OOP HELPER: A GAMIFIED MOBILE APPLICATION FOR OBJECT-ORIENTED PROGRAMMING CONCEPTS

A MINI THESIS SUBMITTED IN PARTIAL FULFILMENT
OF THE REQUIREMENTS FOR THE DEGREE OF BACHELOR OF
SCIENCE IN COMPUTER SCIENCE OF
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BY

Akawa Johannes Sheepo
218200218
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MAIN SUPERVISOR: Mr Titus Haiduwa

Abstract

Teaching and learning Object Oriented Programming (OOP) requires appropriate and effective pedagogical approaches. One of the problems that occur while learning OOP concepts is that only fewer students have an interest or are motivated in learning OOP concepts. This leads to most students either dropping out or repeating the OOP modules. The university however can embrace mobile technology to complement and support the existing eLearning platform to deliver OOP learning concepts effectively. Based on this background, this study aimed to gamify the OOP concepts through a Gamified mobile application to complement the current OOP teaching practices and improve student performance. This study applied a mixed research methods which involves combining or integration of qualitative and quantitative research and data in a research study. A waterfall software development model has been adopted to guide the development of the "OOP Helper". A survey with open and closed questions was administered to computing undergraduate students at UNAM who pilot tested the learning tool and expressed their experiences and opinions. A random sampling technique was used to select from the targeted population. The survey results showed that the OOP Helper game provides a helpful and motivating platform to learn OOP concepts. The study recommends educational institutions consider offering gamified learning to their students for improved results. Future work includes the development of the iOS-based application.

Table of Contents

List of Tables

List of Figures

List of Abbreviations and/or Acronyms

OOP	Object-Oriented programming
NDP5	Fifth (5^{th}) National Development Plan
UNAM	University Of Namibia
UNAM JEDs	University Of Namibia Jose Eduardo Dos Santos Campus
SDLC	Software Development Life Cycle
UI	User Interface
API	Application Programming Interface
APK	Android Application Package
IT	Information Technology

ACKNOWLEDGEMENTS

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Thank you all

DEDICATION

I dedicate my thesis to my mother Mrs Katrina Angula-Akawa, to Mr Shimpanda Petrus and his family, and to my brothers Akawa Aron and Akawa Salom.

DECLARATIONS

I, **Akawa Johannes Sheepo** hereby declare that this study is my own work and is a true reflection of my research, and that this work, or any part thereof has not been submitted for a degree at any other institution.

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Name of Student Signature Date

Chapter 1: Introduction

1.1 Introduction

This chapter introduces the study on a gamified mobile application for object-oriented programming concepts. This chapter begins with presenting the background of the study, statement of the problem and the objectives of the study. It further presents the significance of the study, motivation, limitation of the study and delimitation of the study. It also provides a brief outline of the thesis and the conclusion of this chapter.

1.2 Background of the study

Object-Oriented Programming (OOP) is one of the most critical module required by all Computer Science or Information Technology (IT) students as it is widely used and very popular in the software development industry. It is very important to understand the concept of OOP as students to be able to compete in the industry. However, mapping real-life objects with basic Object-Oriented Programming (OOP) concepts becomes a challenge for beginners to understand (Abbasi, Kazi, Khowaja, Baloch, 2021). Object oriented programming is a programming paradigm that has been designed around objects reader than procedures (Elaachak & Bouhorma, 2018). OOP implements real world entities like object, class, encapsulation, inheritance, polymorphism, and abstraction in a programing language. Lecturing OOP is not as easy as expected. Lecturing unmotivated students is a predicament faced by lecturers every single day. Most students have a passive learning style that does suit the way of teaching offered at the university. Another factor that contributes to the challenges affecting the delivery of OOP contents is the lack of understanding of programming contents from previous programming classes.

In recent years, the passing rate of OOP module at the University of Namibia (UNAM) has dropped to around 30 to 40%. Although the e-learning platform was introduced to aid the traditional classroom-based learning, it is not effective to deliver all OOP concepts to the students. To increase the interest of students in learning, gamification approach should be used, which delivers learning contents in an easier, interesting, competitive and entertaining way. Gamification is a method that adopts game elements into a context that none related to a game with purpose attract user attention

and motivation (Lubis, Rosmansyah, & Supangkat, 2014). Gamifications proves to stimulate creative thinking and promote active learning.

1.3 Statement of the problem

The current use of student-centred approach proves to be insufficient for the inexperienced students doing Object oriented programming. According to Iyawa et al. (2019) in a study to design, develop and evaluate a gamified mobile application to support the learning of basic and advanced computational concepts in the Department of Computer Science at UNAM, identified that OOP is one of most challenging module in the UNAM school of Computing. In 2019, eighty-three (83) students registered for OOP 2. In a group of these students, 25% of the student did not qualify to write the examination. This indicate that most students struggle with mastering the OOP basic concepts (classes, objects, inheritance, polymorphism, exceptions, string manipulation and data structure). Despite the use of interactive e-learning platform (Moodle), the university need to explore more on options provided by gamification. The Moodle learning platform (eLearning platform) needs to be aided with the mobile application to facilitate the learning process in the OOP modules. Since mobile phones can be used by students at any time anywhere, they offer new opportunities for teaching and learning programming paradigms (Frohberg, Göth, & Schwabe, 2009). Furthermore, there is a gap in knowledge and literature on the game-based learning approach even though games are considered efficient tools for learning OOP paradigm. (Wong & Hayati, 2013).

1.4 Objectives of the study

The primary objective of this study is to develop a gamified mobile application to improve students' motivation and engagement in the OOP module and to add a mobile application to an existing eLearning platform in order to provide an interactive way to deliver OOP contents.

1.5 Significance of the study

There have not been any gamified mobile application in the context of OOP at the University Of Namibia. Therefore, this study will genuinely contribute to the body of literature on gamification for educational purposes in the context of Object Oriented Programming in Namibia. In addition, it

aims in promote quality delivery of education in Namibia through game-based learning. A necessity presented in the Namibia's fifth (5^{th}) National Development Plan (NDP5) that is to "improve quality of teaching and learning in university and strengthen research capacity at higher education institutions" (National Planning Commission , 2017).

1.6 Motivation

Statistics for 2019 and a study by Iyawa (2019) has shown that OOP1 and OOP2 is a challenging module to students. For this reason, it has raised a desire for the researcher to help student who facing challenges in the OOP module by creating an application to motivate them.

1.7 Limitation of the study

The researcher's intention was to have the study involve all the two campuses, UNAM Main Campus and UNAM JEDs Campus. However, due to long distance between the two campuses and limited financial resources, this study is restricted to UNAM Main Campus. In addition, due to time constraints the researcher only decided to involve participants from easily accessible campus.

1.8 Delimitation of the study

Object Oriented Programming is offered to both students at UNAM Main Campus and UNAM JEDs Campus. Hence, the scope of this study was only limited to students doing OOP 1 and OOP 2 modules at UNAM main campus. Reason being, the two campuses a far apart from each other making hard for the researcher to engage all students from both campuses.

1.9 Outline

The remaining sections of this paper are structured as follows: Chapter 2 presents literature reviews; Chapter 3 present and discusses the methodologies. Chapter 4 presents the results and discussions. Last of all is conclusion and references.

1.10 Conclusion

This chapter introduced the study, provided a brief description on the background of the study, indicated the statement of the problem, objectives of the study, signification of the study, motivation the limitation and delimitation of the study and the outline. The next chapter reviews the related work pertaining to the study.

Chapter 2: Literature Review

2.1 Introduction

The literature review is "an analysis on works previously done on a subject matter, analysis done based on credible sources" (Ishak & Fauzan, 2015, p. 5). This is chapter will define what is gamification according to different researchers. It will review the related work of gamification. This chapter will further discuss the application of gamification in different fields such as marketing, healthcare and education. The usage of gamified mobile application in tertiary education shall be discussed in the chapter before focusing on the impacts of gamified mobile applications to student engagement and motivation and academic performance. It finally discuss the SDLC used to develop the OOP Helper.

