Higher Studies and Career Guidance Possibilities Suggesting System for Students

W I S J DE ALWIS
2021

Higher Studies and Career Guidance Possibilities Suggesting System for Students

A dissertation submitted for the Degree of Master of Information Technology

W I S J de Alwis
University of Colombo School of Computing
2021

Declaration

The thesis is my original work and has not been submitted previously for a degree at this or any other university/institute.

To the best of my knowledge, it does not contain any material published or written by another person, except as acknowledged in the text.

Student Name: W I S J de Alwis
Registration Number: 2018/MIT/009
Index Number: 18550093

11/30/2021

Signature Date:

This is to certify that this thesis is based on the work of

Mr./~~Ms.~~ W. I. S. J. de Alwis

under my supervision. The thesis has been prepared according to the format stipulated and is of an acceptable standard.

Certified by:
Supervisor Name: Dr. H. A. Caldera

H. A. Caldera

11/30/2021

Signature Date

Abstract

Choosing the perfect higher studies option and a suitable career is essential for success in life. When considering the workers' job skills and satisfaction, it is known that some people get to know that they lack qualifications and skills once they have started their careers. Hence, this issue has lead workers to become unsatisfactory and to produce low-quality output in their operating companies. The root of this problem is choosing the wrong career without knowing their natural skills and qualifications. When considering the subject selection and selecting the right career path, the person should be aware of his/her capabilities and weaknesses and choose them appropriately.

This dissertation report suggests a system to identify higher education paths and suitable careers for a person (student) by processing specific student data, according to Howard Garden's Theory of Multiple Intelligences. The future system would analyse the input data, such as student marks and his/her behavioural qualities and extracurricular skills and suggest suitable subjects for higher studies and a career path. This project would help students target their future careers and produce people capable of relevant job skills in the current job market.

The system will initially fetch all the required data, such as student, subject, class, marks, teachers records. The system will store the data inside a database. When a person (teacher) wants to get details of a student of his higher studies and the future career path, the system will analyse and filter all the required details and display them along with suitable charts for easy understanding. Further, the system will analyse the data and generate teacher performance reports and comprehensive reports, which helps higher managerial decisions.

An MVC platform such as CodeIgniter is was used when developing the system. HTML and Bootstrap were used to develop the system's front-end, while PHP language was used to develop the back-end. MySQL is the database which uses to store all the relevant data. The system was developed from scratch as a stand-alone system in a web environment.

Around thirty two users participated in the evaluation process to determine whether the project's goals were achieved. According to the user evaluation feedback, the system can be decided as a success and can suggest higher studies and career options for students.

Acknowledgements

I would like to convey my heartfelt appreciation to Dr Amitha Caldera, my supervisor, for his helpful advice, encouragement, and essential assistance during the course. More significantly, I received sound advice on how to endeavour a success.

Further, I would like to convey my appreciation to the University of Colombo School of Computing faculty for offering this master's degree program to students interested in pursuing knowledge in the information technology field from the start of the program.

Moreover, I would like to convey my heartfelt appreciation to the personnel at St Peter's College Colombo 4 for their advice and help during the entire process, which began with the data collection procedure. Especially to the Rector (Principal), Rev. Fr. Rohitha Rodrigo, for providing the chance to execute the pilot project and to the ICT division personnel for their encouragement in executing the data collection procedure from students.

Also, I want to convey my heartfelt appreciation to my colleagues at UCSC for their advice, assistance, and invaluable support in ensuring the success of this initiative.

Finally, but certainly not least, I want to express my sincere gratitude to my loving parents and family for providing me with complete freedom to do my project work during the year.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

AI	Artificial Intelligence
CRUD	Create, Read, Update and Delete
EER	Extended Entity Relationship
IDE	Integrated Development Environment
LMS	Learning Management System
MVC	Model-View-Controller
UI	User Interface
UML	Unified Modelling Language
VLA	Virtual Learning Assistant

Chapter 1 - Introduction

1.1 Project Overview

Choosing the perfect higher studies option and a suitable career is an essential factor for success in life. However, when choosing the most suitable higher studies and the career option for a person, the person has to concern about many factors. It is essential to know that the association between human intelligence and education and career is vital. According to Howard Gardner, an American development psychologist who introduced the 'Theory of Multiple Intelligences', humans have numerous distinct processing methods, and these methods are relatively independent of one another. (Gardner & Hatch, 1989) Hence, research conducted by Richard Juma Atela in Maseno University, Kenya, clearly states a strong relationship between Gardner's types of intelligence and career choice (Atela, et al., 2019). This project aims to develop software to guide students to seek the type of their intelligence and suggest a higher education and the career option, with the aid of Howard Gardner's Multiple Intelligences theories.

This chapter will include the project's motivation, a brief discussion of the problem background, the project's objective and scope, the details of the feasibility studies performed, and the requirement analysis and the structure of the dissertation.

1.2 Motivation

Deciding on choosing the appropriate education and career path is essential. One of the main reasons people are not happy with their work is choosing the wrong higher education and not having the proper skills for their career. This had become a significant issue globally nowadays. Apart from the above-stated issue, in Sri Lanka, lack of career guidance, parents and social influence, inadequate education, and lack of other infrastructure facilities have led students to make incorrect decisions in their lives. Not having proper career guidance makes students uncertain when choosing their following higher education. Choosing the right higher education and the career path plays a significant role in every student's life, determining their entire future life. Besides, this does affect the country's economy and wealth. Research confirms that employee happiness does significantly affect directly to productivity in a company (Bellet, et al., 2019)· Therefore, the suggested computer-based solution will aid students in being on the right track and making the correct decision on their future.

1.3 Aim and Objectives

This project aims to develop a computer-based solution to allow students to choose their suitable career path by analysing their scholastic and behavioural aspects using the Multiple Intelligence Theory by Howard Gardner. The result would positively support the students seeking to find their best and the most suitable career paths.

The prime objective is to develop software that provides the best higher education and career path for their students by processing the data according to *Howard Gardner's theory of Multiple Intelligences* (Gardner & Hatch, 1989). The following objectives are also considered.

- To collect data (examination marks/skills / behavioural) of each student by providing a web interface to the teachers.
- To process the collected data accordingly and to display suggestions for subject selections.
- To generate the student field of interest type according to the behaviour of the student.
- To process the data and evaluate the teacher's skills.

1.4 Background of the study

Today, there are various types of new businesses and numerous educational pathways produced, and many higher studies options available for students to pursue their career paths. To decide on a suitable career, students must identify their skills, abilities, and intelligence types. The parents and the school administration play a significant role in this matter and should know their students' skills and intelligence level to guide them to a promising future. However, with the lack of identification of students' skills and intelligence, and the paucity of knowledge of current study options and the career opportunities availability, the parents come up with wrong assumptions and provide inaccurate guidance. Hence, it leads to suggest unsuitable higher studies options and career paths for their students.

Furthermore, many students have failed to identify their skills, abilities, and intelligence level by themselves and choose the proper study path and career. As a result, they select the wrong higher studies options and choose the wrong career path. It triggers people who lack interest in their jobs and negatively affect the country's economy and the industry they work in.

1.5 Scope of the study

The project's primary purpose is to allow students to choose their preferred subjects according to their skills and behaviours and pursue their higher studies and career path. Following modules will be included to achieve this goal.

1. User Management
   a. Provide user logins at different levels.
2. Student and Teacher Management
   a. Add and modify students and teacher details.
3. Managing subjects
   a. Add and removing subjects and lessons.
   b. Assign the type of Multiple Intelligence for a subject by weighing the subject content (lessons) and giving points to each lesson.
4. Managing Examinations
   a. Add, modify, or remove examinations.
   b. Assign the types of multiple intelligences for each question in examinations.
   c. Add or modify the examination marks.
5. Student Skills and Behavioural Management
   a. Add or modify students' extra performances and achievements (such as sports, extracurricular activities and behavioural activities)
   b. Assign the types of Multiple intelligences and points for the above skills and behavioural activities.
6. Manage higher educational and career options.
   a. Maintain higher educational and career options.
   b. Categorise them into different types of Multiple Intelligences.
7. Generating Suggestions and Reports
   a. Generate student subject options according to his/her performance.
   b. Generate higher studies options.
   c. Generate career path options for a student.
   d. Generate teacher evaluation reports.

The main concentration is implementing the main feature of suggesting the students' best higher education and career path and evaluating teachers' skills. The system will be mainly developed as a Web-Based System to input and display the desired output.

1.6 Feasibility Study

During the feasibility study, the following aspects were concerned.

- Economic Feasibility – The suggested project does not need any special software/hardware requirements, and therefore, it is economically feasible.
- Legal Feasibility – The legal implementation feasibility mainly concerned the data protection of the system. As this software mainly collects all the students' data, the data will be encrypted and stored in a MySQL database. The database is password protected.
- Operational Feasibility – The primary users of the suggested software will be teachers. Considering that teachers have limited knowledge of using technological equipment, providing services to the requirements was analysed using how easy the new product will be to operate and maintain after deployment.
- Technical Feasibility – Implies whether the system can be designed and thrived regarding the familiarity with the technology used, the project developer's familiarity, and its size. Following were the tools (technical resources) that were initially decided to build the system.
- Schedule Feasibility – This project must be completed within one year, a strict timeframe is scheduled, and with a manageable project plan, this software can be developed within the given timeframe.

1.7 Structure of the dissertation

The dissertation is presented under six main topics.

- Chapter 1 – Introduction
  - The first chapter of the dissertation explains the entire project's overview, the motivation and the objectives. Further, it describes the problem background, the scope and defines the project feasibility in five different aspects.

- Chapter 2 – Background
  - This chapter describes the requirement analysis conducted and similar systems which have already been implemented. Some similar systems which were discovered are discussed in this chapter. Moreover, this includes a detailed overview of the functional and non-functional requirements of the project.

Further, it considers the systems available and contrasts the functionalities with the proposed system.

- Chapter 3, Analysis and Design
    - This chapter is reserved for discussing the factors relevant to the Analysis & Design of the proposed system. The architecture of the system, design considerations are discussed and presented in a diagrammatic form. Aspects related to the Software requirement specification is also discussed in this chapter. User interfaces and the final results are included in the latter part of this section.

- Chapter 4 – Methodology
    - The progress of the project is described. Moreover, the project's technical background, sample codes with complex flow diagrams are included in this chapter.

- Chapter 5 - Evaluation and Testing
    - This chapter describes the quality aspects, the testing and the evaluation of the project. Sample test cases will also be discussed here.

- Chapter 6 - Conclusion and Future work
    - The final chapter describes the future work that will improve the proposed system's usefulness, together with the concluding remarks.

Chapter 2 – Background

2.1 Introduction

Choosing the best higher education and the professional path is critical to life success. When it comes to job happiness and talents, it is well known that some people discover they lack qualifications and skills after starting their employment. As a result, workers are unsatisfied and create low-quality products in their organisations—problematic career choices without inherent skills and qualifications. Currently, available systems do not recognise this issue or apply solutions. This chapter describes how the new system obtains functional and non-functional needs, compares it to similar systems, and describes the design process.

2.2 Requirement Analysis

Extracting requirements, which is the process of gathering the information about the system that must be created, is vital to producing a well-thought-out solution. There can be some unclear, incomplete, or even inconsistent requirements now. Data was collected from the relevant people in the requirement gathering phase, especially the grades 10, 11 and Advanced Level students. The data was then used to study how the students think of their higher studies path and future career and what obstacles they have to overcome when deciding their future path. Brief discussions were held with them to understand what decisions they have made already at present. At the same time, it noticed what guidance they require when choosing their correct career path.

- ***Interviews -*** To understand the students' perspective on their future ambition and the barriers they have to get through when selecting a subject, a group of thirty (30) students from St. Peter's College, Colombo 04, were interviewed. The students were selected from grades 10, 11 and Advanced Level (ten students from each grade) so that the data collection was non-biased and helpful to get a clearer view.
- ***Observations -*** Observations were carried out to understand the behavioural categories of the students. The behavioural patterns of grades 10, 11 and Advanced Level students were especially monitored during this process. Clarifications in the observation stage were discussed with the school administration and the teachers to learn the current process.

