

A STUDY ON THE USE OF AUGMENTED REALITY ON BATAAN DEATH MARCH FOR GAME BASED LEARNING AND AFFECTIVE LEARNING

A Thesis Proposal

presented to

the Department of Software Technology
College of Computer Studies
De La Salle University

In partial fulfillment
of the requirements for the degree of

Bachelor of Science in Computer Science
Major in Software Technology

by

CUSTER, Mark John Tiamzon
PARK, Sehyun
SILLONA, John Eugene Justiniano
TUCO, Kevin Bryan Layugan

Christian Terrence Esguerra
Adviser

August 9, 2024

Abstract

History class has always been a trouble for students due to its nature in memorization for an exam-based classroom settings and requires an ability to visualize the events through word and pictures. Game-based learning has risen to be effective in getting the attention of the students due to their inherent appeal and similarity to games; from which students and teens alike play worldwide. There has been numerous studies on game-based learning to overcome this problem but there are limited studies on integrating augmented reality technology into classroom settings to promote affective learning, with few studies found within the Philippines'. This study aims to close the gap by developing mobile-based AR application, and provide insights into its applicability and effectiveness within the Philippines' educational system, and additionally assess the effects of different AR components on student performance through an analysis of interactive elements, historical content representations, and immersive feature.

Keywords: Augmented Reality, Game-based Learning, Affective Learning, History

Contents

Chapter 1

Introduction

1.1 Background of the Study

History is normally taught with traditional methods such as lectures and discussions. As it requires high levels of understanding, the youth often avoids history. There are other methods that lecturers utilize in teaching history, such as creative means like audio-visual presentations, software, and interactive means. Video games, especially a simulations provide an excellent example of interactive and affective learning (?, ?). Not only is it popular among the new generation, but it grants freedom to choose however they may play the game and achieve different results based on their playstyle.

1.1.1 Students' Hardship in Classes

There are multiple factors which makes a student lose their interest and participation in a typical classroom settings. Some of the factors include easy or difficult materials, lack of interest in a subject, and a lecture-based environment (?, ?). Out of all the problems which causes the students to disconnect from the act of learning, test-driven classroom culture was one of the biggest factor which significantly impacts students' educational experience (?, ?). The student's negative view of the classroom primarily focused on multiple standardized test they needed to prepare, and how classes were centered around these tests rather than students.

The same study by (?, ?) showed how students were less bored and engaged when the classes were integrated with more interactive and hands-on activities

such as poster-making and science experiments, rather than typical lecture based classroom set ups. This behavior of the students opens up to the possibility of integrating augmented reality based learning material to enhance the involvement of the students to the class and further enhance their performances by creating a student-centered environment with affective learning.

1.1.2 Utilization of Augmented Reality with Affective Learning

Technological advancements are enhancing the education of students (?). Included in these advancements are virtual reality, mixed reality, and augmented reality. Most studies that are mentioned here have shown that using extended reality technologies have a positive impact with the way that students learn.

A study was conducted to investigate if augmented reality can promote learners' emotional and cognitive connection to a puzzle game that contains local cultural knowledge (?). The experimental group was given information using augmented presentations through a smartphone. On the other hand, the control group was provided with paper-based materials. The results show that combining augmented reality with the puzzle game have shown an increase in their understanding and their immersion with unique historical and geographical contexts. Additionally, it has also shown that the experimental groups have maintained their memory much longer.

To further support their correlation, a study by Lampropoulos et. al. has compiled 188 editorials and used bibliometric analysis and scientific mapping approach to create a general trend on extended reality technologies. The results show that there is a strong relationship between augmented reality and affective learning/computing. One particular example was implementing augmented reality with engineering education which has further increased the affective states of students, emotions, behaviors, preferences, and actions.

1.2 Research Objectives

The project aims to develop an augmented reality application that includes affective learning to enhance the user's understanding of historical events, focusing on the Bataan Death March. The project aims to investigate and address the factors causing student's difficulties in history classes and develop strategies to enhance student's learning experience using augmented reality.