2.2 Overview of Gamification and Object-oriented Programming

Gamification is the use of game design element in non-games context (Durin et.al, 2019). Faiella and Ricciardi (2015) clarified that gamification does not employ games for non-entertainment purposes, as serious games, but rather it affords elements of a game experience to improve retention. Apostol *et al.* (2013) identify eight elements of games that are used for the gamification of learning, such as: rules, goals and outcome, feedback or rewards, problem solving, story, player(s), safe environment, sense of mastery. Gamification via mobile apps is a quite new and unique approach that combines educational games and mobile apps to create a gamified teaching environment that is fun, creative, exciting, engaging and challenging (Khaddage, 2014).

Object-oriented programming is a programming paradigm or methodology that creates programs using classes and objects. This programming paradigm is based on several concepts e.g. "object, class, inheritance, polymorphism, abstraction and encapsulation. The main aim of OOP is to bind

together the data and the functions that operate on them so that no other part of the code can access this data except that function (Rishabh, 2021).

2.3 Review of related work

2.3.1 Application of Gamification in Marketing

Gamification has become a common strategy to reach consumers online and through connected mobile devices. Gaming techniques such as goals and outcome, feedback or rewards, problem solving are used to attract customers with the aim to creating connections with customers and to motivate customers to return for the services and products at their business. The central objective of gamification as a marketing tool is to boost sales and increase profit (Gamification Marketing Examples Being Used in Business, 2020).

An application of gamification in marketing is the Chipotle Love Story Game that is based on their short film called A Love Story. The Chipotle Love Story Game uses the game techniques to engage the customer to match the ingredients together while avoiding the use of added colours and flavours. Players are rewarded with a buy-one-get-one-free coupon for any food item. The reward encourages consumers to play the game, stay engaged with the company, and purchase more, while the game itself reinforces the brand message of using healthy, real ingredients as opposed to artificial colours and flavours ("Gamification Marketing Examples Being Used in Business", 2020). This gamified application provides an opportunity for customers to interact with the brand in a fun and joyful way.

2.3.2 Application of Gamification in Healthcare

Gamification is also applied in health care to help patients in certain problems. An Empower application is the application designed to help patients with chronical conditions to be proactive about maintaining and improving their health and overall wellness. The Empower application

reminds patients daily that they need to record their daily behaviours. The patients are motivated through simple a games, surveys and rewards. Over time, the daily behaviours turns into new lifestyle habits. Another example is the Mango Health app designed to motivate patients to take their medications on time. It also provides information about various types of medication and warns about side effects and drug interactions.

2.3.3. Application of Gamification in education

Gamification is also practiced in education and this concept is the focus of this study. An example of a gamified application in education is Duolingo. This is a mobile application that is designed so that students can learn a given language online while helping to translate websites and documents (Munday, 2017). Munday also indicated that application allows beginners to start with basic and simple sentences from the web until they progress to a level where they can receive sentences that are more complex. The DuoLingo's algorithm is designed to test the user's memory by providing a list of words that the user has studied or already knew. The application display the user performance such as skill points, achievements and time bonuses when questions are answered correctly within a given time limit. A study conducted by Vesselinov and Grego (2012) to evaluate the DuoLingo shows that that the main factor for higher efficiency was the motivation of the participants, with people studying for travel gaining the most and people studying for personal interest gaining the least.

2.4 Mobile Learning

2.4.1 Usage of Gamified mobile application in tertiary education.

2.4.1.1 CS challenger

CS Challenger is a mobile application that incorporates gaming techniques for motivating students so that they can entertainingly tackle challenging modules in the Department of Computer Science at UNAM (Iyawa et al., 2019). This mobile application was developed in the UNAM context for the modules that are identified by students as challenging. The modules includes the Object

Oriented Programming, Computer Theory, Database Programming, Digital Electronics and Math for Computer Science. The CS Challenger is quite similar to the OOP Helper as it developed the application in the UNAM context however, the OOP Helper only focused on the OOP1 and OOP2.

2.4.1.2 Alice 3D

Alice is a three-dimensional (3D) animation programme, which provides highly interactive and visualised environment for the players to construct a virtual world by inserting different levels of Java coding. Alice 2D has a proven record as a great tool for learning logical and computational thinking skills and fundamental principles of programming. The Alice 3D is different from the OOP Helper since it uses gamification features to teach players how to code in Java programming language, while the OOP helper only focuses on teaching the OOP concepts.

2.4.1.3 Greenfoot

Greenfoot is another teaching and learning program that uses simulations and games to teach object-oriented concepts and principles in a fun, easily accessible manner. Greenfoot is a text-based programming application which uses Java language to create sophisticated applications that match the students' expectations as well as prepare them for progression into a more general and higher level of programming environment(Kolling, 2012). This application is almost similar to the OOP helper as it focuses they all focus on teaching OOP concepts. However, Greenfoot is quite different from OOP Helper in a manner that it only focuses on general OOP concepts while OOP Helper focuses on OOP concepts recommended in the UNAM teaching contents.

2.4.2 Impacts of gamified mobile applications to student engagement and motivation and academic performance.

Andharini (2016) indicated that many researchers have attempted to utilize gamification to increase student engagement, motivation and achievement. It is quite noticeable that gamification promote

student engagement in learning. Wong and Maizatul(2013) in the investigation on gamified mobile application as learning and teaching tool for object oriented programming in higher education institution, summarised that " most of the students agreed that the gamified mobile application able to meet the learning and teaching objective" p.223. Besides that, all participants agreed that game based learning is an effective tool for learning and teaching object oriented programming. This proved evident because among 40 participated students, 16 students obtained grade A for the Introduction Object Oriented Programming (Wong & Maizatul, 2013).

Along with the spread of Gamification, some researchers also detected little evidence supporting positive effects on both psychological states and cognitive processes, and focussed their work on finding out more about its long-term effects on learning (Dichev & Dicheva, 2017).

2.5 OOP Helper

1. Mobile App Overview (Technologies)

The OOP Helper is a mobile application that incorporate gaming features in order to tackle OOP concepts. The following components were used in designing the application. Microsoft Visual studio 2019 - this was used for the core development of the application in C#. The Unity game engine version 2020.3.1f1 (64-bit) for the creation of the User Interfaces (UI) using XML and C#.

2. Mobile App Development

1. Software Development Life Cycle (SDLC)

The Mobile App was developed using the Waterfall Model – SDLC. This model is also known as sequential linear model because it follows a top down approach. This model was used because the waterfall is a plan-driven process. , all process activities are planned and scheduled before starting the software development. This means the researcher did the development in phases, and only when the phase was done, then researcher move to the next phase.

The following phases of the model were considered in the use of the Waterfall Model- SDLC.

1. Requirements analysis and definition

The user and system requirements were identified as follow.

User Requirements

The user should be able to:

- Learn OOP concepts through app
- Test the knowledge acquired through the app
- Trace the progress made while learning

System Requirements

- The system should run Android operating system.

2. **Software design**

   Through the Waterfall model, the system was design in phases using the Microsoft Visual studio 2019 and The Unity game engine version 2020.3.1f1 (64-bit). The application was design in the following sequences: Designing the all user interfaces, then writing the code behind.

3. **Testing**

   The application was tested to remove all bugs and ambiguity in the code. The unit testing approach was used to test the App. The app was divided into three units that were tested. The first unit consisted the first two levels(Level 0 and Level 1). This two level are based on the introduction to OOP concepts, classes and objects. The second unit consisted of Level 2 and 3 that focuses on the basic algorithm and inheritance. Finally, the last unit tested the three levels, the fourth level (Level 4), the fifth level (Level 5), and Level 6.

4. **Deployment**

   The Unity game engine version 2020.3.1f1 (64-bit) is a unique cross-platform mobile application development. This means that the Unity game engine version 2020.3.1f1 (64-bit) platform create applications that run on both iOS and Android operating systems. After debugging cleaning and building our application was released to Google Play Store and App Store. The steps involved were:

   Configure the application release build

   This involves giving the application a name , version and application icon.