By going through the collected requirements, functional and non-functional requirements were generated.

2.2.1 Functional Requirements

Functional Requirements contains the core requirements which are expected from the proposed solution. These explain the inputs and outputs of the solutions based on user expectations.

- The system administrator has the access and rights to configure all the master data (pre-defined data) in the system. (such as Point values for various behavioural aspects)
- The system administrator should create different user logins.
- A chosen member from the staff (act as the Staff Administrator) should add students / remove students from the system.
- The Staff Administrator should have the privilege of adding/removing examination details to the system.
- The staff administrator has the privilege to assign the type of Multiple Intelligence for a subject by weighing the subject content (lessons) and giving points to each lesson.
- The staff administrator can add/remove the examinations, add or modify extra performances and achievements of students (such as sports, extracurricular activities, behavioural activities) and assign multiple intelligences and points for the above skills and behavioural activities.
- The staff administrator should maintain higher educational and career options and categorise them into different types of Multiple Intelligences.
- Teachers should be able to modify the students' marks and their behavioural data.
- Teachers should be able to assign the types of multiple intelligences for each question in examinations.
- Both staff administrators and teachers can generate student performance reports, higher studies options, students career path, and teacher evaluation reports.

2.2.2 Non-functional requirements

Non-Functional requirements are the non-technical requirements of the project. However, some of these requirements are essential for the system to operate.

- **User Interface**
  - Dashboard support for different devices – Since the system is web-based, any device with a web browser can be used.
  - Support commonly used resolution sizes – Minimum 1024 x 768
  - Page loading time – 1 to 4 seconds.
  - Individual chart loading time – 2 to 4 seconds.

- **Accessibility**
    - Compliance to accessibility (Colour-blind users, etc.) – No
    - System Accessible – only for the internal staff of the school.
    - Minimum Network Bandwidth – Standard network bandwidth.
- **Availability**
    - Server failures and network downtimes will stop system availability until servers get restored – Yes
    - Available 24 x 7 – Yes
- **Security**
    - Role-based authorisation – Yes
- **Data Retention**
    - Data archival period – 12 years
- **Concurrency**
    - Number of concurrent users (for efficient and smooth system running) – 50 users
- **Scalability**
    - User growth per year – 500 per annum

2.3 Review of Similar Systems

2.3.1 'Essential Skills' software **(Skills, 2021)**

Essential Skills instructional software is designed for elementary pupils, and older remedial learners find it to be an invaluable tool for both teachers and students. This program gives a personalised learning environment and specific attention to each student. It has a 'Assessment function' that generates tailored programs to target skill weaknesses. Furthermore, all programs contain Marks Manager, a student monitoring, assessment, and reporting system. *(Figure 1)*

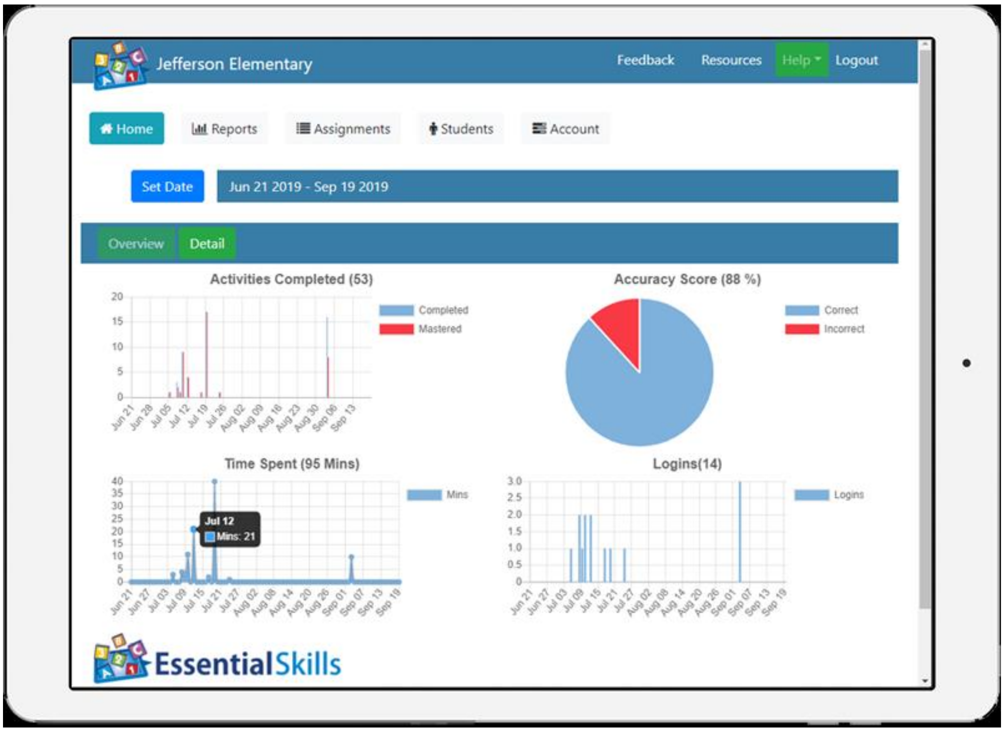
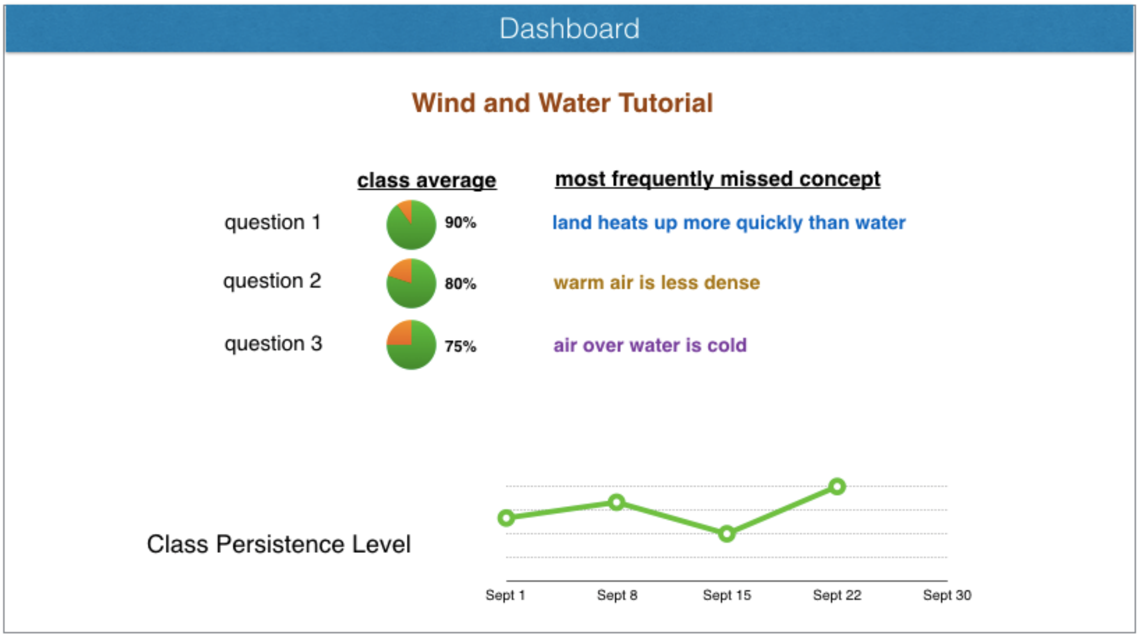


Figure 1 - Essential Skills Software - It automatically individualises instruction for every student.

2.3.2 Cognii's Virtual Learning Assistant (Cognii, 2021)

Cognii VLA is an AI Tutor that engages students in a natural language conversation while providing instant personalised feedback and assessments. It can automatically grade students' open-response (short essay) answers and extract rich pedagogical insights and analytics to improve faculty members' productivity. Cognii open-response assessments support high-quality pedagogies of critical thinking and problem-solving skills, essential for success in the 21st century workforce compared to traditional multiple-choice tests. Cognii Analytics displays real-time insights for educators with unique high-resolution data valid for personalisation and intervention. It reveals knowledge gaps and mastery at the concept level, gives graphical overviews at the class, student, question, or specific concept level, the option to "replay" any Cognii-student conversation or virtual tutoring, downloadable reports, and is incorporated into the Cognii Learning Platform. *(Figure 2)*



Dashboard

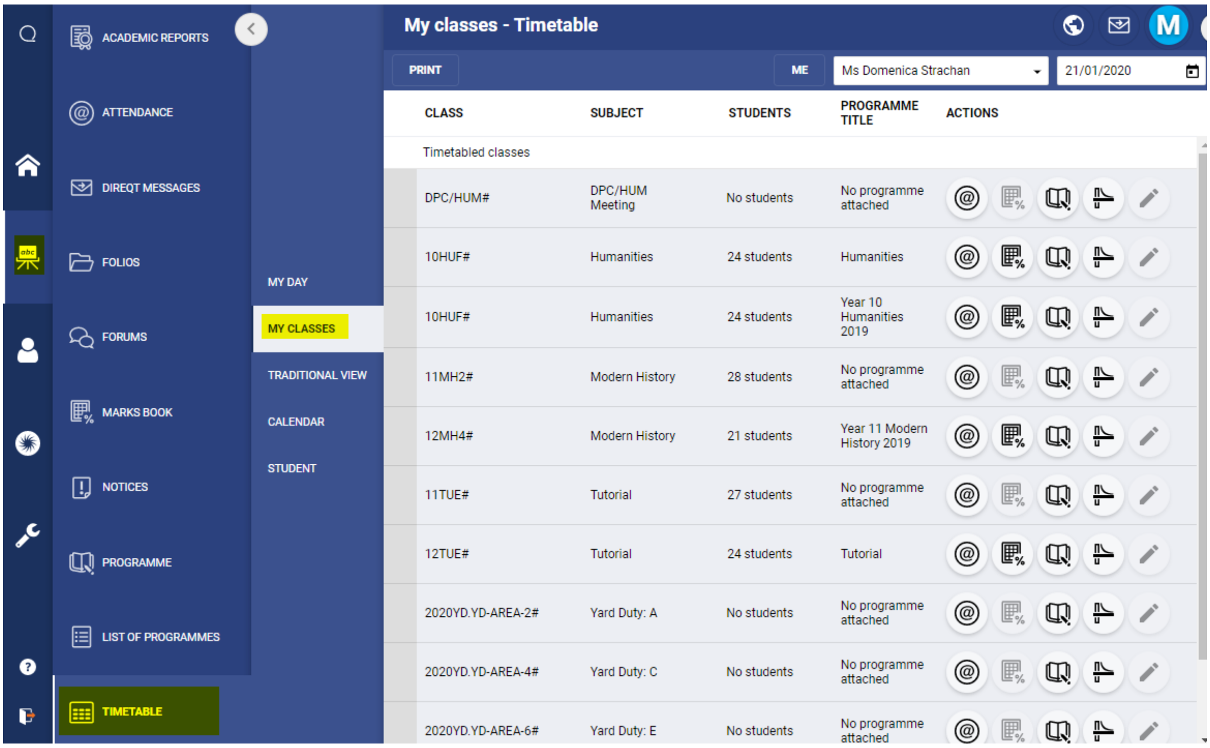
Wind and Water Tutorial

	class average	most frequently missed concept
question 1	90%	land heats up more quickly than water
question 2	80%	warm air is less dense
question 3	75%	air over water is cold

Figure 2 - Cognii Analytics displays real-time insights for educators.

