# LEARNING BIOSPHERE CYCLES USING AUGMENTED REALITY

Project Id: 2020-160

Project Proposal Report

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B.Sc. (Hons) Degree in Information Technology

Department of Information Technology

Sri Lanka Institute of Information Technology
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## DECLARATION

I declare that this is my own work and this proposal does not incorporate without acknowledgement of any material previously submitted for a degree or diploma in any other university or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

| Name | Student ID | Signature |
|---|---|---|
| N.M.W.K.P.C Naranpanawa | IT17098588 | |

The above candidate is carrying out the research for the undergraduate Dissertation under my supervision.

Signature of the Supervisor:

……. ……..

Ms. Uthpala Samarakoon Date

**ACKNOWLEDGEMENT**

I would like to express my sincere gratitude to my supervisor, Ms. Uthpala Samarakoon for providing her valuable guidance, comments, and suggestions throughout this paper.

I would also like to extend my gratitude to all of my group members who have supported me immensely.

Thank you all of you for giving me your valuable time with kindness.

**ABSTRACT**

In present days, technology has become an important part in everyone's life, making it nearly impossible to survive in any field without it. Education is one of those fields which use technology for its development and enhancement in order to obtain the desirable outcome. Combining technology and education has opened new opportunities for immersive learning environments, and it has brought education to a level which makes it more beneficial and effective for the students. Among different kinds of technologies which are been used for the educational advancements, Augmented Reality (AR) has become one of the most popular technologies these days. It is being used as a new medium to combine aspects from ubiquitous computing, tangible computing, and social computing. Moreover, it has its own characteristics and benefits that are promising to support learning and make students more interested in learning. This research aims to develop a biosphere cycles mobile learning system using augmented reality for the ordinary level students in Sri Lanka. Main purpose of implementing this system is to make it easy for the students to learn the biosphere cycles using 3D image visualization.

***Keywords:*** Augmented Reality, Biosphere Cycles, Mobile Learning System

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# 1. INTRODUCTION

## 1.1 Background

Augmented Reality has been widely used in various fields such as Medical training, Design and Modelling, Tourism Industry, Education, Repair & Maintenance etc. One of the main reasons for using AR is that, its inability to display physical objects using 3D models. It enhances the perception of the user; provides a better understanding about the interaction of the real world objects by visualizing them virtually. These virtual objects demonstrate information which are complicated for the users to detect or observe directly by themselves. These information transmitted by virtual objects can help the users in performing their tasks. In education field, both the processes of teaching and learning can be developed and enhanced by applying AR. As an example, examining or studying animals would be more interesting and productive if the animals can be directly observed in an environment where they roam freely and naturally. Even though it is true, there can be situations where it is impossible to watch animals in a natural environment or at least in a zoo, because of its cost, distance, and time. But with augmented reality it is possible to bring the real life experience of observing the natural behaviours of the animals. Inability of observing the extinct animals using AR can also be shown as an example to emphasize its capabilities and potential. Moreover, studying monotonous subjects such as history would be more interesting if the characters and the scenarios in the text book can truly be seen. With AR, all the above mentioned scenarios has become a reality.

This study is an effort of making it easy for O/L students to learn about the biosphere cycles using an augmented reality mobile application. Currently, the research has been carried out to provide the learning support for only three biosphere cycles: Water, Carbon and Nitrogen cycles.

## 1.2 Literature Survey

Applying augmented reality for education would become an immense support to improve the learning process, because AR has the potential to change the traditional classroom-based learning to distance learning. Since the learning process should be all about creativity and interaction, it is not mandatory for teachers to always be there in the classroom to guide students. In addition, the ultimate goal of the learning process is to make students interested and motivated in a subject, and AR has the capability of doing that. Therefore, many researchers have put their efforts in topics such as learner motivation and engagement in learning using AR.

Rita Layonaa, Budi Yuliantob, and Yovita Tunardi together have carried out a research to develop an AR application for human body anatomy learning in order to make it easier for students to understand the content clearly. For collecting data for the research, a questionnaire has been distributed among 48 junior and senior high school students of a higher education institution in Jakarta, Indonesia. As mentioned in the research, this application enables students to learn human body anatomy with 3D object interaction, and previously it was taught using textbook and mannequin, and therefore, students have faced a difficulty in understanding its content. As a solution, this application has provided a three-dimensional practice form for the students to visualize the anatomy of a two-dimensional body shape. Similarly, another research has been carried out to develop an AR mobile application to learn railway transportation. As mentioned in this research, this AR application has been tested among 18 users, and as per the results gained from the testing process, using the AR application has made its users to learn boring and difficult subjects in a more interesting way [1].

