RESEARCH PROPOSAL

Gamifying the Learning of Object Oriented Programming (OOP) Concepts through a Mobile Application Platform

Akawa Johannes Sheepo

218200218

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.

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Chapter 1. Introduction

1.1 Background

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 which could be caused by lack of engaging methods to facilitate learning. 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. The gamified learning approach is

considered to be an effective method to learning OOP contents, this is because it makes learning more attractive and joyful so students can be more motivated to achieve learning targets.

1.2 Statement of the problem

The current use of student-centred approach proves to be insufficient for the inexperienced students doing Object oriented programming. A study by Iyawa(2019) 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, attributes, methods, inheritance, polymorphism, and encapsulation). Despite the use of interactive e-learning platform (Moddle), the university need to explore more on options provided by gamification. The Moddle learning platform(elearning) needs to be aided with the mobile application facilitate the learning process in the OOP models. Since mobile phones can be used by students at any time anywhere, it can 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, 2014). For these reasons, this study aims to solve the problem of unmotivated students in learning OOP by using Gamification concept. It also intent to contributes to the body of knowledge on gamification for educational purposes in the context of Object Oriented Programming in Namibia.

1.3 Objectives of the study

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

1.4 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) and that is to "improve quality of teaching and learning in university and strengthen research capacity at higher education institutions" (National Planning Commission , 2017).

1.5 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. Also, due to time constraints the researcher only decided to involve participants from easily accessible campus.

1.6 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.

1.7 Outline

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

2. Literature Review

2.1. Introduction

During these last few years, many object oriented programming games have been created to help students understand and visualize the concept of the object-oriented programming paradigm. Gamification has been used commonly in various fields like healthcare, marketing and education. An example of gamification applied 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 colors and flavours. 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 is gamified application provides an opportunity for customers to interact with the brand in a fun and joyful way.

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 activities, games, surveys and rewards. Over time, the daily behaviours turns into new lifestyle habits.

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). In 2017, Munday 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.

Wong, Maizatul and Tan (2018) investigated in the learning object oriented programming paradigm via game-based learning game using the pilot study. The results of the study showed that the game-based learning was found to be useful as the learning approach for OOP teaching according to the results obtained from the pilot testing. Wong et al. (2018) further indicated that the pilot testing also showed

that students were actively learning and applying OOP paradigm according to the game level and the game mechanics. Therefore, the game-based learning has demonstrated its efficiency as a game-based learning tool for tertiary level education.

Although there is little research regarding gamification in education, the results of research studies focuses on student's motivation, engagement and learning outcomes. This study reviews the literature and synthesize the findings of empirical studies on gamification impacts on student's motivation, engagement and learning outcomes.

2.2 Impact of Gamification on student's motivation and engagement

Andharini (2016) indicated that many researchers have attempted to utilize gamification to increase student engagement, motivation and achievement in the classroom with varying degrees of accomplishment. It is quite noticeable that gamification promote student engagement in learning.

Karmela, Branko and Philip (2017) conducted a research at Zagreb School of Economics and Management (ZSEM) on the influence of gamification on student engagement in education. A research was conducted in the winter semester of an academic year 2016/2017 where 20% of ZSEM students participated from undergraduate level (Karmela, et al., 2017). The result of the research shows that students expressed their positive attitude towards gamification in class. This is because students revise their lectures through a fun game that provides extra motivation.

Wong and Maizatul(2013) in the investigation on computer game as learning and teaching tool for object oriented programming in higher education institution, summarised that " most of the students agreed that the computer game 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).

On the other hand, Domínguez, Saenz-de-Navarrete, de-Marcos, Fernández-Sanz, Pagés, and Martínez-Herráiz (2013) argued that gamification is not an important motivating factor for students because some students do not like to compete with their classmates.

2.3 Effect of Gamification on learning outcomes

Learning outcomes are behaviour or content goals a student needs to achieve and exhibit to show understanding (Kimberly, n.d). Lee and Hammer (2011) indicate some of the following positive outcomes of gamification. They point out that a game-based learning develops problem-solving skills through a complex system of rules that encourages active exploration and discovery. They also emphasise that games offer the possibility of reframing failure as a necessary part of learning due to the fact that error becomes an opportunity to try, to practice, and to improve.

Bustillo, Rivera, Guzmán, and Ramos (2017) investigate the learning outcomes on the English course using the Duolingo application. The result of the investigation confirmed that there was a significant improvement in students' listening skills and indicated that there was a positive attitude towards using the app as a learning support. Castañeda and Cho (2016) noted another positive learning outcome in gamification through a gamified conjugation application. They indicated that the application increased student's confidence and also improved the accuracy in conjugating verbs in Spanish. Similarly, Berns, Isla-Montes, Palomo-Duarte and Dodero. (2016) showed positive effects of a gamified tool (VocabTrainerA1) on students' attitudes towards the app. The participants also expressed a high-

perceived learning by using the gamified learning tool that was in line with positive academic results, specifically in grammar and vocabulary.

However, critics of gamified learning believed that the learning outcomes are greatly dependent on the users using the gamified application. Filomena and Ricciardi (2015) also opposed the effectiveness of gamified learning and state that "gamification to improve learning experiences and outcomes has not been established experimentally and, then, it is not possible to have unequivocal indication on how to use gaming elements in educational process"p.18.