   Compile and build the application

   After configuration of the app, the app was compiled and built in a Release Mode. The app was published and Archived for publishing .

5. **Operation and maintenance**

   The application is easy to use and very user friendly. Only the developer will be maintain the App.

3. User Screen (UI)

a. User interfaces

The user interface are screens that the user can see and interact with. A minimalistic design approach was taken into consideration when designing the user interface using a few icons that give the user an idea of what function they represent instead of using text to clutter the interface. This approach is one of the principles of proper user interface design. The different screens a user interacts with once they start the OOP Helper are application are described in the following sections.

1. OOP Helper Game rules

The OOP helper is a learning application . It is made of the window with a character that helps the player navigate to the level she/he wants to take. The quizzes are presented in levels.When attempting to answer all the levels they are timed with a timer. The player is expected to answer the questions in the required time. After completing the level the player is given the feedback of what he/she scored in the level, the player then chooses to either retry or move on to the next level. The levels are based on the following OOP concepts. The level zero (Level 0) is the introduction which is made of true/false question regarding the introduction of OOP concepts in general. The first level is based on classes and objects. The second level is based on basic algorithms, were the player is required to provide the appropriate basic algorithm to use on a given problem. The third level is all inheritance and polymorphism in which the player is expected to choose an answer in the options provided. The fourth level is made up of multiple choice question focuses on files and exception. The fifth level challenges player on string manipulation where the player is asked to give the correct output of the code. The last level presents the data structures where the player is expected to complete the provided codes with correct missing codes.

2. **The FirstPage screen**

   Upon running the application, this is the first page that show up. Figure 1.1 illustrate the first page.

Figure I

The screen has the start Play Button that takes the user to the Player Window of the application.

3. **Player Window**

   Figure 2.1 shows the window that a user interacts with in order to access all contents of the application

Figure II

The following components make up the Player Window

The window has the character where the player chooses which level to take by moving the character to the level of the choice. Upon reaching the arrow icon the level, open up.

4. **Intro quiz**

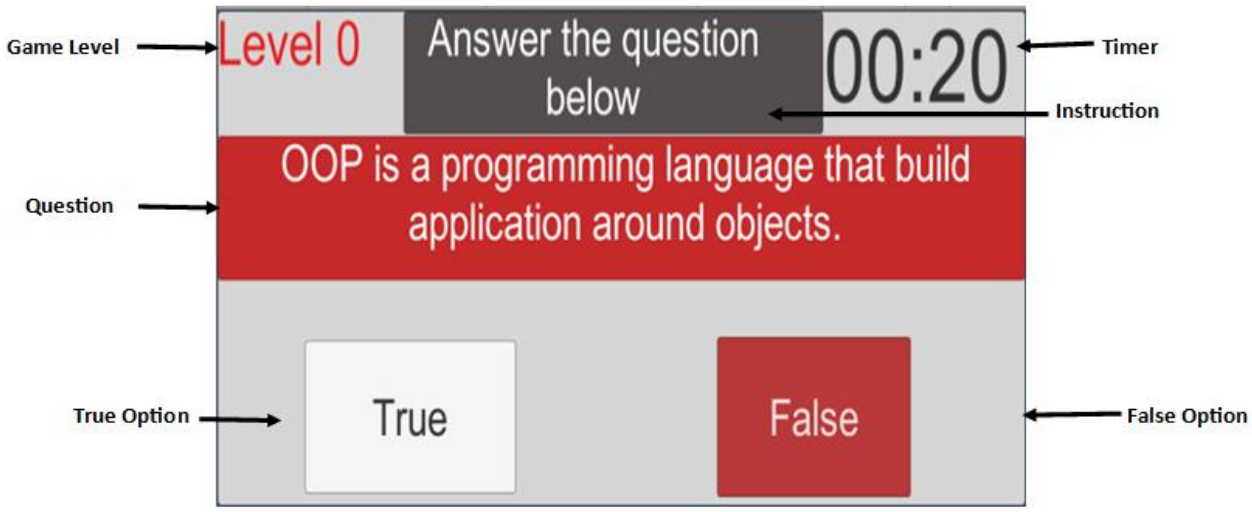

Figure III

Figure III show the Level 0 screen. The following components makes up this screen:

Game level – a label that indicate the level at which the player is at.

Time – a timer that gives a user a chance to answer the question in the given time.

Instruction- a label that contain the instruction on how to answer the question

Question – label that contain the question to be answered.

False – the button with an option to indicate the question is false.

True – the button with an option to indicate the question is true

5. **Multiple-choice screen**

Figure IV

Game level, Question, Timer, Instruction and Question components serve the same function same as those described in figure III.

Options buttons- these are buttons that contain different options for the answers.

6. Structured Question Screen

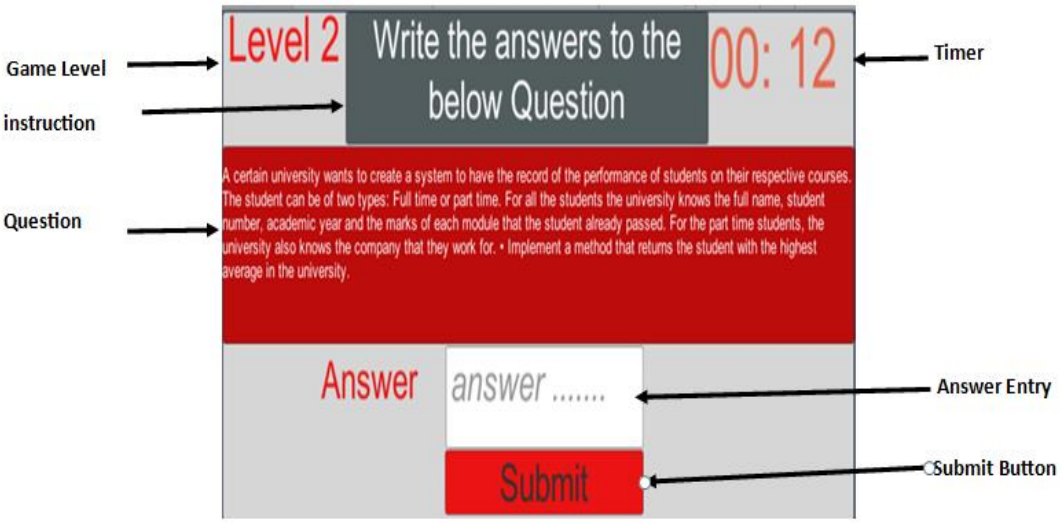

Figure V

Figure V show the layout of all the structured questions. The following components were used in implementing the structure screens:

Game level, Timer, Instruction and Question components serve the same function same as those described in figure III.

Answer Entry – this is the space where the player type in the expected answer.

Submit Button – the button that saves the user answer after entry

7. Feedback Screen

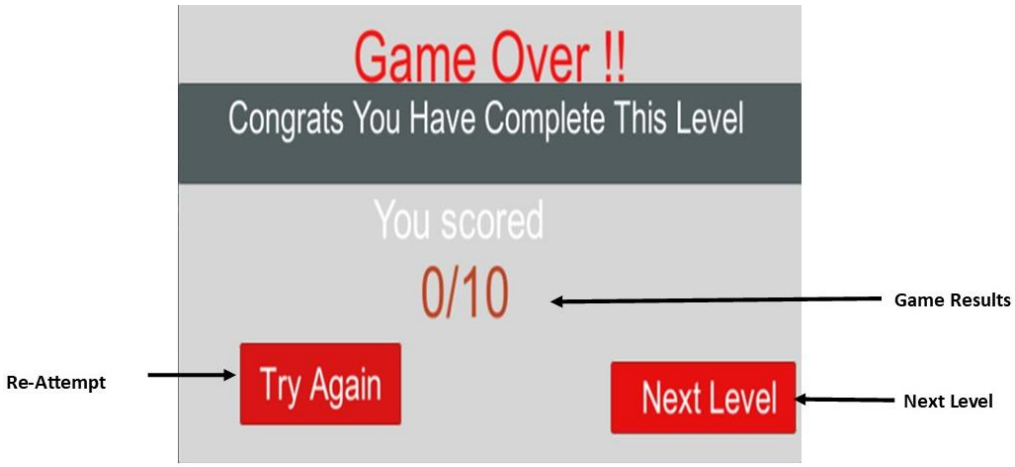

Figure VI

Figure VI illustrate the game over screen. This is the screen that is displayed when the user reach the end of the level. The following components makes up the screens.