2.3.3 SEQTA Analyse (Software, 2021)

SEQTA is a School Learning Management System (LMS) for teachers that streamlines teaching and expands student learning. SEQTA's intelligent, instinctive workflows naturally reduce workloads, allowing teachers to focus on what is important to children. It promotes transparency in the teaching and learning process, allowing everyone in the school to examine lessons, units of work, student results, feedback, and wellbeing data. SEQTA Analyse is a robust data analytics tool that offers a wide range of pre-defined and customisable reports, including academic achievement, academic progress, attendance analytics, pastoral care analytics and program analytics. The data captured from the teachers' activities in its LMS platform is used for the insights. *(Figure 3)*



My classes - Timetable

Ms Domenica Strachan

21/01/2020

CLASS	SUBJECT	STUDENTS	PROGRAMME TITLE	ACTIONS
Timetabled classes				
DPC/HUM#	DPC/HUM Meeting	No students	No programme attached	
10HUF#	Humanities	24 students	Humanities	
10HUF#	Humanities	24 students	Year 10 Humanities 2019	
11MH2#	Modern History	28 students	No programme attached	
12MH4#	Modern History	21 students	Year 11 Modern History 2019	
11TUE#	Tutorial	27 students	No programme attached	
12TUE#	Tutorial	24 students	Tutorial	
2020YD.YD-AREA-2#	Yard Duty: A	No students	No programme attached	
2020YD.YD-AREA-4#	Yard Duty: C	No students	No programme attached	
2020YD.YD-AREA-6#	Yard Duty: E	No students	No programme attached	

Figure 3: SEQTA Software Homepage

2.3.4 SPA Standard (Spaplatform.com.au, 2021)

The SPA standard module is a tool for educational institutes that analyses, displays, stores & communicates students' summative assessment data. It colour-codes the data to reflect the year level at which each student works, allowing them to see the students' spread of abilities. It can compare scores against the state and national benchmarks to understand where the students sit compared to other students. It can also produce reports that allow to interpret and monitor the individual students' growth. By uploading the school's data, SPAstandard can analyse and display results to quickly classify students performance, long term school tendencies and how much "value-added learning" is occurring. Staff members can also identify student misconceptions and gaps in knowledge or curriculum delivery. *(Figure 4)*

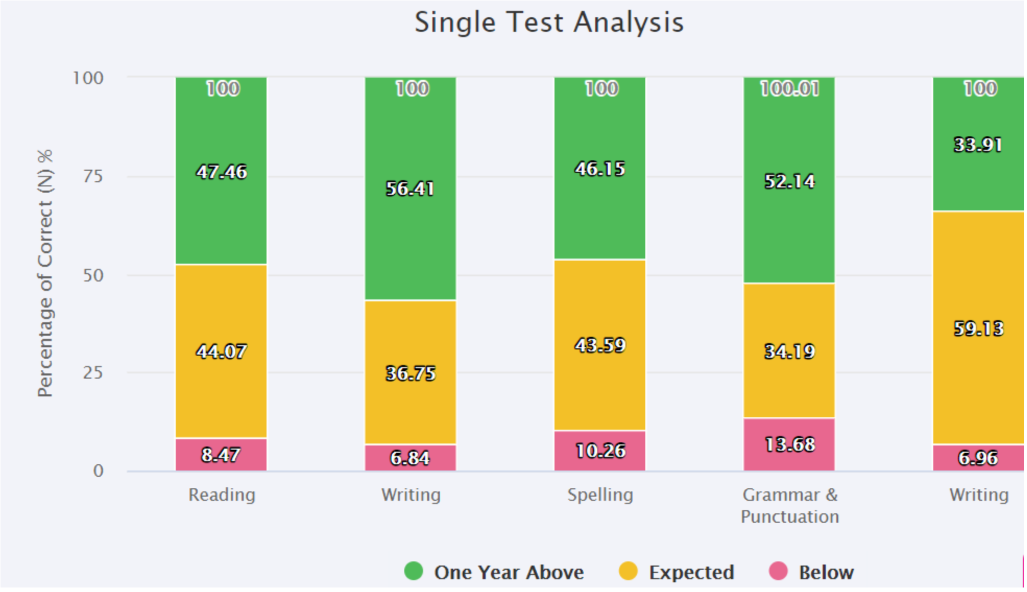


Figure 4 - The SPA Standard tool can represent an individual student's performance using charts.

2.3.5 'Edu-One' Career Guidance Platform (Edu-One, 2021)

Edu-One is the first-ever comprehensive career guidance platform in Sri Lanka, helping students understand their passion, abilities and make well-informed career decisions. The platform helps students understand their passion, skills, and demand in the job market to make lucrative career decisions by analysing them with a questionnaire. It uses a custom evaluation model to obtain results according to the given answers by students. Their independent & unbiased entity helps students find the best suited academic path and higher education provider(s) aligned with their career aspirations and financial ability. *(Figure 5)*

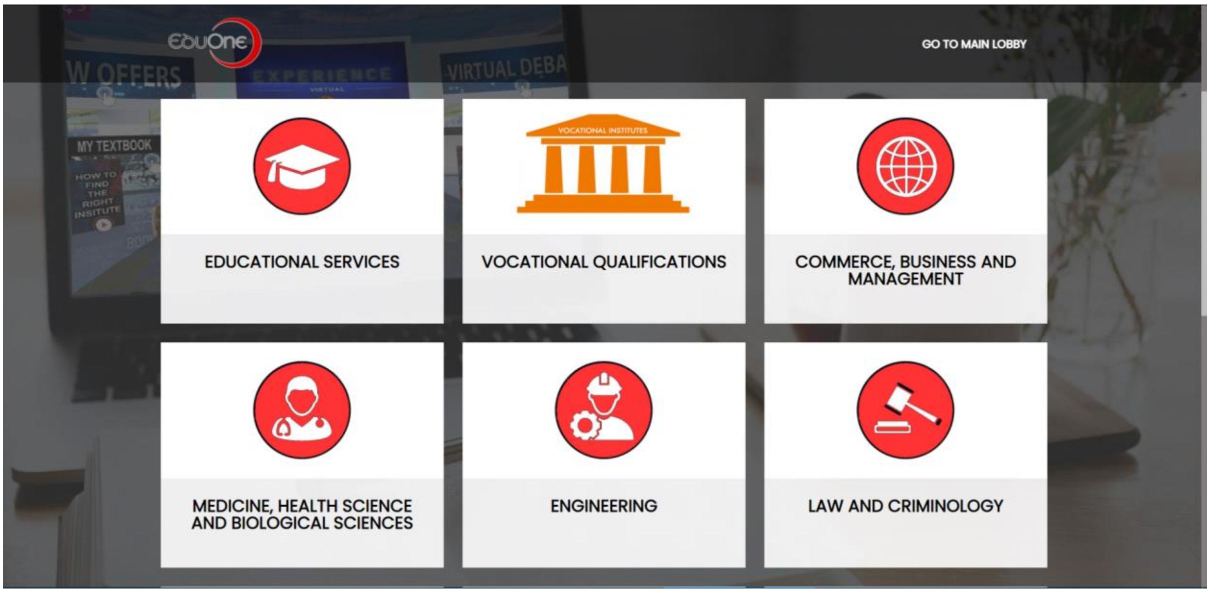

EduOne
GO TO MAIN LOBBY
W OFFERS
EXPERIENCE
VIRTUAL DEBA
MY TEXTBOOK
HOW TO FIND THE RIGHT INSITUTE
VOCATIONAL INSTITUTES
EDUCATIONAL SERVICES
VOCATIONAL QUALIFICATIONS
COMMERCE, BUSINESS AND MANAGEMENT
MEDICINE, HEALTH SCIENCE AND BIOLOGICAL SCIENCES
ENGINEERING
LAW AND CRIMINOLOGY

Figure 5: 'EduOne' Homepage

2.4 Quality of the solution

The proposed project will address all the available functions and the impaired functions of the systems mentioned above. *(Table 1)*

Features of the new software	**‘Essential Skills’ software**	**Cognii’s Virtual Learning Assistant**	**SEQTA Analyze**	**SPA Standard**	**‘Edu-One’ Career Guidance Platform**
User Management	✓	✓	✓	✓	✓
Student & Teacher Management	✓	✓	✓	✓	
Managing Subjects	✓	✓	✓	✓	
Managing Examinations			✓	✓	
Student Skills & Behavioural Management					✓
Manage Higher Education & Career options					✓
Generating Suggestions & Reports	✓	✓	✓	✓	✓

Table 1 - Quality of the Solution

2.5 Related Design Strategies

- The proposed system plans to develop from scratch on Model-View-Controller (MVC) architecture using CodeIgniter MVC Framework. The (MVC) is an architectural design that splits an application into three main logical mechanisms: the model, the view, and the controller *(figure 6)*. The Model component resembles all the data-related logic that the user works with. The View module is used for all the User Interface logic of the application. Controllers act as an intermediate between the Model and View components to process all the business logic and incoming requests, operate data using the Model component and interact with the Views to render the final output. (TutorialsPoint, 2021)

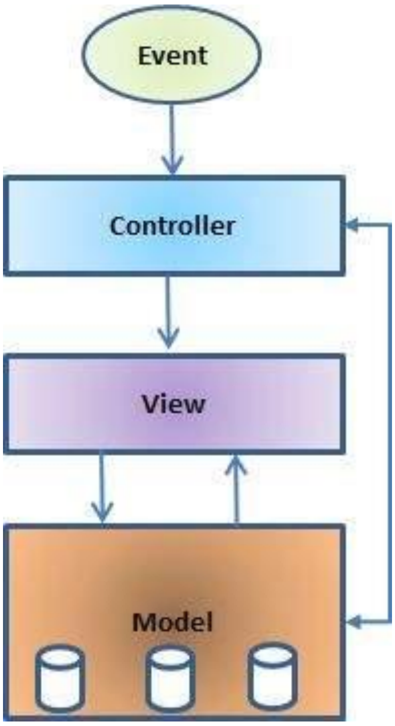


Figure 6 - MVC Architecture (TutorialsPoint, 2021)

Hardware and Software requirements are as follows:

- Minimum Hardware Configuration (Developer PC)
  - Intel Core i3 Processor,
  - 2 GB RAM
  - 32-Bit/64-Bit Operating System
  - 100 GB Hard Disk Drive

- Software / Application Configuration (Developer PC)
    - Apache Web Server 2.4.9
    - PHP 5.5.12 and PHP MyAdmin support
    - MySQL server 5.6.17
    - Sublime Text code editor
- Minimum Hardware Configuration (Server)
    - 3.0Ghz Intel Processor
    - 4 GB RAM
    - 100 GB Free Hard Disk Drive
- Software/Application Configuration (Server)
    - Apache Web Server 2.4.9
    - PHP 5.5.12
    - MySQL server 5.6.17
- Minimum Hardware Configuration (Client)
    - Any network-connected PC has a processor speed of more than 2.0 GHz.
- Software/Application Configuration (Client)
    - JavaScript enabled Web Browser

2.6 Summary

In the background chapter, the requirement analysis is briefly explained and stated how the analysis was done using students to identify the new system's requirements. The functional and non-functional requirements were then listed using the above results. A similar systems review was done and contrasted the differences between them and the new system to highlight the features, with the help of the requirement analysis. Thus, it further signifies that the importance of the new system. Also, the design strategy implies the system's environmental requirements such as hardware, software, and architecture. Complete detail of the system development is included under the next chapter.

Chapter 3 - Methodology

3.1 Introduction

This chapter describes the system’s architecture, example user interfaces, and UML diagrams to help the reader visualise the project's overall structure and present diverse perspectives to help the reader to gain a better grasp of the project's overall structure.

3.2 System Architecture

System development's design and implementation phase will address the proposed system's design utilising the unified modelling language (UML) and converting the design into the necessary design specifications into source code. The implementation's primary purpose is to write the source code while adhering to the standards. In this project, PHP and MySQL were used to create the back-end, while HTML, CSS, and Bootstrap were utilised to create user-friendly interfaces because they are the most suited and preferred programming languages for creating web-based applications. Figures in the following chapters show the designed ER diagrams and UMLs.

3.3 User Interface Design

A user interface (UI) design specifies how a single user interacts with a digital information system. Any user interface design aims to make the user's interaction with the device and the interface as seamless as possible. The following are some of the User Interfaces included in the HTML and Java-based application (Bootstrap).

