

***Ashesi University College***

**A Mathematics E-learning Platform for High School  
Students in Ghana.**

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**2014**

***Applied Project***

**Ashesi University College**

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Students in Ghana.**

**Onyeka Gbolahan Jackson-Ekwugum**

*Dissertation submitted to the Department of Computer Science,  
Ashesi University College*

*In partial fulfillment of the requirements for the award of  
Bachelor of Science degree in Computer Science*

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## DECLARATION OF INTENT

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature:.....

Candidate's Name:.....

Date:.....

I hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by Ashesi University College.

Supervisor's Signature:.....

Supervisor's Name:.....

Date:.....

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## **ABSTRACT**

This project deals with designing a Web application that delivers KHAN ACADEMY® instructional videos and attempts to give SHS students, access to educational resources that are relevant to the WASSCE syllabus. The ultimate objective of this project is to help students improve their math learning abilities by giving them reach to vast resources which can be accessed offline. The added value of this application is that it allows teachers to use this resource to assist their students by uploading their own content i.e. exercises, assignments and explanations on various math topics. This application should help curb the rate of failure in WASSCE Math exams and improve the results of many SHS students in Ghana.

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# Chapter 1: Introduction

## 1.1 Introduction

Failure to pass math in WASSCE has been a recurring problem in Ghana and most parts of West Africa. Math is a compulsory subject at all levels in pre-university education. Due to the importance of math, the government has been involved in investing excessively into the math curriculum for both JHS (Junior High School) and SHS (Senior High School) schools in Ghana [1]. The math curriculum is therefore, meant to adhere to standards of the world. WASSCE is usually taken at the SHS stage and each student is expected to build on mathematical competence to be able to use his/her knowledge to solve real-world problems and secondly, be well equipped to be admitted into the university and then into preferred professions.

In spite of government efforts, the results of SHS students who write math have reflected poor performances and the negative performances seem to be increasing as the years go by. Moreover, a study took place in 2003 and 2007 by the Trends In Mathematics and Science Study (TIMSS) and Ghana's 8<sup>th</sup> graders i.e. Junior High School (JHS) students were ranked 43<sup>rd</sup> amongst 44 countries and 46<sup>th</sup> among 47 countries respectively [1]. This also reflects in the Senior High School level as the failure rate in math is discouragingly high and not substantially improving. As a result a lot of SHS students cannot further their education at the university level [1].



Drawing from this background, this project seeks to address this negative trend in mathematics by incorporating design and technology into the teaching and study of mathematics for students in Ghana. The project should help assist students in learning math topics that are in line with their curriculum. It should also boost their morale to learn math and increase their passion to master math concepts. The world has now migrated into ICT and this project will be a stepping stone to helping these students gain experience with technology. Technology also has the ability to make things fun therefore this project seeks to make math learning easy, fun and attractive.

## 1.2 Problem

The rate of failure in mathematics as a core subject has been high for many years and has not seemed to improve. According to Fredua-Kwarteng, Y. in Confronting National Mathematics Phobia in Ghana (Part 2), some of the major reasons why students are not performing well are:

*"1. Students learn mathematics by listening to their teacher and copying from the chalkboard rather than asking questions for clarifications and justification, discussing, and negotiating meanings and conjectures. Consequently, students learn mathematics as a body of objective facts rather than a product of human invention.*

*2. Students hardly read their mathematics textbooks or other mathematics texts books. Where students read the prescribed mathematics textbooks, they read them like the way they read novels or newspapers.*

3. Students could go to the library to read newspapers or novels, not mathematics. Mathematics is learned only in the mathematics classrooms or for examinations, quizzes, or tests.

4. Students could form a small study group outside of their classroom to do homework assignments or prepare for an examination or tests, but not for discussing mathematical concepts that were taught to them in the classrooms.

5. Students learn mathematics by regurgitating facts, theorems or formulas instead of probing for meaning and understanding of mathematical concepts. That is to say, students hardly ask the logic or philosophy underlying those mathematical principles, facts, or formulas.

6. Students accept whatever the teacher teaches them. The teacher is the sole authority of mathematical knowledge in the classroom, while the students are mere receptors of mathematical facts, principles, formulas, and theorems. Thus, if the teacher makes any mistakes the students would also make the same mistakes as the teacher made.

7. Most students do mathematics assignments and exercises not as a way of learning mathematics, but as a way of disposing those assignments to please the teacher. This implies that mathematics assignments are not construed as an instrument for learning mathematics.

8. Students go to mathematics classes with the object to calculate something. Therefore, if the classes do not involve calculations they do not think that they are learning mathematics. So students learn mathematics with the goal to attain computational fluency, not conceptual understanding or meaning. For

*conceptual understanding requires students to think critically and act flexibly with what they know. Students are fond of asking how you calculate that instead of asking why you calculate it in that way.*

*9. Students learn mathematics with the aim to pass a test or examination. After passing the test or examination mathematics is no longer of importance to the students.*

*10. Students have internalized the false belief that mathematics learning requires an innate ability or the brains of an elephant.” [2]*

Imagine an interface that incorporated the math syllabus with tutorial videos, practice questions that is educating yet entertaining. This application could be a major milestone to increase the improvement in math in Ghana.

### 1.3 Objective

The objective of this project is to develop a Web interface app that delivers Khan Academy content aligned to the WASSCE Core Math syllabus and textbook offline. This interface or app will incorporate Khan Academy instructional videos sequenced to the WASSCE syllabus. It will also incorporate guided practice past questions from the official WASSCE Core Math textbook which would allow students to take matters into their hands. It would also be a resource for teachers who need ideas and additional strategies for teaching Core Math and for National Service teacher training.

## 1.4 Motivation

My motivation for this project comes from two areas of my academic journey. First of all, it is the idea of giving back to the society. I have learnt from Ashesi University that being socially responsible and socially conscious of your community or environment develops me as an individual and also raises your ability to be creative and be a problem solver in order to impact the society. The second reason is personal interest. I wanted to improve my skill in Web designing and development and this project helps to address that need. I believe that this project can empower students to be less wary of math and also improve their skill as well as their passion for it.

## 1.5 Methodology

I acquired the math curriculum for Khan Academy and the WASCCE math curriculum and aligned them so that I can see corresponding content of Khan and WASSCE.

I downloaded content from KA Lite. KA Lite is an existing application that delivers Khan Academy quality educational videos and exercises in an offline setting. This is very close to what I am doing, however I streamlined this videos to suit the WASSCE curriculum and my application has more additional features e.g. uploading contents, accessing past questions but to mention a few that will help the Ghanaian students.

I performed user research in order to get qualitative data from the high school students. I conducted some interviews and performed a survey which helped

to find out the scope of the project and also lead me to the approach to take in the design of the project and the interface.

I also performed a SWOT analysis to find out the best mode of creating this application and they are shown below:

#### 1.5.1 Website (using Internet)

##### Strengths

- Any student can access this videos from any location.
- it is possible to submit progress to Khan Academy and be able to Track individual progress

##### Weaknesses

- Student must be connected to internet
- It is expensive to use internet to download or watch videos
- You can lose progress because of internet connection

##### Opportunities

- Videos can be watched on youtube for better streaming
- Internet provides easy accessibility and can spread from Ghana to West Africa.

##### Threat

Reliance on internet.

### 1.5.2 Web Application Using a Local Server

#### Strengths

- Videos can be easily accessed without internet.
- Videos are easy to download.
- The application will not consume memory on your computer

#### Weaknesses

- Application cannot be accessed from any location.
- Restricted to location in terms of distribution of application.

#### Opportunities

- It is not expensive to access it.
- Can be easily set up

#### Threat

- Distribution to every student in Ghana.

### 1.5.3 Desktop Application

#### Strengths

- Application can be accessed offline.

#### Weaknesses

- Application will be huge in terms of memory size
- Must have access to internet to download the app

#### Opportunities

Anybody can be able to access this application after it is downloaded.

#### Threat

It may take a long time to download.

### 1.5.4 Mobile Phone Application

#### Strengths

- It is easier to get access since many students in SHS do not own computers

#### Weaknesses

- Videos are too small in size.
- It is expensive to access it over internet because of data bundle.

#### Opportunities

- Since students have phones they have better accessibility.

#### Threat

Expensive.

### 1.5.5 CD

#### Strengths

- It can be distributed easily amongst students.
- It is not restricted to one computer but can be used on any computer.
- It can spread widely across Ghana

#### Weaknesses

- There may be a price tag on CD
- Logistics like breaking or scratching.

#### Opportunities

- Students who do not have access to computers at all can get the CD and use in cybercafés.

#### Threat

No threat.

I decided to build the Web application using a local server from the SWOT analysis. The reason being using a local server would help improve accessibility to the resources on my application without the reliance of the Internet.

## 1.6 Overview of Report

This report highlights the initial research and processes that would lead to the development and implementation of this Web application. The literature review was explained in chapter 2. The following chapter also described the system requirements and the system architecture which includes diagrams of use cases and activity diagrams. The next chapter described the general design, tools and approaches used, user interface designs and other important aspects of the application. The last chapter described the details of activity, the challenges faced, conclusions and recommendations.



## Chapter 2: Literature Review

### 2.1 Internet Access in Ghana

Information and Communication Technology has become the tool that has integrated and become resourceful in people's lives ranging from health, politics, social, culture, entertainment and education. However, the Internet has been a valuable medium for knowledge dissemination and opportunities for development and growth.

