SCIENCE APP FOR O/L STUDENTS USING AUGMENTED REALITY – ACIDS COMPONENT

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Dissertation submitted in partial fulfilment of the requirements for the B.Sc. Degree in Information Technology Specialising in Software Engineering

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DECLARATION

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ABSTRACT

Chemistry carries a considerable weightage in the O/L syllabus and is much more a practical based subject. But some schools are not having the ability to give a proper practical exposure for their students. Also the concepts taught in chemistry are somewhat hard to understand because of the abstract nature of chemical concepts and the inability to understand the language (formulas) used in chemistry. The study on acids is a major component of the science syllabus and almost most of the concepts relevant to that topic are described in note basis. The survey we conducted shows that most of the O/L students are having difficulties in understanding concepts related to acids. The intension of this research was to provide a solution which would support O/L students on their practical aspects even without the need of proper lab equipment and to make students feel more interested in learning acids. Today's young generation is very keen in learning new technologies and they are experts in using mobile phones. Mobile Augmented reality is an effective technology used in many fields and specially using it for elearning purposes will provide students an engaging experience and also it will be an interactive way to teach even difficult concepts in a more understandable manner. The developed Acids component is to support chemistry by covering the content related to acids using augmented reality. A mobile application was developed using augmented reality to provide a practical experience for students along with the ability to learn on acids in an interesting manner.

Keywords – Acids, ELearning, Augmented Reality

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AR	Augmented Reality
G.C.E	General Certificate of Education
2D	Two Dimensional
3D	Three Dimensional
IDE	Integrated Development Environment

1. INTRODUCTION

1.1 Background Literature

The statistics of O/L results of previous years published by the national examinations department [1] shows that the amount of students who were able to pass science at their O/L examination is comparatively low than other main subjects. Also even among the passed students the amount of students who have scored higher grades are unsatisfactory.

The prevailing education system in Sri Lanka is a method which is based on face to face interaction between the teacher and the students. Most of the time due to lack of proper resources science teachers are not having the ability to use visual aids at their lessons. In most of the schools science lessons are done only using oral communication. There are so many drawbacks in teaching chemistry for O/l students using this traditional approach.

In an online newspaper article [3] Gina Truman describes the drawbacks of traditional science education system. According to her, teacher is the only source of education. Students won't take any effort to learn new things by themselves. Also if schools are not having proper lab facilities students are not getting a proper practical experience. This method is not successful in learning a subject like chemistry which is a highly practical subject and also it needs student interaction rather than just learning theory. Students will not get the opportunity to be familiar with the practical aspects of chemistry. Sometimes traditional learning might make students feel boring and tired in learning chemistry and also it will be a reason for students to feel chemistry as a burden. So it would be effective if an interactive application for students to learn chemistry while engaging in practical approaches.

There are so many researches carried by several people to discuss the weaknesses in the prevailing education system of Sri Lanka.

I.M Kamala Liyanage discusses in her research[4] that most of the students who fail O/L are from low equipped schools. She shows that there is a visible disparity across

regions in educational attainment of students. She says that most of the students who fail O/L is due to less facilities in schools, not having well qualified teachers in rural schools. All these things have affected the quality of education in Sri Lanka. This has become a main reason for low equipped students to have low interest in science and specially the chemistry content relevant to O/L. It would be a great support for such schools if an augmented reality based application could be introduced as it would be helpful for them even though they are not having proper facilities or teachers.

As the world is moving towards digitalization most of our day to day activities are having a digitalized impact. So education also should not have an exception. Specially as chemistry is a more practical based subject it would be better if chemistry can be taught in a digitalized manner with the support of a new technology which is able to provide students an engaging experience.

Dr Jayarathne discusses in his report[5] the way how science can be taken to rural areas. He says that an interactive nature similar teaching method would be supportive to learn science. He says that active participation in the subject will improve students' knowledge. Augmented reality is having the ability to provide this nature similar teaching approach.

Several researches have been carried out to eliminate the use of augmented reality in chemistry education.

Research paper [6], shows how interactive augmented reality is when teaching chemistry. It shows how atomic structures can be augmented into 3D models and also the use of using AR in demonstrating acids is also discussed. It shows that students will be engaged in the subject interactively and also the paper discusses how students can learn chemistry using AR even though they are lacking proper facilities.

Considering all of these conditions it was decided that AR technology would be the best method to teach students O/L chemistry in an attractive way. And it would remove the barriers for students in low equipped schools to get a practical experience in science. Augmented reality is having the ability to demonstrate experiments by

only capturing an image target. Students can get experiences in their practical lessons even without the need of any additional material.

As the initial step of the project a survey was conducted among several O/L students and some science teachers in order to gain requirements for the application. The survey results depicted that among the topics discussed under chemistry most of the students were facing difficulties in learning acids because they had to memorise some formulas and reactions related to acids in the syllabus. So responses given in the survey showed that it would be worthy if there is an effective way to understand the concepts easily.

After investigating the responses given in the survey it was decided to focus on the lessons based on acids and this application will cover the entire content related to acids using Augmented Reality. This will help students to grab the content in an attractive manner. Augmented Reality is a growing field of technology. Currently it is being used in many fields like medicine, eLearning etc. It is really helpful in eLearning because even harder concepts can be taught in a way which students can understand it easily.

1.2 Research Gap

Currently there are no existing augmented reality based applications to study on acids by focussing on the G.C.E ordinary level syllabus. Though there are several mobile applications which use augmented reality to demonstrate certain chemistry content those are not specific to the O/L syllabus. They might not cover the entire content related to acids in the syllabus like experiments of reactions, explanations relevant to the syllabus etc. But our application will be covering all the necessary requirements of the syllabus under the acids category.

Table 1: Comparison of existing work

Product / Feature	Chemical bonds Visualization [6]	Mobile AR on learning chemistry [7]	Molecular kit [8]	New Product
3D Molecular Shapes with animations	✓	✓	✓	✓
Augmented demonstration of reactions	×	×	×	✓
Converting text to augmented videos	×	×	×	✓
Based on acids and specific to the local O/L syllabus	×	Based on acids but not specific to the syllabus	×	✓

Table 1 is a comparison of some similar work with the newly developed application. All the products in the application are using marker based augmented reality and in using such applications students will have to use markers for each and every visualisation. This adds additional cost and also it would be a trouble for students to use markers. But our application is using the science text book as the target instead of using markers to demonstrate the AR content. This would be pity easy for students to use the application. They will only need to use a mobile phone along with their science text book and will not need to use additional markers.

Chemical Bonds Visualisation [6] is a product by Christyowidiasmoro and Surya Supeno which is based on acids but it is marker based and it demonstrates only 3D models of the formation of molecules in acids. In addition to the formation of molecules in acids there are some other requirements based on acids relevant to the syllabus. This application doesn't demonstrate any reactions and productions done by acids which are very important parts in the O/L syllabus. But our application focuses on all of these important sections related to acids in the syllabus.