The specific objective of this project is directed into answering these following questions

1. Can augmented reality technology be improved such that it would be utilized to create an immersive environment for the users?
2. How can the integration of augmented reality aid in teaching history through the use of affective learning?
3. How do students assess the effectiveness of augmented reality in improving their comprehension and engagement with historical events?

The expected outcome of this project is to develop a mobile-based augmented reality application with Unity engine with Vuforia add-on, which the student's can utilize to experience the Bataan Death march with immersive atmosphere. The application will immerse the user in a first-person perspective of the victim of the Bataan Death March and guide them through the event. Dialogues describing the actual historical event will be incorporated into the game play for user interaction, enhancing the application's historical value for education. The users are expected to learn and absorb the historical event of Bataan Death March through affective learning at the end of the simulation, leading to a deeper understanding of the event compared to traditional classroom settings.

1.3 Scope and Limitations

Scope

This study aims to focus on implementing augmented reality into historical learning as well as identifying the possible frameworks, technologies, and practices in developing augmented reality software assisting in learning.

Limitation

The proposed Augmented Reality application aims to depict fictionalized events and scenarios of the Bataan Death March. It aims to observe multiple events that may or may not have happened based on recorded histories and captured footage. Thus, the proposed application will only be partially historically accurate and authentic.

1.4 Significance of the Study

This project aims to further allow augmented reality technology to be incorporated in the field of education and allow different teaching strategies to be developed for the students. There are multiple studies abroad with utilization of game-based learnings and their integration into a classroom settings (?, ?). Despite the growing interest and advancements in augmented reality applications for education globally, the related studies are scarcely found in the Philippines.

This project is expected to bridge the gap by developing a mobile-based AR application, and provide insights into its applicability and effectiveness within the Philippines' educational system. This study aims to offer valuable data on how AR can be adapted to meet the Philippines' educational needs and challenges, and to assess the effects of different AR components on student performance through an analysis of interactive elements, historical content representations, and immersive features. The goal is to determine which elements within the AR technology are most successful in enhancing student engagement, comprehension, and retention of historical events at the end of the project.

Chapter 2

Related Works

2.1 Difficulty in Classes

There are multiple factors which affects students' hardship in classes (?, ?).

1. Students may not see value in their curriculum
2. Students does not believe their work will increase their performance
3. Demotivated by the results and reward
4. Restricted classroom environment
5. Physical, mental, or other personal problems

The examples above doesn't describe all but some of the significant factors which students are mostly affected with. There were several attempts in previous studies where some of these factors were negated with an integration of game-based learning in classrooms. (?, ?) developed and introduced a video game to the classroom to teach students about World War II. Their study was able to turn static classroom environment into more friendly student-centered class and amplify the students' participation with the learning module. (?, ?) evaluated an effectiveness of an augmented reality application called *Historic Augmented Reality Application* to increase an involvement of students by integrating a software where students can be interacted with the learning materials within the classroom environment. Their study was able to prove the improvement of students' attention span within the class with the usage of AR application and occupy them with discussions

and class participation. These studies from the past have proven the game-based learning's positive effects, as well as its side effects thoroughly. It is essential to analyze and understand why game-based learning enhances the performance of some students while proving less effective for others. Understanding these factor is crucial for pinpointing what specific conditions or variables contribute to the efficacy or ineffectiveness to this approach.

2.2 Game Based Learning

Game based learning is a learning technique which utilizes a game either digitally or non-digitally to increase a performance of a student by enhancing critical thinking and problem solving skills and creating student-centered environment in classes (?, ?). Some of the known example of the game based learning includes Menti, Kahoot, Handmade Board games, and real-life games which involves physical participation of the student.

Data from several case studies involving the integration of game-based learning into classrooms shows its effectiveness in improving student performance. A study from (?, ?) showed increase in students' preference and engagement from gamified lectures, and their ability to interact and share ideas reported to be more effective and amplified. Another study from (?, ?) involved *Making History* - a video game designed with an educational purpose to teach students the history of World War II. This case study showed how the integration of game-based learning into a standard American classroom was able to convert the restricted teacher-centered classroom where students were mostly passive into a more student-centered environment which made students more engaged and less hesitant to share their ideas to the class.

