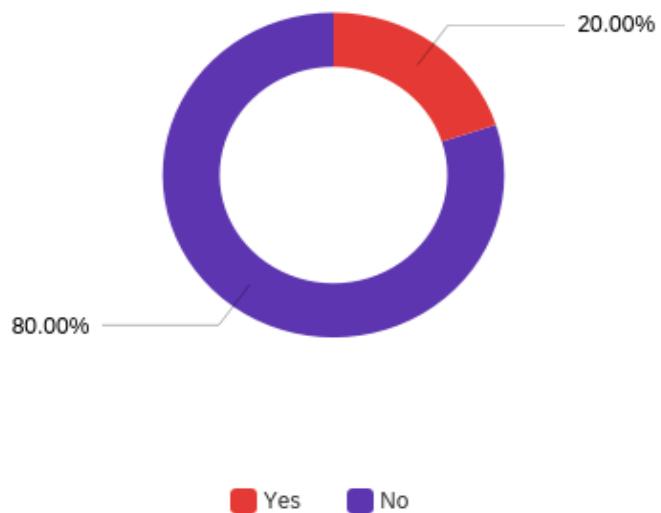


Figure 22: A pie chart showing the percentage of participants answer to the question

The purpose of this question is to determine whether the application encountered any technical or functional difficulties. This information can be put to use to iron out any bugs or flaws in the app's functioning and ensure that it will run smoothly for users in the future. As shown in the pie chart above 20% of the participants of the questionnaire encounter an issue. The next question would determine if the issue was a serious one. While 80% of the other participant did not encounter any issues.

Q4: When you encountered an issue while using the app, how long did it take for you to recover from it?

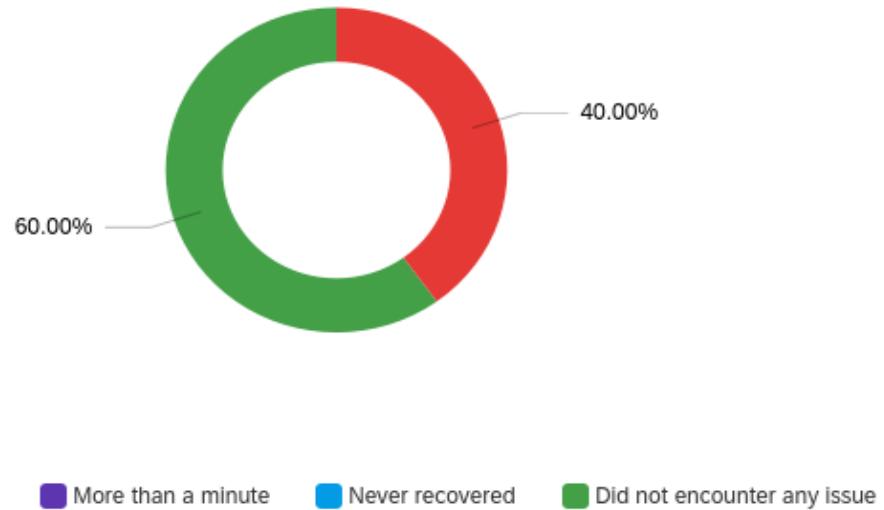


Figure 23: A pie chart showing the percentage of participants answer to the question

This question was asked to evaluate the usability of the app as well as the user's ability to rapidly recover from any technical or functional challenges that may arise. The user experience can be improved by using the feedback to pinpoint areas of the app that can be enhanced to reduce the amount of time needed to recover from errors, hence improving the overall quality of the app. As shown in the pie chart the issues participants encountered it took them less than a minute to recover from them.

Q5: Would you agree that the use of transitions and game elements made this app more fun?

