XAVIER UNIVERSITY – ATENEO DE CAGAYAN

COLLEGE OF COMPUTER STUDIES
DEPARTMENT OF INFORMATION TECHNOLOGY

INTERACTIVE AR APPLICATION ON SHAPES FOR GRADE 1 LEARNERS WITH SPATIAL LEARNING DISORDER

A Capstone Project presented to the
Department of Information Technology
College of Computer Studies

In partial fulfillment of the requirement for the degree of
Bachelor of Science in Information Technology

by:

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Navarro, Gerald L.
Tejada, Randy Louis Gabriel M.

JANUARY 2022

ADVISER'S RECOMMENDATION SHEET

This Capstone Project entitled

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by:

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And submitted in Partial Fulfillment of the Requirement for the Bachelor of Science in Information Technology degree has been examined and is recommended for oral defense

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by the Department of Information Technology
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CERTIFICATE OF ORIGINALITY

This is to certify that we assume full responsibility over the work entitled "INTERACTIVE AR APPLICATION ON SHAPES FOR GRADE 1 LEARNERS WITH SPATIAL LEARNING DISABILITY" submitted as a requirement for the degree BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY at the College of Computer Studies, Xavier University – Ateneo de Cagayan, that this work is our own, that this is original except as specified in the acknowledgements, footnotes, citations or in the references and that this has never been submitted to this or any other school for a degree or other requirements.

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Chapter 1

Introduction

In this section of the paper, the researchers will provide the general introduction of what the capstone, Interactive AR Application on Shapes for Grade 1 Learners with Spatial Learning Disability, is all about. This part will explain what the real-world problems are and why the study is pursued. Moreover, it will explain the overview of the study and the benefits to its target audiences.

1.1 **Background of the Study**

With the onset of the COVID-19 pandemic, education has been done online. Because of this, it has been quite a struggle to educate students.[8] Students are also not as engaged with traditional material, because of the lack of interactivity.[7] This study aims to maintain the interest of the students as well as increase their productivity through a fun and interactive AR application on shapes. As students, the researchers desire to help younger students and develop their three-dimensional spatial and mathematical skills which are also geometrical in nature. The difficulty in perceiving different three-dimensional constructs during this lockdown proves to be a challenging task for learners to understand spatial problems. The goal of this paper is to revitalize learning while being stuck at home with an interactive and informational system that provides three-dimensional spatial learning, and through this training create a powerful tool for students.

Software development is the process of conceiving, specifying, designing, programming, documenting, testing, and bug fixing involved in creating and maintaining applications, frameworks, or other software components. The software can be developed for a variety of purposes, the three most common being to meet specific needs of a specific client/business (the case with custom software), to meet a perceived need of some set of potential users (the case with commercial and open-source software), or for personal use (e.g. a scientist may write software to automate a mundane task). [1]

Educational software is a term used for any computer software which is made for an educational purpose. It encompasses different ranges from language learning software to classroom management software to reference software, etc. The purpose of all this software is to make some parts of education more effective and efficient.[2] The main goal in an active and interactive teaching-learning process must be to help the students to discover the pleasure of inquiry and learning, which leads to increased confidence in their abilities. The usage of modern technologies and educational software is a must of the modern educational process [3]

This web application will allow students and teachers to properly have an interactive teaching-learning process through a fun and engaging way utilizing

educational software such as E-Learn, Microsoft Teams technologies such as augmented reality, etc.

Spatial learning ability is the training of students through education on courses in graphics or geometry related to augmented reality. And undergoing these training programs designed to foster the different innate spatial ability learners have, an experiment towards the comparison of a trained group and an untrained control group to showcase the different significant spatial performance.

1.2 Statement of the Problem

The research aims to address the problem of grade 1 learners, specifically those who have a learning disability towards spatial three-dimensional shapes, similar to dyslexia but more focused on spatial shapes.

1.3 Objectives of the Study

This section discusses the general and specific objectives of the study.

1.3.1 General Objectives

This paper aims to design and develop an interactive AR application about shapes for Grade1-2 learners.

1.3.2 Specific Objectives

The specific objectives of this study are:

1. To gather data on interactive AR applications and shapes
2. To analyze the data gathered
3. To design an interactive AR application about shapes for Grade 1 learners.
4. To develop an interactive AR application about shapes for Grade 1 learners using Android Studio.
5. To test the interactive AR application about shapes by conducting a survey for Grade 1 learners.

1.3.3 **Research Questions**

What are the features of the app that can assist learners who have a learning disability like dyslexia in a visual spatial space?