Another research has been carried out about applying augmented reality technology using a marker-based approach in E-learning system for transmitting virtual objects into the real-world scenes. According to this research, there are two approaches for transmitting virtual objects into the real world scene; Marker-based and Monitor-based registration approach. Finally, the research has indicated that a subject which is explained using several pages can be eliminated by replacing it with a small marker [2]. In another research carried out by Kamalika Dutta, the benefits and the detriments of AR with regard to e-learning has been emphasized. Furthermore, this

research has explained some relevant aspects which are need to be considered in order to identify the true benefits of the AR technology in order to improve the learning processes [3]. Similarly, V. Camilleri and M. Montebello have emphasized in their research that the industrial-age approach has added barriers between the “classroom” setting and the real world, and AR is one of those powerful technologies which can break these barriers. Moreover, the following advantages of AR have been mentioned in the research [4].

- Flow in balancing inactivity and challenge.
- Repetition allowing learners to repeat their experimentation until they are satisfied with the outcomes.
- Experimentation in encouraging learners to try and learn in the process.
- Experience which is more engaging than other digitally mediated technologies.
- Doing through practice.
- Observing through an essential communication platform.
- Motivation stimulated by the people’s own active part.

Apart from the above mentioned researches, another research has presented four applications developed using augmented reality for e-learning; two has focused on collaborative work of students and the other two on biology and geography. As mentioned in the paper, the use of images, 3D models, sounds and animations are the important factors in AR which get the attraction from the students, and it is effective more than the classical teaching methods. The paper has explained further that these augmented elements allow students to retain new information more easily, and tests designed as games contribute to reduce their stress. This paper has mainly focus on indicating the use of augmented reality in order to improve the communication and collaboration skills between children, especially autistic children, and the game-based evaluation of pupils in various teaching areas, allowing for a stress free testing environment [5].

According to the above mentioned facts, it is clear that AR is one of the most effective and powerful technologies which can be used to improve the field of education. Although it is evident, in Sri Lanka, this technology is not being used for the purpose of enhancing the education of our children. Therefore,

implementing an AR application can be highly important in Sri Lanka, and it can surely be useful to obtain the educational advancements, and encourage the students for learning.

### 1.3 Research Gap

In different countries different researches have been carried out to enhance the science education of their students using AR, but there are no researches or applications have been developed to explain the biosphere cycles. In this research the topic “Biosphere” in the O/L Science syllabus is considered, and it has explained how the AR technology can be applied in order to learn those cycles. Following table is a summarized comparison which shows the gap in order to emphasize the importance of carrying out the current research.

***Table 1: Comparison between the Current Research and the Existing Researches***

| Existing Research and Applications | Ability to visualize the text book objects using 3D images | Provide videos for better understanding of specific areas | Questions are represented as a game | Relevant to the O/L subject | 3D models can be rotated and magnified |
|---|---|---|---|---|---|
| **Human Anatomy Learning Systems Using Augmented Reality on Mobile Application** | ✓ | ✗ | ✗ | ✗ | ✓ |
| **Enhancing the Attractiveness of Learning through Augmented Reality** | ✓ | **Audio only** | ✓ | ✗ | ✓ |
| **Web based Augmented Reality Application for Human Body Anatomy Learning** | ✓ | ✓ | ✗ | ✗ | ✓ |

| | | | | | |
|---|---|---|---|---|---|
| **Increase The Interest In Learning By Implementing Augmented Reality** | ✓ | **Audio only** | ✗ | ✗ | ✓ |
| **Current Research** | ✓ | ✓ | ✓ | ✓ | ✓ |

## 1.4 Research Problem

Currently, there is only a traditional learning approach to learn the topic “Biosphere” in the O/L Science subject. Therefore, several reasons can be identified for the inability of most of the students to understand this topic, specially the biosphere cycles. Those reasons can be mentioned as follow.

- The processes of biosphere cycles are complicated and hard to understand.
- Some students are not much interested in studying.
- Lack of proper demonstration of the cycles.