Try again button: This button that allow the user to re-attempt the level.

Next Level button: This button go to the next Level of the game.

b. System Architecture

- The architecture of the OOP Helper is visually illustrated on figure VII. The app is designed using the Model-View-ViewModel (MVVM). In this model, the Views or user interfaces are isolated from the model. ViewModel does not manipulate controls directly. The Views interact with ViewModel via data binding. This means the OOP Helper QuestionModel is separated from the QuestionViewPage.

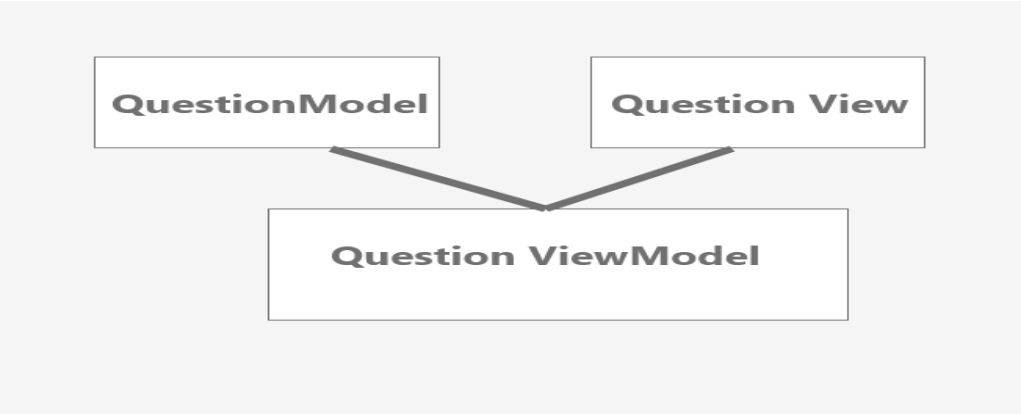

Figure VII

c. Diagrams

a) The class diagram

A class diagram is a static diagram. It represents the static view of an application. Class diagrams are not only used for visualizing, describing, and documenting different aspects of a system, but they are also for constructing executable code of the software application (Asjia et.al). A class diagram describes the attributes and operations of a class, and the constraints imposed on the system.

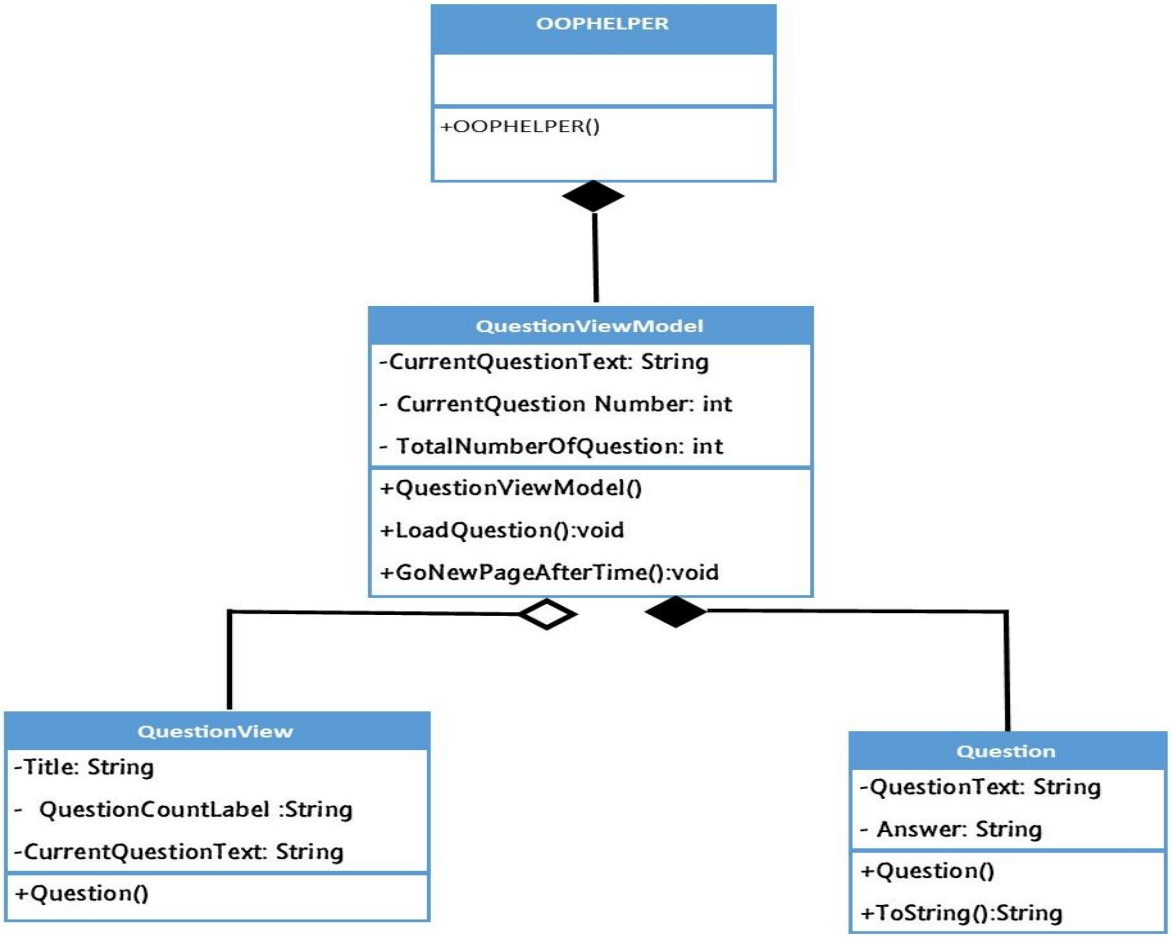

Figure VIII

2.4 Chapter Summary

In this Chapter, an overview of gamification was given. It defined both the Object-oriented programming and Gamification in details. The chapter also discussed the application of Gamification in different fields such as Marketing, Health Care and in Education. It further review the related work on the usage of gamified mobile application and the impacts of gamification on student engagement and motivation and academic performance. It also presented the Mobile Application development which comprises of the Software development Life Cycle (SDLC), the user interfaces, deployments and the class diagrams. The next chapter discusses the Research methods guiding this study.

Chapter 3: Research Methods

3.1 Introduction

This chapter consist of a detailed description of the research design, population, sample and sampling method, research instruments, procedures, and data analysis methods. It further stated the research ethical considered

3.2 Research Design

The study employed mixed research methods. Mixed methods involves combining or integration of qualitative and quantitative research and data in a research study. Qualitative data are open-ended without predetermined responses while quantitative data usually includes closed-ended responses such as found on questionnaires or psychological instruments (Creswell, 2014). From this understanding, qualitative research methods was used because in this method the researcher relies on the views of participants , asks broad or general questions, describes and analyzes these words for themes , and conducts the inquiry in a subjective, biased manner. A descriptive research design accounts to describe the students experience in learning OOP concepts , student perspectives on the introduction of Gamified Application to aid e-learning and the student viewpoints on the use of the OOP helper . The overall purpose of this research design was to have a qualitative data assisting in explaining the quantitative results. The quantitative methods was used because participants in the study do not know the researcher and their biases. Participants were asked to describe their experiences through an online questionnaire and this qualified the use of a qualitative research design method.

3.3 Population

A population is an entire group about which the research data is required to be ascertained(Nchindo, 2016) This group of participants in the population must share at least a single attribute of interest. The target population of the study comprised of all the students doing OOP 1 and OOP2 module at UNAM Main Campus. There are 68 full time students registered for OOP1. This population was chosen due to the fact it represent the majority of the group of students taking OOP.