1.4 **Conceptual Framework**

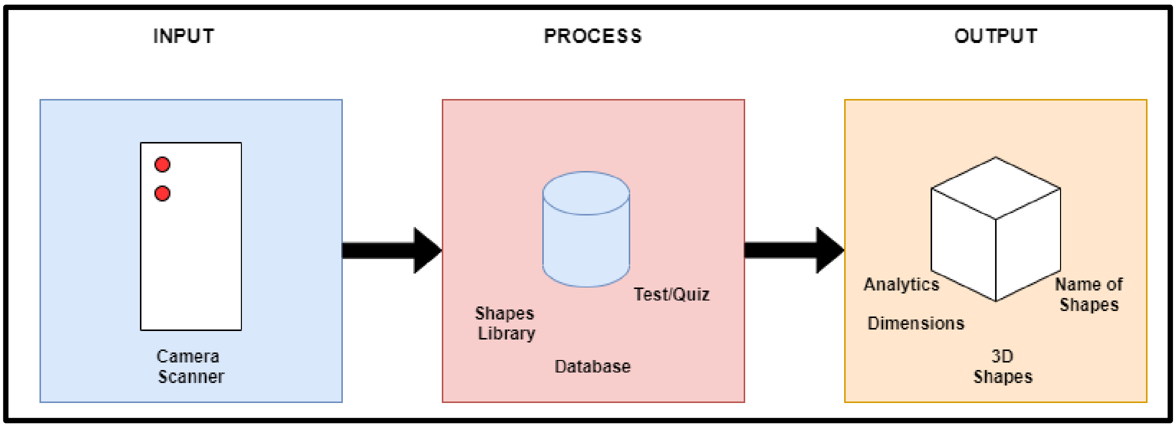

Figure 1. Conceptual Framework

1.5 **Scope and Limitation**

The scope of this research are grade 1 learners currently enrolled in this new online setting, and grade 1 learners who have devices that are capable of running the AR education program. Programming languages such as Java to serve as our primary syntax. The pandemic is a liability during this study creating any face-to-face interaction with the students impossible, making this research solely online based. The app will focus on shapes only and not detect text nor audio. This will also be limited to people with visual-spatial learning disorders.

1.6 **Significance of the Capstone project**

This project will benefit the following:

K-12 (Grade 1) students: They will find how visual education through augmented learning is much more interactive than the normal learning method.

Grade 1 Teachers: In this study, teachers will have more ways of teaching mathematical shapes to students, these are interactive and through a spatial reality.

Parents of Grade 1 Learners: This study helps their child develop a greater understanding of spatial constructs.

Future Researchers: The result of this capstone project can serve as the basis and foundation for future projects and study.

The Researchers: The researchers can develop their skills in developing AR applications

1.7 Basic Concepts and Terminologies

Augmented Reality – is an enhanced version of the real physical world that is achieved by digital visual elements, sound, or other sensory stimuli delivered via technology. It is a growing trend among companies involved in mobile computing and business applications in particular.

Depth of Perception – Depth perception is the visual capacity to view the environment in three dimensions while also determining the distance between objects.

K-12 – Students who are currently Grade 1

Spatial Learning Disability - individuals who have a difficult time grasping spatial shapes and depth of perception.

Spatial Learning – Spatial learning refers to the process by which an organism acquires a mental representation of its environment. Spatial learning has been found in both vertebrate and invertebrate species.

Spatial Reality - The ability to perceive and understand objects within your visual and it is the evaluation of visual details and the comprehension of visual spatial relationships. It reflects the ability to comprehend and apply spatial reasoning among visual objects, as well as the ability to quickly analyze important visual details.

Spatial Sense – Spatial sense is an intuitive feel for shape and space. It involves the concepts of traditional geometry, including an ability to recognize, visualize, represent, and transform geometric shapes.

Web Application - is application software that runs on a web server, unlike computer-based software programs that are run locally on the operating system of the device.

Chapter 2

Review of Related Literature

This chapter presents different related literature and studies from both local and foreign sources. These studies will help in familiarizing information that were relevant and similar to the present study. These will include finished thesis, conclusions and methodologies from the related literature. The aim of the study is to help the Local citizens to buy their desired products with its price information and address of the pharmacy, as well as for the business to help them advertise their products and sell them.

2.1 Educational software

In recent years, thanks to the Internet and the rapid development of technologies, multimedia applications and hypermedia-based software have become more important, joining traditional media in the information diffusion framework. Moreover, due to their characteristics, these kinds of tools were very suitable to gain learners' attention. Thus, by consequence, software producers, institutions, and private programmers started using their potential for the development of instruments to be used expressly for teaching: the so-called educational software (ES). [4]

According to Moraru et. al 2010, an active and interactive teaching and learning process, the student is no longer a passive receiver of knowledge processed and spread by the teacher. Mostly the main goal of an active and interactive teaching-learning process must be to help the students to discover the pleasure of inquiry and learning, which leads to increased confidence in their forces.