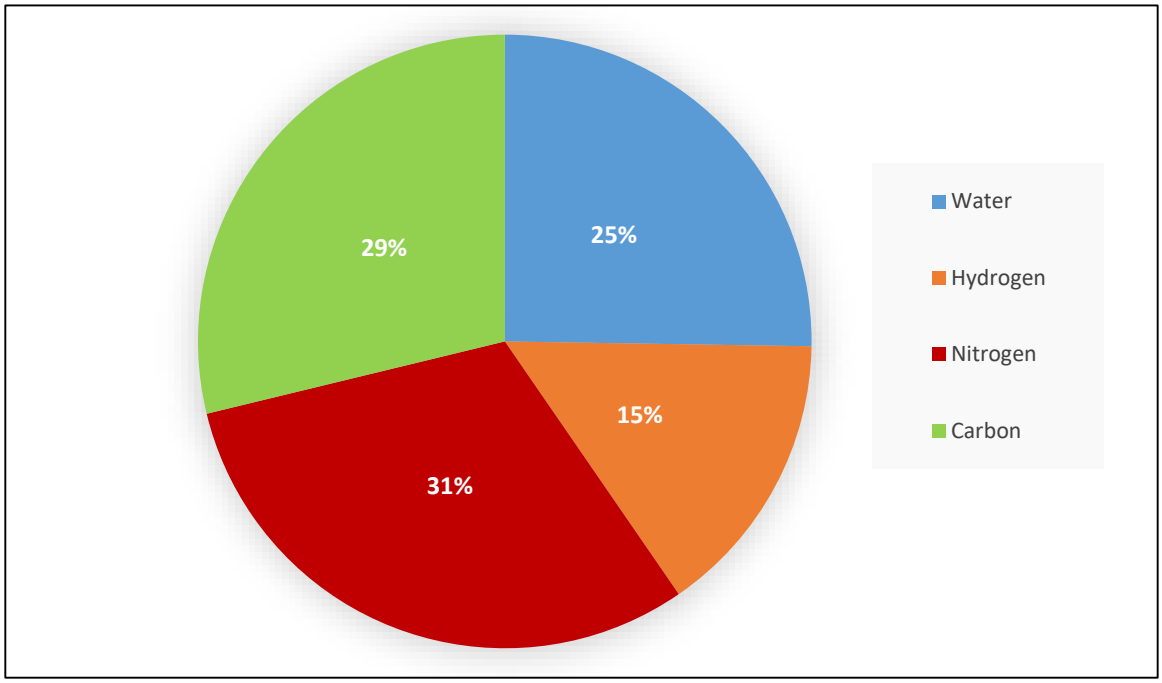


***Figure 1: Difficulty in Understanding the Main Biosphere Cycles***

## 2. OBJECTIVES

### 2.1 Main Objectives

The main objective of this research is to implement a mobile application using Augmented Reality in order to provide necessary knowledge about the biosphere cycles in the O/L Science text book.

### 2.2 Specific Objectives

- Generating 3D models on 2D images to make studying more effective and interesting.
- Focus on practical approach and usage rather than focusing only on learning the theories in the text book.
- Making it easy for students to learn and understand the biosphere cycles by visualizing the processes of these cycles.
- Motivating students to learn the cycles, since operating the mobile app is less time consuming than reading the text book.

## 3. METHODOLOGY

The results of the survey depicts that most of the students like to have 3D support on the water cycle, Carbon cycle and the nitrogen cycle. This was because these three cycles are somewhat hard to understand compared to the other aspects covered under the topic “Biosphere”.

Once a 2D image of water, carbon or nitrogen cycle is captured and identified by the application, it will search for a suitable 3D model from the Vuforia database and a 3D model for the specific cycle will be displayed for the students. The application will also include the animations in order to give a clear demonstration for the processes of the cycles. Moreover, there will be clickable objects for the complicated stages or steps in the cycles. If a student wants to further analyse a cycle, he/she can click on these clickable objects for further learning. For those objects, data will be extracted from the database and it will be displayed to the students as an audio, image, or as a video depending on the content of the selected object in the cycle.