Mobile AR on learning chemistry [7] is a mobile app which demonstrates acids using augmented reality but it is not specific to the O/L syllabus in Sri Lanka. Only 3D molecular shapes of acids are demonstrated in that application. Molecular kit [8] is also another mobile app which visualises 3D shapes of molecules with animations using AR. None of these applications are demonstrating experimental reactions between acids and other elements using AR. But that is a very important part in the O/L science syllabus. Also these existing products are not having the ability to convert captured texts into augmented videos or audios. But our application will fulfil all of these requirements.

The application developed by us is having the ability to capture texts or images and play augmented videos on top of those. Therefore it is having the ability to demonstrate experiments of the reactions between acids and other elements using augmented reality. And almost all the existing AR apps for acids are using English as the language. But our application is giving the ability to select either English or Sinhala as the language to proceed with augmented reality. This will be a massive help for students who are unable to understand English. All of these concerns make our application unique from other existing augmented reality applications for science.

1.3 Research Problem

Examination department's statistics of previous years [1] show that the G.C.E ordinary level science results are comparatively low than other main subjects. Most of the students have been unable to score higher grades for science at the O/L examination.

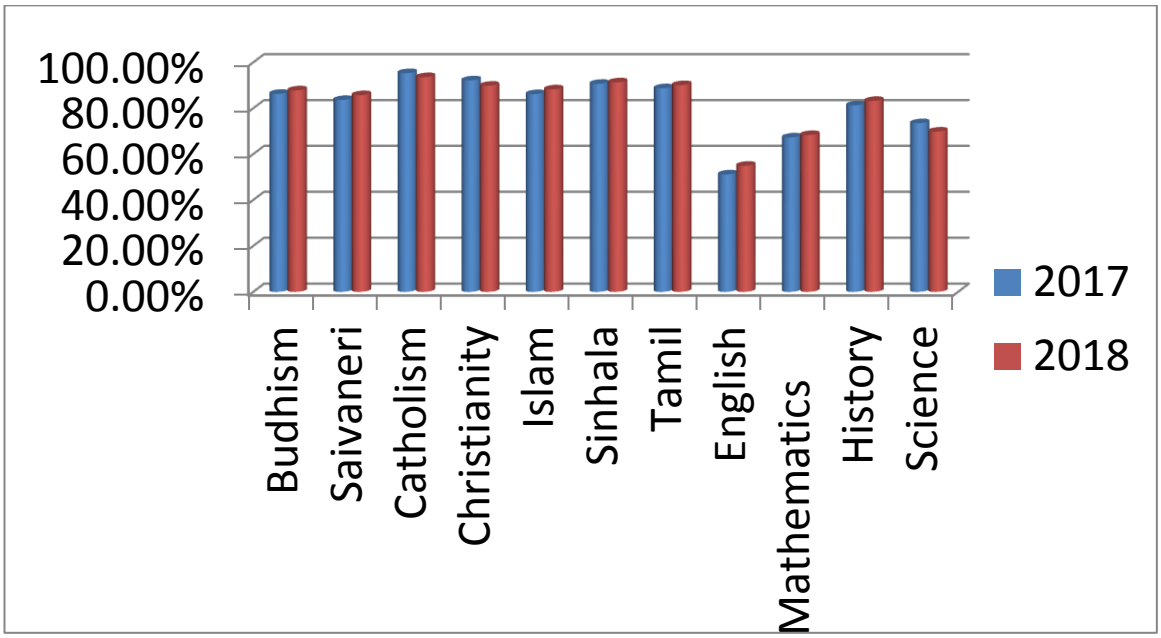

Figure 1: Passed percentage of compulsory subjects during previous two years [1].

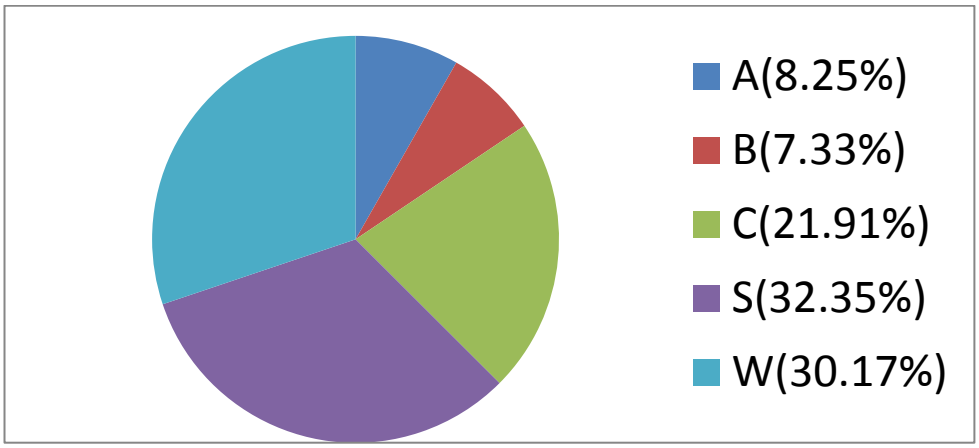

Figure 2: Science results of 2018 by grades [1].

Figure 1 depicts that the amount of students who have passed science is somewhat low than other major subjects and Figure 2 depicts that the amount of students who have scored higher grades at the ordinary level examination is low. Most of the students have scored average grades (c and s).

There are several reasons for the inability of most of the students to score higher grades in science.

- The concepts of science are complicated and hard to understand.
- Some students are not much interested in studying science.
- Lack of proper practical experience as some schools are not having proper lab facilities.

1.3.1 Problem Specific to the Component

As a result of the survey we conducted among several O/L students we were able to find out that for most of the survey participants it was hard to understand the concepts related to acids. It was because of the complexity of that area. So it was decided to provide a solution using augmented reality for content relevant to acids in the syllabus.

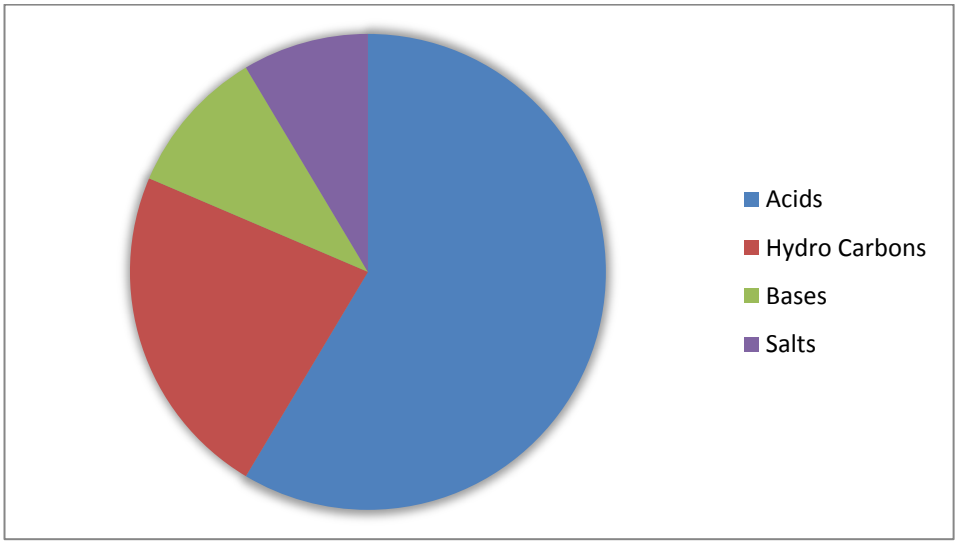

Figure 3: Desire of topics to be learned using 3D technology.