Educational software can help students discover the pleasure of inquiry and learning. In Moraru, et al's study, they came up with numerous educational software pertaining to mathematics, science, and music. The students can be provided with sequences, which can vary from lesson stages, tests, and so on. Similarly, Ibrahim (2016) had developed educational software used to design and simulate electronic circuits. Ibrahim (2016) states that the computer's graphic capabilities make them useful in designing devices and in simulating complicated processes. The educational software is entirely interactive. provided with sequences, which can vary from lesson stages, tests, and so on. Similarly, Ibrahim (2016) had developed educational software used to design and simulate electronic circuits. Ibrahim (2016) states that the computer's graphic capabilities make them useful in designing devices and in simulating complicated processes. The educational software is entirely interactive. provided with sequences, which can vary from lesson stages, tests, and so on. Similarly, Ibrahim (2016) had developed educational software used to design and simulate electronic circuits. Ibrahim (2016) states that the computer's graphic capabilities make them useful in designing devices and in simulating complicated processes. The educational software is entirely interactive. provided with sequences, which can vary from lesson stages, tests, and so on. Similarly, provided with sequences, which can vary from lesson stages, tests, and so on. Similarly, Ibrahim (2016) had developed educational software used to design and simulate electronic circuits. Ibrahim (2016) states that the computer's graphic capabilities are provided with sequences, which can vary from lesson stages, tests, and so on. Similarly, Ibrahim (2016) had developed educational software used to design and simulate electronic circuits. Ibrahim

(2016) states that the computer's graphic capabilities make them useful in designing devices and in simulating complicated processes. The educational software is entirely interactive.

The main teaching advantage of these lessons is represented by the fact that they implement a well-thought teaching methodology, resulting in an interactive working strategy, with the taught subject being presented in a varied way with the help of specific programming techniques. These techniques appeal to and trigger specific skills of the student, which enables him/her to learn more easily. [5]

2.2 **Interactive Learning Environment**

Concerns about adolescents have recently been raised in Taiwan due to a lack of workouts. ‘‘Learning while exercising" may be part of a viable solution in educational contexts when student exercise is constrained by schedule limitations and a lack of physical activity has become a critical concern. In terms of learning achievement and learning attitude, this study developed the Ecosystems Augmented Reality Learning System (EARLS) and compared it to existing keyboard/mouse-based computer-assisted instruction (KMCAI) approaches and traditional face-to-face teaching methods. In this study, 1211 people were polled and divided into five groups. Most teachers, it was said, felt under such pressure to assist teenagers to achieve higher academic performance to get into a good senior high school that they would rather utilize the old teaching technique than spend more time experimenting with new technology. According to the Research, Development, and Evaluation Commission (RDEC) of the Executive Yuan of Taiwan (2008), 99.2 percent of teenagers aged 15 to 20 use computers, and 98.7 percent use the internet. The survey was conducted over the phone, with a total of 16,131 random samples. According to RDEC (2008), time spent on the internet increased from 2.72 hours per day in 2007 to 2.78 hours per day in 2008. Some researchers are concerned about the health of adolescents since time spent on physical activity is dropping while time spent on computers is increasing (Luepker, 1999; Wang & Wu, 2003). According to a recent study, online game players are fitter than the general population in the United States (Williams, Yee, & Caplan, 2008). The authors also stated that the average age of online game players in this study of a massively multiplayer online game was 31.16 years older than the average age of online game players.

Among 400,000 15-year-old students from 57 countries, Taiwanese students won the championship in math and placed in the top four in science. They, on the other hand, ranked among the bottom four in terms of scientific confidence. They also scored poorly on other items relating to scientific learning attitudes. The potential for using new AR technology to promote positive learning attitudes will also be investigated in this study, in addition to learning achievement. Comparisons will be drawn between the new AR technology, the KMCAI approaches, and traditional face-to-face instruction in both ways. The teaching material in the learning section provides learners with more interactions between the system (the virtual images), the learners, and the real objects, as AR has the potential to engage and motivate learners to explore teaching material from real and virtual objects (Kerawalla, Luckin, Seljeflot, & Woolard, 2006; Shelton & Hedley, 2002). Learners in EARLS could use ‘‘learning by doing" instead of ‘‘learning by reading" as in traditional face-to-face teaching. Both of these teaching methods were developed with the help of students' prior knowledge and experience, which they had gained in earlier grades. The significance of this study was to make learning easier while exercising by utilizing EARLS to give one possible answer to teenagers' lack of physical activity and potential physical damage caused by long-term usage of computer keyboards and mouse. In response to high school teachers' pessimism about EARLS' effect and impact on learning achievement, EARLS' ‘‘learning while exercising" has successfully provided a way to address health concerns without reducing learning achievement, especially in educational environments where student exercise is limited by scheduling constraints.[6]