### 3.1 High Architectural Diagram

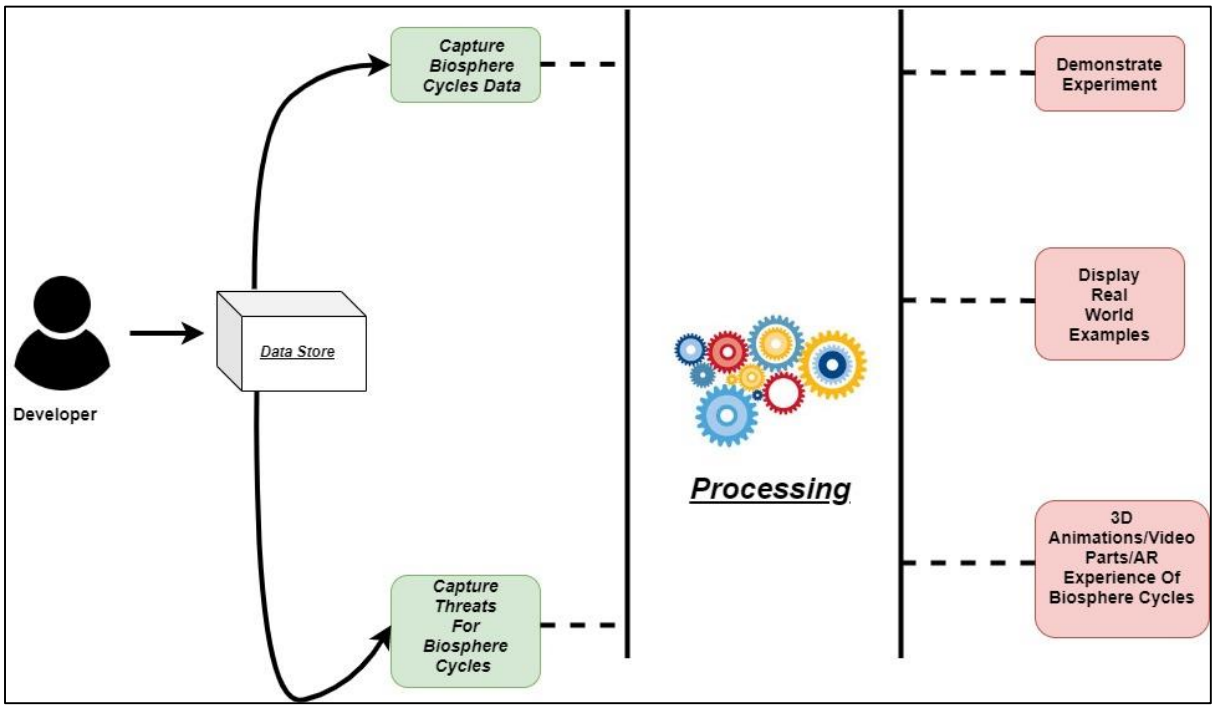


*Figure 2: High Architectural Diagram*

## 3.2 Work Breakdown Structure

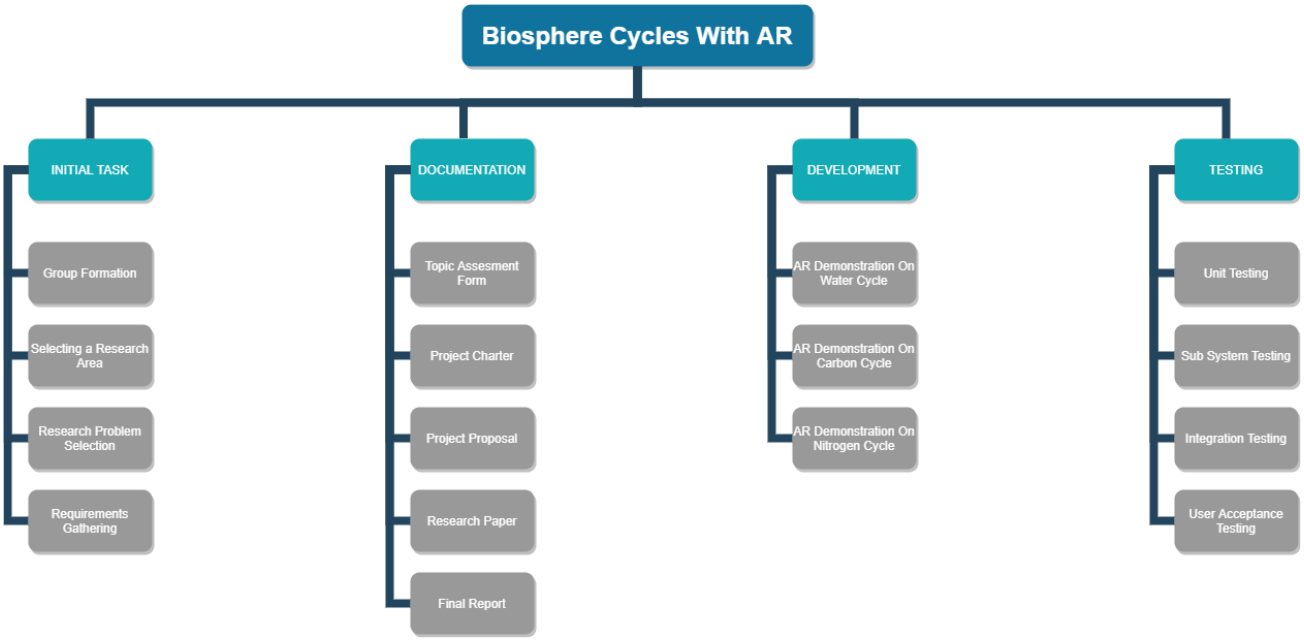


***Figure 3: Work Breakdown Structure***

## 3.3 Gantt Chart

| | Task Name | Duration | Start | ETA |
|---|---|---|---|---|
| 1 | Forming a Group | 1 day | 04.10.2019 | 05.10.2019 |
| 2 | Selecting a Research Area | 6 days | 06.102019 | 12.10.2019 |
| 3 | Identify an Existing Problem | 5 days | 13.10.2019 | 18.10.2019 |
| 4 | Requirement Gathering | 1 month | 18.10.2019 | 30.11.2019 |
| 5 | Topic Registration Form Preparation | 3 days | 30.11.2019 | 03.01.2020 |
| 6 | Charter Preparation | 4 days | 18.01.2020 | 22.01.2020 |
| 7 | Preparation for the proposal presentation | 6 days | 22.01.2020 | 28.01.2020 |
| 8 | Preparation for the Proposal document | 3 weeks | 28.01.2020 | 14.02.2020 |
| 9 | Completing 50% of development | 4 months | 15.02.2020 | 02.06.2020 |
| 10 | Development | 1 month | 05.06.2020 | 06.07.2020 |
| 11 | Preparation of the research paper | 9 days | 07.07.2020 | 16.07.2020 |
| 12 | Preparation of Final report(Draft) | 11 days | 17.07.2020 | 28.07.2020 |
| 13 | Completing 90% of development | 40 days | 29.07.2020 | 09.09.2020 |
| 14 | Sub Component Testing | 5 days | 10.09.2020 | 15.09.2020 |
| 15 | Intergration | 5 days | 16.09.2020 | 21.09.2020 |
| 16 | Final Report feedback from supervisor | 1 day | 02.10.2020 | |
| 17 | Doing requested changes of the report | 5 days | 03.10.2020 | 08.10.2020 |
| 18 | Integration Testing | 5 days | 09.10.2020 | 14.10.2020 |
| 19 | User acceptance Testing | 2 days | 14.10.2020 | 16.10.2020 |