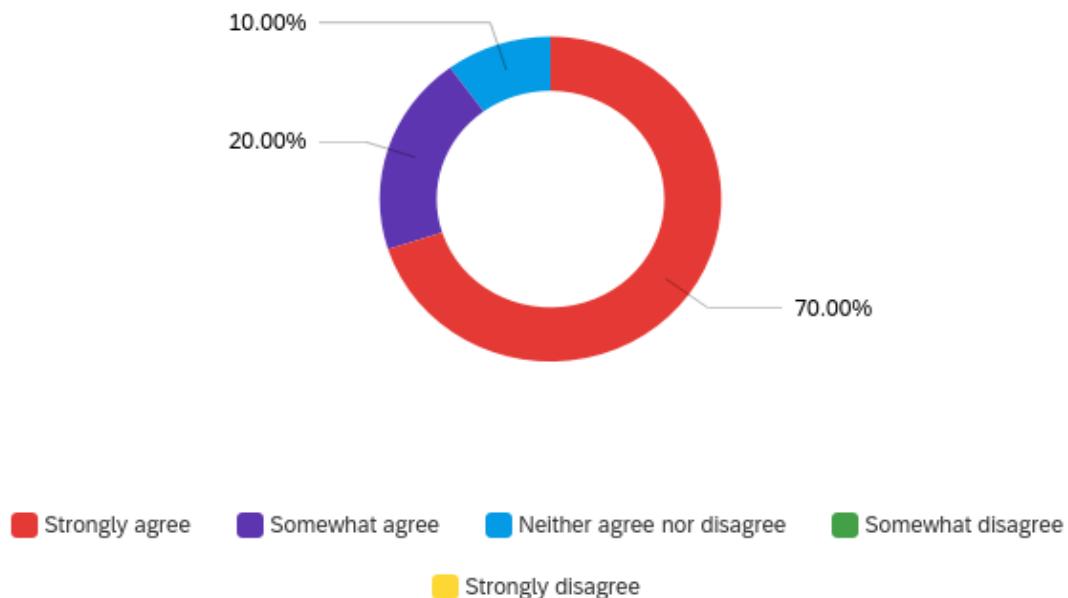


Figure 24: A pie chart showing the percentage of participants answer to the question

The purpose of this question is to assess how well the app integrates game elements and transitions into the educational process of its users to improve the quality of the material. The feedback can be used to determine which features are most valued by users and give priority to those features in the development of future versions of the app. Based on the results of the questionnaire as shown in the pie chart 70% of participants strongly agreed that the use of game elements and transitions made the app fun and 20% somewhat agreed. So, we can conclude that the addition of game elements and transitions made the app more fun.

Q6: Would you agree that this app has helped you learn both the theoretical and practical aspects of the web-based mobile app development module?

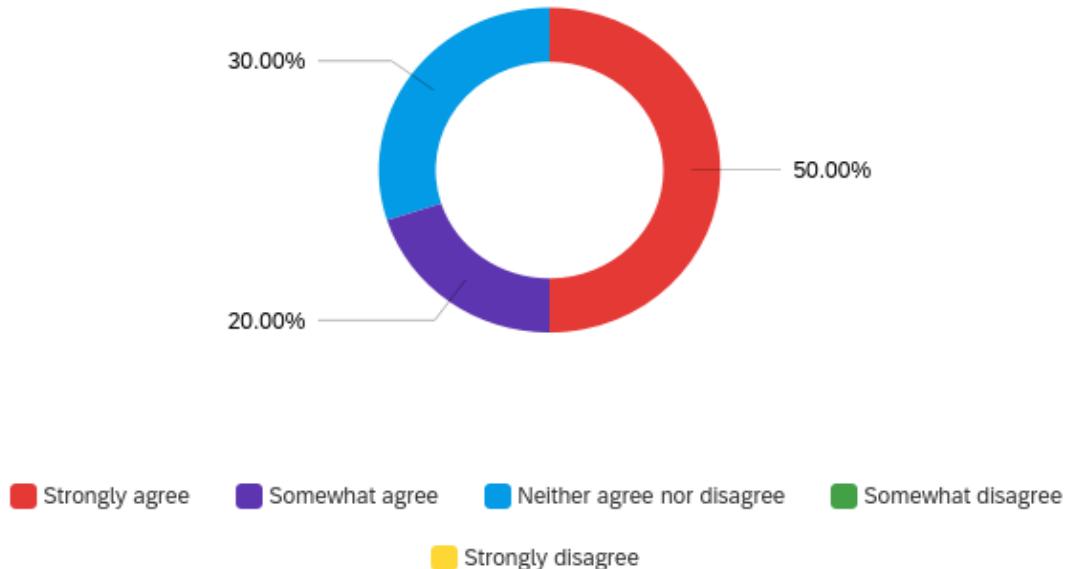


Figure 25: A pie chart showing the percentage of participants answer to the question