2.3 **Augmented Reality on Special Disability in Higher Education**

Spatial mental rotation, a visuospatial skill, refers to the ability to manipulate representations of visual objects mentally. This ability is used to rotate two-dimensional (2D) and three-dimensional (3D) objects in an imaginative space. Neurobiological research associates it with the human ability [11]. we use AR to present a complete 3D animation with real spatial information of the background environment, allowing the user to see the virtual 3D model rotate corresponding to a tangible manual controller (cube) rotating in their hand. The user has real motor perception and visual feedback from the 3D spatial visualization display AR paves the way for students to practice knowledge and skills through the seamless combination of digitalin formation with actual real-world surroundings (Wojciechowski & Cellary, 2013). It also enables practicing skills and knowledge on real-world instances and provides interactive learning environments via activities of the same caliber (Chen et al., 2015) AR is deemed to be a technology with promising possibilities when it comes to teaching and learning, increasing students' success. Studies reported that AR technology can promote teaching and learning, resulting in enhanced achievement, motivation, improved perception, confidence, increase independence and daily life skills, spatial ability, interest, engagement and ultimately, satisfaction

2.4 **Constructivist Methods**

The main argument of cognitive constructivism is that children construct their own knowledge as they interact with the world around them. Steiner (2014) describes these interactions that "enable students to create schemas or mental models; the models are changed, enlarged, and made more complex as children continue to learn." *The Process of Education* by Bruner has been translated into many different languages, it has been recognized of different curricula in many countries. Bruner adopts a different view from Piaget about development stages. He believed that a child could be taught all subjects if they were introduced to them in a proper method depending on their development stage, in his words "We begin with the hypothesis that any subject can be taught effectively in some intellectually honest form to any child at any stage of development" Bruner suggests that children in social environments help towards children, Bruner has believed that children are naturally curious, but if the problems turn into something complex, they start to lose their interest. Students should be able to solve the problem themselves in an increasing difficult manner, learning is an active process that a learner should actively partake in as Bruner has states in his work constructivist method.

2.5 Synthesis

The proposed capstone is reminiscent of the studies that were mentioned, namely the educational software-based studies because the aims are quite similar. Notably, this is similar to the research, Educational Software as a Learning Tool for Primary School Students, as they target mainly grade 1 which fall under the category of spatial learning disability. As stated by Moraru et al, the software can help students discover the pleasure of inquiry and learning. It showed that the students were engaging with the software and the capabilities of education that it can give. With this, the proposed capstone will fall under educational software targeted towards grade 1 students to achieve comparable results for the benefit of these people.

In contrast, the proposed application will be an augmented reality application whereas this research is not, this would make the proposed application will be more interactive since it involves augmented reality. Constructivist methods is quite essential for the development of this paper for we the researchers are handling young minds, a proper introduction towards their age level should be implemented. As Bruner states any child can be taught if they were introduced to it in a form befit to them.

Chapter 3

Methodology

This chapter will now discuss the research design of the study then followed by a full explanation of how each phase is carried out. Furthermore, it will explain the procedure and methods used to conduct this study.

3.1 Research Design

The research design is the Modified Waterfall Model. A waterfall is a sequential operation plan in which each stage must be completed before proceeding to the next.