While game-based learning does provide positive effects toward students, there are side effects which may occur if not integrated properly to the class. In recent years, there has been an increase in phenomena of *Gaming the System*, where learners attempt to exploit the education system to achieve a high performance rather than attempting to absorb the lessons (?, ?). It is important to understand why students choose to game the system to create a educational that students do not attempt to exploit it.

According to (?, ?) in his study on what makes things fun to learn, there are certain criteria which needs to be considered to create an effective game for education. 1. The game must have clear goal and must be compelling, 2. The player must know if they are getting closer to the goal, 3. Game should provide

varying difficulty for the varying skill levels of the players. Another insight from (? , ?) in the perspective of the games that will be used for education must be 1. Not too costly, and must be easy to install, 2. The game should be playable under 40 minutes to be used in a classroom settings, 3. If not, the game is better to be used as a homework instead. These criteria from the previous studies must be carefully observed and integrated into the project accordingly to avoid exploits from the students.

Immersion in Fear of Losing

According to Juul (2013), humans are naturally inclined to desire success and competency. However, game players engage in activities that can result in failure. Juul (2013) described this contradiction as the paradox of failure, wherein humans continuously consume materials that may result in failure. Failure is a concrete human phenomenon with an emotional cost that relies on personality and personal beliefs (Juul, 2013). Juul (2013) noted in his findings to "replace frustration with curiosity" and sees failure as a learning opportunity rather than a way to achieve psychological gains by winning (Juul, 2013). Frustration is an emotional feeling that occurs when players stop progressing in a goal-attainment process, wherein players cannot fulfill their desired outcomes due to unsatisfying situations where they are not in control of the process to progress further (Nylund Landfors, 2015). There is a positive frustration and negative frustration that players feel when playing (Nylund Landfors, 2015).

According to Nylund Landfors (2015), players experiencing negative frustrations by blaming the game for its failure, a sign of a bad game design. An example of these games include bad mechanics and complicated controls. In contrast, positive frustration leads to players blaming themselves for their failures and intrinsically motivating themselves to improve. The difference between positive and negative frustration from failure is the learning situation the players achieve when playing, which encourages them (Nylund Landfors, 2015). Positive frustrations result in a more profound sense of immersion for the player due to increased motivation and emotional engagement because of the weight and risk added to the player's actions in the game (Nylund Landfors, 2015). Players prefer that they feel responsible for their failure and feel the need to reconsider their strategy after failing (Juul, 2011). Failure is central to the overall immersion of players in the game and is not a contrast to winning (Juul, 2011). The idea relies on people to avoid failure, but success without failure leads to dissatisfaction, as failure adds to the content of a game (Juul, 2011).

2.3 Affective Learning and World War II History

According to Mahadeo and Nepal (2023), a teaching method that recognizes the vitality of emotions in learning improves students' experience, creating a positive and effective outcome. Affective Learning, as defined, is the process of learning skills and attitudes through emotional engagement. It enhances curiosity and enthusiasm in learning outcomes that foster a deeper understanding of the context with meaningful retention of information. It is an approach that tailors to cognitive and emotional dependency to promote holistic and impactful learning experiences. Nurturing positive emotional experiences can improve student engagement, critical thinking, and academic performance by creating a transformative learning experience that allows personal and educational growth.

The strategy of using Affective Learning in teaching World War II History can affect how the students can see the gravity of the effects of war on the country and the people without having to experience it and by only seeing it through the lens of those who lived it. A study by Kim et al. (2019) showed the hardships of comfort women during World War II. The Japanese Military during World War II created comfort stations that used women as tools for relief, stripping the dignity and freedom of the comfort women. The study used male and female students of diverse ethnicities to interview comfort women survivors who narrated their experiences. One of the students said that he learned the facts about comfort women in class, but hearing the reality from the person who survived made the history "more real." According to Waters and Russell III (2012), the violation of human rights in the context of history should be taught in social studies classrooms to help students become better citizens. Discussing and exploring the issues of human rights violations in the context of World War II history helps students conceptualize and identify current human rights violations while stating that mere recognition of injustices is not enough to pursue actions.