3.4 Sample

Probability sampling techniques was used to select the sample from the targeted population. A simple random sampling was used. Creswell (2014) defines simple random sampling as a procedure in qualitative research for selecting participants. The sampling was chosen among other methods because it provides best results since all the participants have an equal chance of being chosen. This study aimed to have a sample with the maximum of 28 participants without considering gender or any other factor. The sample size was determined by using the formula to find the sample size which is :

Desired sample size: $Ns = \frac{(Np)(P)(1-P)}{(Np-1)\left(\frac{B}{C}\right)^2+(P)(1-P)}$

Where:

Ns = complete sample size needed

Np = size of population

P = proportion expected to answer a certain way (50% or 0.5 is most conservative)

B = acceptable level of sampling error (0.05 = ±5%)

C = Z statistic associated with confidence interval (1.960 = 95% confidence level)

Since every member had an equal opportunity of being selected, the selection of the sample is unbiased and it will be reasonable to generalize the results from the sample to the population of the study (Sharma, 2017). Based on the 68 Computer Science and Information Technology full time students registered this academic year (2021) for OOP1, 28 participants are found to be sufficient for the evaluation of the study.

3.5 Research Instruments

The instrument that was used to collect data is the online questionnaires. To collect data that are more meaningful from different students, the questionnaire will consist of both open and closed questions. The questionnaires went through two type of testing, pre-testing and pilot testing. Pre-testing was administered to four students from the sample. After the data analysis from the pre-testing, adjustments were made to the questionnaire and be placed for pilot testing. The pilot testing removed ambiguity that where not uncovered by the pre-testing. After a successful pilot test, the questionnaire was administrated to the whole sample population.

3.6 Procedure

Google forms was used to create the questionnaire. This is an online platform that was used to create and host the questionnaire. The link to the questionnaire was shared to the participants through e-mails or WhatsApp contact details. The researcher will explain the research purpose to the participants and letting the participant know the right to withdraw from the study if need be. For ethical and anonymity reasons, the participant's names or anything that may reveal the participant identity were not asked in the questionnaire.

3.7 Procedure for Pre-testing and Pilot Testing

The pre-testing is a stage in the research when the research instrument was tested on participants in the study. The main aim of pre-testing in this study is to help to identify the problems and their solutions before the actual launching of the questionnaire as well as to get information that may help improve the game instrument. The questionnaire was administrated to four participants from the sample. The participants in the pre-test were randomly selected. After the data analysis from the pre-testing, adjustments were made to the questionnaire and be placed for pilot testing. The pilot test further ensures that the questionnaire is reliable and valid in order to obtain reliable information that will help in achieving the research objective. Another four participants were randomly selected

for the pilot testing without considering if a certain participant took part in the pre-test. This is to remove ambiguity that were not discovered during pre-testing.

3.8 Data analysis

The researcher used a descriptive statistics and thematic text analysis of data. Descriptive statistics were used to summarize data in an organized manner by describing the relationship between variables in a sample or population (Kaur, Stoltzfus & Yellapu, 2018). The descriptive analysis was used to analyse data from closed questions, and to scrutinize the data from the open questions. Data was coded and processed using Microsoft (MS) Excel., and charts and graphs were generated using Google forms.

3.9 Research Ethics

The researcher ensured that confidentiality was observed in order to protect the participants of the research. The researcher did not disclose the identities of the participants. Finally, the researcher ensured that the all the data collected was used solely for the purpose of the study.

Chapter 4. Results and Discussions

4.1 Introduction

This chapter presents the results as well as the discussion of the finding in this study. Firstly, the demographic information of the participants was discussed, followed by the analysis of the responses from each question. Secondly it discussed the student gaming experience and the findings are presented and discussed to give meanings to the context of this study.

4.2 Demographic Information

This study reached data saturation with 28 participants. The participants of this study were asked questions to identify their gender and current year of studies level.

No Of Participants	Gender		Current Level Of Studies			
28	Male	Female	1st year	2nd year	3rd year	4th year
	18	10	1	15	9	3

From Table 1 we observe that the majority of the respondents among students in this study where male (64 %) and the rest are female. It is also evident that the distribution of student accord to the current year of studies is fairly distributed. The 2nd year had many participants because the OOP modules are offered in second year. The 3rd and 4th years are represented with a lower number of participants simply because they are repeating the module.

4.3 Results and Discussion

The questionnaire was designed to get results that are more meaningful with the purpose to help in the design the applications. With the analysis from the responses, the result helped in building an application that cater for most student needs. Below is the representation and discussion of the results.

4.3.1 Have you ever experienced any difficulty in learning Object Oriented Programming (OOP) Concepts

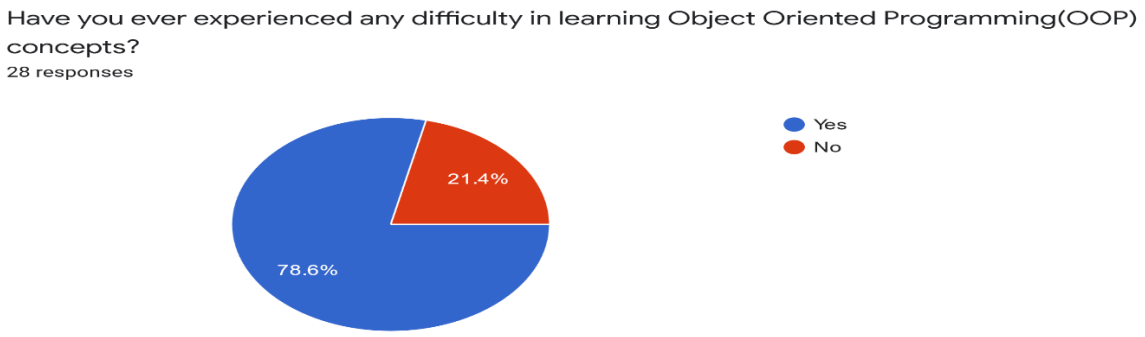

Figure IX

Most of the student indicated that the face challenges when learning OOP concepts. A total number of 22 students that represent 78.6% of the sample indicated they experienced difficulties in OOP concepts and only 6 students which constitute 21.4% of the sample indicates that they had no problem in learning OOP Concepts . Students were asked to mention the OOP concepts in which students experience the difficulties whenever the indicated with a Yes. Polymorphism, inheritance and data structure are the most concepts identified by the students as challenging.

4.3.2 Are you satisfied with student-centered approach way of learning offered by the university

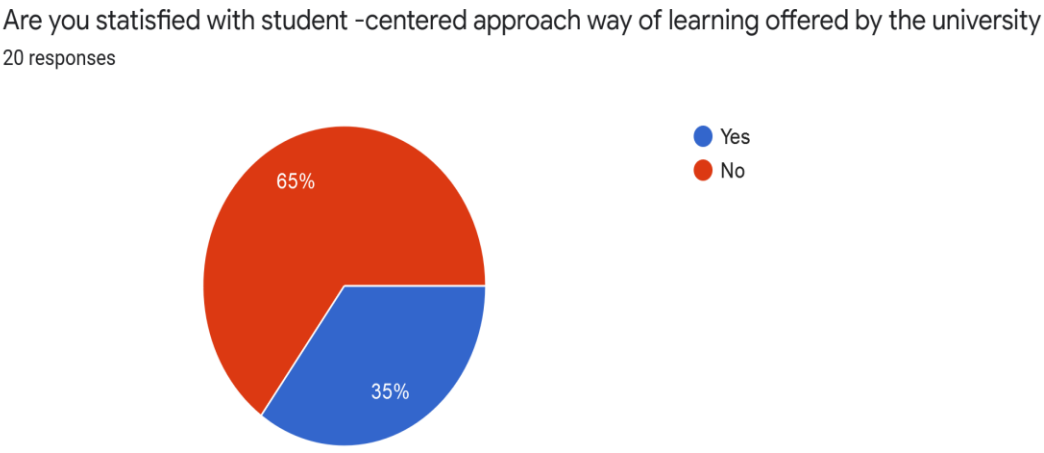

Figure X

The results showed that students are not satisfied with the student-centered approach way of learning offered by the university. Only 35% of the sample population are pleased with the approach , while 65% indicated their dissatisfaction.