Figure 3 shows that most of the students who participated in the survey would like to get 3D support on learning about acids. As a requirement for the G.C.E O/L examination students have to memorise reactions of acids with elements and productions done by those. This is hard for students and they would like if there is an interactive method for them to keep all of these concepts in their mind. The productions done using acids are described using detailed descriptions in the text book so students are feeling bored in reading those and sometimes the content presented might not be clear enough for them to understand. The developed solution will convert these detailed text based descriptions into effective animated videos. So students will be able to understand the concepts more clearly.

Rather than having 2D structures of the formation of acids in acidic compounds it would be more effective if students can learn those with the help of 3D models.

The developed solution will solve above discussed issues by providing AR support on learning acids in the O/L Science syllabus.

1.4 Research Objectives

1.4.1 Main objective

The main objective of this research is to uplift the G.C.E ordinary level Science results of students by providing an interest in the subject. The main objective of this component is to support the above mentioned objective by providing interest in the Acids section of the grade 11 Science syllabus and provide practical experience for the experiments relevant to this section even without the need of any lab equipment.

1.4.2 Specific objectives

- Providing the ability to select either Sinhala or English as the language in using the application.

  The application is developed in a way which the user is having the ability to choose which language he wants the app to work. This feature will benefit both Sinhala and English medium students in their Science subject. All the instructions given in all UIs as well as the audios which are played in the app will be in the language which the user selected.

- Ability to identify formulas of acids and equations of reactions between acids and elements through the mobile camera and match them with suitable AR content in the Vuforia database.

  Once the application opens the mobile camera the user can capture an equation in the acids section of the Science text book and then the application will demonstrate the relevant experiment using Augmented Reality. The objective of this feature is to provide practical exposure for students who are not having proper facilities to get their experiments done.

- Displaying 3D models of the molecular formation of acids.

  If the user captures a formula of an acid the application will demonstrate a 3D model of the molecular structure of that acid along with a background audio to explain some further details of that acid. The objective of this feature is to provide an attractive way for students to understand the concepts related to acids

- Demonstrating experiments related to acids using augmented reality.

- Converting detailed text based descriptions to attractive AR content.

  The objective of this feature is to make students feel interesting in studying the lesson. Also the content would be more understandable than reading detailed descriptions.

- Playing audios to explain content related to acids.

2. METHODOLOGY

2.1 Methodology

The Acids component is a solution for the problem discussed above. The component is using augmented reality to cover the content relevant to acids in the O/L syllabus. The component is developed in a manner which can provide students an engaging experience on the content and also students will be able to get a practical experience even without using any lab equipment.

According to the task performed the component is sub divided into three sub components.

- Visualisation of acidic bonds using augmented reality.
- Demonstrating experiments for the reactions between acids and elements.
- Converting descriptions on productions done by acids, into image slideshows using augmented reality.

A mobile application is developed to fulfil above mentioned tasks using Unity. Unity is a real-time development platform which can create 3D visualisations. It is a cross-platform IDE which is very familiar among AR developers. It enables most of the interesting AR features like 3D rendering, animations, videos etc. Unity provides the ability to perform many tasks with less effort for developers [9]. C# scripts were implemented to perform various AR features.

Vuforia was used as the database to store image targets. Vuforia supports AR development and it can be used as the image store in AR apps developed using Unity 3D.

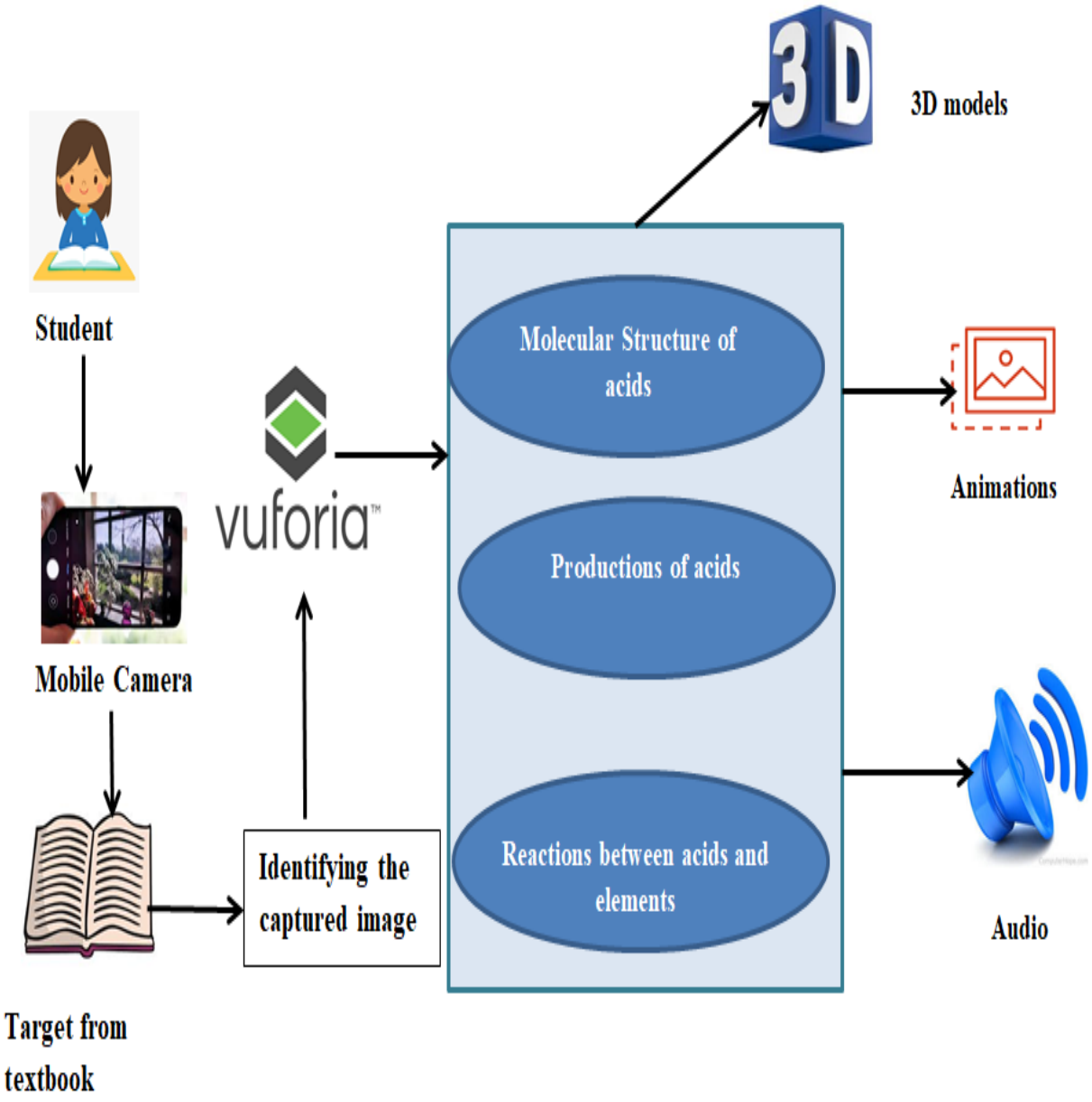

Figure 4: High Level Architecture.