3.3.1 Teacher Login Interface (figure 7)

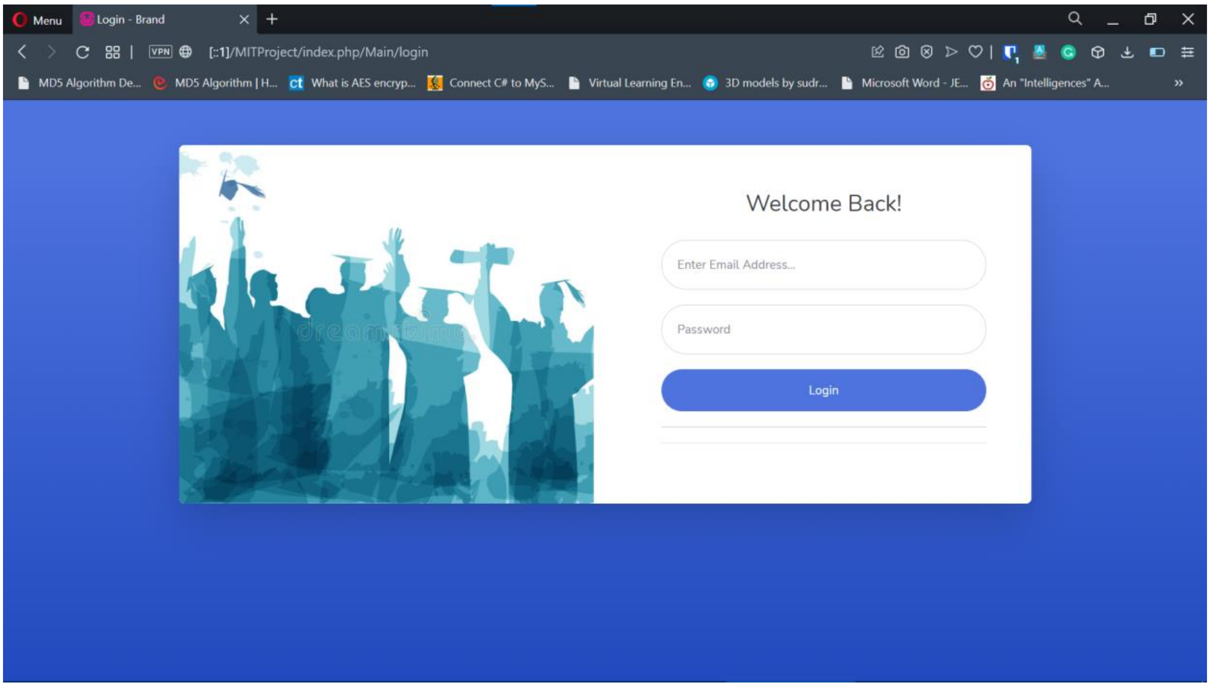
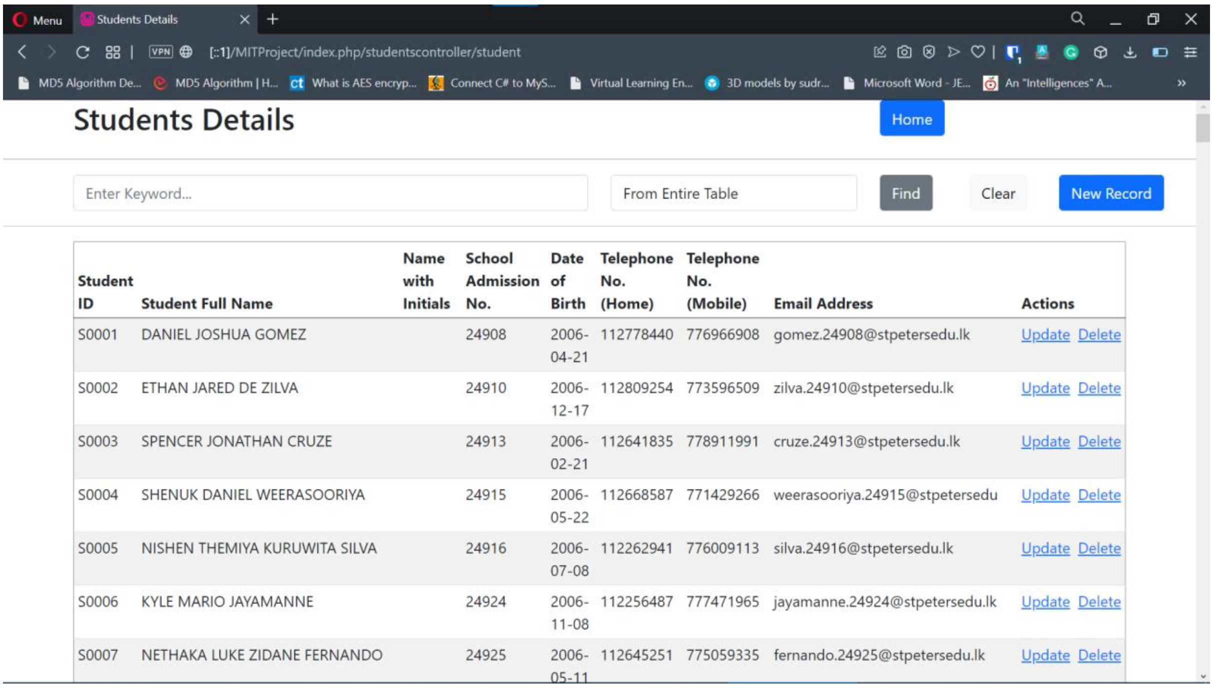


Figure 7 Teacher Login Interface

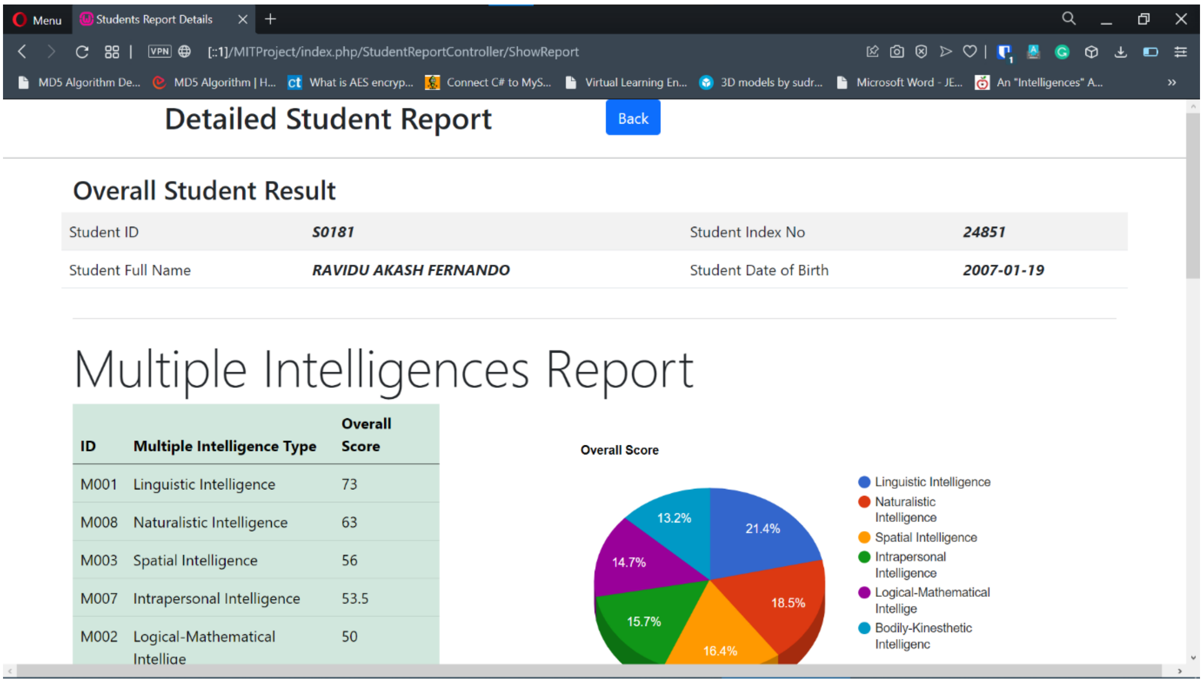
3.3.2 Student Information Find page interface (figure 8)



Student ID	Student Full Name	Name with Initials	School Admission No.	Date of Birth	Telephone No. (Home)	Telephone No. (Mobile)	Email Address	Actions
S0001	DANIEL JOSHUA GOMEZ		24908	2006-04-21	112778440	776966908	gomez.24908@stpetersedu.lk	Update Delete
S0002	ETHAN JARED DE ZILVA		24910	2006-12-17	112809254	773596509	zilva.24910@stpetersedu.lk	Update Delete
S0003	SPENCER JONATHAN CRUZE		24913	2006-02-21	112641835	778911991	cruze.24913@stpetersedu.lk	Update Delete
S0004	SHENUK DANIEL WEERASOORIYA		24915	2006-05-22	112668587	771429266	weerasooriya.24915@stpetersedu	Update Delete
S0005	NISHEN THEMIYA KURUWITA SILVA		24916	2006-07-08	112262941	776009113	silva.24916@stpetersedu.lk	Update Delete
S0006	KYLE MARIO JAYAMANNE		24924	2006-11-08	112256487	777471965	jayamanne.24924@stpetersedu.lk	Update Delete
S0007	NETHAKA LUKE ZIDANE FERNANDO		24925	2006-05-11	112645251	775059335	fernando.24925@stpetersedu.lk	Update Delete

Figure 8 Student Information Find page

3.3.3 Student Details Viewing Interface (figure 9)



Detailed Student Report

Overall Student Result

Student ID	*S0181*	Student Index No	*24851*
Student Full Name	*RAVIDU AKASH FERNANDO*	Student Date of Birth	*2007-01-19*

Multiple Intelligences Report

ID	Multiple Intelligence Type	Overall Score
M001	Linguistic Intelligence	73
M008	Naturalistic Intelligence	63
M003	Spatial Intelligence	56
M007	Intrapersonal Intelligence	53.5
M002	Logical-Mathematical Intellige	50

Figure 9 Student Details Viewing Interface

3.4 UML Diagrams

3.4.1 EER Diagram

An Entity–Relationship diagram in software engineering illustrates entities and their relationships, which are commonly used in computing for data organisation within databases or information systems. A piece of data, an item, or a notion about which data is recorded is referred to as an entity. Entities and the interactions that can exist between them are the core components of ER models. (Farouk, 2016) The EER diagram below *(in figure 10)* illustrates the main entities used as tables, such as Teacher, Class, Subject, Multiple Intelligence Categories, Examinations, Marks, and each table's attributes (columns). Further, it implies the relationship and the cardinality between each table. It helps to build the database with refined functional dependencies and to prevent anomalies.