2.4 Historic Augmented Reality Application (HARA)

There has been several studies on applying augmented reality (AR) technology into education to amplify the learning of the students and create an immersive environment for them (?, ?). Although there are numerous studies from various parts of the world, there are few papers discussing the application of AR technology in school settings in the Philippines.

Historic Augmented Reality Application (HARA) is an application developed in the Philippines which aims to teach students the Philippines-American colonization period through immersive story telling (?, ?). The application aimed to teach students the three distinct event during the American colonization, namely the battle of manila bay, mock battle of manila, and the first shot in Philippines-American war.

HARA is a mobile-based application integrated with AR technology, and the decision was made to develop it using the Unity and Vuforia engine. This choice was influenced by Unity's capability to publish across over 25 platforms compared to other suitable mobile development platforms such as Android Studio, and technical aspect of how Vuforia engine is easily co operable with Unity engine was another factor in the decision making. The HARA relies on image recognition of the predefined set images through the cameras of the mobile phones, after which the application overlays a 3D animated scene displaying the event shown in the images. The development of the HARA lasted from May to October of year 2018, with first four months spent on development and beta release of the application, and final two for user evaluation and modification.

HARA was the first application in the Philippines which utilizes augmented reality with 3D animated scenes to be used to teach history in a classroom setting. As a pioneering application in the field, to ensure the standard in the field of human-computer interaction field, the application usability was surveyed with a questionnaire based from the works of Guimarães and Martins which is used to evaluate AR application in terms of variables such as effectiveness, efficiency, and such by the co-designers of the application. The application received 82 percentage markings on its effectiveness, but received poor markings on satisfaction - 51, and efficiency - 43 from the co-designers due to factors such as slow animation and loading time. While the designers weren't fully satisfied with the application, the overall qualitative feedback from the users were positive. The application received a high overall markings of 4.2 out of 5, and got positive reviews from both students and teachers. Overall, the HARA shows how the AR technology is a promising tool in a field of education to effectively create immersive environment for the students.

2.5 EON-XR: The Urban Planning of Rome

With the growth of popularity of video games worldwide and the advancement in the field of Augmented and Virtual reality (?, ?), Augmented Reality (AR) is no longer a technology that is foreign towards the young audiences such as high

school and college students around the world. With student's apparent lack of motivation to study (?, ?) and their hardship in classes, there has been numerous case studies on integrating gamification into education to boost the student's performance in class (?, ?).

The study on *EON-XR*, stands out among similar works as it is a simulation video game embedded with both Augmented and Virtual reality technology and was developed to be used for educational purposes (?, ?). The application was developed for mobile settings using Unity with Vuforia engine plug-ins for AR. The models of the buildings and characters were made with a 3DS Max modeling tool, maximizing the details of each assets for greater user immersion.

The students were allowed to utilize the AR portion of the application to observe the visualization of the city elements with an optional description on the side to further enhance the explanation. This activity was told to increase the educational value of the game, and is to amplify the immersion of the era for the students. Aside from its AR feature, the *EON-XR* application also provides the user with a virtual reality (VR) simulation to allow them to walk around the cities of ancient Rome and visit notable landmarks such as The Colosseum on foot. The user can roam around a pre-designed city or build a city on their own to create an immersive simulation to their liking. To increase the historical potential of the game, the developers added a scroll with information of notable buildings inside them which the users can read in first person upon entering the buildings. *EON-XR* shows a strong evidence of AR and VR being utilized to create immersive environment for the users, and create suitable environment around them to absorb the information efficiently.

2.6 A Deep Dive into Immersive Technology

Immersive technology, which includes AR and VR, have an increased in scholarly attention through the years. With that attention, only a few studies have been done to discuss the current state of this kind of research. A literature review was done from 54 rigorously selected articles and their findings were summarized into one study; all to show the current state of immersive technology, and to give light on gaps on research (?, ?).