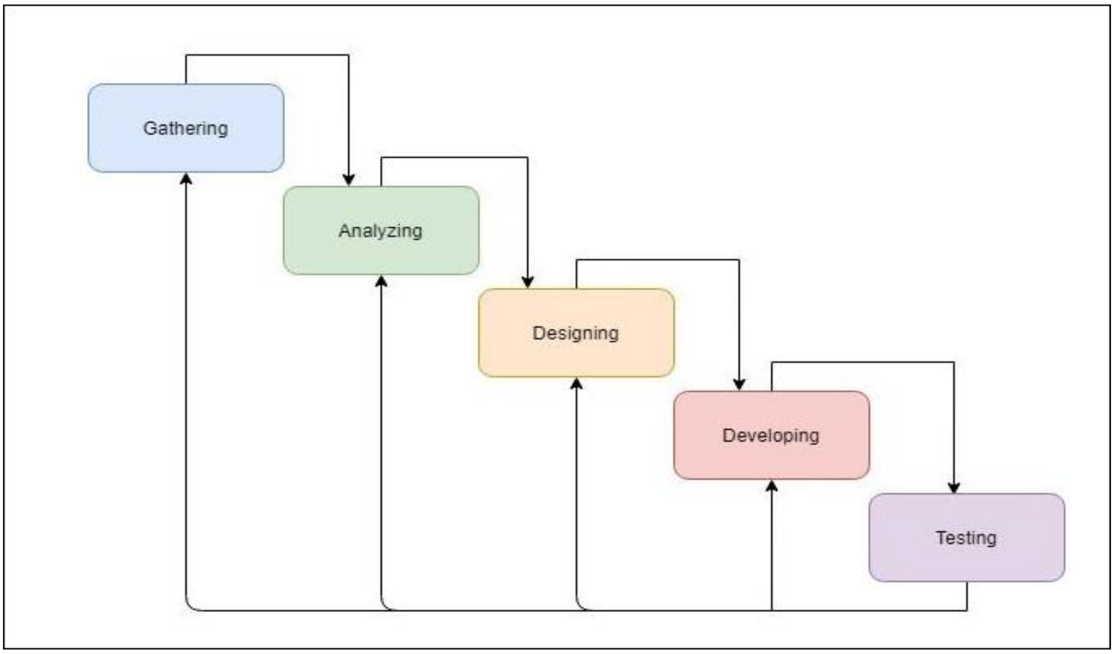

Figure 2. Modified Waterfall Model

The systematic model of the plan creates a life cycle with different important steps that provide a singular objective in the project. With each series of steps that provide the necessary input for the next, the waterfall method is useful in returning to specific parts of the cycle if need be.

3.2 Detailed Methodology

This section describes what will be done on every phase of the Modified Waterfall Model such as the requirements gathering, analysis, design, development, and implementation, and testing evaluation.

3.2.1.1 Requirements Gathering

Requirements will be gathered during this phase of the research to identify what needs to be done. The forms will be sent to teachers currently teaching grade 1 via email. The questions will revolve around the interaction of students regarding educational technology. The survey would be beneficial since it would give information on how to craft the system properly for the target audience.

3.2.1.2 Analysis

To design a system that meets the criteria of associated users, the researchers will use a variety of techniques to ascertain the user's requirements for an augmented reality application. These approaches include conducting an interview, conducting a survey, and personally watching the individuals of interest. It is critical to understand their requirements in order to develop an application capable of achieving the goal of increasing the user's interest via the application's usage. The researchers will conduct a survey with parental consent to ascertain their reach and to highlight any issues they encountered in a face-to-face setting. By analyzing the survey data, the researchers can establish that the issue they experience is that the face-to-face situation does actually-- create learning difficulties. By compiling the survey, it is possible to determine that to enhance their learning ability. The adoption of augmented reality applications is highly encouraged. The program will assist students in identifying three-dimensional shapes. With the issue on data privacy the developers have prepared an informed consent form for the parent/s to sign. (Please refer to Appendix B)

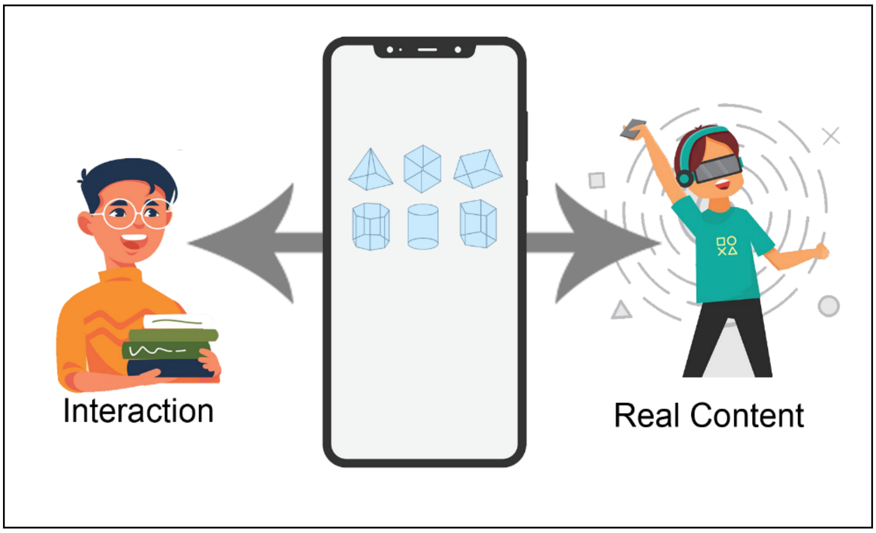

Figure 3.1 Analysis Diagram

Figure 3.1 above shows that augmented reality is a gateway to both interaction with students and provider of real content.