#### 2.1.1 SHS Students Access to Internet

With all these major improvements in technology, it is proposed that students in the 21st century are "Digital Natives" [3]. Thus it is assumed that students in the 21<sup>st</sup> century are more technologically enlightened than their teachers. There is also expressed concern that there is an apparent lack of technological literacy among teachers. Sarfo F.K and Ansong Gyimah conducted a survey with a sample size of 300 students in 4 select schools [3]. Generally the results showed that Ghanaian students are technologically savvy. This finding is in line with the proposition that students in the 21<sup>st</sup> Century are "Digital Natives" [3].

In the survey, 60% of the students had access to computers and 40% did not. Furthermore, in the same survey, 22% of students had access to Internet which meant that many students seem to have access to computers but their access to Internet is somewhat limited. Thus, the situation of Ghanaian SHS students accessing the Internet is significantly poor compared to that of developed countries [3]. The absence of Internet to most of the Ghanaian SHS students is a basic problem in most developing countries; and this can be

explained in line with the notion of “Digital Divide” which describes the economic inequality between groups or countries with the use of, or knowledge of Information and Communication Technologies (ICT) [4].

However, the Web application I am building will not make use of the Internet and will exploit the fact that many students have access to computers so that they can get access to many good resources on the Web application offline.

## 2.2 The Role of ICT in Learning Math

As we move into the 21st century, technology has become more important to our society. Computers have become more affordable and people depend on them to conduct their daily affairs. Since computers are becoming more affordable to purchase, schools have been able to purchase more computers for their students. As more and more computers are purchased, a growing need for technology education emerges [5].

Most schools have computer laboratories which means that students get access to computers these days. Learning using ICT accelerates and enriches basic skills of students. An interview conducted by David Dwyer who is Vice President of advanced learning technologies for Computer Curriculum Corporation, compared the use of computers for basic skill instruction with paper and pencil approaches and found increases of 10 to 15 percent in the computer-using group [5]. Another finding that the study showed was an increase in efficiency. It also took students 30 percent less time to learn the same things with help from the computer [5].

Using ICT in math has been yielding good results in recent time and students are truly beginning to gain more from this technology. Key benefits of using ICT in math include:

- *"Greater collaboration between students*
- *An increased focus on strategies and interpretation*
- *Fast and accurate feedback to students using ICT*
- *Increased motivation amongst students."* [6]

A successful technology-based learning also relies heavily on the context of use. Classroom teachers play a significant role in facilitating student learning and aligning educational technology with content that are useful is paramount. This means that teachers play an important role in the successful performance of students. I found from a study that teachers with positive attitude radiated confidence in students which made them develop positive attitude towards the learning of Mathematics [7]. Teachers are the people who will feed the next generation of tomorrow's leaders and with the use of ICT they can maximize the impact on students in various ways such as:

- *"Using ICT as a tool in working towards learning objectives*
- *Developing a knowledge of the multimedia software available*
- *Considering how to provide access to ICT resources for all*
- *Incorporating the use of portable ICT equipment in teaching."* [6]

This is why my Web application will incorporate interaction between the teachers and students whereby the teachers can use the application as a

resource by uploading content that is relevant to the students so that the students learn from it and improve their math. The students get access to these contents and they get to also share their understanding of a particular topic which coherently starts reaping the benefits of ICT in learning math.

### 2.3 Overview of KA Lite (Existing Solution)

Salman Khan's model for free online education hinges on the micro lecture brief tutorials on nearly every subject under the sun delivered through YouTube. Khan Academy was launched in 2006, and now has a library of 3000 videos [8]. Their goal is to provide a "free world-class education for anyone anywhere." With the help of hundreds of volunteers, the site's content is accessible in 18 languages [8]. But even with all of that effort, Khan doesn't achieve the global reach that it promises. Research has shown that only 35 percent of the world's population has access to the Internet, which puts the idea of online learning behind a virtual firewall for many people [8].

KA Lite is an offline version of Khan Academy developed by a team of volunteers from around the world in collaboration with the Foundation for Learning Equality. KA Lite's agenda was to improve universal accessibility to education and their main target was those without Internet connection or slow Internet connection. KA Lite is an open source application that delivers Khan Academy's quality educational videos and exercises in an offline setting.

## 2.4 WASSCE Syllabus

Math is a fundamental topic that cuts across everything all over the world. The technological challenges of the 21st century are assuming a respectable role in the society and Math and Science are the foundations for finding a solution to these challenges. According to Sherrod, it is clear that those nations in the world which have taken the culture of mathematics and science seriously, are leading, whereas those economies, in which this culture has played little or no role, find themselves lagging behind and their very survival threatened [9]. The main rationale for the mathematics syllabus is focused on attaining one crucial goal: to enable all Ghanaian young students acquire the mathematical skills, insights, attitudes and values that they will need to be successful in their chosen careers and daily lives [10]. It is very important that the structure of the resources on my Web application align with the Ghanaian WASSCE math syllabus so that students get to relate with the resources.

## Chapter 3: System Requirements Specification

This section of the document provides the system requirements specification for the application.

### 3.1 Features of Web Application

- **Watch Videos:** Users (Students) of this application can click on desired link and watch a video pertaining to that link. The links are populated with the WASSCE math curriculum which are subdivided into topics and subtopics where you can access a math tutorial video.
- **Past Questions:** Users (Students) of this application can access past questions of math pertaining to their different topics in the WASSCE math curriculum.
- **Upload Content:** Users (Teachers) of this application have access to a text editor that will allow the user to upload content to the database. The content involves exercises, shapes, images and videos that would be used as assisting materials for students to use to learn math. Students also have access to a text editor so that they can share their understanding of a particular topic.
- **Search:** Users can search content ranging from videos relating to particular topics to exercises and explanations relating to particular topics.

## 3.2 User Classes and Characteristics

**Students of Schools:** This group consists of both technologically competent users and others who are not too familiar with Web applications.

**Teachers of Schools:** This group consists of mainly technologically competent users and a few who are not too familiar with Web applications.

Due to differences in the levels of technological competence of the anticipated users, it is necessary to make the Web application exceptionally user friendly. The usefulness of this application would result from the ability of the anticipated users to easily perform the actions of the expected system.

## 3.3 System Features

**Upload Content:** One of the major highlights of this Web application will be its ability to allow users of this system to upload relevant content so that content that is stored can easily be retrieved and accessed. One class of user which is the teacher should find the ability to upload content, easy and useful because they frequently hand out exercises and assignments for students to go and solve or practice. From my user research, I found out that the teacher basically types out his exercise or assignment with Microsoft Word and then logs on to the Internet where he would select all the students in a particular class SHS1-SHS3 and then send a mail with the attached Microsoft Word document to all the students in a particular class. This process has many weaknesses and the major weakness is that of the Internet. This means that if the Internet is down the teacher is obstructed from sending out the exercise and if he sends out the exercise it may take a long time to reach the desired

receiver. With my application, the teacher will just have to access my Web application from a local server in the school using a local IP address which would grant him access. The teacher can then login and have access to a text editor just like Microsoft word where he or she can type out the exercise and click on "upload button" to upload the exercise. When the teacher has uploaded content he can go to class and tell his class to go to the computer lab and check on the exercise he or she has uploaded that relates to the topic that was taught to the students in class.

On the other hand, students can upload an explanation of a particular topic he or she understands. The student is not required to login so therefore he or she accesses the Web application with a local IP address and clicks on the link, post explanation where he is granted access to an editor that looks like Microsoft word and he uploads the explanation. This process is important because I discovered it when I conducted interviews on students who have taken WASSCE examinations. In the interview process, I asked what the students does when studying for math and what helped most when they had difficulty understanding a math topic. Most responses were they solved questions in their text book, they solved past questions and they had a study group. Another response was that they learn from their colleagues in the group study when discussing difficult topics. From research, students helping other students or sharing their knowledge with other students improved collaborative learning. Research also shows that cooperative learning improves students' achievement, persistence, and attitudes. Collaboration with fellow learners increases motivation and helps students take responsibility for their



own and their peers learning [11]. Moreover, learning experiences built around student collaboration are not prevalent in normal classroom experience and there are not many models that prompts students to help each other learn. My Web application seeks to bridge this gap by allowing students to share their understanding with other students because helping each other learn, mimics humans' innate learning process; a process for which we are genetically and environmentally engineered [11]. This shows that learning amongst your peers can be very impactful to the students.

**Retrieval:** The application should support quick and easy retrieval. This involves retrieving exercises, their solutions, explanations and links to videos.