This question is designed to assess how well the application achieves its primary goal of delivering an all-encompassing educational experience. The feedback can be used to evaluate how well the app teaches users both the theoretical and practical aspects of developing web-based mobile applications. Based on the result gotten as seen in the pie chart 50% of the participant strongly agreed, 30% neither agreed nor disagreed, and 20% somewhat agreed. Because in my design, users cannot watch an actual lecture video or have access to an actual book, it is hard to say that users would learn much about the theoretical and practical aspects of the web-based mobile app development module. But in the real world, with all features working like they should, I believe students would engage themselves more in learning.

Q7: What were the most exciting/engaging activities you encountered while using the app?

Q7 - What was the most exciting / engaging activities you encountered while using the app?

What was the most exciting / engaging activities you encountered while using the app?
The quizzes on Vue.js and Javascript
Completing the quiz
The nice transitions
My favourite parts were the way the courses and lessons were presented. Presenting the lessons in video format rather than plain text. I liked also how the app keeps track of where you have left and shows how much of the course you have completed so far in percentage. I also like that you have added quiz where you can earn points and badges and you can compete with other players to whoever does best and this persuade the user to learn their best in the course
Tiny animations
The quiz was very fun and interactive.
N/A
completing a quiz
Excellent use of transitions and themes
The most exciting / engagaing activity for me is the quiz

The purpose of this question is to gather feedback from users regarding which aspects of the app are most successful in terms of engaging and encouraging users. The information that was acquired can be used to improve the features of the app that were the most successful and to continue those improvements in future app development. Based on the information gathered for each participant, six out of ten participants found the quiz to be the most engaging and exciting. Two of the participants mentioned the transitions. And one of the participants (4th response) went into detail, explaining what they liked, as shown in the above table. This has shown that the inclusion of game elements, transitions, videos, and quizzes was a good way of getting users / students to engage more in learning.

Q8: What improvements/changes would you love to see in this app?

Q8 - What improvement/changes would you love to see in this app?

What improvement/changes would you love to see in this app?

Better font selection

More game elements and animation

None I can think of

Maybe the only thing missing is a review page, students can write their opinion on the course in general or specific topics/videos after they have finished it

Improved and aesthetic design

Reducing the size of the header navigations but overall, the app is very useful

A way to visually see when a badge is earned

more animations

More features

Make better use of colors and add more transitions aside that the app is really good

The purpose of this question is to gather comments and suggestions from users regarding aspects of the app that could be enhanced or modified. The feedback can be used to determine which aspects of the app need to be improved the most and then give those aspects higher priority in the development of future versions. A participant observed that "a review page" was lacking which prompted me to include one in my design. Another participant suggested, "a way to visually see when a badge is earned." It is possible that this participant did not view all parts of the design or had difficulty navigating, as the app displays how and when users earn badges. The remaining participant discussed colour, font, additional animation, and game elements, as well as a more refined design. I believe there is always room for improvement

6.3 Meeting Requirements

Functional Requirements	Implemented
Users should be able to register for an account, log in, and access their profile.	Yes
The design should contain a number of web-based mobile application development courses, including topics, lessons, and exercises.	Yes
The design should monitor the user's progression through the course material and provide performance feedback.	Yes
The design should include game-like elements, such as badges, levels, points, and leaderboards, to incentivize learning.	Yes

To provide a more immersive learning experience, the software should be able to integrate with third-party tools, such as code editors and development environments.	No
The design ought to include video presentations of lectures and lessons on how to develop web-based mobile applications.	Yes
The design should include interactive quizzes and evaluations to evaluate user knowledge and provide immediate feedback.	Yes
The design should include social learning features, such as discussion forums, that enable users to collaborate and learn from one another.	Yes