Figure 4 depicts a high level view of the acids component. The main purpose of this component is to provide O/L students the ability to learn about acids using an interactive approach. This component will demonstrate the molecular structure of acids, productions done by acids and the reactions between acids and elements using 3D models, animations, videos and audios. The underlying technology which was used to fulfil these tasks was augmented reality.

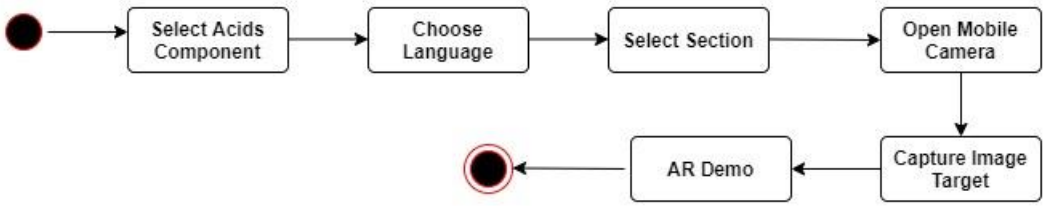

Figure 5: Workflow of the component

Figure 5 depicts the process which a student should follow in using the Acids component. The user can select the acids component from the home page and it will navigate him to the Acids component. There he is given the chance to choose his language preference either Sinhala or English. The selected language will be used throughout the component. Next he can select the subsection he wants to proceed. The component is divided into separate sections to demonstrate the molecular formation of acids, reactions between acids and elements and productions done by acids. Once the student navigates to a particular section the app will automatically open the mobile camera. After the user captures a relevant image target from his mobile camera the app will demonstrate necessary AR content.

Figure 6: Home page of the application

Figure 7: UI to choose a language

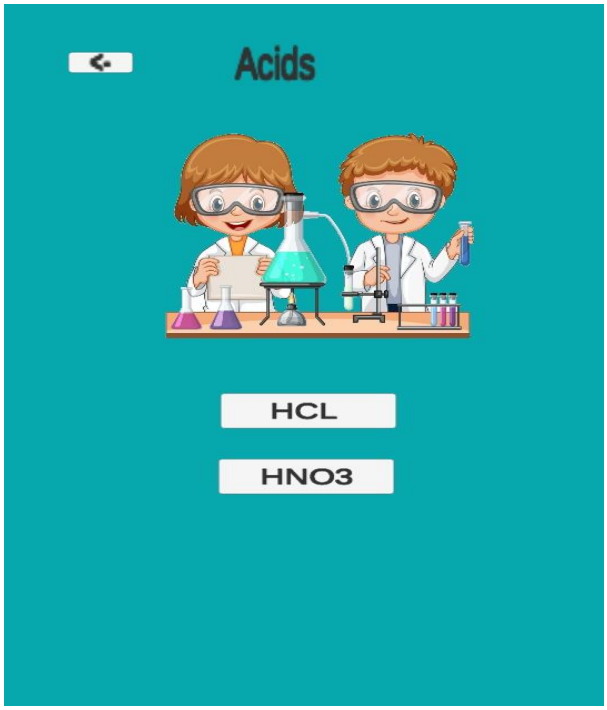

Figure 8: UI to choose an acid to learn in English

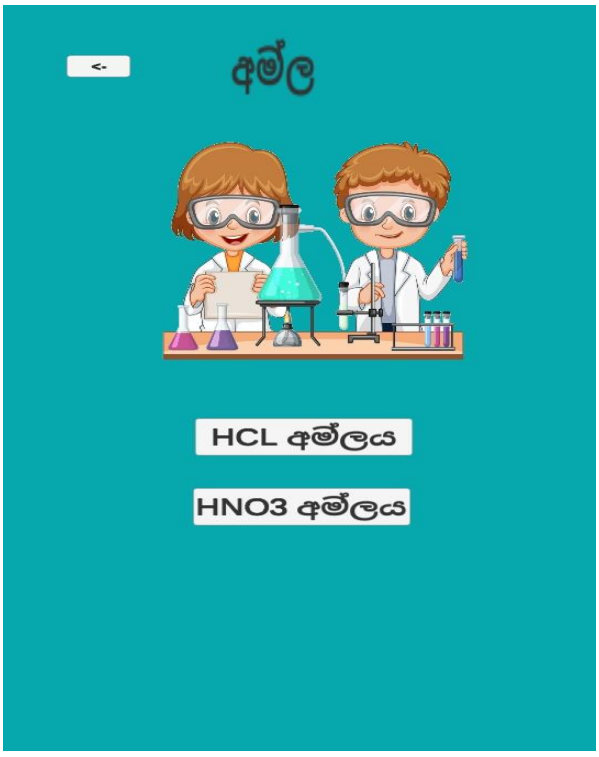

Figure 9: UI to choose an acid to learn in Sinhala

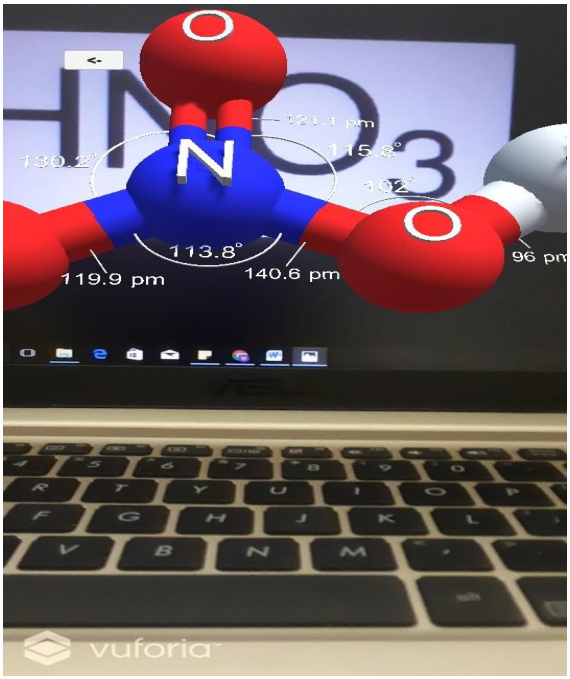

Figure 10: AR demo

2.1.1 Demonstrating 3D models using augmented reality

This feature was used to demonstrate the molecular structure of acids. Once the user captures a formula of an acid the application will identify the captured formula and a suitable 3D model will be retrieved from the Vuforia database and it will be displayed on top of the captured formula.