## 3.4 System Architecture

### 3.4.1 Layered Architecture

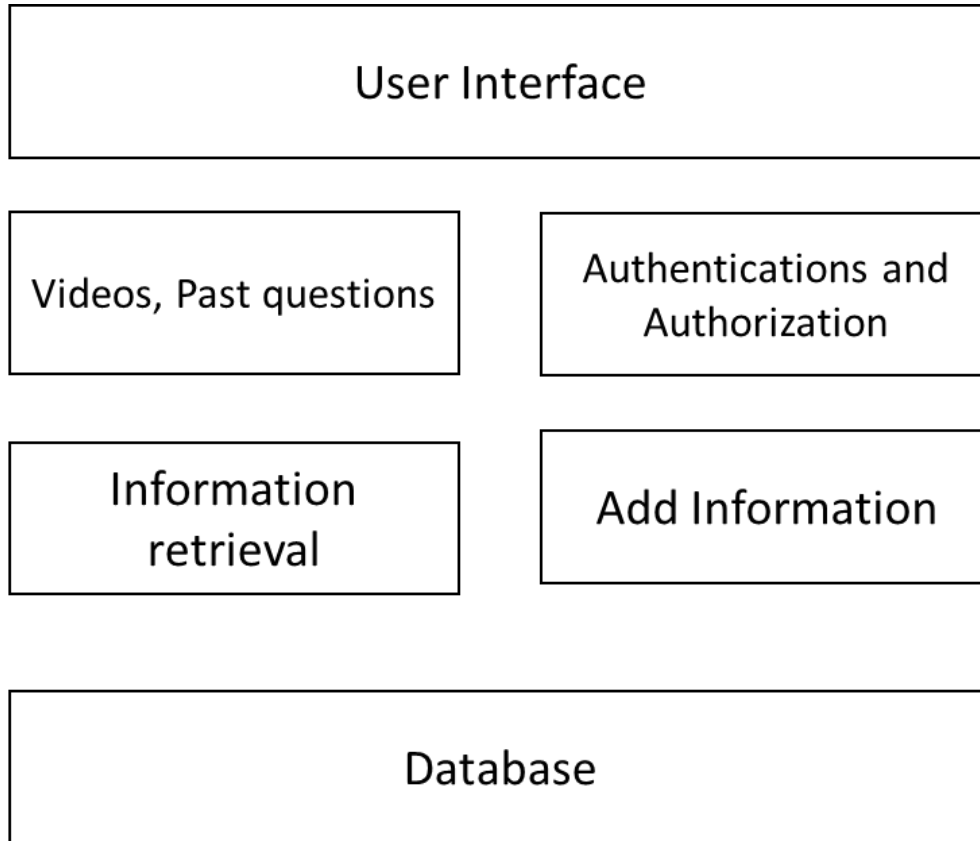
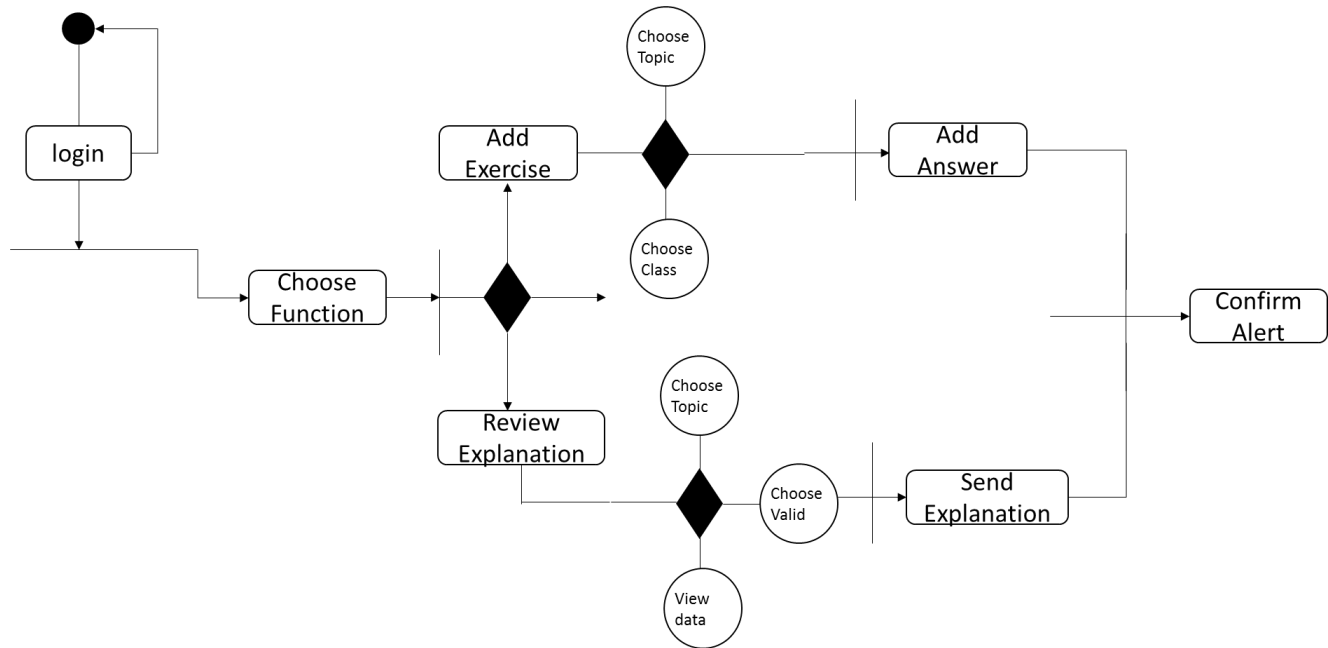


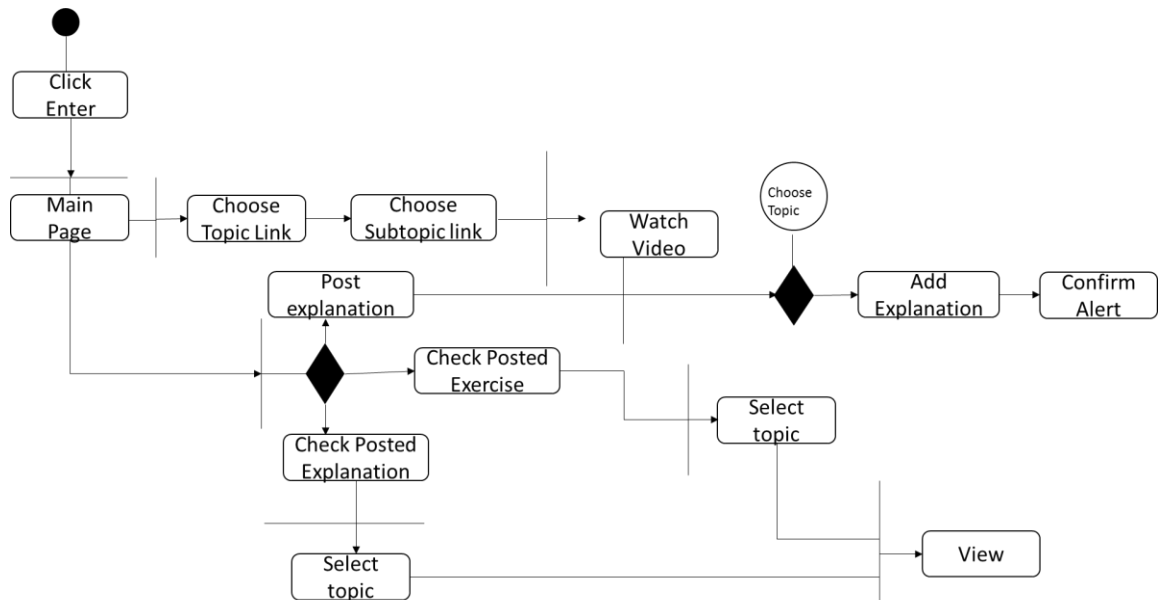
Figure 3.1 System Architecture

### 3.4.2 Activity Diagram

#### 3.4.2.1 Activity Diagram for Teacher



#### 3.4.2.2 Activity Diagram for Student



## 3.5 Requirement Specification Using Use Cases

### 3.5.1 Teacher

The subsection specifies the functional requirements primarily associated with teachers.

#### **Definition**

A teacher is the role played by an employee in the school who performs teaching functions using the Web application.

#### **Responsibilities**

A teacher has the following responsibilities:

- Types out exercises and its solutions.
- Reviews explanations.

#### **Required Capabilities**

A teacher needs the following required technical expertise, experience, and training to effectively interact with the Web application:

- Basic IT skills
- Use username and password to log onto the teacher section of the user interface i.e. should be familiar with login process.

## Use case diagram

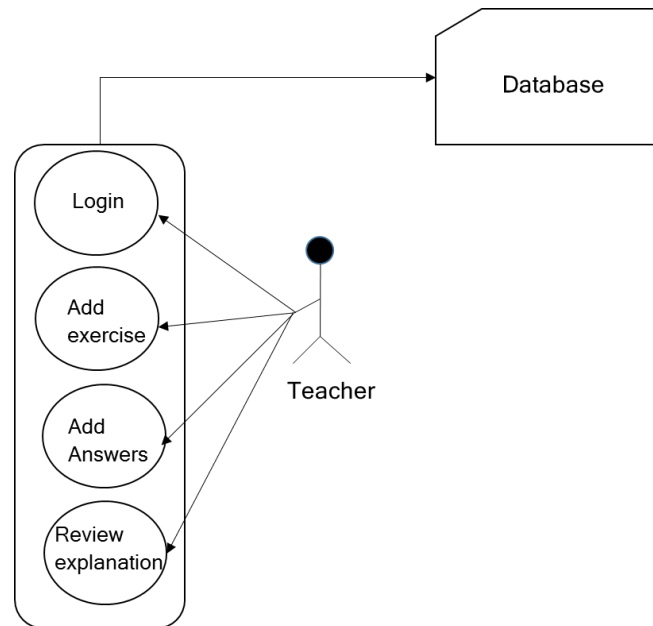


Figure 3.2 Use Case Diagram for Teacher

## **Use Cases**

- Teacher Add exercise
- Teacher Add answers
- Teacher Review explanation

#### *3.5.1.1 Use Case: Teacher Add Exercise*

##### **Use Case Requirement**

The Web application shall enable teachers to add content:

- Choose topic
- Choose class (SHS1-SHS3)
- Add questions in text editor
- Add solutions to the questions in text editor
- Click on upload

#### *3.5.1.2 Use Case: Teacher Review Explanation*

##### **Use Case Requirement**

The Web application shall enable teachers to review explanation:

- Choose topic
- View explanation with date
- Choose valid explanation by ticking checkbox
- Send chosen explanation by clicking on accept button

### 3.5.2 Student

The subsection specifies the functional requirements primarily associated with students.