The study summarized and combined results and data from the set of studied articles into multiple tables and figures that show aspects of both VR and AR (?, ?). The literature review summarized that immersive technology is good at increasing learning effectiveness and engagement while also improving attitudes

at said learning materials; the study also discussed that, to increase immersion and effectiveness, it is better to have interactive elements, even better they are collaborative in nature (?, ?).

The literature review delved deep into both AR and VR technology and points out key concepts that are important in the application of those technology. The study’s findings provide guidance for the creation of the applicaiton and aims to offer an immersive and effective AR experience. Lastly, the study established a framework from which the project can be built upon, as shown in figure below (?, ?).

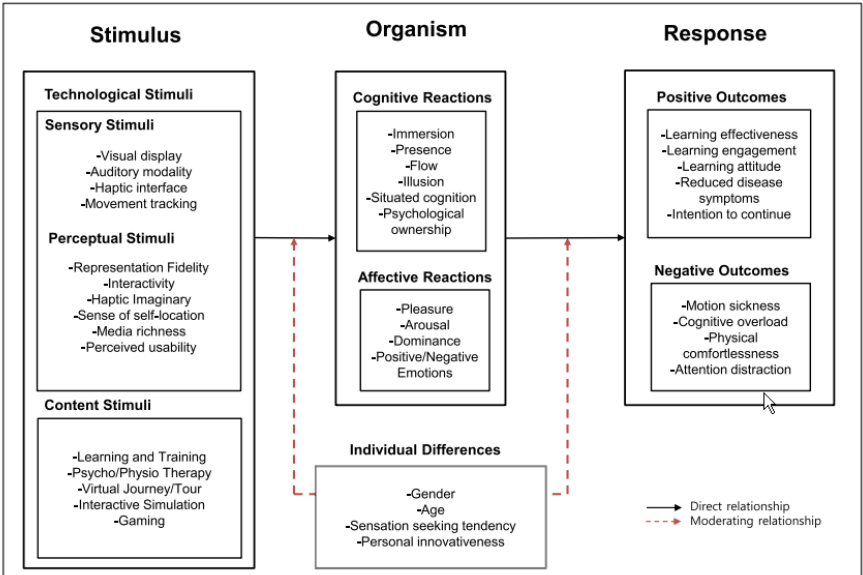


Figure 2.1: Immersive Technology Framework

2.7 User-centric View on Immersion in Augmented Reality Games

The term *immersion* can have different definitions depending on the context in which it is used. In Virtual Reality (VR), immersion refers to a user’s perception of strong sense of presence in a computer-generated world (?, ?). Immersion in VR is achieved through surrounding the user with stimuli such as sound and images to create a total environment and induce hallucinations for them (?, ?). However, what does immersion signify in the context of Augmented Reality (AR) technology?

According to (? , ?), immersion in AR refers to an experience which allows the users to connect to the partial virtual world presented by AR, and is conceptualized as a mental sensation of engagement and a cognitive feeling of involvement. Shin explains that users' sense of presence and connection is influenced by their ability to effectively integrate and interact with virtual components within the real environment. Another paper by (? , ?) also defines immersion in a psychological aspect, stating that immersion is the 'psychological state of testing being enveloped by interacting with an environment that allows users a continuous stream of experiences'. The primary scope of immersion in AR is to enhance and augment the real-world experiences of the users without fully disconnecting them from reality (? , ?).

Several factors in AR can be leveraged to bring out an immersion-based feeling and empathy from the users. Realism, interactivity with the virtual world, stereo sounds, graphics, and narratives are significant elements that contribute to creating immersion in AR (? , ?).

Literature by (? , ?) emphasizes on the relationship between a flow, presence, and immersion in determining user experience in AR. Flow is defined as the mental state where an individual has a complete involvement and enjoyment in the process of the activity, while presence refers to the level of significance of another person in the interaction and the resulting importance of the interpersonal relationship. The study suggests that these three factors had a significant impact on user satisfaction by providing users a sense of confirmation - a users' perceptions of the alignment between their expectations of technology usage and its actual performance.