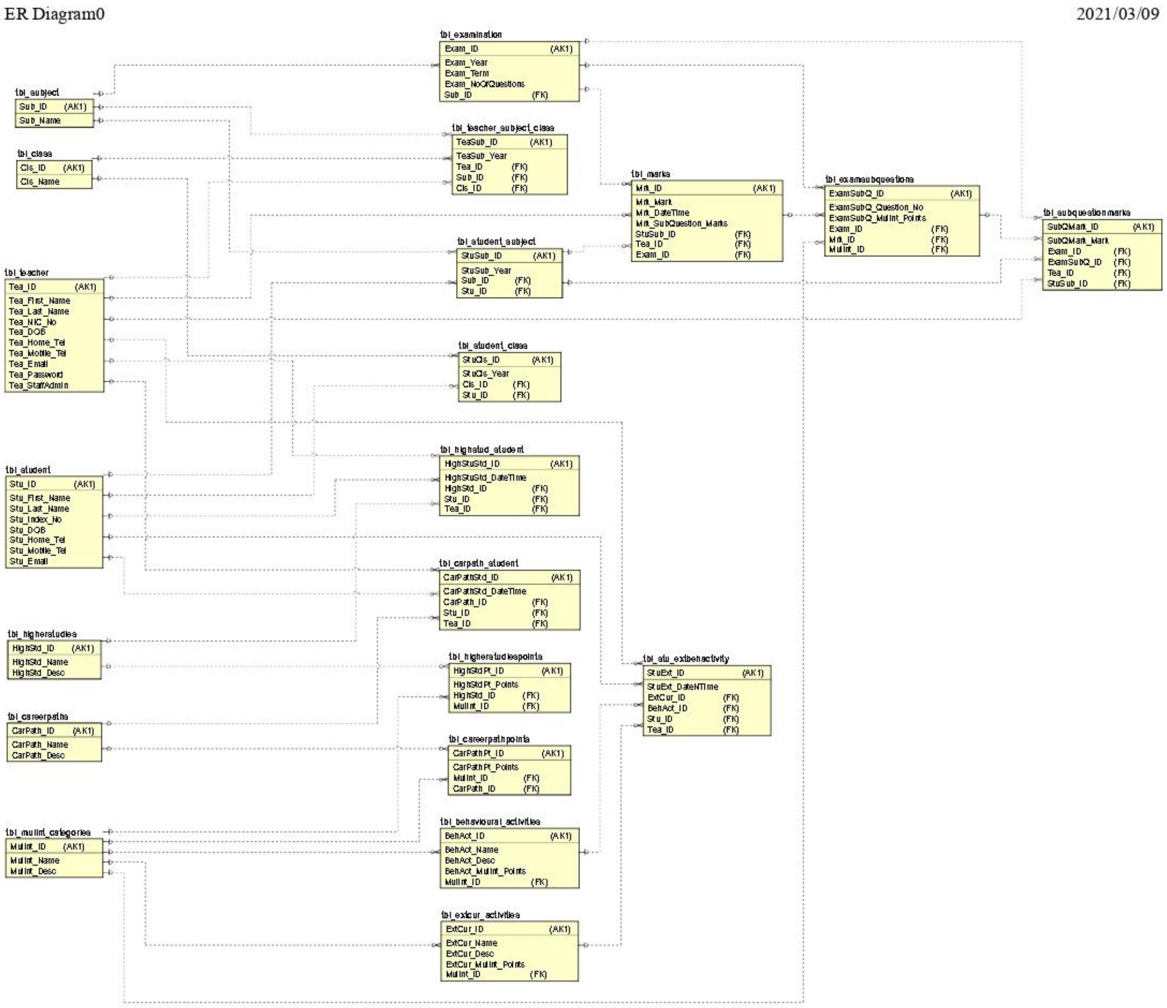


Figure 10: The EER Diagram

The above EER diagram *(Figure 10)* illustrates the basic structure of the project's database. Entities such as student, teacher, subject, class, higher studies, career paths and Multiple Intelligence categories are set into tables. Other tables such as Examination, Marks, teacher subject relationships, student subject relationships, student class relationships, student multiple intelligence relationships use the foreign keys from the tables mentioned previously. Most of these tables are highly co-related to reduce the data redundancy and increase data consistency and reliability. The relationship between the tables is mentioned clearly in the relational database model below.

3.4.2 Relational Database Model

- **Subject** (Subject_ID, Subject Name)
- **Class** (Class_ID, Class Name)
- **Teacher** (Teacher_ID, First_Name, Last_Name, NIC_No, DateOfBirth, Home_Tel, Mobile_Tel, Email, Password, isStaffAdmin)
- **Student** (Student_ID, First_Name, Last_Name, Index_No, DateOfBirth, Home_Tel, Mobile_Tel, Email)
- **HigherStudies** (HigherStudies_ID, Name, Description, *MultipleIntelligence_ID*)
- **CareerPaths** (CareerPath_ID, Name, Description, *MultipleIntelligence_ID*)
- **MultipleIntelligenceCategories** (Category_ID, Name, Description)
- **Examination** (Examination_ID, Year, Term, NoOfQuestions, *Student_ID*)
- **Teacher_Subject_Class** (TeacherSubjectClass_ID, Year, *Teacher_ID, Subject_ID, Class_ID*)
- **Student_Subject** (StudentSubject_ID, Year, *Subject_ID, Student_ID*)
- **Student_Class** (StudentClass_ID, *Student_ID, Class_ID*)
- **BehaviouralActivities** (Behavioural_ID, Name, Description, *MultipleIntelligence_ID*)
- **Marks** (Marks_ID, *StudentSubject_ID, Exam_ID, Teacher_ID*, Mark, Date&Time, SubQuestionMarks)
- **StudentExtraCurricularBehaviourActivity** (StudentActivity_ID, *ExtraCurricular_ID, Behavioural_ID, Student_ID, Teacher_ID*, Date&Time)

Note: Primary Keys are denoted with an Underline, and Foreign keys are referenced in the *Italic format* in the above relational data model.

3.4.3 Class Diagram

A class diagram is a static structure diagram in UML and describes the types of objects in the system and the various kinds of static relationships. Class diagrams are the primary building block in object-oriented modelling. It is used both for general conceptual modelling of the systematics of the application and for detailed modelling, translating the models into programming code. (DOONDO, 2021)

Below is the Class diagram of the proposed project. *(Figure 11)*

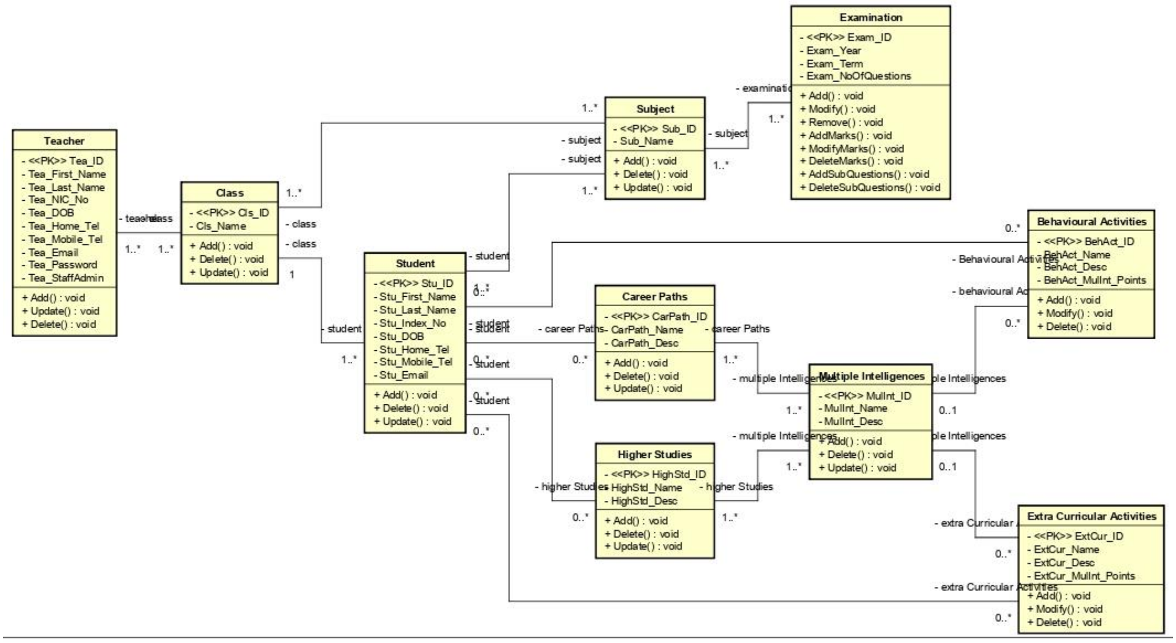


Figure 11 - Class Diagram of the proposed system

3.4.4 Use Case Diagram

A Use-Case diagram is a graphic that allows the reader to visualise the architectural blueprints of a system. UML depicts the many actions that users can carry out in the system and represents the system's dynamic features. It also provides users' perspectives on the system. Actors in a Use-Case diagram are system users who play specific roles. Below *(Figure 12)* is the overall Use Case Diagram of the proposed project, which implies the significant functions as use cases.

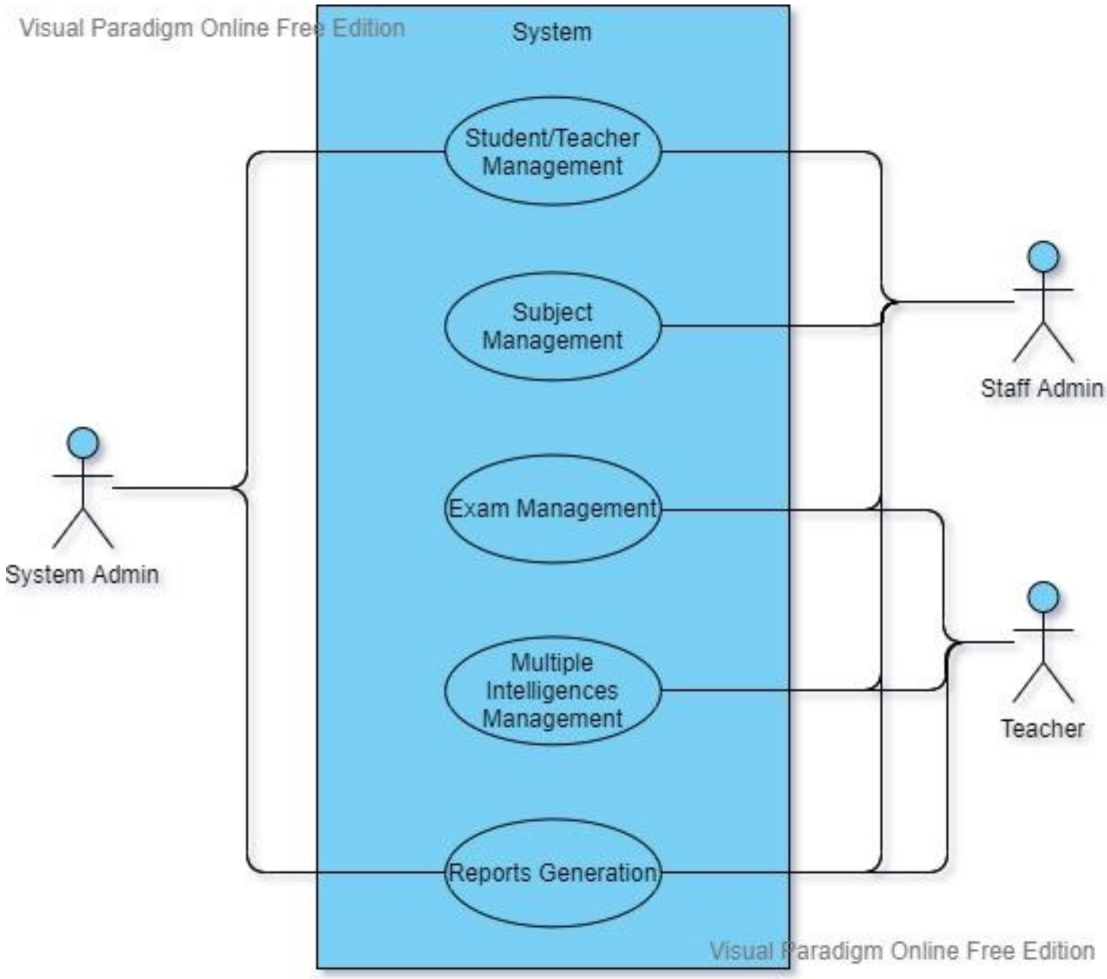

Visual Paradigm Online Free Edition
System
Student/Teacher Management
Subject Management
Exam Management
Multiple Intelligences Management
Reports Generation
System Admin
Staff Admin
Teacher
Visual Paradigm Online Free Edition

Figure 12 – Overall Use Case Diagram of the proposed system

The functions and subfunctions of each use case are described in *Appendix A.*

3.4.5 High-Level Architecture Diagram

A high-level Architecture Diagram describes the architecture used to create a system. The architectural diagram depicts a whole system, highlighting the significant components built for the product and their interfaces. (Sommerville, 2016)

The High-Level Architecture Diagram is given below *(Figure 13)* implies the connectivity between the users and the system. The system is based on a 3-tier Model View Controller (MVC) architecture.