#### **Definition**

A student needs this application as a resource to assist them in learning math.

#### **Responsibilities**

A student has the following responsibilities:

- Watch videos.
- Check for content on particular math topics e.g. exercises, explanations.
- Provide explanations on particular math topics.

#### **Required Capabilities**

A student needs the following required technical expertise, experience, and training to effectively interact with the Web application:

- Basic IT skills

## Use case diagram

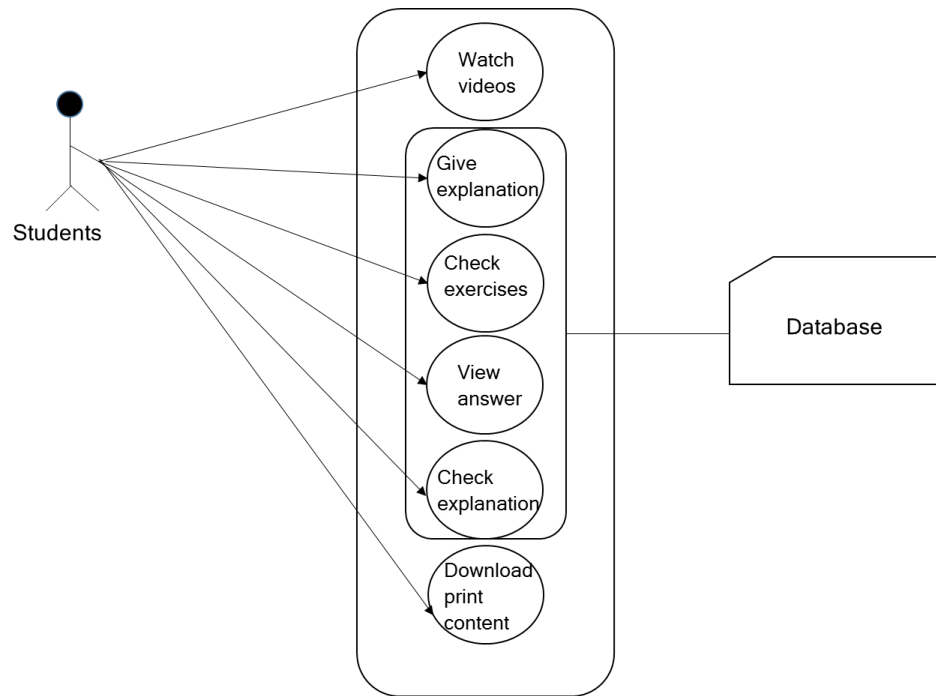


Figure 3.3 Use Case Diagram for Student

### **Use Cases**

- Student Watch videos
- Student provides explanation
- Student Check exercises
- Student View answers



- Student Check explanation
- Student download/print content

#### *3.5.2.1 Use Case: Student Watch Videos*

##### **Use Case Requirement**

The Web application shall enable student to watch videos:

- Click on enter button
- Click on WASSCE topics
- Click on WASSCE subtopics
- Click play and Watch video

#### *3.5.2.2 Use Case: Student Give Explanation*

##### **Use Case Requirement**

The Web application shall enable students to add explanation:

- Choose topic
- Add explanation
- Click upload

#### *3.5.2.3 Use Case: Student Check Exercise*

##### **Use Case Requirement**

The Web application shall enable students to check exercises:

- Choose topic
- View Exercises
- Choose particular exercise

- View answer

#### *3.5.2.4 Use Case: Student Check Explanation*

##### **Use Case Requirement**

The Web application shall enable students to check explanation:

- Choose topic
- View Explanation
- Choose particular explanation

#### *3.5.2.5 Use Case: Student Download/Print Content*

##### **Use Case Requirement**

The Web application shall enable students to download and print content:

- View Print button by
  - Choosing particular Exercises
  - Choosing particular Explanations
  - Clicking on Check Past Questions Button
  - Clicking on Test Yourself button

## Chapter 4: Design

### 4.1 Tools and Approach

In completing this project, the following tools were used for development.

**PHP:** This tool is a server side scripting language that may be used for development of Web applications. PHP has a great online resource support and it is freely available for use and comes with several built-in libraries that can be applied for rapid development.

- Compatibility - PHP supports MySQL and can be easily integrated with both HTML and MySQL. Site Visitors to PHP rendered pages do not need any plug-ins or added functionality to experience the work being done in the background by PHP. PHP is also very portable because it can run on almost all mainstream operating system environments. PHP interaction with databases has a high performance unlike other scripting languages. My application involves frequent retrieval from database therefore PHP is the most preferred as it offers higher execution speed and good interaction.

**MySQL:** This is an open source database server and a very useful database server choice for many Web applications.

- Storage design - MySQL is a relational database management system and stores data in simple two dimensional tables. It covers up the complex data structure it uses to organize data in the background and simplifies the storage system. It is very easy and convenient to use.

- Compatibility and Optimization - It works well with PHP and it was very useful for this project. It is fairly optimized and it makes good use of assigned system resources.

**HTML, CSS, JQuery, JavaScript:** These tools were used to create the look, feel and some basic functions of the Web application. This application is expected to run in a browser therefore HTML pages were created to allow interaction with the application. HTML helped in telling the browser how to present the pages and CSS and JQuery were used to enhance the look of the HTML pages. CSS improved the aesthetics of my application and JQuery and JavaScript was important in promoting the human computer interaction with the Web application. HTML, CSS and JQuery are easy to use languages that can be manipulated using a text editor and they are very efficient.

**Ajax:** Ajax helped in improving the interaction of the Web application between user and Website as pages are not reloaded for content to be displayed. Instead a loader appears on the page to give it a responsive feel.

**Bootstrap:** This is a frame-work that is used to develop the front-end of a Website. Bootstrap is was very useful in the design of the Website as it comes with embedded CSS and JavaScript that allows you to create attractive interfaces and also saves time.

## 4.2 Database Architecture

The Web application required a simple database system that allows for multiple queries and produce fast results. The database structure had to be arranged carefully in order to ensure efficiency in retrieving data from the database.

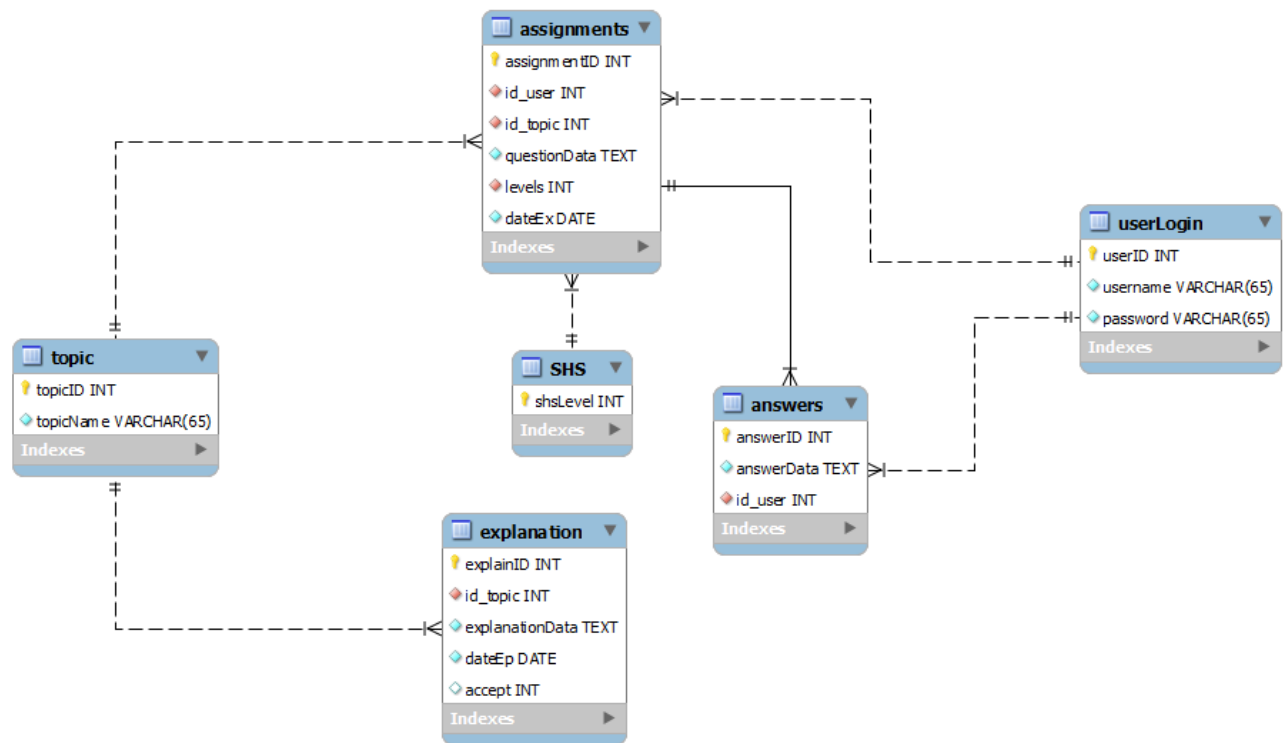


Figure 4.1 ER diagram showing the relationship among entities

Database Schema: The final architecture of the database as shown is formulated as a result of many iterations.

## 4.3 Operating Environment

The Web application would ideally be supported by all major browsers. However, Google Chrome was the main browser used during the development and also performs better than any other browser during testing as compared to other browsers.

## 4.4 External Interface Requirements

The Web application has two main pages provided in the menu header options.



Figure 4.1 Home (Index) page

The home page leads the user to the Enter button where the user enters the section where they are provided with the major functionality of the Web application.