3.2.2 **Design**

The design should be user-friendly and modern so that the grade 1 would enjoy using it, with information that heavily emphasizes the different spatial shapes that are easily navigable by the learners. The fluidity and interface should carry on to different devices so that a wide array of devices may be used for augmented learning, with android the basis of the platform the team is choosing to build with. The learners are met with the main menu that gives them the options on which mathematical shapes they wish to interact with, they are then given more options to interact with the shape which promptly outputs the desired option.

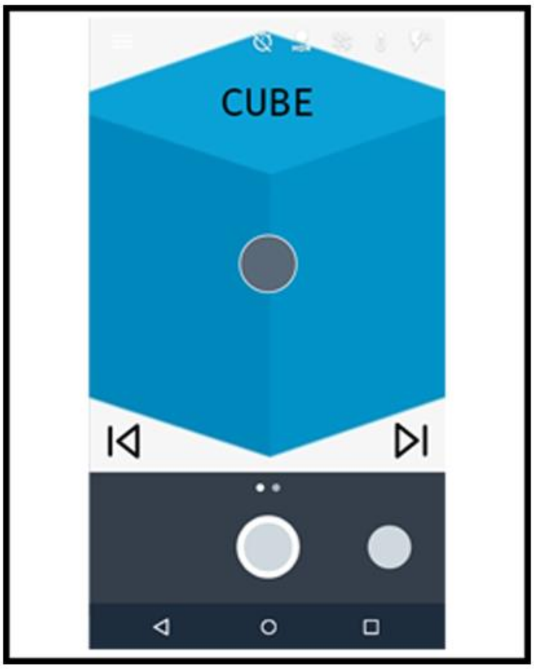

Figure 4 Proposed design of Augmented reality scan for object

Figure 4 demonstrates how the student will see the shape when it is scanned by the camera on their device, it showcases the name of the shape and its information.

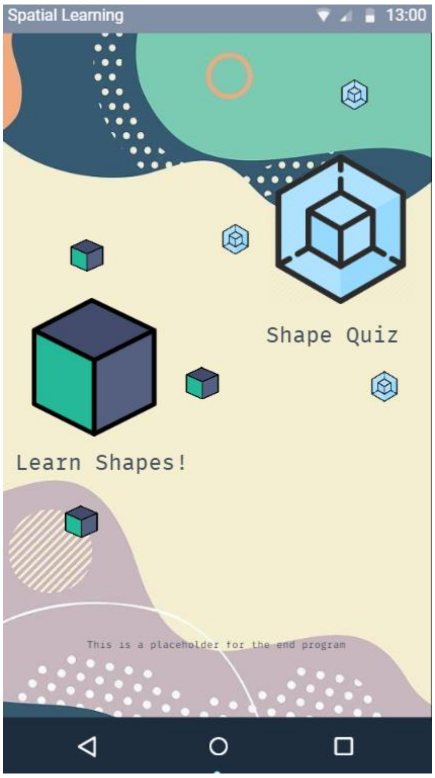

Figure 5 Proposed design of the Menu of the application

Figure 5 is the proposed design of the menu of the application where the students can navigate the shape quiz or learn more about shapes, this gives them the ability to choose whether they would like to immerse themselves in learning about shapes through a spatial reality environment or test their ability in the quiz section.

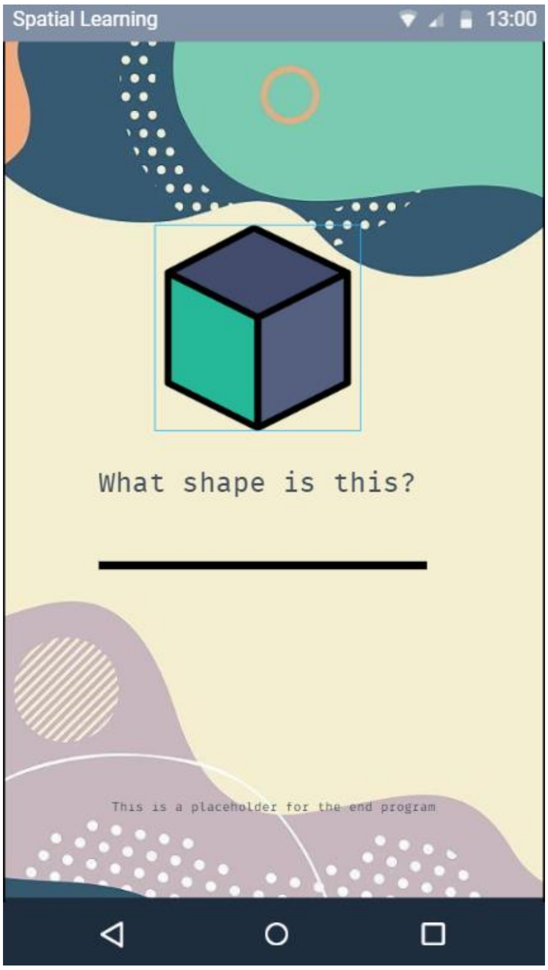

Figure 6 Proposed design of Augmented Reality Quiz

Figure 6 is what the user will see when answering the augmented reality questions, this provides a variety of different geometrical identification questions in which they provide the answer in the blank below.