6.4 Usability Heuristic Evaluation

Rule of Thumb	Is this rule being applied? How so?	Is this rule violated? How so?	How can this rule further improve usability, utility and desirability?
1. Visibility of system status	Yes. For example, at the end of a quiz, the user is informed lesson is complete.		With this rule, users can easily and constantly know what's going on, making the app's features easier and more pleasurable to use and helping them to reach their goals quickly and precisely because they would not get trapped.
2. Match between system and the real world	Yes. The design incorporates readily recognizable icons that correspond to those in the real world.		Since users would easily be able to identify icons that match the real world, they would be able to easily navigate through the app and complete their tasks quickly
3. User control and freedom		Yes. When testing the prototype, users do not have complete freedom and control over what they do.	
4. Consistency and standards	Yes. Because the terminology was consistent, the words, actions, and designs in my design are never unclear; users never have to question whether the words, actions, or designs had a different meaning.		With this rule applied users are able to achieve their tasks faster
5. Error prevention		Yes. Since this is only a design it does not have any error-effective messages.	If this rule was applied users would be able to recover from error faster.
6. Recognition rather than recall	Yes. This design includes various images and icons that resemble those found in the actual world. Therefore, it is easy for users to identify items like the home, settings, messages, personal information, etc. Users would rather view images and icons rather than repeatedly read text.		Users do not have to wonder while using the app as images and icons are easily identifiable therefore making them complete their tasks faster.
7. Flexibility and efficiency of use		Yes. On this app, users cannot conduct a search.	
8. Aesthetic and minimalist design	Yes. The design of the app is enjoyable, uncomplicated, and aesthetically pleasing. It contains several game elements and interactive quizzes that keep the user interested and not bored.		With this rule applied and game elements added users would engage and interact more on the app.
9. Help users recognize, diagnose and recover from errors		Yes. Since this is only a design it does not have any error-effective messages.	
10. Help and documentation			

7. Conclusion

According to my research and literature review, the implementation of a gamified e-learning app has the potential to solve the issue of student disengagement in web-based mobile app development modules. It has been demonstrated that the incorporation of game elements such as points, badges, and progress bars increase student participation and motivation, which could ultimately contribute to improved academic performance and a better overall educational experience.

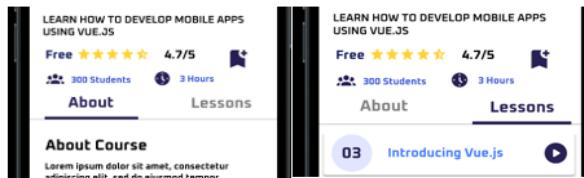
As the app's designer, I designed and implemented the app's prototype with these ideas (game elements) in mind. The evaluation of the design and prototype included a questionnaire, usability heuristics, and the eight core drives of the Octalysis framework, indicating an extensive and purposeful approach to the design and evaluation of the application. The questionnaire revealed that the participant who attempted this prototype felt engaged and, more significantly, enjoyed the quiz.

Now the question to be asked is: "Does my design and prototype solve the problem of students' disengagement in the theoretical and practical aspects of learning web-based mobile application development?" Yes and no. No, because not enough material regarding learning the "web-based mobile application module" has been included in the design; it is difficult to determine if users gain much understanding from using the app. However, I can conclude that the inclusion of game elements increased user engagement, and this design might be successful and work in the real world when implemented as an actual app with other third-party apps. But not all students may respond positively to gamification strategies, and individual differences must be considered.

8 User Guide

- To view the prototype, click the link <https://www.figma.com/proto/SZT3FCyizpYcVdvAUSjeNh/Gamification-of-an-e-learning-app-for-web-based-mobile-app-development-module?page-id=0%3A1&type=design&node-id=1-1574&viewport=201%2C-381%2C0.27&scaling=scale-down&starting-point-node-id=1%3A1574>

- Then wait for the splash screen to load and navigate through the onboarding screen. At the last onboarding screen a “get started” button slides in click on the button, and you are taken to a page to sign up or login sign up.
- After signing in you are taken to the home screen which shows your courses. Click on the “view progress” button on the courses this takes you to the “progress screen page” which shows how much progress and result has been made.
- On the progress screen page, you can choose to start a new course or continue. It also has a scroll bar for you to scroll through the page. Click on “start” or “continue” to take you to the lesson page.
- On the lesson page, you should see something like the picture below you are first taken to the About page course to go to the lessons page click on lessons and it takes you to the lessons page. After which you can click on the play icon to take you to the lesson video tutorial page.