#### 4.4.1 Student Page

**Curriculum:** In this page you are provided with links representing each topic of the WASSCE curriculum and when you click on the topic it leads you to a subtopic of that topic and then you watch a video relating to that topic.

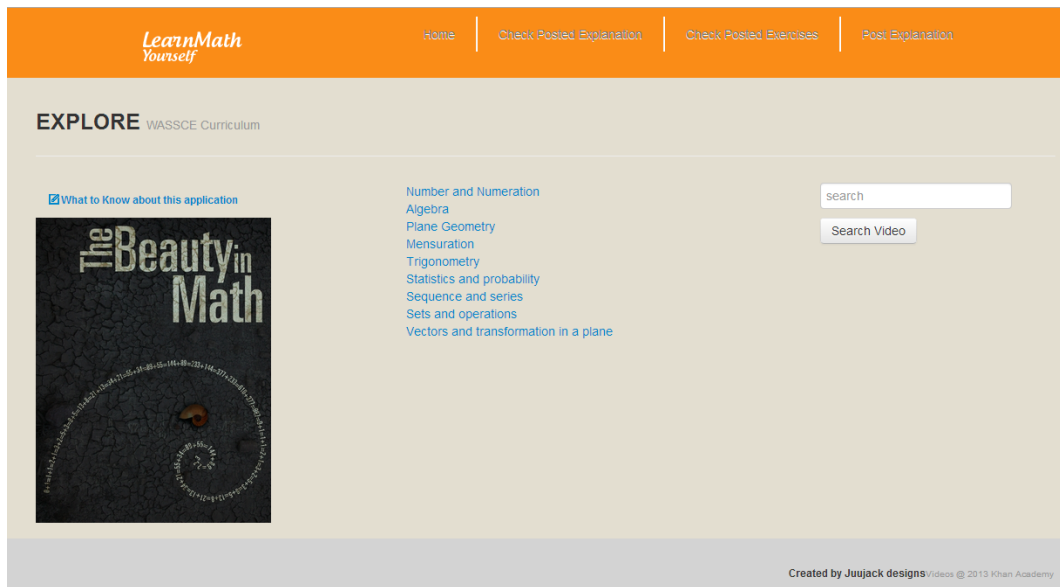


Figure 4.2 Curriculum page

Click on the Links that have the topics:

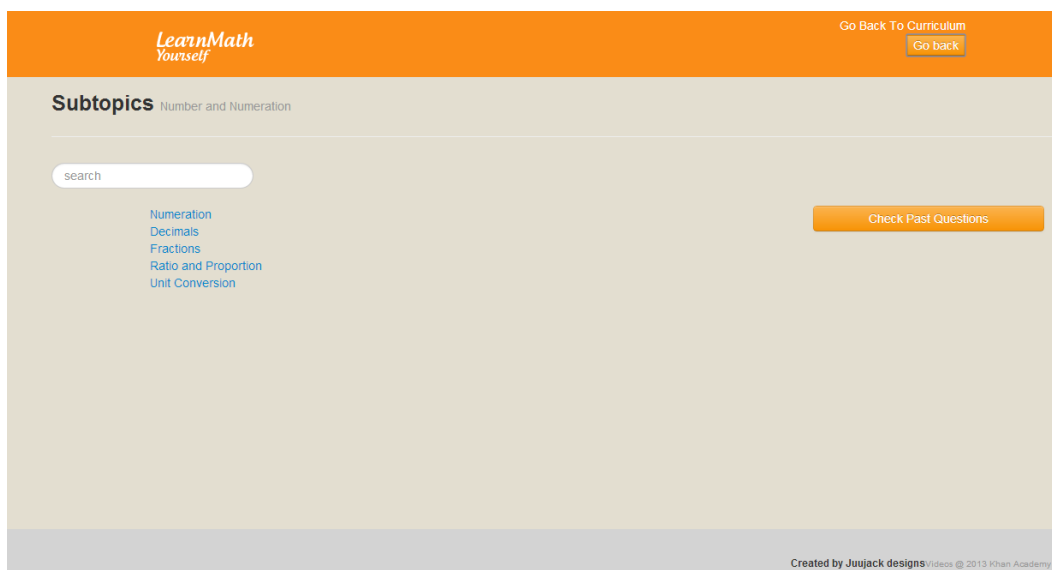


Figure 4.3 Number and Numeration Page

**LearnMath Yourself** Go Back To Curriculum  
Go back

**Subtopics** Number and Numeration

search

Numeration  
Decimals  
Fractions  
Ratio and Proportion  
Unit Conversion

Divisibility tests  
Divisibility and factors  
Prime numbers  
Prime factorization  
Least common multiple  
Greatest common divisor  
Negative number basics  
Adding and subtracting negative numbers  
Multiplying and dividing negative numbers  
Absolute value

Check Past Questions

Created by Juujack designs Videos © 2013 Khan Academy

Watch Video:

**Watch Video** ×

Divisibility by: 2, 3, 4, 5, 6, 9, 10

2, 799, 588      5,670      100,765

6:32 ▶ 🔊 📺

Close Test yourself

Figure 4.4 Watch Video on Link



Click on Test Yourself to go Test Yourself Page:

The screenshot shows a web page titled 'LearnMath Yourself' with a 'Test Yourself' section for 'Numeration'. It includes a 'Go back' button, a list of exercises posted by teachers, and a table with columns 'Teacher' and 'Exercise'.

**LearnMath Yourself** [Go back](#)

### Numeration Test Yourself

This are the list of exercises that have been posted on this topic by your teachers

View list of Posted Exercises

Teacher	Exercise
<a href="#">nathan</a>	$3102 + 9 \times 3100 + 3103/3 = ?$
<a href="#">nathan</a>	www
<a href="#">nathan</a>	mobile app-will build an api that would giv links

Created by Juujack designs Videos @ 2013 Khan Academy

Figure 4.5 Test Yourself page

LearnMath  
Yourself

Curriculum

Explore Past Questions

Two students appeared at an examination. One of them secured 9 marks more than the other and his marks was 56% of the sum of their marks. The marks obtained by them are:

A. 39, 30      B. 41, 32  
C. 42, 33      D. 43, 34

[View Answer](#)

Two students appeared at an examination. One of them secured 9 marks more than the other and his marks was 56% of the sum of their marks. The marks obtained by them are:

A. 39, 30      B. 41, 32  
C. 42, 33      D. 43, 34

[View Answer](#)

Two students appeared at an examination. One of them secured 9 marks more than the other and his marks was 56% of the sum of their marks. The marks obtained by them are:

A. 39, 30      B. 41, 32  
C. 42, 33      D. 43, 34

[View Answer](#)

Two students appeared at an examination. One of them secured 9 marks more than the other and his marks was 56% of the sum of their marks. The marks obtained by them are:

A. 39, 30      B. 41, 32  
C. 42, 33      D. 43, 34

[View Answer](#)

Two students appeared at an examination. One of them secured 9 marks more than the other and his marks was 56% of the sum of their marks. The marks obtained by them are:

A. 39, 30      B. 41, 32  
C. 42, 33      D. 43, 34

[View Answer](#)

Two students appeared at an examination. One of them secured 9 marks more than the other and his marks was 56% of the sum of their marks. The marks obtained by them are:

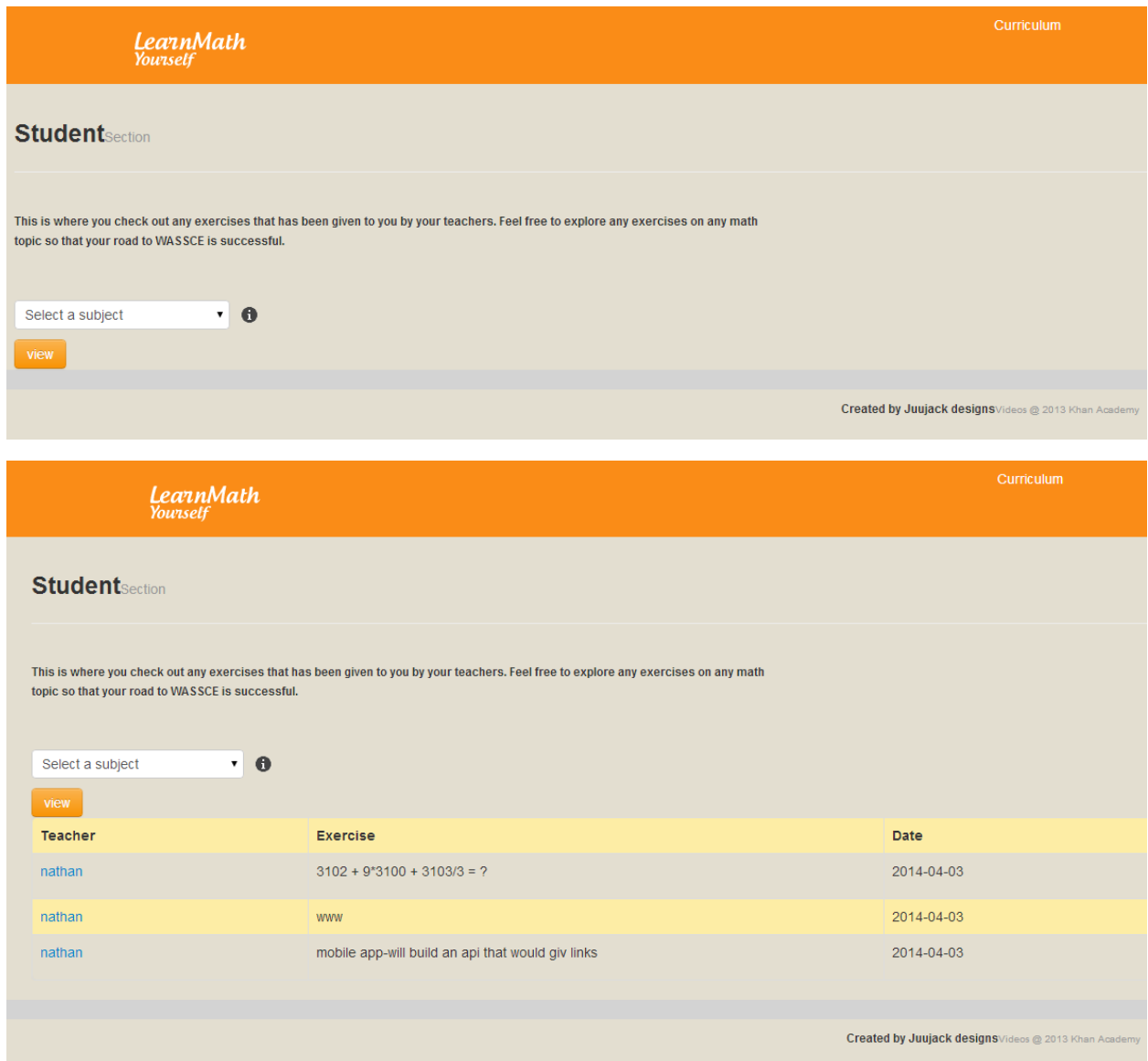
A. 39, 30      B. 41, 32  
C. 42, 33      D. 43, 34