3.4.5.1 Model-View-Controller (MVC) Architecture

The Model-View-Controller (MVC) shows the connectivity between each component in different tiers. The users mainly interact with the components in the 'Controller' tier. Different users' accessibility for different components is shown in this diagram. The View tier components interact with the Controller tier components, and the Controller Tier components interact with the Model tier components. The Model components are directly in contact with the database. When a user submits the request to the controller, it will collect relevant data from the Model component (from the database) and send it to the view component. The user sees the outcome through the View component *(figure 13)*.

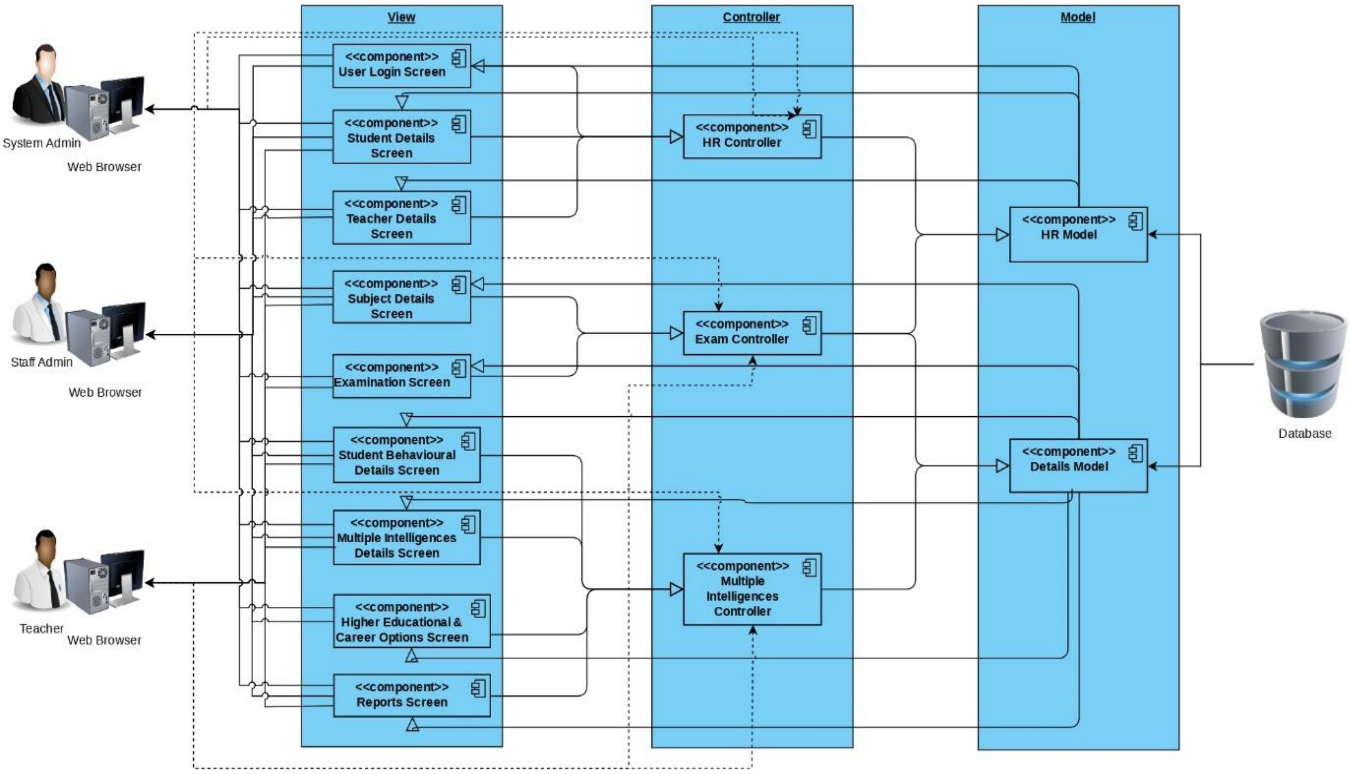

View
Controller
Model
System Admin
Web Browser
Staff Admin
Web Browser
Teacher
Web Browser
<<component>> User Login Screen
<<component>> Student Details Screen
<<component>> Teacher Details Screen
<<component>> Subject Details Screen
<<component>> Examination Screen
<<component>> Student Behavioural Details Screen
<<component>> Multiple Intelligences Details Screen
<<component>> Higher Educational & Career Options Screen
<<component>> Reports Screen
<<component>> HR Controller
<<component>> Exam Controller
<<component>> Multiple Intelligences Controller
<<component>> HR Model
<<component>> Details Model
Database

Figure 13 High Level Architecture Diagram of the System

3.5 Summary

The approach of the system design is clearly explained in this chapter. The System Architecture section mentions the design tools, such as PHP, MYSQL, HTML and CSS, that were used to develop this system. Sample user interfaces are included in the user interface design section to allow the reader to get an idea of how the final system would look. In the UML Diagrams section, the EER diagram, Relational database model, the class diagram, the use case diagram and a high-level architecture diagram is included to allow the reader to capture the overall idea of the system structure. The next chapter will describe how the system was developed using the tools mentioned above.

Chapter 4 - Implementation

4.1 Introduction

This chapter describes the project's implementation environment. The components that were re-used to build the application, the related technologies used, and the sample code segments that were taken from the application are briefly mentioned in this chapter.

4.2 Implementation Environment

The implementation environment is below to display the relevant hardware and software used to develop the project.

Hardware Environment:

- Processor: Intel(R) Core(TM) i7-1065G7 CPU @ 1.30GHz   1.50 GHz
- RAM: 16.0 GB
- System Type: x64-based PC
- Storage Device (SSD): Kioxia XG6 M.2 512 GB PCI Express 3.0 3D TLC NVMe (KXG60ZNV512G)
- GPU: Intel(R) Iris(R) Plus Graphics

The hardware mentioned above configuration is vital for developing, testing the project, and running the development software mentioned below.

Software Environment:

- Operating System: Windows 10 Home Single Language
- Web Development Environment: WAMPServer**
- Database Development Environment: MySQL

**WampServer enables users to install a server on their Windows machine and create active web applications with Apache, PHP, and the MySQL database under the same development conditions as on the development server. One of the great advantages of WampServer is that it allows you to construct, update components, do any web development work, and test everything offline to begin with, reducing the chances of problems on the live server.

4.3 Re-used Components

Following built-in components were re-used in the project.

- Bootstrap: Bootstrap is a massive repository of reusable HTML, CSS, and JavaScript code. It is also a front-end development platform that lets designers and developers create entirely responsive websites quickly. (OUELLETTE, 2021)

4.4 Related Technologies

Following technologies and IDEs were used during the project development.

- Apache Web Server

The webserver technology used in the proposed web application is Apache Server. It is a popular web server program that many people use. An open-source developer community creates and maintains Apache.

- PHP

PHP is a popular open-source general-purpose scripting language ideal for web development and can be embedded in HTML. The PHP code is executed on the web server, and the resulting HTML is sent to the client. Except for the underlying code, the client would obtain the results of running that script. PHP is a web programming language with a built-in interface with the most popular open-source database MySQL.

- MySQL Server

MySQL is a well-known and straightforward RDBMS language. It is available under an open-source license. It manages a significant portion of the functionality found in the most expensive and powerful database solutions. Furthermore, MySQL employs a standard version of the well-known SQL data language, and it performs admirably even with massive data volumes.

- HTML 5

HTML is the mark-up language widely used to develop websites. HTML 5 is the latest, and it has many new features and supports all modern browsers. HTML 5 widely supports multimedia and graphics.

- PhpStorm

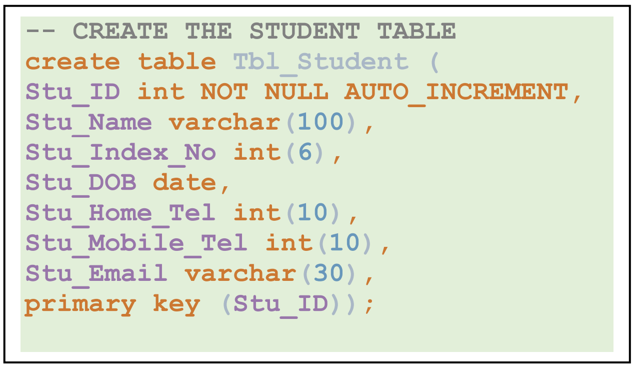
PhpStorm is an intelligent and lightweight PHP IDE that focuses on developer usability. It has a thorough understanding of the code and can include intelligent code completion and on-the-fly error testing.

4.5 Major Code Segments

The necessary sample codes of the project are mentioned below.

4.5.1 SQL Database

- Student Table Creation *(Figure 14)*

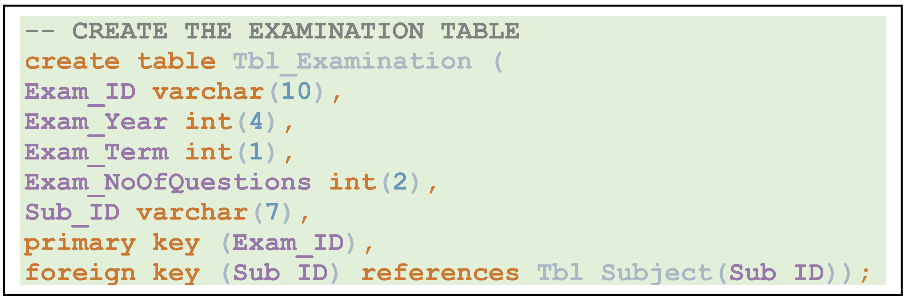


```sql
-- CREATE THE STUDENT TABLE
create table Tbl_Student (
Stu_ID int NOT NULL AUTO_INCREMENT,
Stu_Name varchar(100),
Stu_Index_No int(6),
Stu_DOB date,
Stu_Home_Tel int(10),
Stu_Mobile_Tel int(10),
Stu_Email varchar(30),
primary key (Stu_ID));
```

Figure 14: Student Table Creation

The ‘Student’ table in the database stores the primary details of the student. The table includes the Student ID (Autoincrement value), Student Name (First Name and the Last Name), Student Admission (Index) Number, Date of Birth, Home Telephone Number, Mobile Telephone Number, and the Email address of the student. The Primary key of the student is the ‘Stu_ID’.

- Examination Table *(Figure 15)*



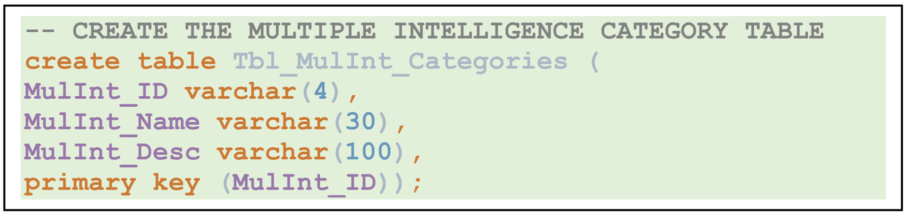
```sql
-- CREATE THE EXAMINATION TABLE
create table Tbl_Examination (
Exam_ID varchar(10),
Exam_Year int(4),
Exam_Term int(1),
Exam_NoOfQuestions int(2),
Sub_ID varchar(7),
primary key (Exam_ID),
foreign key (Sub ID) references Tbl Subject(Sub ID));
```

Figure 15: Examination Table Creation

The ‘Tbl_Examination’ stores the Examination details. It includes the *Exam_ID*, Year of the exam *(Exam_Year)*, Exam Term *(Exam_Term)*, Total Number of Questions

(Exam_NoOfQuestions), and the Subject ID *(Sub_ID)*. The Primary Key is *Exam_ID*, whereas the Foreign Key is the *Sub_ID* which refers to the *Sub_ID* of the Tbl_Subject (Subject Table).