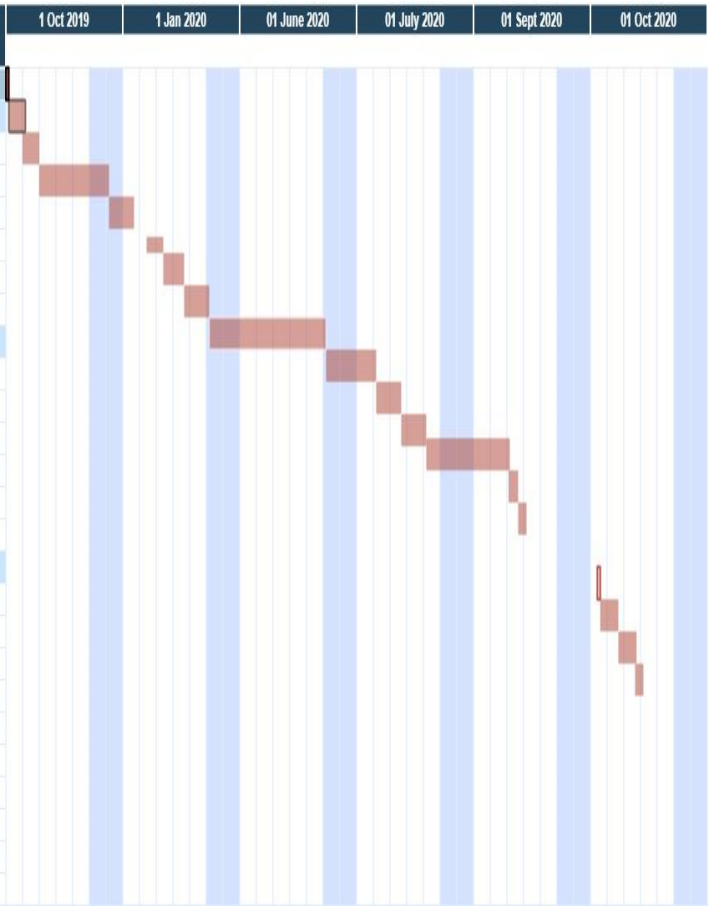


***Figure 4: Gantt chart***

## 4. CONCLUSION

Within this study, an AR mobile application is being proposed to be developed in order to enhance the student motivation and interest in learning the topic “Biosphere”. Almost all the students are willing to learn this topic using the proposed AR application since it can make learning bored or difficult topics such as “Biosphere” more interesting, impressive, and it gives motivation for the students to learn more and more. Furthermore, AR can change traditional classroom-based learning to a distance learning while giving more advantages and benefits. Therefore, developing an AR mobile application for learning O/L science topics can be an immense opportunity for a country like Sri Lanka.

## 5. REFERENCES


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**6. APPENDICES**

# AUGMENTED REALITY SCIENCE APP FOR O/L STUDENTS

***We are a final year project group at Sri Lanka Institute of Information Technology (IT17107624 – De Silva K.V.P.W, IT17106252 – U.S Hettihewa, IT17157988 – Liyanage P.M, IT17098588 – N.M.W.K.P.C Naranpanawa). The purpose of this questionnaire is to gather requirements for our final year research project. Please spare few minutes from your busy schedules and be kind enough to respond to this survey. Further, we will assure that all correspondence, including completed survey forms will be kept confidential and secure.***

1. What is your expected grade for science at the O/L examination?
    i. A
    ii. B
    iii. C
    iv. S
    v. F
2. Are you facing any difficulties in studying science?
    i. Yes
    ii. No
3. How familiar are you in using mobile phones?
    i. Very familiar
    ii. Somewhat familiar
    iii. Not familiar
4. Do you think that a mobile app with 3D technology will support you to study science more effectively?
    i. Yes
    ii. No
    iii. Neutral
5. Which way will be more convenient for you to study science?
    i. Reading notes
    ii. Using a mobile app with 3D technology
6. Number the following according to the order you think that 3D technology will be benefited most study (1- most benefited, 4 – least benefited)?
    i. Acids
    ii. Bases
    iii. Salts
    iv. Hydrocarbons
7. Number the following according to the order which is hard for you to study (1- most, 4 - least)?
    i. Digestive System
    ii. Respiratory system
    iii. Urinary System
    iv. Blood Circulatory System
    v. Reproductive System

8. Which of the below topics on plant processes, you feel difficult in your studies? Number according to your preference. (1-most difficult, 3-least difficult)

| | | |
|---|---|---|
| i. | Photosynthesis | |
| ii. | Plant respiration | |
| iii. | Reproduction | |

9. Number the following according to the order which is hard for you to study (1-most, 4 - least)?

| | | |
|---|---|---|
| i. | Plant cell structure | |
| ii. | Plant tissue organization | |

10. Which of the following experiments do you feel difficult from your science syllabus?
(1-most, 5-least)

| | | |
|---|---|---|
| i. | Starch production during photosynthesis | |
| ii. | Need of light energy for photosynthesis | |
| iii. | Need of CO2 for photosynthesis | |
| iv. | Need of chlorophyll for photosynthesis | |
| v. | O2 production during photosynthesis | |

11. Number the following cycles according to the order which is complicated for you to understand? (1 – most, 4- least)

| | | |
|---|---|---|
| i. | Water Cycle | |
| ii. | Hydrogen cycle | |
| iii. | Nitrogen cycle | |
| iv. | Carbon cycle | |

12. According to you, what kind of benefits you can gain by using a mobile app with 3D technologies to study your O/L science syllabus?

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***Appendix 1: Questionnaire***