[View Answer](#)

Created by Juujack designs Videos @ 2013 Khan Academy

Figure 4.6 Past Questions page

**Exercises:** This page shows a list of exercises that has been posted. You are provided with a drop down that shows a list of different topics and a button that retrieves the data from the database. You are also provided with information icon that explains what the user should do.



The top screenshot shows the 'LearnMath Yourself' interface. The header is orange with the logo on the left and 'Curriculum' on the right. Below the header, the page title 'StudentSection' is displayed. A paragraph explains that this is where users can check out exercises given by teachers. Below this is a dropdown menu labeled 'Select a subject' with a downward arrow and an information icon. An orange 'view' button is positioned below the dropdown. At the bottom right, a footer note reads 'Created by Juujack designs Videos @ 2013 Khan Academy'.

The bottom screenshot shows the same interface but with a table of exercises displayed below the 'view' button. The table has three columns: 'Teacher', 'Exercise', and 'Date'. The first row shows a teacher named 'nathan' with the exercise '3102 + 9\*3100 + 3103/3 = ?' and the date '2014-04-03'. The second row shows 'nathan' with the exercise 'www' and the date '2014-04-03'. The third row shows 'nathan' with the exercise 'mobile app-will build an api that would giv links' and the date '2014-04-03'. The footer note is also present at the bottom right.

Teacher	Exercise	Date
nathan	$3102 + 9 \cdot 3100 + 3103/3 = ?$	2014-04-03
nathan	www	2014-04-03
nathan	mobile app-will build an api that would giv links	2014-04-03

Figure 4.7 Check Posted Exercises page

**Explanations:** This part of this page shows the user a list of explanations that has been posted and a list of exercises that has been posted in a table format. You are provided with a drop down that shows a list of different topics and a button that retrieves the data from the database. You are also provided with an information icon that explains what the user should do.

LearnMath Yourself Curriculum

Student Section print

You don't understand a particular topic, then you are in the right place. Feel free to explore any explanation on any math topic you have difficulty with from your colleagues.

Select a subject *i*

VIEW

Date	Explanation
2014-04-04	Of the 80 students in class, 25 are studying German, 15 French and 13 Spanish. 3 are studying German and French; 4 are studying French and Spanish; 2 are studying German and Spanish; and none is studying all 3 languages at the same time. How many students are not studying any of the three languages?

Created by Juujack designs Videos © 2013 Khan Academy

Figure 4.8 Check Posted Explanations page

**Give Explanation:** In this page, you are provided with a text editor where you can type out your explanation. User selects topic and uploads the explanation.

LearnMath Yourself Curriculum

StudentSection

Please select a topic and then upload. Select a subject

File Edit Insert View Format Table Tools

Formats B I [List Icons] [Link Icon]

p Words: 0

Upload

Created by Juujack designs Videos @ 2013 Khan Academy

Figure 4.9 Post Explanations page

#### 4.4.2 Teacher Page

This page provides a login page where user is authenticated before accessing this portal.

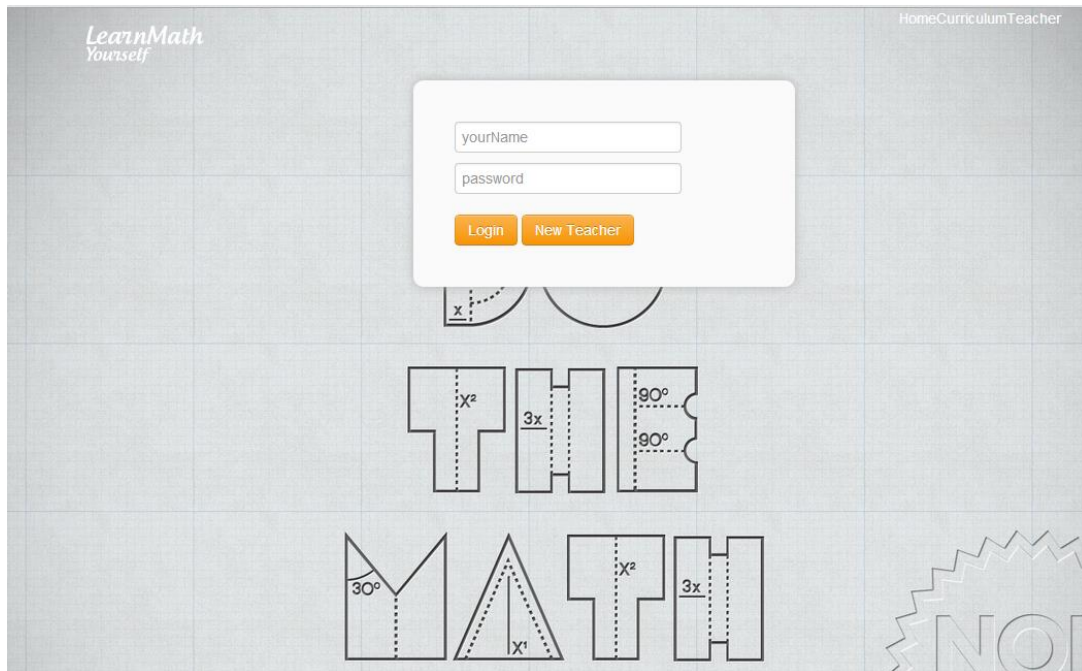
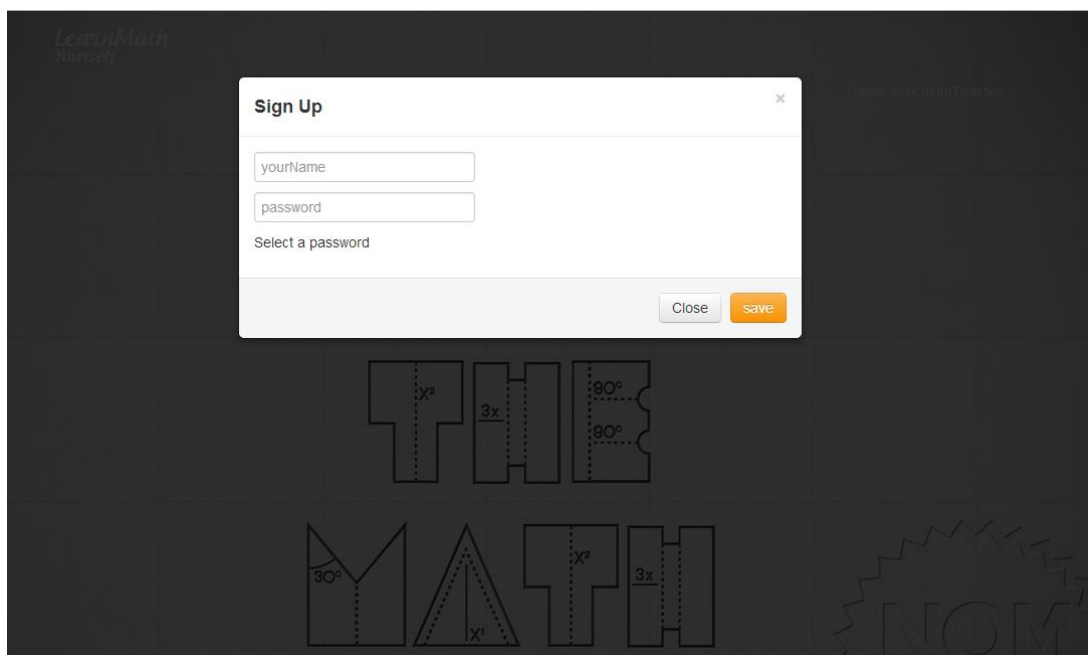
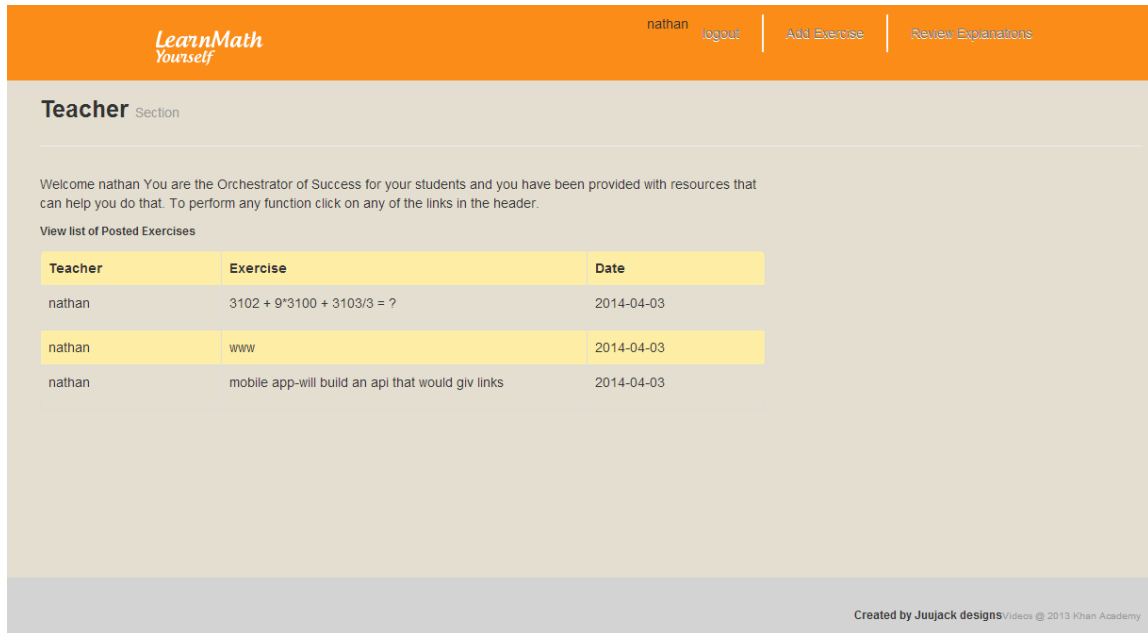