- Multiple Intelligences Category Table *(Figure 16)*

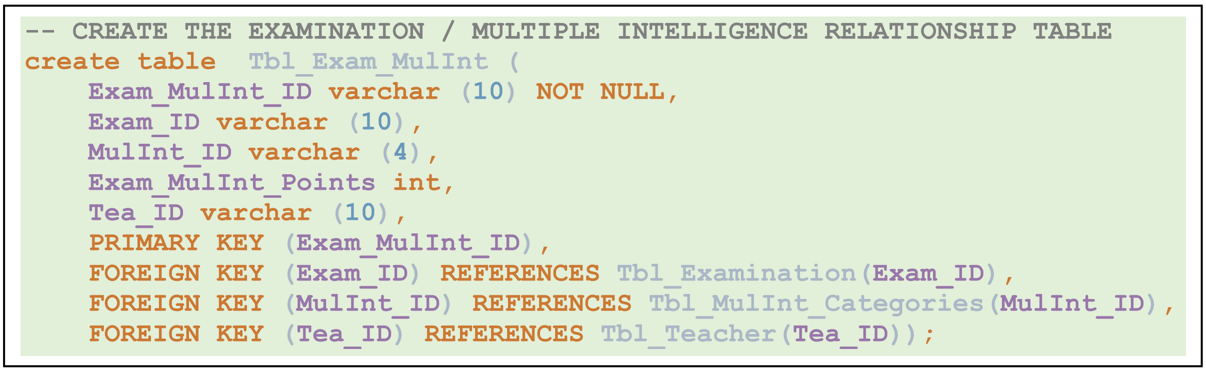


```
-- CREATE THE MULTIPLE INTELLIGENCE CATEGORY TABLE
create table Tbl_MulInt_Categories (
MulInt_ID varchar(4),
MulInt_Name varchar(30),
MulInt_Desc varchar(100),
primary key (MulInt_ID));
```

Figure 16: Multiple Intelligences Category Table Creation

The 'Multiple Intelligences Category' table includes the details of Multiple Intelligences categories introduced by Howard Gardner. It includes the Multiple Intelligences ID *(MulInt_ID)*, The name of the Intelligence *(MulInt_Name)*, and the description of the multiple Intelligence *(MulInt_Desc)*. The Primary Key is the *MulInt_ID* which is referenced in other tables as a Foreign Key.

- Examination / Multiple Intelligences Relationship Table *(Figure 17)*



```
-- CREATE THE EXAMINATION / MULTIPLE INTELLIGENCE RELATIONSHIP TABLE
create table  Tbl_Exam_MulInt (
    Exam_MulInt_ID varchar (10) NOT NULL,
    Exam_ID varchar (10),
    MulInt_ID varchar (4),
    Exam_MulInt_Points int,
    Tea_ID varchar (10),
    PRIMARY KEY (Exam_MulInt_ID),
    FOREIGN KEY (Exam_ID) REFERENCES Tbl_Examination(Exam_ID),
    FOREIGN KEY (MulInt_ID) REFERENCES Tbl_MulInt_Categories(MulInt_ID),
    FOREIGN KEY (Tea_ID) REFERENCES Tbl_Teacher(Tea_ID));
```

Figure 17: Examination / Multiple Intelligence Relationship table creation

This table stores the details of the relationship between the Exams and the Multiple Intelligences Types. The Primary Key is the *Exam_MulInt_ID* followed by Examination ID *(Exam_ID)*, Multiple Intelligences ID *(MulInt_ID)*, Multiple Intelligences Points *(Exam_MulInt_Points)*, and the Teachers' ID *(Tea_ID)* who enters the record.

Note: The column names of each table starts with the partial name of the table to identify a particular column quickly, especially when referenced in another table as a Foreign Key.

4.5.2 PHP Code

- Code Segment 1 – Teacher Login function *(Figure 18)*

```
public function teacherlogin() {
      $this->load->view( 'teacherlogin' );
      if ( $this->input->post( 'login' ) ) {
         $data[ 'userid' ] = $this->input->post( 'LoginID' );
         $data[ 'password' ] = $this->input->post( 'pw' );
         $result['Tea_ID'] = $this->MODELDB->teacherlogin( $data );
         if ( empty( $result ) ) {
            echo "Invalid Teacher ID/Password. Please re-check.";
         } else {
            $data['teacherID'] = $result['Tea_ID'];
                                          $this->teacherhomepage($data);
         }       }   }
```

Figure 18: 'teacherlogin' function in the COLTROLLER.php

This code is located in the *CONTROLLER.php*. This code is used to check the validity of the teachers' userid and the password. The user will see the *teacherlogin.php* page, which asks for the username and the password as below *(Figure 19)*.

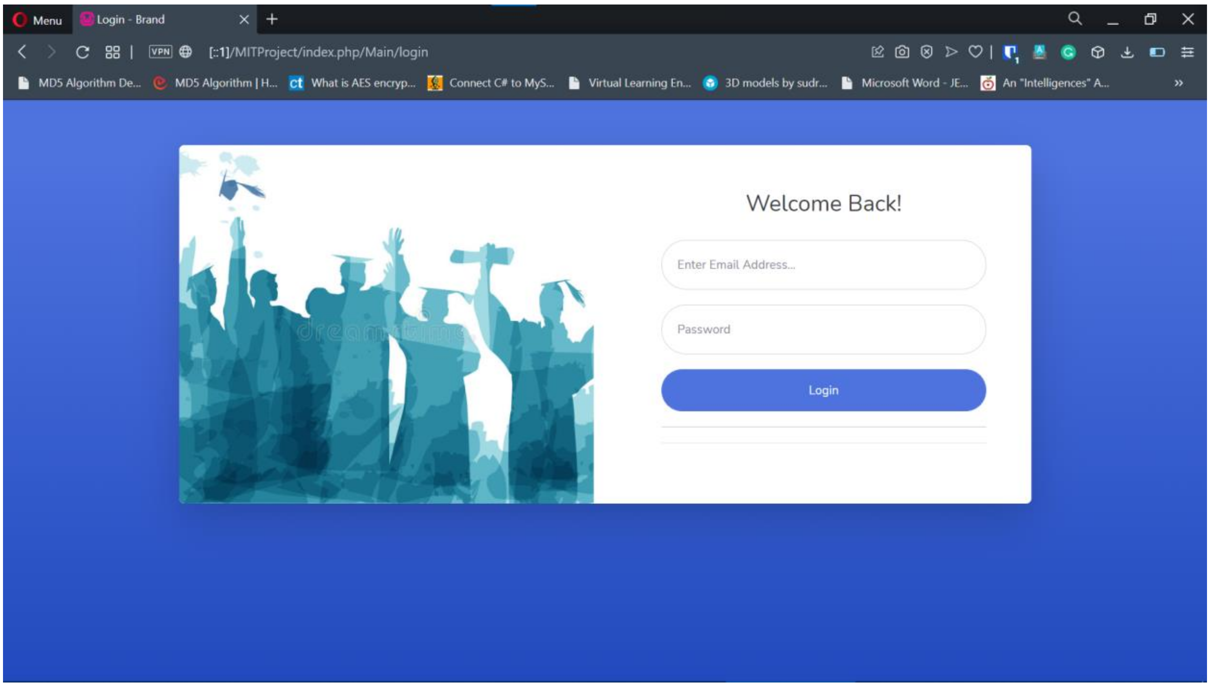


Figure 19: Teacher Login page

Once the teacher enters the login ID (Email address) and the password, the function will pass it to the 'teacherlogin' function in *MODELDB.php* to retrieve the details of the teacher. If the user is found, it will load the Teachers' Homepage. Otherwise, it displays a message "Invalid Teacher ID/Password. Please re-check." Then, it asks to re-enter the details.

```
public function teacherlogin( $details ) {
       $uid = $details[ 'userid' ];
       $pw = $details[ 'password' ];
       $query = "SELECT tbl_teacher.Tea_ID FROM tbl_teacher WHERE(tbl_teacher.Tea_Email =
'$uid' AND tbl_teacher.Tea_Password = md5('$pw'))";
       $DBResult = $this->db->query( $query );
       return $DBResult->result();
   }
```

Figure 20: 'teacherlogin' function in the MODELDB.php

The ‘teacherlogin’ function *(Figure 20)* will query the database and check whether the username and password exist. The teacher password is always encrypted (using MD5) and saved in the table to comprise security.

4.6 Summary

The Implementation chapter mainly describes the project environment. The hardware and the software environment is defined in detail. In addition, re-used components, such as Bootstrap, is mentioned in this chapter. Furthermore, the related technologies and IDEs, such as Apache Web Server, PHP, MySQL Server, HTML 5, PHPStorm software, are described in detail under this chapter. Moreover, sample code segments featured in the development process are taken and explained under the Major Code Segments section. After concluding the development phase, testing of the system was initiated and described briefly in the next chapter.

Chapter 5 - Testing and Evaluation

5.1 Introduction

This chapter is concerned with the evaluation and testing of the software that the team has developed. The goal of the evaluation process is to establish how successfully end users can learn and use the product to achieve their objectives; also connected to the level of satisfaction expressed by end-users with the process is how well the process is designed.

5.2 Related Testing Types

The purpose of software testing is to ensure that end-users are presented with accurate information about the product's overall performance. It is an objective and independent representation of the process of identifying and analysing the risks associated with the software. During the testing process, system implementation and incremental testing should be carried out in tandem. The approach that is most usually employed is divided into four sections. a. Introduction

5.2.1 Unit Testing

- In the Unit Testing Phase, individual modules were tested to ensure that they can operate independently.
    - E.g., the Student Module was tested to ensure that the CRUD operations are working correctly, and the users can enter the student details, read details, update and delete details acceptably.

5.2.2 Integration Testing

- After executing the Unit Testing for all the modules, the Integration Testing was implemented to check whether the combined modules (sub-systems) worked as expected. This was done to ensure the reliability of the data CRUD operations.
    - E.g., The 'Marks Management' function uses four (04) data tables *(Namely Student, Student_Subject, Exam and Marks)*. CRUD operations in the Marks Management function are crucial steps, and it was thoroughly tested to ensure that it considers the year, term, student id, exam id, subject id and the marks are handling as expected.

5.2.3 System Testing

- All the sub-systems were combined and tested thoroughly to check that each sub-system can cooperate with other sub-systems and does not give any errors. Additionally, it ensures that the system satisfies both functional and non-functional requirements.
    - E.g., the final objective of forecasting the higher studies and the career path for a student was tested to see that the sub-system can execute its functionalities without giving any errors.

5.2.4 Acceptance Testing

- Acceptance testing is the final level of system testing before the system is approved for operational usage. First, the system is validated using data from confirmed consumers. Because real-world data places a different demand on the system than test data, acceptance testing may expose errors and omissions in the system requirements description. It may also show requirements issues, such as the system's facilities not meeting the user's requirements or the system performing poorly.
    - E.g., The entire system was tested by selected teachers to ensure that they can use the system without any hassle and certify that they get the expected output.

5.3 Test Plan

A comprehensive test strategy was established, and a unique approach to project testing for this system. The following are the objectives of the test plan that was established.

- Create a detailed test plan outlining the kind and scope of tests required to accomplish the project's test objectives, including software and hardware needs.
- Create an organised schedule of operations, identify necessary equipment and organisational provisions, establish test techniques and tactics, and select what to provide.

Given below are some test plans conducted for each function of the system *(Table 2).*

5.3.1 Student/Teacher Management (Table 2)

	Function	Testing Procedure	Expected Output
Function: Login Control			
01	Login attempt without entering both username and password	Do not enter any credentials	Display an error message
02	Login attempt by only entering correct username	Entering the username only	Display an error message.
03	Login attempt by only entering a password	Entering a password only.	Display an error message.
04	Login attempt by entering invalid usernames and passwords	Entering invalid username and a password	Display an error message.
05	Login attempt by only entering correct username and wrong password	Entering correct username and wrong password	Display an error message.
06	Login attempt by entering correct username and password.	Entering correct username and password.	Go to the homepage.