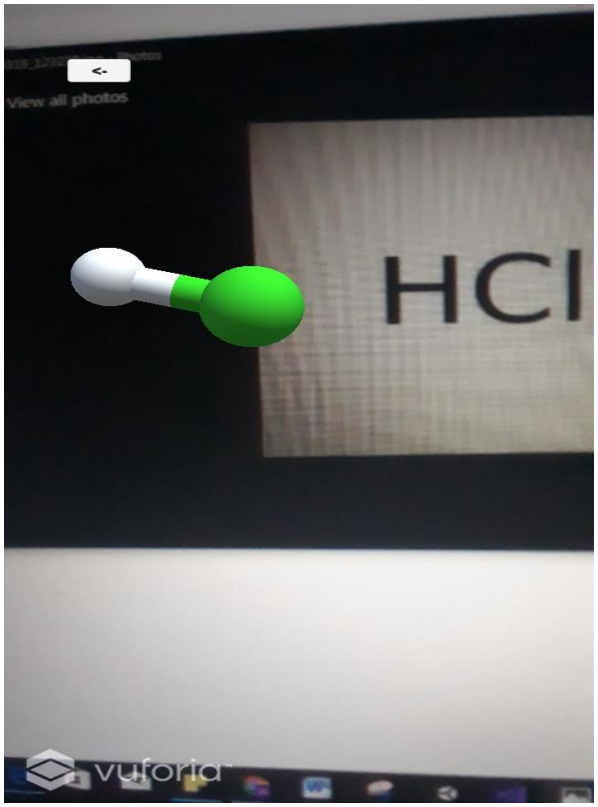

Figure 11: 3D model of an acid

Figure 11 shows how the 3D model of the HCL acid is displayed using augmented reality once the application identifies the formula of HCL using the mobile camera.

The application will play animations when displaying 3D models with the intent to make the demonstrations more attractive. C# scripts were written to enable animations to 3D models.

```
1   using System.Collections;
2   using System.Collections.Generic;
3   using UnityEngine;
4
5   public class NewBehaviourScript : MonoBehaviour
6   {
7       //speed of rotation
8       float speed = 50.0f;
9
10      // Start is called before the first frame update
11      void Start()
12      {
13
14      }
15
16      // Update is called once per frame
17      void Update()
18      {
19          transform.Rotate(Vector3.right * speed * Time.deltaTime);
20
21      }
22  }
23
```

Figure 12: C# scripts to enable rotations

Figure 12 shows the C# script which was used to rotate 3D models which will be displayed using augmented reality.

2.1.2 Playing videos/ audios on an image target using augmented reality

Once the user captures an equation of a reaction between an acid and an element an experiment will be demonstrated using augmented reality. This will be useful for students with less laboratory facilities. Even without any materials they can get an experience on the experiments related to acids in the O/L syllabus.

Audios are also played along with the AR content in order to give students the ability to understand the concepts more clearly. The content in the text book relevant to acids will be presented in a more attractive and simplified way by combining audios to the AR demonstrations.

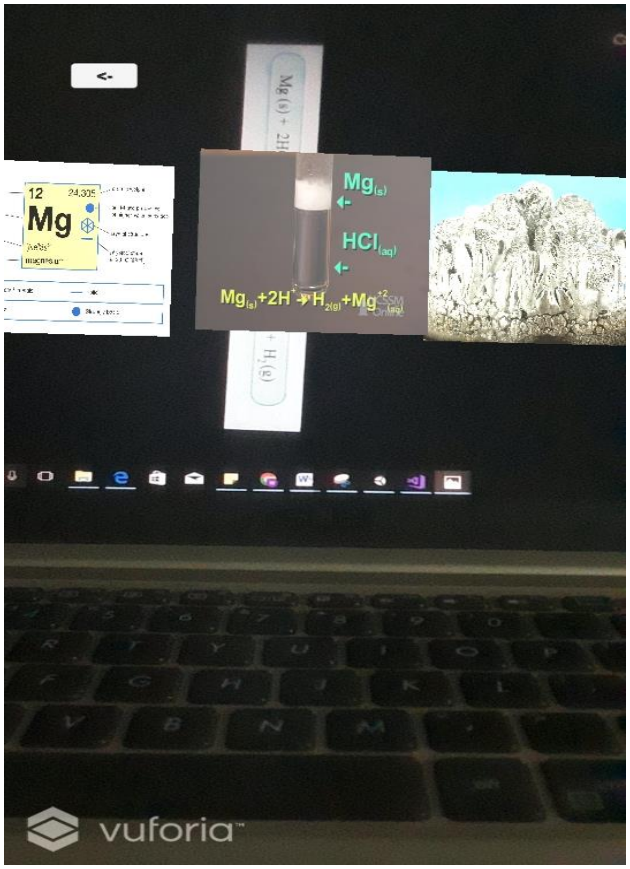

Figure 13: Video displayed using AR

2.1.3 Image slideshows using augmented reality

This feature was used to convert detailed text based descriptions into attractive image slideshows using augmented reality.

```
public class slideshow : MonoBehaviour
{
    public GameObject nextBtn;
    public GameObject prevBtn;
    public string[] mImg;
    private int counter = 0;
    void Start()
    {
        mImg = new string[] { "a", "b", "c" };
    }
    public void next()
    {
        counter++;
        checkBtns();
        gameObject.GetComponent<SpriteRenderer>().sprite = Resources.Load<Sprite>(mImg[counter]);
    }
    public void prev()
    {
        counter--;
        checkBtns();
        gameObject.GetComponent<SpriteRenderer>().sprite = Resources.Load<Sprite>(mImg[counter]);
    }
    private void checkBtns()
    {
        if (counter < 1) {
            prevBtn.SetActive(false);
        }
        else
        {
            prevBtn.SetActive(true);
        }
        if (counter > mImg.Length - 2)
        {
            nextBtn.SetActive(false);
        }
        else
        {
            nextBtn.SetActive(true);
```

Figure 14: C# script to demonstrate image slide show.

Figure 14 is the C# script which was used to enable slideshows to a set of images which will be displayed on a captured detailed text based description.

2.2 Commercialisation Aspects of the Product

The targeted audience of this application is Science teachers and O/L students in Sri Lanka. Both Sinhala and English medium students can get benefited from this product as it supports both languages.

The main intent of the Acids component is to provide support for O/L students in studying the lessons based on acids in the O/L Science curriculum. This section is one of the highly practical based sections in the O/L Science syllabus. But as some rural schools are not having proper lab equipment, students in such schools are not having the ability to get their practical done. Studying an area like acids only by learning theory without doing any experiments is a disadvantage for students. But this component will definitely solve this issue. The acids component is demonstrating all the experiments relevant to the acids section in the syllabus using augmented reality. This will give students the ability to engage in the needed experiments even without the need of single lab equipment.

Also the acids part is somewhat a hard area for most of the students to understand due to its complexity. But our application will present the content relevant to this area in an interactive way using AR. It will support students to understand even harder concepts in a simplified manner.

This application will also help Science teachers to attract students towards the lesson as it provides a 3D experience which would be very interesting for students. All of these concerns prove that the Acids component of our application is having a high commercial value and it would be very popular among O/L students in Sri Lanka as well as Science teachers.

2.3 Testing and Implementation

The project followed agile methodology and the development was done in two sprints each which completed 50% of the project. Microsoft planner was used to plan tasks within the team. Following a proper plan from the beginning itself made it easy to complete the application without any delay. A Gitlab repository was maintained throughout the implementation process. Four separate branches were used in the repository each for each component and frequent commits were done to all branches. Finally we were able to integrate the system without any merge conflicts.