Figure 4.10 Login page



**Teacher:** you are provided with a list of exercises that has been posted and a list of explanations that has been posted. There are links provided in the header that state the functionalities of the teacher.



**LearnMath Yourself** nathan [logout](#) | [Add Exercise](#) | [Review Explanations](#)

### Teacher Section

Welcome nathan You are the Orchestrator of Success for your students and you have been provided with resources that can help you do that. To perform any function click on any of the links in the header.

[View list of Posted Exercises](#)

Teacher	Exercise	Date
nathan	$3102 + 9 \times 3100 + 3103/3 = ?$	2014-04-03
nathan	www	2014-04-03
nathan	mobile app-will build an api that would giv links	2014-04-03

Created by Juujack designs Videos @ 2013 Khan Academy

Figure 4.11 Teacher Home page

**Add exercise:** You are provided with a text editor where you can add your questions and also add your answers to the questions.

The screenshot shows the 'Add Exercise' page in the 'LearnMath Yourself' application. The page has an orange header with the logo 'LearnMath Yourself' on the left and user links 'nathan', 'logout', and 'Back' on the right. Below the header, the section is titled 'Teacher' with a subtitle 'Section'. A message says 'Please Select a topic. Select a class and then upload.' There are two orange buttons: 'Add Exercise' and 'Add answers'. To the right of these buttons are two dropdown menus: 'Select a subject' and 'SHS'. Below these is a rich text editor with a menu bar (File, Edit, Insert, View, Format, Table, Tools) and a toolbar with icons for undo, redo, bold, italic, text color, background color, bulleted list, numbered list, link, and unlink. The editor area is empty, with a 'p' at the bottom left and 'Words: 0' at the bottom right. An 'Upload' button is at the bottom left. The footer says 'Created by Juujack designs/videos @ 2013 Khan Academy'.

**Add Solution to exercise:**

The screenshot shows the 'Add Solution to exercise' page in the 'LearnMath Yourself' application. The page has an orange header with the logo 'LearnMath Yourself' on the left and user links 'nathan', 'logout', and 'Back' on the right. Below the header, the section is titled 'Teacher' with a subtitle 'Section'. There is an orange button labeled 'Add answers'. Below this is a rich text editor with a menu bar (File, Edit, Insert, View, Format, Table, Tools) and a toolbar with icons for undo, redo, bold, italic, text color, background color, bulleted list, numbered list, link, and unlink. The editor area is empty, with a 'p' at the bottom left and 'Words: 0' at the bottom right. An 'Upload' button is at the bottom left. The footer says 'Created by Juujack designs/videos @ 2013 Khan Academy'.

Figure 4.12 Add Exercises page



**Review Explanations:** You are provided with a list of explanations in a table with checkboxes to check valid explanations and accept to send the explanations.

LearnMath  
Yourself

nathan  
logout  
Back

TeacherSection

You can tick which of the explanations are valid and accept the explanations so that it is posted for the students to see.

Select a subject

view

Date	Explanation	Accept
2014-04-04	android hive	<input type="checkbox"/>
2014-04-04	Of the 80 students in class, 25 are studying German, 15 French and 13 Spanish. 3 are studying German and French; 4 are studying French and Spanish; 2 are studying German and Spanish; and none is studying all 3 languages at the same time. How many students are not studying any of the three languages?	<input type="checkbox"/>

accept

Created by Juujack designsVideos @ 2013 Khan Academy

Figure 4.13 Review Explanations page

## Chapter 5: Implementation

### 5.1 Approach, Methods, Processes

#### 5.1.1 Stages of Adding Exercises

When the teacher logs onto the system, the teacher can click on “add an exercise” and then the page displays a text editor with two dropdowns so that the teacher can choose what topic he or she wants to make an addition to. The teacher can then select the class he wants the exercise to go to. When the teacher clicks “upload the exercise data”, the topic and class is then saved in the *assignments* table in the database and an automatic ID called *assignmentID* is assigned. The *assignments* table also records the current date automatically so that each exercise that is uploaded has a date attached to it. This is to help the teacher update answers to the exercise by referencing the *assignmentID* as a foreign key. When the teacher wants to add an answer to the exercise which will be another text editor, it is displayed on the page where the teacher types out the answers and uploads it.

#### 5.1.2 Stages of Adding Explanation

When the student accesses the application the student can click on the “post an explanation” link where the student is provided with a text editor with a dropdown menu where he or she can select the topic they want to explain. When the student clicks “upload”, the explanation data and the topic is saved into the *explanation* table in the database.

The *explanation* table also records the current date automatically so that each explanation that is uploaded has a date attached to it.

### 5.1.3 Stages of Reviewing Explanations

When the teacher logs onto the system, the teacher can click on the “review explanations” button where he is provided with a dropdown menu that can allow him to choose any topic and then click on “view” so that he sees all explanations on each topic. The explanation data appears in a table format along with the date the explanation was added, the explanation itself and a check box assigned to each row. The check boxes are provided so that the teacher can read up the explanation and then check the check box if it is valid or leave the checkbox unchecked, meaning it is invalid. A button is provided for the teacher to click on, so that all checked explanations are saved in in the *explanation* table in the database. What happens is that there is a column called “accept” in the *explanation* table in the database that is null when an explanation is uploaded. Then the *accept* column is updated when the teacher clicks on “accept” and all accepted explanations update their corresponding rows to true in the “accept” column in the *explanation* table.

### 5.1.4 Access Documents Externally

For the purposes of taking exercises home to practice or explanations to revise, the *window.print()* function was incorporated into the application using JavaScript. This function helps the students to be able to print exercises or save them as PDF.

## 5.2 Testing

The following tests were performed:

### 5.2.1 Compatibility Testing

This test was carried out to test the compatibility of the application with different browsers and on other operating systems. The target host machines for this application was mostly Windows because most computers available in schools operate using the Windows Operating System. It is always useful to ensure that the built-in system is compatible across several operating system environments. I tested browser compatibility by using Google Chrome, Mozilla Firefox and Internet Explorer. The system worked well in the tested environments and they also performed well.

### 5.2.2 Usability Testing

I tested the first prototype of this application by allowing SHS students from Labone High School within classes from form 1 to form 3 use it. One major issue that came up associated with usability was navigation of the whole application. Most users could not get back to previous pages since “back” buttons were not provided on the pages and did not know where to go to perform their functionalities. There were also issues understanding the wording of links and buttons. The navigation problem to the videos was fixed by color coding the links so that when the user clicks on the link for the main topic the subtopic appears on the same page with another color. The navigation to previous pages was fixed by use of the method “onclick = ‘history.go(-1)’” to get a user to their previous page. I performed the second test after modifying

the Web application to a group of “Adesua Ye” students (SHS students partaking in remedial lessons) and the responses were more positive as students understood what to do when they used the application. The interface was considered user friendly and easy to use as test users found it easy to understand the labels which provided enough information on what button or link does.

### 5.3 Challenges

In developing this application, several challenges were faced. This section details some of the challenges that were encountered and how some were controlled.

1. The first major challenge I faced in this project was the distribution of this application to SHS students in Ghana. I came up with two possible solutions which were the Internet or CD. The issue with the Internet is that many Ghanaian SHS students do not have access to stable Internet in the schools. The issue with the CD was the size of memory. The Web application will contain several math tutorial videos from Khan Academy and downloading all these videos into a CD could be a problem. I decided to use a local server which will host the Web application and be accessed using a localhost IP address in a particular location e.g. a school, and making the application accessible throughout the vicinity of that address. I also decided to categorize the curriculum into different CDs for example “Number and Numeration” with its videos will go into a CD and “Algebra” will go into another CD and so on.