In general, despite the fact that literatures points out a number of benefits of gamification in education, some researchers' claim that there might be several implicit negative effects that people normally ignore. Jones (2013) indicated that gamification can become predictable and boring. Ford (2015) raised another claim against gamification applied to education that "the fast pace and immediate feedback creates a problem with student attention span". Filomena and Ricciardi (2015) argue that integration of game elements in class requires more careful consideration of their strengths and weaknesses rather than thinking of gamification as the educational panacea. Research has not yet clarified if context of gaming allows the transfer of knowledge as it is dissimilar from traditional educational settings (Hanus & Fox, 2015). To conclude, a critical review of the literature suggests that exploring ICT in education within the Namibian context is not new; however, gamification in learning has not been investigated.

3. Methodology

3.1 Introduction

The methodology chapter comprises two sections, the Software development methodology and the Research methodology. The Software Development Methodology is defined as a set of related activities that leads to the production of a software (sommerville). Research methodology is defined as theoretical analysis of the methods applied to the study or a way to systematically solve the research problem(Kothari, 2004).

3.2 Software development methodology

This project will use the waterfall model to design a mobile application. This model will be used for this reason. The waterfall model is a plan-driven process. , all process activities are planned and scheduled before starting the software development. This means the researcher will do the development in phases, and only when the phase is done will the researcher move to the next phase. Below is the illustration on the waterfall model.

Picture

3.3 Research Methodology

This section consist of a detailed description of the research design, population, sample and sampling method, research instruments, procedures, and data analysis methods.

3.3.1 Research Design

The study will employ qualitative research methods. Qualitative research methods will be 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 phenomenological research design will be used in this study in order to get an in-depth analysis on the student motivation and engagement in the OOP module. A phenomenological research design is a qualitative research method used to describe how participants experience a certain phenomenon (Nchindo, 2019.) The phenomenon of this study is identified as challenges student experience in learning OOP concepts. Participants will be asked to describe their experiences through an online questionnaire and this qualifies the use of a qualitative research design method.

3.3 Project development Methodology

3.3.2 Population

A population is an entire group about which the research data is required to be ascertained. 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.

3.3.3 Sample

Probability sampling techniques will be used to select the sample from the targeted population. A simple random sampling will be used. Creswell (2014) defines simple random sampling as a procedure in qualitative research for selecting participants. This study aims to have a sample with the maximum of 20 participants without considering gender or any other factor. 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 for OOP1, 20 participants are found to be sufficient for the evaluation of the study. The randomly selected participants will have a chance to pre-test and post-test the proposed game.

3.3.4 Research Instruments

The instrument that will be used to collected 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 will go through two type of testing, pre-testing and pilot testing. Pre-testing shall be administered to four students from the sample. After the data analysis from the pre-testing, adjustments should be made to the questionnaire and be placed for pilot testing. The pilot testing will remove ambiguity that where not uncovered by the pre-testing. After a successful pilot test, the questionnaire shall be administrated to the whole sample population.

3.3.5 Procedure

3.4.1 Research Procedures

The researcher shall seek permission from relevant authorities to conduct the research. Google forms will be used to create the questionnaire. This is an online platform that will be used to create and host the questionnaire. The link to the questionnaire will be 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 are not asked in the questionnaire.

3.4.2 2 Procedure for Pre-testing and Pilot Testing

The pre-testing is a stage in the research when the research instrument is 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 will be administrated to four participants from the sample. The participants in the pre-test will be randomly selected. After the data analysis from the pre-testing, adjustments should be 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 will be randomly selected for the pilot testing without considering if a certain participant tool part in the pre-test. This is to remove ambiguity that were not discovered during pre-testing.

3.3.6 Data analysis

The researcher will use a descriptive statistics and thematic text analysis of data. Descriptive statistics are 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 will be used to analyse data from closed questions, while the thematic text analysis will be used to scrutinize the data from the open questions. Data will be collected, coded and processed using the Statistical Package for Social Sciences (SPSS) while charts and graphs were generated in Microsoft (MS) Excel.

4. Research Ethics

The researcher will ensure that confidentiality will be observed in order to protect the participants of the research. The researcher will not to disclose the identities of the participants. The researcher intend to seek permission from relevant authority to conduct the research at the university. Finally, the researcher will ensure that the all the data collected will be used solely for the purpose of the study.

5. Results and Discussions

This chapter will present the results of data collected during the study. It will also discuss how the research finding will be presented. The results of the study will be presented and discussed by focusing on the two main constraints.

I. Analysis of Student Performance in OOP using the proposed game.

After the student exposure to the game, the interaction of the student with the game will be recorded and analysed. The section shall interpret the result to assess the effectiveness of the proposed game. This will be done by looking at factors such as the student motivation towards learning OOP concepts using a gamified approach, the overall performance of the student compared to the traditional way of

teaching and the student engagement with the proposed game , The results will be presented in percentages using bar chart , pie chart and frequency tables.

II. Questionnaire results analysis

The data will be collected from the targeted sample using questionnaire. The questionnaire mainly serves as a platform for the student to comment and provide constructive opinions about the proposed game. The questionnaire will consist of open and closed question in order to get results that are more meaningful. After both descriptive statistics and thematic text analysis of data, responses from the questionnaire shall be grouped into two different categories. Data from the closed questions, which are analysed with descriptive statistical analysis, and data from open questions that are analysed with thematic text analysis. Closed questions responses are therefore grouped, summarized and presented in the form of graphs, charts and tables

6.Conclusion

The proposed research offered a game-based learning game, 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. A proposed game 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.

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