From the very beginning of the implementation process of the acids component unit testing was done in order to ensure that the component was error free. Unit testing prevented the component from having more complicated errors in later parts of the implementation. Once the component was completed component testing was carried out designing several test cases to cover all the scenarios of the component. Finally the component was integrated with other three components and integration testing was carried out to fix errors that occur as a result of integration. Following are some test cases which were carried out during the component testing process of the Acids component.

Table 2: Accessibity of mobile camera

Test Case ID	01
Description	Checking accessibility to the mobile camera
Pre-condition	User should start the Acids component
Steps	1. User chooses a language. 2. User selects a section. 3. Clicks button to open mobile camera.
Expected Output	The mobile camera gets opened successfully.
Actual Output	The mobile camera gets opened successfully.

Table 3: 3D molecular structure of acids

Test Case ID	02
Description	Identifying a formula of an acid
Pre-condition	User should start the Acids component.
Steps	1. User selects a language. 2. User selects the molecular structures section. 3. Opens mobile camera. 4. Captures a formula of an acid.
Input	Camera capture of an acidic formula.
Expected Output	3D molecular structure of the acid using augmented reality.
Actual Output	3D molecular structure of the acid using augmented reality.

Table 4: Experiments using augmented reality

Test Case ID	03
Description	Demonstrating experiments using augmented reality.
Pre-condition	User should start the Acids component.
Steps	1. User selects a language. 2. User selects the molecular reactions section. 3. Opens mobile camera. 4. Captures an equation of a reaction between an acid and an element.
Input	Camera capture of an equation.
Expected Output	The experiment relevant to the captured reaction using augmented reality.
Actual Output	The experiment relevant to the captured reaction using

	augmented reality.

Table 5: Productions done by acids using augmented reality

Test Case ID	04
Description	Converting detailed descriptions of productions of acids into attractive image slideshows using augmented reality.
Pre-condition	User should start the Acids component.
Steps	1. User selects a language. 2. User selects the productions section. 3. Opens mobile camera. 4. Captures a detailed description about productions done by acids from the text book.
Input	Camera capture of a description about productions by acids..
Expected Output	Image slideshow based on productions done by acids using augmented reality.
Actual Output	Image slideshow based on productions done by acids using augmented reality.

Table 6: Sinhala and English language support

Test Case ID	05
Description	Ability to give instructions in any language either English or Sinhala.
Pre-condition	User should start the Acids component.
Steps	1. User selects a language. 2. User selects a preferred section. 3. Opens mobile camera. 4. Captures a suitable image target

Input	1. Image target. 2. Language preference.
Expected Output	Instructions should be given from the language which was selected by the user.
Actual Output	Instructions should be given from the language which was selected by the user.

3. RESULTS AND DISCUSSION

3.1 Results

The main outcome of the research was a mobile application which uses augmented realty to support O/L students in improving their Science results. After completing the implementation each component was subjected to testing. The expected final result for the Acids component was to provide an interactive approach for students to study the content relevant to acids in the O/L Science syllabus. To ensure that the Acids component has achieved its maximum objective it was given to several randomly selected O/L students from different schools and to some Science teachers for testing. Their feedback was collected and further improvements were done according to their comments.

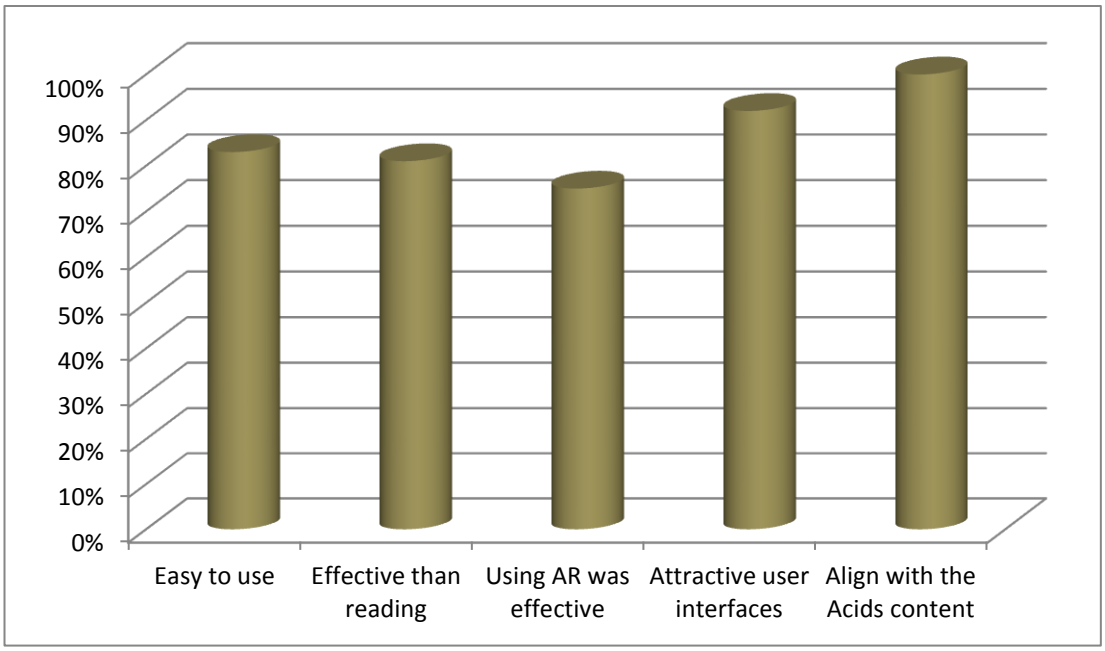

Figure 14: Summarized Responses of Students

The Acids component was given to several grade 11 students from different schools to test whether the application is effective for them and whether it will be a support for their Science subject.

Among the students who participated in the evaluating process 83% stated that the Acids component was easy for them to use as it is not much complicated to use though the application was developed using an unfamiliar technology for them. 81% of the students stated that they interesting in using the application as it was using attractive methods to teach the content relevant to acids and the component provided and engaging experience in the content relevant to acids. Also 80% of the students mentioned that the application would be effective for them as it is teaching the content relevant to acids in an interactive manner and it would be easy for them to understand even harder concepts easily. 92% of the students who participated in the survey were satisfied with the user interfaces as those were very much user-friendly.

Also the application was given to several Grade 11 Science teachers in different schools to check whether the application was appropriate for students.