2. Issues with Text editor – There were many issues with getting the right text editor that provided the user with all the necessary tools to type up exercises. *TinyMCE* was the text editor that was used in the Web application. This editor has a lot of plugins that can allow the user to put various items in the editor ranging from images to videos and other text formatting elements. Saving data in the text editor was a major issue. The text editor stores data in frames and using PHP save into database MySQL, was proving very difficult. I could not read the content from the text editor into a PHP variable but I could read the dropdown values. I decided to use Ajax to read the content from the text editor and save it into a variable. I also converted the selection of the topics and class into values before calling the Id's of the content, the topics and the class to be referenced in the PHP method that saves into the database. Adding shapes to the text editor so that users can add circles, triangles and so on when setting up exercises was a problem. This problem involved me using image maps to try to add it into the editor as a plugin using JavaScript code to make it embedded in the editor. This problem was not able to be fixed but it is recommended that the user inserts actual jpeg images of shapes to describe the actual shapes and use them to set up the exercise.

3. Using Checkboxes to review explanations - As I am just starting to get familiar with PHP I found this, aspect of using the checkboxes to review explanations to alter the "accept" column in the database, to be a challenge. I used a PHP method to call the id of the selected row when the checkbox is checked and then called the name of the row with its array element. I then altered the column "accept" to a Boolean so that when the check box is checked, it alters the column to 1 meaning true.
4. Accessing WASSCE past Questions – Unfortunately there is no record of WASSCE past questions online on the WASCCE Website so therefore getting soft copies of the past questions proved to be a serious challenge. The other option was to buy a math past question booklet and then group out questions according to their related topics before typing out the questions manually with their various answers and this posed a very serious challenge. There were a few Websites that relayed information that they had software that generated past questions like "myPasscco". I tried to download this application but it kept on sending me to different links and it was not free software. I finally downloaded some PDF math questions that I would use to create generic past questions on the various topics in the WASCCE math curriculum for now as it is still a work in progress to communicate with some of these organizations on a software that would grant access to WASSCE past questions.

## 5.4 Results, Recommendations, Conclusions

### 5.4.1 Benefits

1. The application would help students gain access to international resources through the videos.
2. The application would help students become their own teachers by sharing their knowledge.
3. The application would help students gain access to vast resources without the constraint of the Internet. Therefore, there will be no need for Internet bundles or waiting for a long time because of slow Internet connection.
4. The application would help the teachers so they can also assist students without the constraint of the Internet.
5. The application would increase interaction between students and teachers.
6. The application would also increase student interaction with computers making them more ICT capable.
7. The application would also be segmented into a CD section to help in distribution of these resources therefore students get access to these videos.



#### 5.4.2 Conclusion

The ultimate objective of this project is to help students improve their math learning abilities by giving them access to vast resources without the need for the Internet. The added value of this application is to allow teachers to use this resource to assist their students by uploading their own content so that students can get to practice them. Currently the students in Ghana do not perform well in WASSCE math examination and the aim of this project is to help reduce the rate of failure of math for SHS (Senior High School) students. From creating this application I believe that students will be more motivated to learn math and improve their math skills. I believe this application will also spread amongst many students in Ghana because it will be accessible offline and this will lead to a decrease in WASSCE math examination failure rate.

### 5.4.3 Recommendations

1. I suggest that this application can partner with companies who have developed a software that can generate WASSCE past questions so that students can have access to reliable soft copy of these questions.
2. In order to improve interaction between teachers and students I recommend that a forum can be added to this application. The forum would allow students to get to communicate on various topics and suggest ways of solving difficult questions. Teacher can also use the forum to enlighten students on relevant content and share more content as well.
3. The application could be integrated with an online version so that students can get access it both offline and online.
4. This can even branch into a mobile Web application since a lot of students these days use mobile phones the forum can be put up in a mobile application so that both students and teachers can post and share content with their mobile phones and it appears on the Web application subsequently using Wi-Fi. The mobile application could also be used to share videos from the Web application.

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## Appendix

### Section A: Survey Analysis

access mobile Phones()						HOME(Internet)						Access to computers(home)					
	M	F	Total	%Results			M	F	Total	%Results			M	F	Total	%Results	
F1	14	12	26	86.66667		F1	10	6	16	53.33333		F1	14	10	24	80	
F2	15	15	30	100		F2	11	12	23	76.66667		F2	11	14	25	83.33333	
F3	15	15	30	100		F3	14	10	24	80		F3	13	14	27	90	
	44	42	86	95.55556			35	28	63	70			38	38	76	84.44444	
use Internet at home(edu)						Access to computers(school)						COMPUTER LAB(internet)					
	M	F	Total	%Results			M	F	Total	%Results			M	F	Total	%Results	
F1	5	7	12	40		F1	8	6	14	46.66667		F1	3	6	9	30	
F2	4	9	13	43.33333		F2	10	12	22	73.33333		F2	6	9	15	50	
F3	10	4	14	46.66667		F3	15	14	29	96.66667		F3	6	4	10	33.33333	
	19	20	39	43.33333			33	32	65	72.22222			15	19	34	37.77778	
use Internet at home(ent)						mobilePhones(social)						mobilePhones(edu)					
	M	F	Total	%Results			M	F	Total	%Results			M	F	Total	%Results	
F1	13	8	21	70		F1	14	13	27	90		F1	0	1	1	3.33333	
F2	12	12	24	80		F2	14	14	28	93.33333		F2	1	2	3	10	
F3	14	10	24	80		F3	15	14	29	96.66667		F3	4	0	4	13.33333	
	39	30	69	76.66667			43	41	84	93.33333			5	3	8	8.88889	
use Internet at home(social)						use Internet at school(edu)											
	M	F	Total	%Results			M	F	Total	%Results							
F1	13	12	25	83.33333		F1	9	7	16	53.33333							
F2	11	14	25	83.33333		F2	8	9	17	56.66667							
F3	15	14	29	96.66667		F3	11	9	20	66.66667							
	39	40	79	87.77778			28	25	53	58.88889							

This are the collated results from my conducted survey on student accessibility to internet and ICT.

### Section B:Aligning Khan Academy Curriculum to WASSCE

sets																	
number		KHAN CURRICULUM														WASSCE CURRICULUM	
algebra		Arithmetic and Pre-Algebra														Sets and operations	
geometry		-Intro to addition and subtraction														-sets	
area%vol		-Two digit addition and subtraction														-operations on sets	
trig		-Addition with carrying														-logical reasoning- venn diagrams	
stats		-Subtraction with borrowing (regrouping)														Number and Numeration	
vector		-Addition and subtraction word problems														-rational numbers	
series		Multiplication and Division														-numeration system	
		-Basic multiplication														-real numbers	
		-One-digit division														-binary operation	
		-Starter multiplication and division word problems														-modular arithmetic-truth and false	
		-Multi-digit multiplication														-indices and logarithms	
		-Looong division!														-surds- rational expressions	
		-Lattice multiplication														-ratio and proportion	
		-Partial quotient division														-rates	
		-Fancy multiplication and division word problems														-percentages	
		-Area models and multiplication														-variation	
		Factors and Multiples														Algebra	
		-Divisibility tests														-algebraic expressions	
		-Divisibility and factors														-simple operations on algebraic expressions	
		-Prime numbers														-linear equations	
		-Prime factorization														-linear inequalities	
		-Least common multiple														-quadratic equations	
		-Greatest common divisor														-relations and functions-one to one and one to many	
		Negative numbers and Absolute value														-graphs of functions	
		-Negative number basics														-interpretation of graphs	
		-Adding and subtracting negative numbers														-equation of a line	
		-Multiplying and dividing negative numbers														-construction-bisector and line segment	
		-Absolute value														-loci-point of a circle	

Decimals					Plane Geometry
-Conceptualizing decimals and place notation					-angles at a point
-Regrouping decimals					-properties of parallel lines
-Decimals on a number line					-angle properties of a triangle
-Comparing decimals					-triangles
-Adding and subtracting decimals					-polygons
-Multiplying decimals					-circles
-Dividing decimals					-pythagoras theorem
-Converting between fractions and decimals					Mensuration
-Intro to percentages					-length and perimeter
-Percent word problems					-area
-Estimating and rounding with decimals					-volume
-Significant figures					Trigonometry
-Moving the decimal to multiply and divide by 10					-sine, cosine and tangent
-Adding and subtracting decimals percentages and fractions					-graphs of trigonometry
Fractions					-angles of elevation-depression
-Understanding fractions					-bearings-north degree and south..
-Visualizing equivalent fractions					Statistics and probability
-Equivalent fractions and simplified form					-frequency mode and median
-Comparing fractions					-cumulative frequency
-Decomposing fractions					-standard deviation
-Adding and subtracting fractions					-probability
-Adding and subtracting fractions word problems					Vectors and transformation in a plane
-Multiplying fractions					-vectors in a plane
-Dividing fractions					-transformation in the cartesian plane
-Multiplying fractions word problems					-enlargement-plane and scale figures
-Mixed numbers and improper fractions					Sequence and series
-Mixed number addition and subtraction					-pattern of sequences
-Mixed number multiplication and division					-arithmetic progression,geometric progression
-Decimals and fractions					
-Number sets					
Ratios and Proportions					
-Ratios and proportions					
-Rates					
-Unit conversion					
-Metric system unit conversion					
-Fahrenheit and Celsius conversion					
Applying Mathematical reasoning					
-Reading and interpreting data					
-Multistep word problems					
-Inequalities : Greater than and less than basics					
-Cross topic arithmetic					
-Number patterns					
-Constructing numeric expressions					