3.2.3 **Development and Implementation**

In developing the application, the researchers will be using Jira to allocate the timeframe for each member to do specific tasks, with the code pushed to GitHub so that it can be updated and monitored by each member. Adobe XD will be used to wireframe the UI/UX of the Augmented Spatial Reality Program, while Android Studio would be the main compiler for the duration of the development phase. The program would later be deployed on the Appstore to undergo user stress testing, so that it may uncover potential bugs/glitches in which the researchers would collect and compile data to be used for information gathering.

3.2.4 **Testing and Evaluation**

After the letter of consent has been acknowledged by the school Smart Start Academy, a group of grade 1 students is given the AR educational program to be tested within a four-week timeframe (Please refer to Table 1 Test Schedule) with corresponding tests, in which at the end of the testing phase, they are to complete a google form survey to see if there was a difference in using the application for their studies or without using the application**.** Students will learn how to use the software under the guidance of their teachers, who will use a client user manual guide, they can keep track of which students are having problems with understanding spatial reality, with the guide and questions provided.

Each week corresponds to a different set of questions designed to assess students' capabilities; the first week will assess students' knowledge of spatial constructs and their ability to comprehend them; this will also be the time for us to conduct surveys and ascertain each student's skill set. The second week would consist of an in-depth tutorial on the constructions of various shapes, their dimensions, and size patterns, as well as the application's benchmarking, the third week will assess students' ability to perceive objects in a spatial augmented reality environment and how the software can assist them in comprehending the spatial object. Additionally, that week will include a pre-test for testing and the final week would be a post-test of the testing and a challenge of what they had learned in the previous weeks and how it affects how they view 3-dimensional objects in an augmented spatial reality setting.

Table 1 Test Schedule

Week:	**Testing:**
Week 1	Test 1
Week 2	Test 2
Week 3	Test 3 – Pretest
Week 4	Test 4 – Post test

The first week after receiving the permission from the parents and teachers, the researchers will collect information from the students. This would be about how well they do in class, where they have difficulties in and the overall performance of the students in the class, the teachers will be provided the necessary paperwork to complete the survey. The second week will be benchmarking the students with the Augmented Reality Application and for them to test and familiarize themselves with the application, with a different set of questions given to the teacher’s data will be collected during the first time these students will be interacting with the application, this week will also determine the old way of teaching shapes to the students. The third week will begin the Pretesting to see if the students have ever experienced an Augmented Reality Program and the last week will be Post Testing to test what they have learned and the things that they have assimilated.

3.2.5 **Functionality Testing**

The researchers will conduct two types of testing: functional and stress, with a focus on functional testing. A functional test is a black-box test in which, given a certain input, the application's output is examined to ensure that it matches the intended outcome. The objective of stress testing is to expose the application to a high volume of input, which is often random or pseudo-random. While the stress test will not discover functional faults, it may reveal crashes and other non-functional requirement violations such as memory leaks.

3.2.6 **Usability Testing**

After the Grade 1 students have used the application, they will undergo the System Usability Scale (SUS, where they are given 10 questions and provide a scale from Strongly Agree to Strong Disagree (Refer to Appendix C). Which is then placed in the Calculating System Usability Score, which has two steps that convert the scale of the given answers from the students and then calculates them to provide a SUS score (Refer to Appendix D).

Table 1 shows an example of a test case to be implemented during checking which consists of test case ID, test scenario, test steps, test data, expected results, actual results, pass/fail remarks, conclusion, and Table 2 shows an example of a test log.

Table 2 Test Case Example

Test Case 1	Check button Ok
Test Scenario	Check Button Ok with Valid Data
Test Steps	1. Launch Application 2. Click the selected button 3. Select button Ok
Test Data	
Expected Results	User should click the button
Actual Results	As Expected,
Pass/Fail	Pass
Conclusion	

Table 3 Test Log/s

Test Case Description	**Test Case Result**	**Test Case Conclusion**
To test Button OK functionality when the user exactly selects the correct button.	The User successfully clicked the button OK	Expected result met.

3.2.7 **Non-Functional Testing**

This test determines what devices can run the application, this is done by having multiple devices install and run the software through the Grade 1 students which later they can provide data in the google forms we have given them to determine the different encounters while using the application, through this test the researchers may be able to find the bugs that may persist in different platforms and models and resolve them accordingly. Some of the prevailing relevant things that this part should uncover should be the compatibility of different devices, shapes should be recognizable even on different screen resolutions, it is easy for the users to work around and provide satisfactory results. This test would provide important information when the students are finally using it.