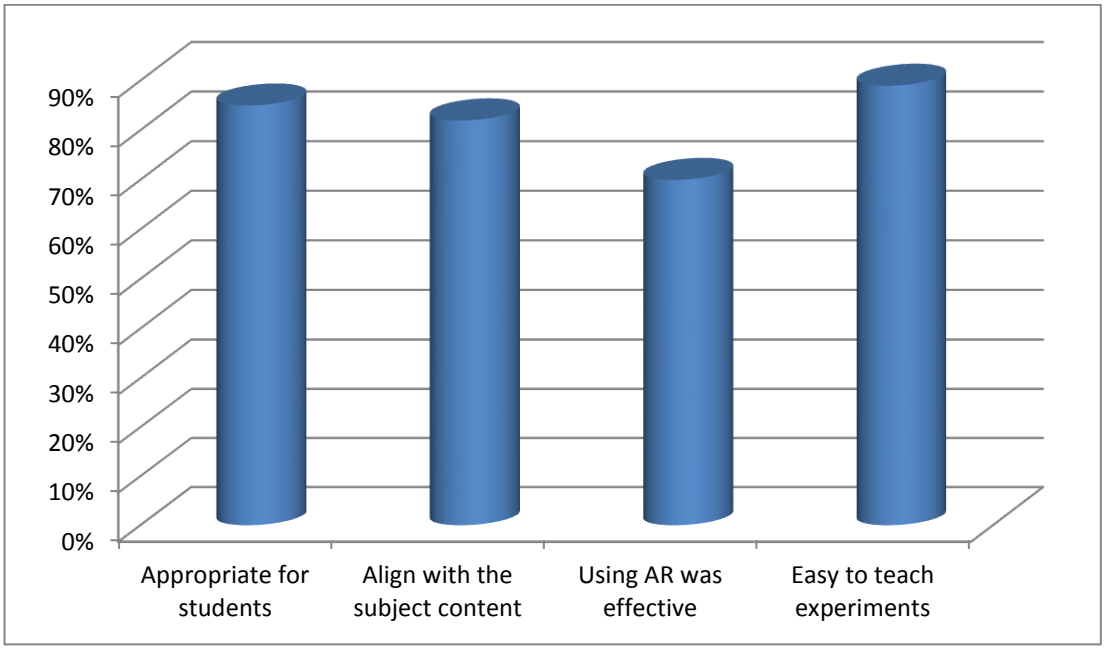

Figure 15: Summarized Responses of Teachers

Among the teachers who tested the Acids component around 85% stated that the acids component is appropriate for students while 82% of the teachers who participated in the evaluation process stated that the application aligns properly with

the subject content. According to their responses the Acids component was covering all the required concepts relevant to the Acids lesson of the O/L syllabus. Only 70% of the teachers stated that the Acids component will be really effective for students while the rest of the teachers stated that the application might not be convenient for some students who are not having a proper understanding on new technologies. Also their opinion was that this application would not be supportive for students who are unable to afford to buy smart phones. The ideas of around 89% of the teachers were that this application would be a good support material for them in teaching the lessons relevant to acids in the O/L syllabus. It would even be helpful to give a good practical exposure for students even without the need of any lab equipment. The suggestions of most of the teachers were to improve this application to cover the entire chemistry content in the O/L Science syllabus. Also some teachers suggested adding some quiz type games based on Acids to the application. These improvements are planned to be done during the future.

3.2 Research Findings

The main intent of this research was to find an interactive solution to improve Science results of O/L students in Sri Lanka by providing interest towards the subject. Before choosing this research a thorough investigation was done on this area to find out issues which most of the local students were facing. As discussed above in the research problem section, the statistics of G.C.E O/L results of previous years which were released by the examinations department show that the amount of students who have scored higher grades for Science are comparatively lesser than the amount of students who have scored higher grades for other main subjects.

The finding of the literature survey which was done at the beginning of the research shows several reasons for why Science has become a difficult subject for most of the students. Some areas in the Science syllabus like the Acids

section are having very complex concepts which are hard for most of the students to understand. The Acids section in the O/L syllabus is having lot of formulas and complicated equations which are hard for most of the students to memorise. And also most of the rural schools in Sri Lanka are not having proper Chemistry lab facilities to satisfy the requirements of O/L students. Even some urban schools are also not having enough equipment in their labs to cater the requirements of the acids section in the O/L syllabus. But the lessons based on acids are much more based on experiments. Just only learning theory will not give the ability to gain the maximum expectation of learning acids. It will make students feel that the lessons are complicated. That's why most of the students feel bored in studying the content relevant to acids.

Our research has introduced a solution using augmented reality to solve the issues which were identified through the research findings. In order to gather requirements for the Acids component an initial survey was conducted among several grade 11 students and the results gained from the survey were considered in implementing the component.

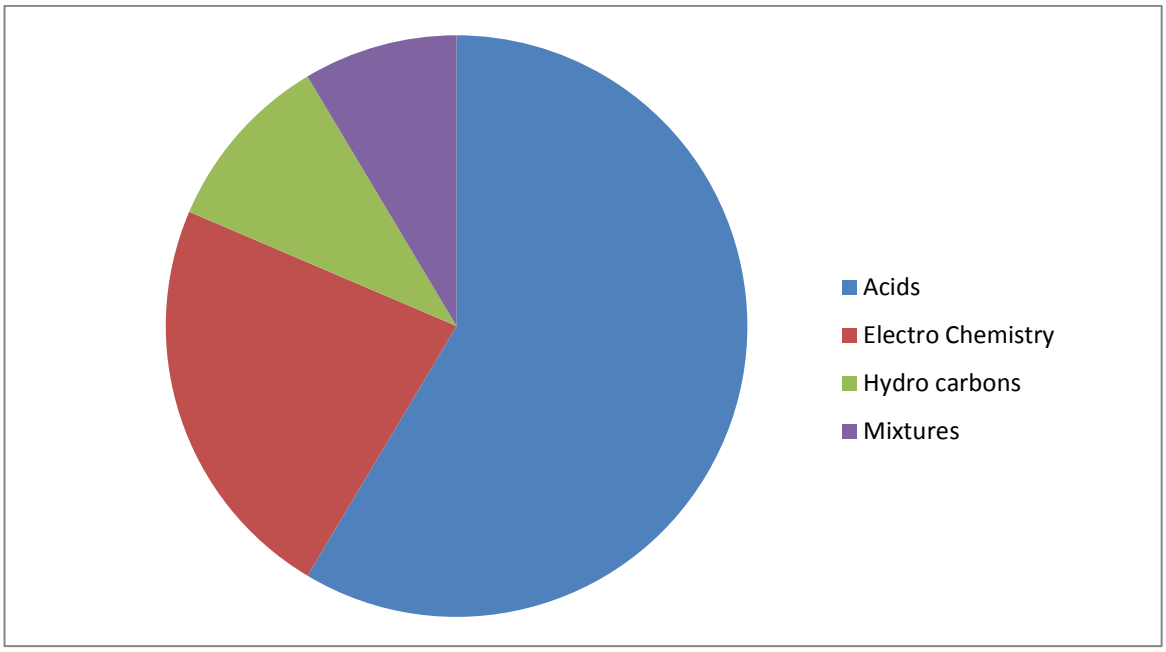

Figure 16: The hardest section belonging to the Chemistry content

As shown in Fig 16 most of the survey participants stated that the hardest lessons which belongs to the chemistry section in the O/L syllabus are the lessons which are based on acids.