- After clicking on the play icon, you're taken to the lesson video tutorial page. This page also has a scroll-down function
- On the lesson video tutorial page after you are done with watching the video's completely you can scroll down and start the quiz. This page also has a scroll-down feature. To start the quiz, click the button “Quiz Time!!!” and you are taken to the quiz.



Above is the bottom navigation bar

- ✓ Home icon- takes you to the home page.
- ✓ Badge icon- takes you to the badge page.
- ✓ Star trophy icon- takes you to the leaderboard page.
- ✓ Bell icon- takes you to the notification page.
- ✓ Person icon- takes you to the personal information page.

Figure 26: User Guide

9 Project Management Plan

An outline of the necessary activities, resources, and dates to carry out a project is known as a project management plan. It functions as a road map for the project, offering advice and direction to all of the project's stakeholders (PMI, 2017).

The value of a project management plan is dependent on its ability to guarantee that a project will continue to make progress and will successfully complete all of its goals and objectives. Having a well-designed strategy for project management can help in lowering risk, making the most of available resources, and increasing the likelihood that the project will be successful (PMI, 2017).

- The primary goal of this project is to create a gamified, user-friendly e-learning mobile app that may be used for teaching concerning web-based mobile app development. The purpose of this is to increase the level of interest and excitement that students have in the theoretical aspects.
- This project would cover the UI and UX design and implementation of a mobile application through prototyping. It would also include the incorporation of game aspects and strategies into the UI and UX design (also known as gamification), a literature review, UX testing, and both functional and non-functional requirements.
- Questionnaires would be used to elicit both the requirements of users and their feedback.
- A Gantt chart would be used to represent a list of tasks that would be carried out in order to effectively complete this project.

9.1 Project Management Schedule

It guarantees that the project is finished within the allotted amount of time and money (Kerzner Harold, 2017).

9.1.1 Gantt Chart

A Gantt chart is an effective instrument for visualising a project's activities, responsibilities, and timeframes (Pinto and Slevin, 1987). It aids in the efficient and timely completion of undertakings (Pinto and Slevin, 1987).

- Use the URL that is provided below to access my most recent Gantt Chart:

[UG Individual project gantt chart.xlsx](#)

10 Ethical Approval

According to a review that was published in the Journal of Medical Ethics, ethical permission is an important phase in the research process because it strives to make sure that investigations are conducted in a responsible and ethical way and that participants' rights and interests are preserved (Smith & Jones, 2010). This review found that the approval of ethics is a vital stage in the research process.

10.1 Ethical Approval Form

Do not amend before use



Research Ethics Screening Form for Students

Middlesex University is concerned with protecting the rights, health, safety, dignity, and privacy of its research participants. It is also concerned with protecting the health, safety, rights, and academic freedom of its students and with safeguarding its own reputation for conducting high quality, ethical research.

This Research Ethics Screening Form will enable students to self-assess and determine whether the research requires ethical review and approval via the Middlesex Online Research Ethics (MORE) form before commencing the study. Supervisors must approve this form after consultation with students.

Student Name:	Benedicta Oghenevole Egbikuadje	
Research project title:	Gamification of E-Learning Apps for Web-Based Mobile App Development Modules	
Programme of study/module:	Bsc Information Technology	
Supervisor Name:	Dr. Luca Piras	Email:L.Piras@mdx.ac.uk



Please answer whether your research/study involves any of the following given below:

1. <input type="checkbox"/> ^H ANIMALS or animal parts.	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
2. <input type="checkbox"/> ^M CELL LINES (established and commercially available cells - biological research).	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
3. <input type="checkbox"/> ^H CELL CULTURE (Primary: from animal/human cells- biological research).	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
4. <input type="checkbox"/> ^H CLINICAL Audits or Assessments (e.g. in medical settings).	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
5. <input checked="" type="checkbox"/> ^X CONFLICT of INTEREST or lack of IMPARTIALITY. If unsure see "Code of Practice for Research" (Sec 3.5) at: https://unihub.mdx.ac.uk/study/spotlights/types/research-at-middlesex/research-ethics	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
6. <input checked="" type="checkbox"/> ^X DATA to be used that is not freely available (e.g. secondary data needing permission for access or use).	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
7. <input checked="" type="checkbox"/> ^X DAMAGE (e.g., to precious artefacts or to the environment) or present a significant risk to society).	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
8. <input checked="" type="checkbox"/> ^X EXTERNAL ORGANISATION – research carried out within an external organisation or your research is commissioned by a government (or government body).	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
9. <input type="checkbox"/> ^M FIELDWORK (e.g biological research, ethnography studies).	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
10. <input type="checkbox"/> ^H GENETICALLY MODIFIED ORGANISMS (GMOs) (biological research).	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
11. <input type="checkbox"/> ^H GENE THERAPY including DNA sequenced data (biological research).	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
12. <input type="checkbox"/> ^M HUMAN PARTICIPANTS – ANONYMOUS Questionnaires (participants not identified or identifiable).	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
13. <input checked="" type="checkbox"/> ^X HUMAN PARTICIPANTS – IDENTIFIABLE (participants are identified or can be identified): survey questionnaire/ INTERVIEWS / focus groups / experiments / observation studies.	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No

14. ¹ HUMAN TISSUE (e.g., human relevant material, e.g., blood, saliva, urine, breast milk, faecal material).	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
15. ¹ ILLEGAL/HARMFUL activities research (e.g., development of technology intended to be used in an illegal/harmful context or to breach security systems, searching the internet for information on highly sensitive topics such as child and extreme pornography, terrorism, use of the DARK WEB, research harmful to national security).	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
16. ² PERMISSION is required to access premises or research participants.	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
17. ³ PERSONAL DATA PROCESSING (Any activity with data that can directly or indirectly identify a living person). For example data gathered from interviews, databases, digital devices such as mobile phones, social media or internet platforms or apps with or without individuals'owners' knowledge or consent, and/or could lead to individuals/owners being IDENTIFIED or SPECIAL CATEGORY DATA (GDPR ¹) or CRIMINAL OFFENCE DATA. <small>¹Special category data (GDPR- Art.9): "personal data revealing racial or ethnic origin, political opinions, religious or philosophical beliefs, or trade union membership, and the processing of genetic data, biometric data for the purpose of uniquely identifying a natural person, data concerning health or data concerning a natural person's sex life or sexual orientation".</small>	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
18. ² PUBLIC WORKS DOCTORATES: Evidence of permission is required for use of works/artifacts (that are protected by Intellectual Property (IP) Rights, e.g. copyright, design right) in a doctoral critical commentary when the IP in the work/artifacts jointly prepared/produced or is owned by another body	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
19. ¹ RISK OF PHYSICAL OR PSYCHOLOGICAL HARM (e.g., TRAVEL to dangerous places in your own country or in a foreign country (see https://www.gov.uk/foreign-travel-advice), research with NGOs/humanitarian groups in conflict/dangerous zones, development of technology/agent/chemical that may be harmful to others, any other foreseeable dangerous risks).	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
20. ² SECURITY CLEARANCE – required for research.	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
21. ² SENSITIVE TOPICS (e.g., anything deeply personal and distressing, taboo, intrusive, stigmatising, sexual in nature, potentially dangerous, etc).	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No

M – Minimal Risk; X – More than Minimal Risk. H – High Risk



If you have answered 'Yes' to ANY of the items in the table, your application REQUIRES ethical review and approval using the MOREform BEFORE commencing your research. Please apply for ethical approval using the MOREform (<https://moreform.mdx.ac.uk/>). Consult your supervisor for guidance. Also see *Middlesex Online Research Ethics* (MyLearning area) and www.tiny.cc/mdx-ethics (CS students).

If you have answered 'No' to ALL of the items in the table, your application is Low Risk and you may NOT require ethical review and approval using the MOREform before commencing your research. Your research supervisor will confirm this below.