3.2.8 Regression Testing

This test checks if the latest version of the Augmented Spatial Reality program has any regression or bugs towards older models that have lower hardware technology, this is seen towards the program not functioning normally such as shapes not displaying proper information or not even working in the first place. Processes that may perform slower with the new version which affects the entire aspects of the software are determined during this testing, this part assists the researchers so that they may be able to provide a better experience for the users.

3.3 Hardware and Software Requirements

The following are the hardware requirements and software requirements needed for this study:

Table 4 Hardware Minimum Requirements

Component	Specifications	Recommended
Processor	4.10 GHz	2GHz or above
Hard Drive	128 GB	64 GB or above
Memory (RAM)	8 -16 GB	4 GB or above
Graphical processing unit	Zotac GTX 1080	4GB or above

Table 5 Software Requirements

Software Requirements
Android Studio
Java
Jira Software
Adobe XD

Table 6 Minimum Requirements

Minimum Requirements
Wireless Fidelity (WIFI)
Personal Computer (PC)
Laptop
Mobile Data

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Appendix A

Work Plan and Implementation Schedule

This Appendix displays the Gantt chart that helps guide the developers in making the project efficiently in a well-organized manner.

Milestone	August 2021	September 2021	October 2021	November 2021	December 2021	January 2021	Feb 2021	March 2021	April 2021	May 2021
Capstone Background										
Scope and Limitations										
Conceptual Framework										
Review of Related Literature										
Methodology										
Requirements Gathering										
Analysis										
Results and Discussions										
Evaluation and Testing										
Conclusion and Recommendation										

Figure A.1 Work Plan and Implementation Schedule

Appendix B

Certificate of Consent

CERTIFICATE OF CONSENT

I have affirmed my consent to partake in this survey, which is entitled INTERACTIVE AR APPLICATION ON SHAPES FOR K-12 LEARNERS WITH SPATIAL LEARNING DISABILITY.

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily for my child to participate as a participant in this study.

Print Name of Parent or Guardian: ____________________
Signature of Parent or Guardian: ______________________
Date: [MM/DD/YYYY]

If Alternatively Schooled

A literate witness must sign (if possible, this person should be selected by the participant and should have no connection to the research team). Participants who are illiterate should include their thumb print as well.

I have witnessed the accurate reading of the consent form to the parent of the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Print name of witness ______________ AND Thumb print of participant:
Signature of witness ______________
Date: [MM/DD/YYYY]

I HAVE GIVEN MY CONSENT AND APPROVAL TO PARTICIPATE IN THIS STUDY.

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that the following will be done:
1. Conduct a survey.
2. Test the program.
3. Collect information

I confirm that the parent was given an opportunity to ask questions about the study, and all the questions asked by him/her have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this Informed Consent Form has been provided to the parent or guardian of the participant

Print Name of Researcher or person taking the assent __________________________
Signature of Researcher or person taking the assent __________________________
Date: <MM/DD/YYYY>

An Informed Assent Form will ____ OR will not ____ be completed.

Appendix C

System Usability Scale

In the System Usability Scale (SUS), participants are asked to answer ten questions on a 5-point Likert scale from Strongly agree to Strongly Disagree:

1. **I think that I would like to use this system every day.**
2. **I found the system very hard to use.**
3. **I thought the system was easy to use.**
4. **I think that I would need the support of an adult to be able to use this system.**
5. **I found the various functions in this system were well integrated.**
6. **I thought the system could be changeable to be easier to use.**
7. **I would imagine that most people would learn to use this system very quickly.**
8. **I found the system very easy to use.**
9. **I felt confident in using the system.**
10. **I needed to learn a lot of things before I could get going with this system.**

Appendix D

Calculating System Usability Scale (SUS) Score

Before we go into the more complicated part of the interpreting System Usability Scale (SUS) score, you need to first calculate the SUS score for each of the respondents. Below are the quickest and most simple steps do so:

Step 1: Convert the scale into number for each of the 10 questions

- Strongly Disagree: 1 point
- Disagree: 2 points
- Neutral: 3 points
- Agree: 4 points
- Strongly Agree: 5 points

Step 2: Calculate

- X = Sum of the points for all odd-numbered questions – 5
- Y = 25 – Sum of the points for all even-numbered questions
- Sus Score = (X+Y) x 2.5

The rationale behind the calculation is very intuitive. The **total score is 100** and each of the questions has a weight of 10 points.

Personal Vitae

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