4.3.3 How often do you use your smartphone for learning purposes in a day

Most students indicated that they usually use their phones most of the times in a day. This means that smartphones provides a great opportunity for learning through mobile phones. The results in of the responses are indicated as shown below

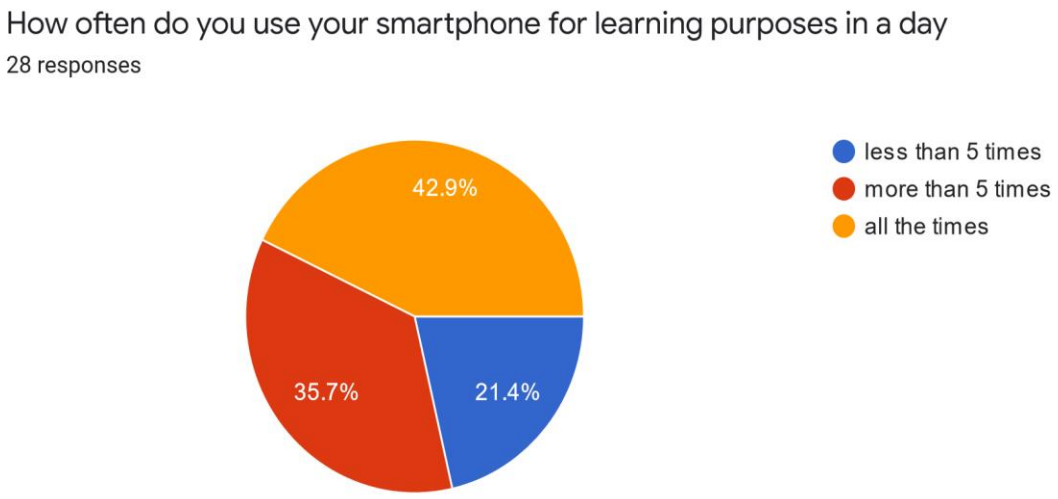

Figure XI

4.3.4 Do you prefer a competitive and entertaining form of learning OOP concepts?

Many students indicated that they do prefer a competitive way of learning. This means they prefer a gamified approach. Only three (3) students from the sample indicated that they do not have a preference in an entertaining and competitive form of learning. The pie chart below indicates the percentages of the results.

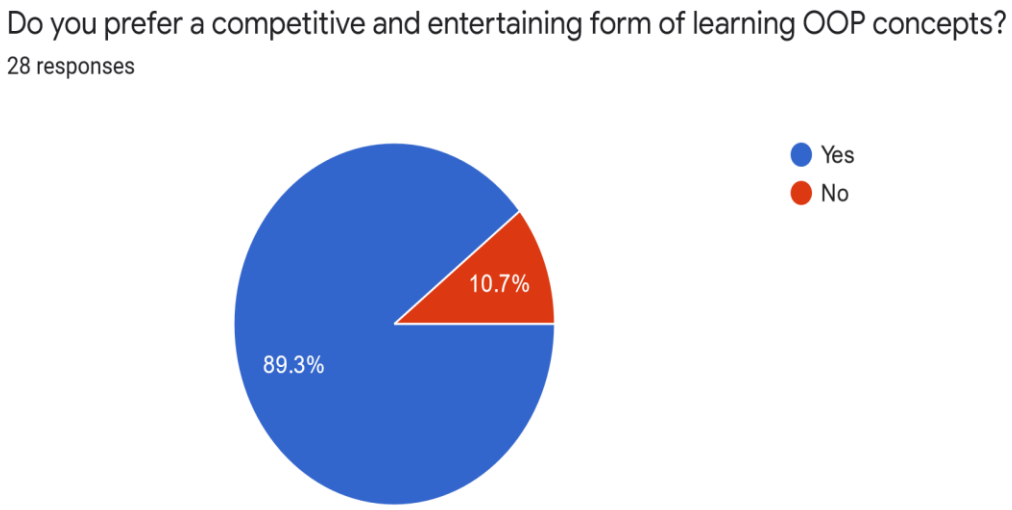

Figure XII

4.3.5 With a mobile application you can learn OOP concepts anytime and at your own pace

From Figure XIV, we observe that the majority of respondents in the sample of students believe that mobile phones promote self-learning and they believe that with a mobile application they can learn at their own pace. 39.3 %, which represent 11 students in the sample strongly, agreed and 28.6% of the students agreed. The 25% of the sample indicated that they are undecided and only 2% that strongly disagreed with the statement. Figure XIV illustrate the responses.

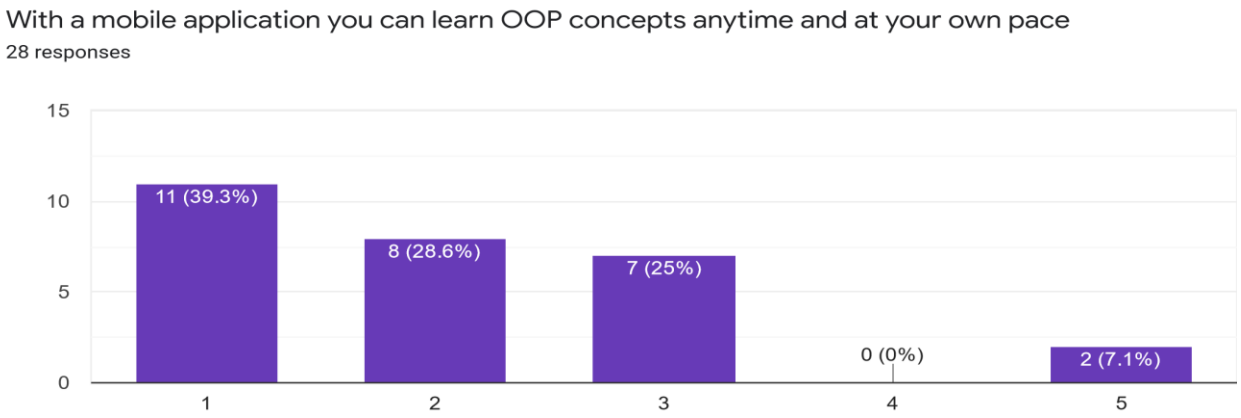

Figure XIII

4.3.6 You currently want an introduction of a mobile application to aid the UNAM eLearning platform

The results indicates that 53.6% of the sample indicates that the strongly agree with the introduction of the mobile application to the university. They are supported by 28,6% of the population that also agree with that statement. To add, 10.7% are yet undecided whether to agree or disagree with the statement. Only two students who strongly disagree. The responses are illustrated below.

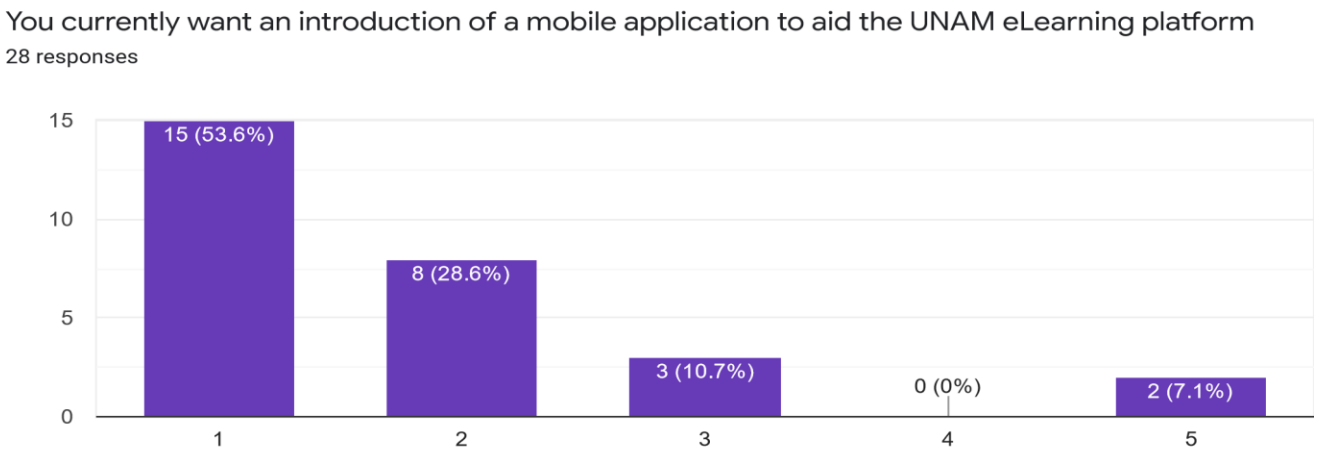

Figure XIV

4.3.7 Using your phone to learn OOP concepts will help me remember OOP concepts easily.

The results from responses are fairly normal. With 35.7% of sample population indicates that they strongly agree, while 21.4 % agreed but not strongly. 25% of the sample represents students that are undecided. Students who disagree and those who strongly disagree represent 10.7% and 7.1% respectively. Figure 5.3.8 illustrates the results