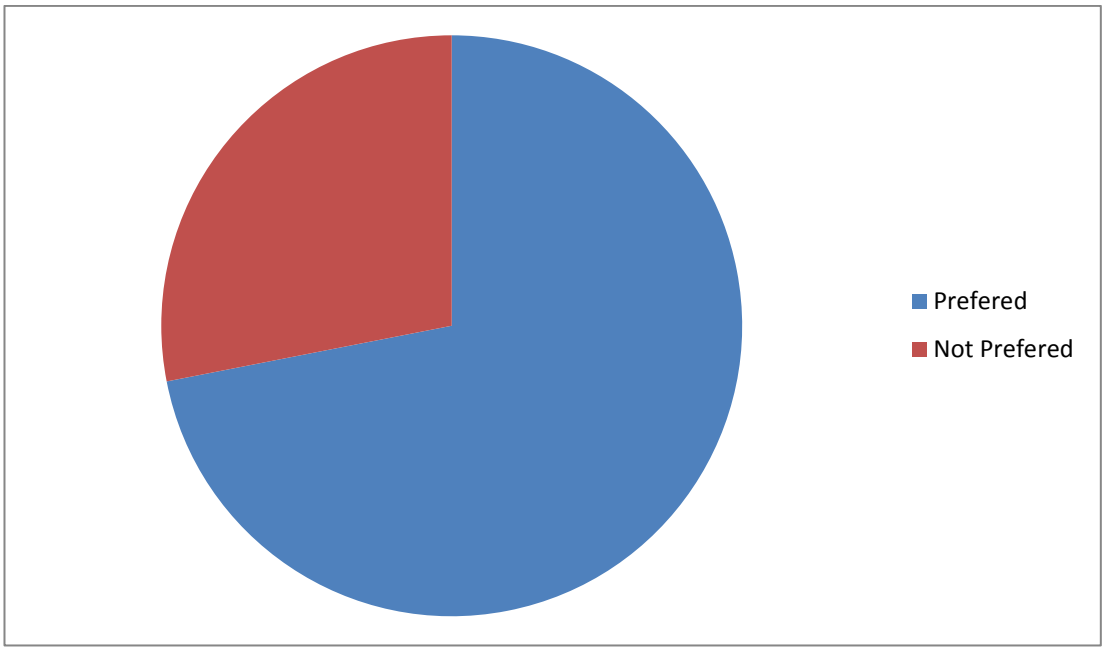

Figure 17: Preference to learn Acids using 3D technology

As shown in Fig 17 most of the survey respondents stated that learning acids using 3D technology would give them the ability to understand even complicated concepts with less effort and it would help them to memorize concepts relevant to acids.

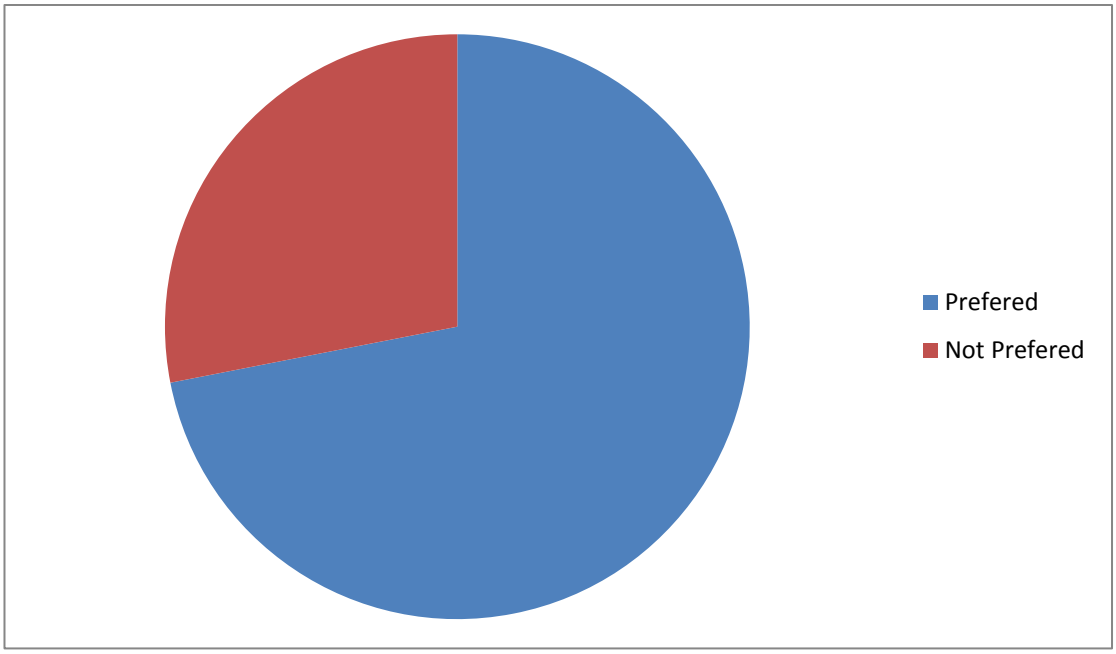

Figure 18: Preference to learn experiments using AR technology

Most of the survey participants stated that using AR technology would help them to get an experience on the experiments based on Acids even without the need of single lab equipment. It would also give them the ability to get an engaging experience on what they are studying and it would help to reduce the complexity of the content relevant to Acids.

All of these research findings have been taken into concern when developing the Acids component of the application.

3.3 Discussion

The main objective of this research was to uplift G.C.E O/L results of students in Sri Lanka by providing them an attractive approach to study.

The research was started in November 2019 and the initial step was to gather information in the selected research area. Afterwards the research team decided to come up with a solution for the problems mentioned in this report. The suggestion was to solve the problem under four sub areas and the Acids component is the sub

component which this report belongs to. The Acids component as discussed above in the methodology is mainly focusing on the lessons relevant to acids in the G.C.E O/L syllabus. In order to gather requirements to this component a study was carried based on this sub area and it was able to figure out the need of an interactive method for O/L students to learn about acids. The investigations done show that augmented reality would be an effective solution for the issues discussed above in the research problem. It is a growing field of technology which is used in many fields and using it even in elearning purposes had been very effective as it gives an engaging experience for users. It would support students to gain interest in studying even a tough area like Acids.

At the beginning of the research a literature survey was carried out to identify whether similar applications were developed before and the limitations of those applications. Though there were several applications developed relevant to acids using augmented reality none of them were able to cater the requirements of the G.C.E O/L syllabus in Sri Lanka. Most of them were focusing only on 3D visualizations of molecular formations in acids. But the Acids component in this application covers all the content relevant to the lessons based on acids in the O/L Science syllabus. As our application is supporting both Sinhala and English languages, the students who are following either Sinhala medium or English medium can get the benefit of this application.

The Acids component of this application can be further improved to use virtual reality so that students can gain a real world experience in doing their experiments. A virtual lab can be added as another feature of this component. This application can even be further improved to cover all other lessons relevant to the chemistry section in the O/L Science syllabus.

4. SUMMARY OF CONTRIBUTION

Table 7: Summary of Contribution

Member	Component	Task
IT17107624 De Silva K.V.P.W	AR support for acids in the O/L science syllabus	• 3D demonstration of formation of acids in acidic compounds. • Demonstrating the reactions of acids with elements using augmented reality. • Converting descriptions on productions of acids into augmented videos, animations and image slideshows.

5. CONCLUSION

The test results and the feedback received from O/L students and Science teachers proves the success of the application and it shows that this application would definitely do a great role in uplifting the O/L Science results of students. The feedback received from Science teachers show that this application would be a support material for teachers to give students the knowledge of experiments relevant to acids even without the need of single lab equipment. Also using this application would make students feel interactive in learning the content relevant to acids. All of these features in the application provides reliable solutions for the problems addressed in the introduction.

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