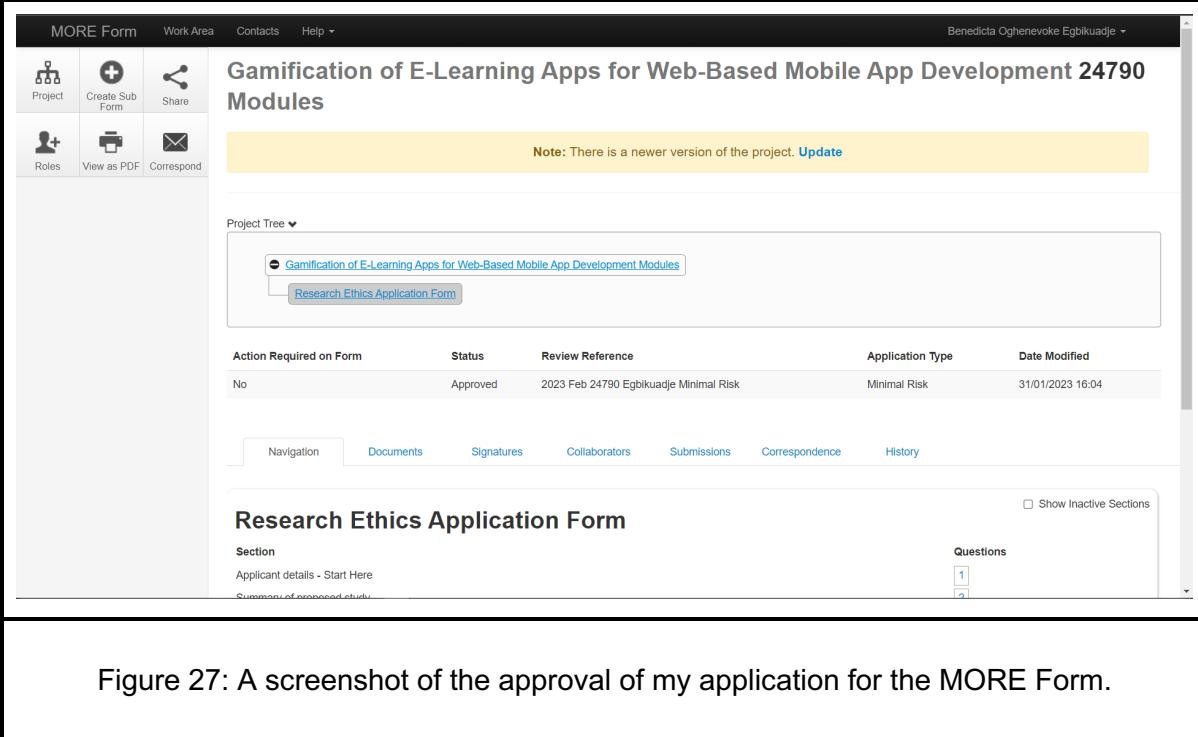
Student Signature:egbiks..... Date:14/12/2022.....

To be completed by the supervisor:

Based on the details provided in the self-assessment form, I confirm that:	Insert Y or N
The study is Low Risk and does not require ethical review & approval using the MOREform	N
The study requires ethical review and approval using the MOREform.	Y

As the ethics approval form has shown above, my study is not low risk and it requires approval using more form because I would be conducting a questionnaire which involves human participants.

10.2 More Forms



The screenshot shows the MORE Form application interface. At the top, there is a navigation bar with links for 'MORE Form', 'Work Area', 'Contacts', 'Help', and a user profile 'Benedicta Oghenevok Egbikuadje'. Below the navigation bar, the main title is 'Gamification of E-Learning Apps for Web-Based Mobile App Development 24790 Modules'. A yellow banner below the title states 'Note: There is a newer version of the project. [Update](#)'. The 'Project Tree' section shows a single item: 'Gamification of E-Learning Apps for Web-Based Mobile App Development Modules' with a sub-item 'Research Ethics Application Form'. Below the project tree, a table displays the following data:

Action Required on Form	Status	Review Reference	Application Type	Date Modified
No	Approved	2023 Feb 24790 Egbikuadje Minimal Risk	Minimal Risk	31/01/2023 16:04

Below the table are tabs for 'Navigation', 'Documents', 'Signatures', 'Collaborators', 'Submissions', 'Correspondence', and 'History'. A 'Research Ethics Application Form' section is shown, with a 'Section' header and a 'Questions' section containing two numbered items. A checkbox 'Show Inactive Sections' is also present.

Figure 27: A screenshot of the approval of my application for the MORE Form.

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