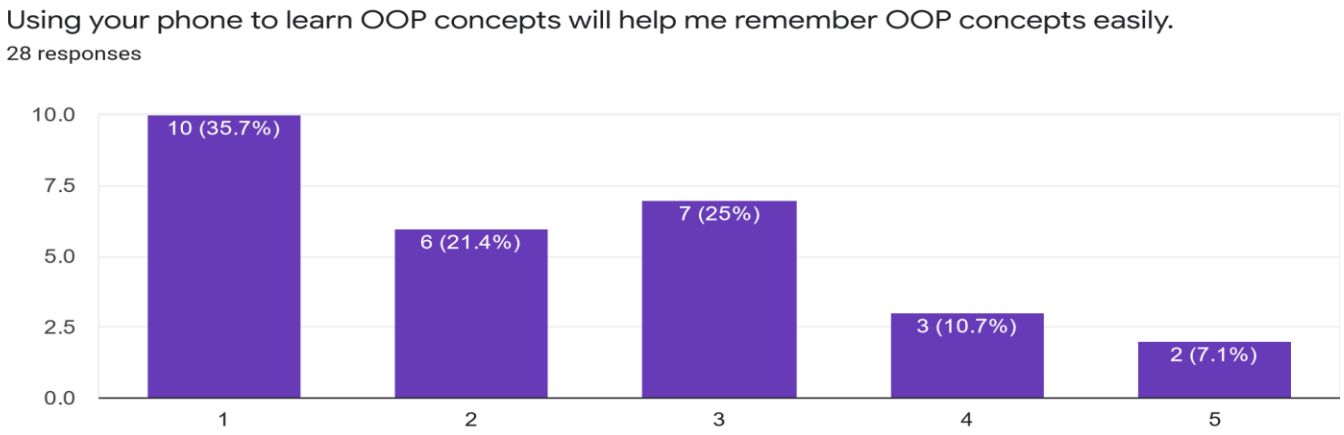

Figure XV

4.3.8 Student Gaming Experience

28 students, which consisted of 18 males and 10 females doing OOP 2 were purposefully selected to share their experience after they have used and interacted with the OOP Helper. This study found that the students were excited and eager to learn OOP concepts in the gamified way. The students' responses were

I was able to learn fast as I did not feel intimidated by the lecturer's presence and of my fellow students

The researcher agrees with student as this study identified that the OOP helper increased the student freedom to learn without any fear or intimidation. This means that some students do not real favour the lecture-based learning due to the fact that they are scared of the lecturer of other students. The OOP helper helps them to learn in an free manner. Another student as:

It is a very useful thing and easy to learn.

This student indicated that the OOP Helper is a useful tool to learn OOP concepts. This is because this type of Application are not utilised in the university. The student also showed that the application is user friendly and easy to learn.

4.3.9 Student Perspectives on the introduction of a mobile application in learning OOP concepts.

-It's pretty much a great idea as it will definitely help students like me who struggle with OOP concepts

This study identified that student had a good perspectives on the usage of a mobile application in learning OOP concepts. The students emphasised that introducing a gamified mobile application to aid the E-learning platform is definitely a great opportunities for students to master OOP concepts in a fun and interactive way.

-I have no objections to it I'm open to try out any form of application that will improve (expand) my learning capabilities

The student indicated that there was no objections to any form of application such OOP Helper that helps in expanding the learning capabilities. This means that the university should also consider exploring the use of gamified application to motivate its student for better academic results.

4.3.10 Students' Viewpoints on Gamified OOP concepts

The students were also asked to give viewpoints learning OOP concepts through OOP helper compared to the normal lecture-based learning . Student general responded with good remarks in favour of the OOP helper. One of the responses was:

The helper is much easier since you can use it at any time on your own time unlike a lecturer with fixed time period and who is only available at some points in time.

From the statement above it is evident that the OOP helper is helpful in teaching OOP concepts due to many advantages such as, it is available at any time, student can learn at own pace or time and students can

learn in a motivated way. However, the students' viewpoints were further scrutinized to come up with the study major findings.

4.3.11 Key Findings of the student viewpoints

4.3.11.1 Finding 1: Current Problems in Learning OOP concepts

The finding of the study identified that most student are not motivated when learning the OOP concepts. Student expressed that attending lectures every day where the concepts are tough to understand is discouraging. In this proves that there is an issue of students not willing to attend lectures because they are uninteresting and not motivating.

Another finding regarding the current problems in learning OOP concepts through lecture-based learning is that the notes are too complicated and hard to understand on your own. This indicates that the complicated notes also contributes to the factor that demotivate student in effectively learning OOP concepts.

4.3.11.2 Finding 2: Student Engagement and Motivation on learning OOP concepts using OOP Helper.

The evaluation of the application by the students has proven that the OOP Helper increased the student motivation in learning the OOP concepts. OOP Helper makes learning experience or process fun and attractive. The OOP Helper has proven to be more effective and benefits students more over the lecture-based way of teaching.

4.3.12 Conclusion

This chapter presented, discussed and analysed the results from the students. It also explained the finding of the study. The next chapter concludes the study, gives the recommendations and finally suggested the future work that that can be applied to this study.

Chapter 5: Conclusion and Recommendations

5.1 introduction

This chapter gives the conclusion of the study that was discussed regarding the research objective. It further discussed the recommendations of the study and concluded the study with suggesting future works.

5.2 Conclusion

The proposed research offered a game-based learning game, which covers the OOP concepts. Gamification makes learning experience or process fun and attractive. The objective of the study was to develop a gamified mobile application to improve students' engagement in the OOP module and to add a mobile application to an existing eLearning platform in order to provide an interactive way to deliver OOP contents. Through the questionnaire, a high percentage (80%) of students indicated that there is a need for the introduction of a mobile application to aid the E-learning platform. Henceforth, the study designed the OOP Helper application in order to meet the objective. The OOP Helper offered a game-based learning platform, which covers the OOP concepts. Gamification makes learning experience or process fun and attractive. Gamification has proven to be more effective and benefits students more over the traditional way of teaching. The OOP helper present OOP concepts such object, class, encapsulation, inheritance, polymorphism, and abstraction in a programing language. Therefore, game-based learning motivates students to learn OOP topics in a more challenging and engaging environment. Gamifications proves to stimulate creative thinking and promote active learning. The gamified learning approach is also considered an effective method to learning OOP contents; this is because it makes learning more attractive and joyful so students can be more inspired to achieve learning targets. The main challenge for this

research is to ensure the learning implicit while making the teaching game fun and interesting to retain students' motivation.

5.3 Recommendations

Based on the findings, the following recommendations were identified with regards to the current study:

To students

- Student should make use of their mobile phones more often to do school work as phones offers a widely opportunity to learn anytime**.**

To researchers

- The study recommends that future researchers need to consider in-depth qualitative studies to assess the effectiveness of gamification in tertiary education in Namibia and Africa at large.
- Furthermore, this study calls for more research to be done regarding Gamification, in the Namibian context as literature is very limited.

5.4 Future work

This study was only limited to designing an Application for OOP concepts that runs on the Android operating system, therefore the future works includes the development of the iOS-based application.

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Annexure

Annexure A Questionnaire

OOP Concepts Research Questionnaire

Dear Participant,

Good day! The researcher is dedicated to developing a Gamified Mobile Application for students doing Objected-Oriented Programming. Through this brief questionnaire, your answers will be helpful in the development of this mobile application. In case you have any questions regarding the question, please contact me at +264814698564. Thank you very much for your time and suggestions.

* Required

Instructions

Taking part in this questionnaire is voluntary
All responses are ANONYMOUS and CONFIDENTIAL

1. Current year of studies *

Mark only one oval.

- ◯ First (1st) year
- ◯ Second (2nd) year
- ◯ Third (3rd) year
- ◯ Fourth (4th) year

2. Gender *

Mark only one oval.

- ◯ Male
- ◯ Female

3. Have you ever experienced any difficulty in learning Object Oriented Programming(OOP) concepts? *

   Mark only one oval.

   - ◯ Yes
   - ◯ No

4. If you answer is Yes in the previous question, mention the concepts *

5. Are you statisfied with student -centered approach way of learning offered by the university *

   Mark only one oval.

   - ◯ Yes
   - ◯ No

6. What is your Experience On the OOP Helper? *

7. What is your perception on the introduction of a mobile application in learning OOP concepts? *

8. What is your viewpoint of learning OOP concepts through OOP helper compared to a normal lecture-based learning? *

9. How often do you use your smartphone for learning purposes in a day *

Mark only one oval.

- ◯ less than 5 times
- ◯ more than 5 times
- ◯ all the times

10. Do you prefer a competitive and entertaining form of learning OOP concepts? *

Mark only one oval.

- ◯ Yes
- ◯ No

On the following remaining question, please indicate the extent of agreement with each statement by selecting the number you think is appropriate

1 for strongly agree, 2 for agree, 3 for undecided, 4 for disagree and 5 for strongly disagree

11. With a mobile application you can learn OOP concepts anytime and at your own pace *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

12. You currently want an introduction of a mobile application to aid the UNAM eLearning platform *

Mark only one oval.

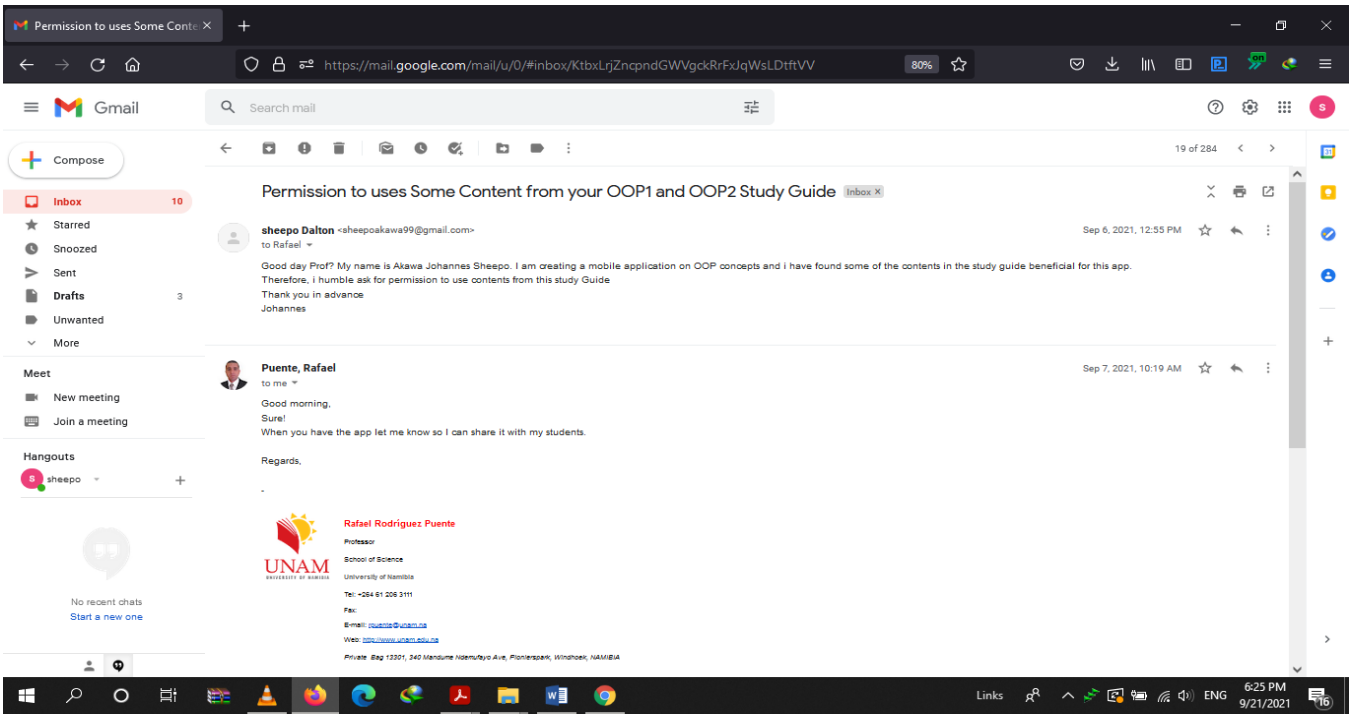
1	2	3	4	5
◯	◯	◯	◯	◯

13. Using your phone to learn OOP concepts will help me remember OOP concepts easily. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

Annexure B Letter to use Study Guide Notes



Source Codes

The full source code of this application can be accessed on this github account. The link is https://github.com/sheepo9/OOP-Helper.git

Level 0 codes

introductionViewModel.cs | Load.cs | studentmove.cs | Loadscene.cs | studentmovement.cs | PlayerMovement.cs | NotesModel.cs | Level2ViewModel.cs*

introductionViewModel | AnsweredTFalse()

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;
using UnityEngine.UI;
using UnityEngine.SceneManagement;

public class introductionViewModel : MonoBehaviour
{    public List<Questions> questions;
    public Text CurrentQuestionText;
    private bool CurrentAnswerValue;
    public int TotalQuestions;
    public int CurrentQuestionNumber;
    private int score;
    public Text ScoreText;

    public GameObject QuizPanel;
    public GameObject GoPanel;
    // Start is called before the first frame update
    public void Start()
    {
        GoPanel.SetActive(false);
        LoadQuestion();
        TotalQuestions = questions.Count;
        CurrentQuestionNumber = 0;
        score = 0;
    }
    public void Gameover()
    {
        GoPanel.SetActive(false);
        QuizPanel.SetActive(false);
        ScoreText.text = score + "/" + TotalQuestions;
    }
    public void AnsweredTrue()
    { if (CurrentAnswerValue == true) score++;
```

Level 1, 3,4 codes

introductionViewModel.cs | studentmove.cs | studentmovement.cs | PlayerMovement.cs | NotesModel.cs | Level2ViewModel.cs* | QuizGame.cs

QuizGame | Start()

```
using System.Collections;
using System.Collections.Generic;using System;
using UnityEngine;
using UnityEngine.UI;
using UnityEngine.SceneManagement;
public class QuizGame : MonoBehaviour
{/* this cclass controls all the multiple choice questions quizzes of the game*/

    public GameObject[] options;
    public int currentQuestion;
    public List<Questions> questions;
    public Text QuestionText;
    public GameObject QuizPanel;
    public GameObject GoPanel;
    public Text ScoreText;
    int totalQuestions = 0;
    public int score;
    public void Start()
    {
        GoPanel.SetActive(false);
        generateQuestion();
        totalQuestions = questions.Count;

    }
    public void retry()
    {
        SceneManager.LoadScene(SceneManager.GetActiveScene().buildIndex);
    }
    public void BackToStart(string scenename)
    {
        SceneManager.LoadScene(scenename);


    }
```

Level 2,5and 6