Table 2: Test Plan - Student/Teacher Management

5.3.2 Subject Management (Table 3)

	Function	Testing Procedure	Expected Output
Function: Assign a student to a subject			
01	Assigning a subject to a student who is not in the database.	Entering an invalid student admission number and press the 'Get Student' button.	Student admission number. Student ID, Student full name boxes get cleared.
02	Assigning a record without entering a year.	Leaving the 'select year' textbox empty.	Display an error message.
03	Assigning a record without selecting a subject	Leaving the 'select subject box' empty.	Display an error message.
04	Assigning a record by entering correct details.	Entering valid student admission no, year and a subject.	Save the record in the database.

Table 3: Test Plan - Subject Management

5.3.3 Exam Management (Table 4)

	Function	Testing Procedure	Expected Output
Function: Updating mark of a student			
01	Entering invalid mark	Entering a mark above 100	Display an error message.
02	Entering invalid mark	Entering a mark below 0	Display an error message.
03	Entering other value than mark or 'AB'	Entering other text than 'AB'	Display an error message.
04	Entering no mark	Leaving the mark box empty.	Save the record in the database.
05	Entering valid mark or 'AB'	Entering a mark between 0 and 100 or entering 'AB'	Save the record in the database.

Table 4 : Test Plan - Exam Management

5.3.4 Multiple Intelligences Management (Table 5)

	Function	Testing Procedure	Expected Output
Function : Insert a new Multiple Intelligence Record			
01	Insert attempt without entering name and description	Do not enter any record.	Display an error message
02	Insert attempt by only entering name.	Entering the name only	Display an error message.
03	Insert attempt by only entering the description.	Entering a description only.	Display an error message.
04	Insert attempt by entering name and description.	Entering name and a description.	Save record in the database.

Table 5 : Test Plan - Multiple Intelligences Management

5.3.5 Reports Generation (Table 6)

	Function	Testing Procedure	Expected Output
Function : Searching for a student report			
01	Finding a student record who is not in the database.	Entering invalid student admission number.	Display an error message
02	Finding a blank admission number.	Leaving the admission number textbox empty.	Display an error message.
03	Finding a valid student report.	Entering a valid student admission number.	Display the report.

Table 6 : Test Plan - Reports Generation

5.4 Test Cases

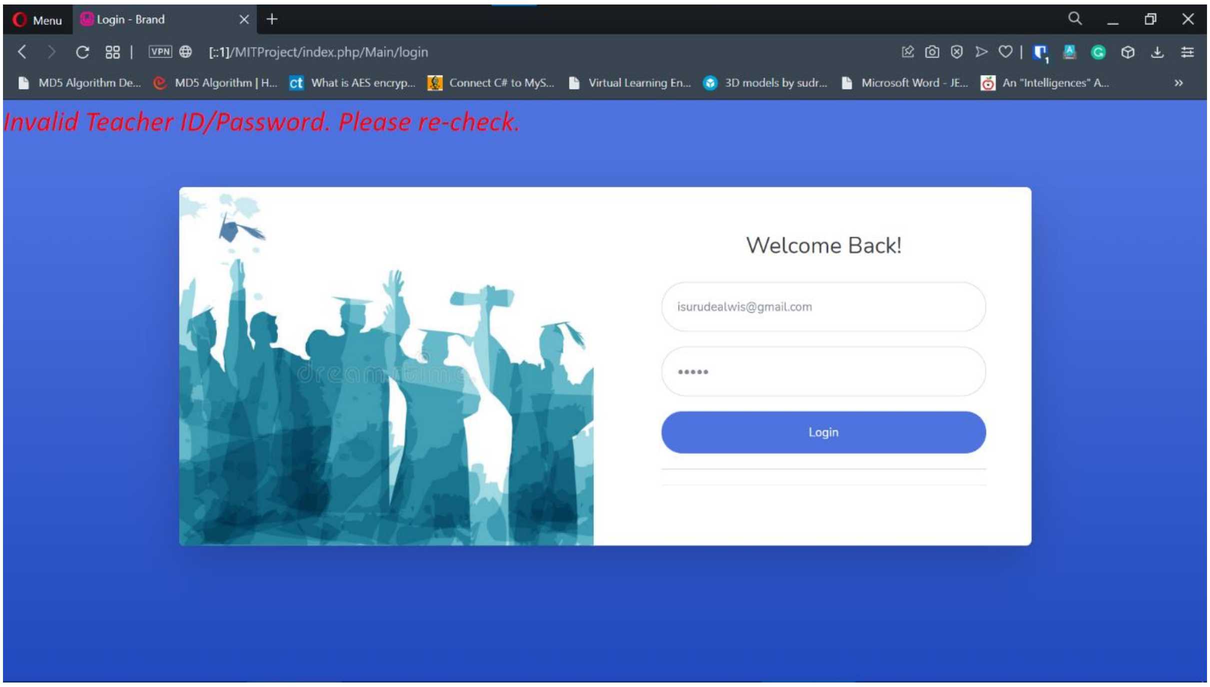
A Test Case is a collection of situations or variables that a tester will use to verify whether a system meets requirements or operates appropriately.

Below are some test cases which were generated during the system testing.

5.4.1 Student / Teacher Management function (Table 7)

Test Case ID		T001	
Test Component		Student / Teacher Management	
Module Name		Login	
Test Case		Login Screen	
Expected Outcome		Successful login and the Main page (Dashboard)	
Test Case Description			
No	**Test Case**	**Actual Output**	**Status**
1	Login Success	Loading the main page. *(figure 22)*	Ok
2	Login Fail	Displaying a message “Invalid credentials.” *(figure 21)*	Ok

Table 7: Test Case ID 1



Invalid Teacher ID/Password. Please re-check.

isurudealwis@gmail.com

•••••

Figure 21: Login Page Error

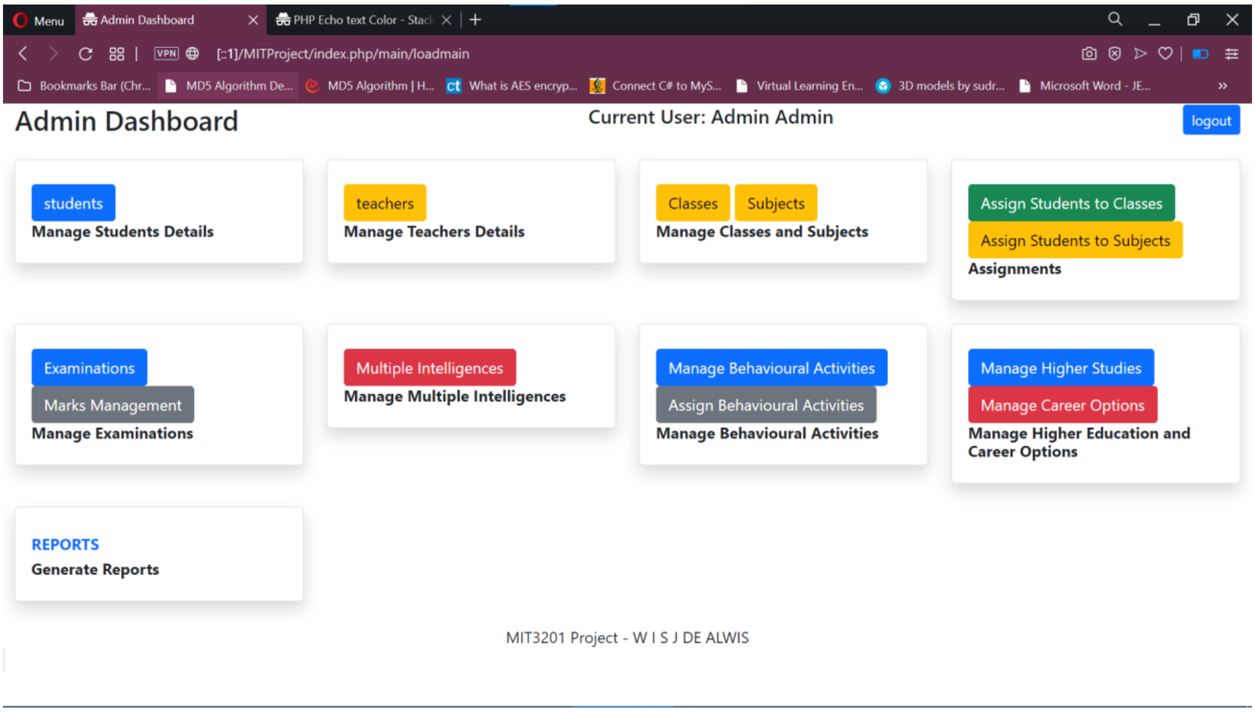
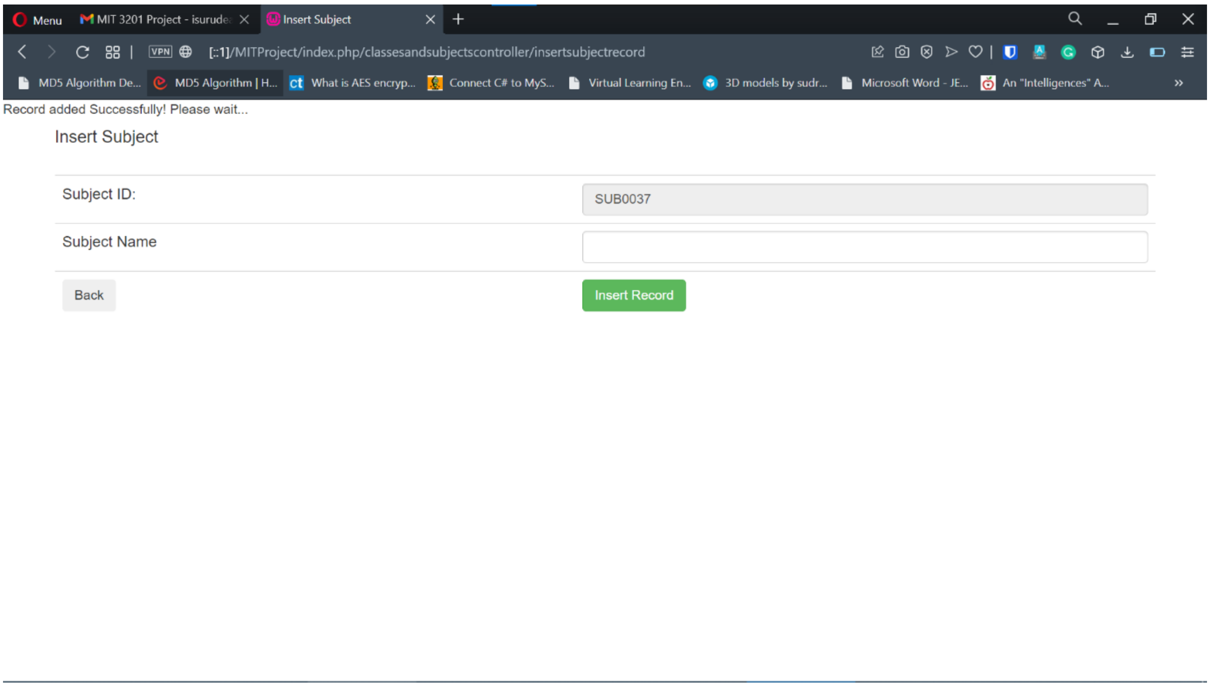


Figure 22: Login Page Success

5.4.2 Subject Management function (Table 8)

Test Case ID		T002	
Test Component		Subject Management	
Module Name		Subjects	
Test Case		Adding a subject with a subject name	
Expected Outcome		Save the new subject to the database and display a message "Record added successfully! Please wait…" Else, it should display "Please fill out this field" message.	
Test Case Description			
No	**Test Case**	**Actual Output**	**Status**
1	Save Success	Displaying a message "Record added successfully! Please wait…" *(figure 23)*	Ok
2	Empty Subject Name	Displaying a message "Please fill out this field." *(figure 24)*	Ok

Table 8 : Test Case ID 2

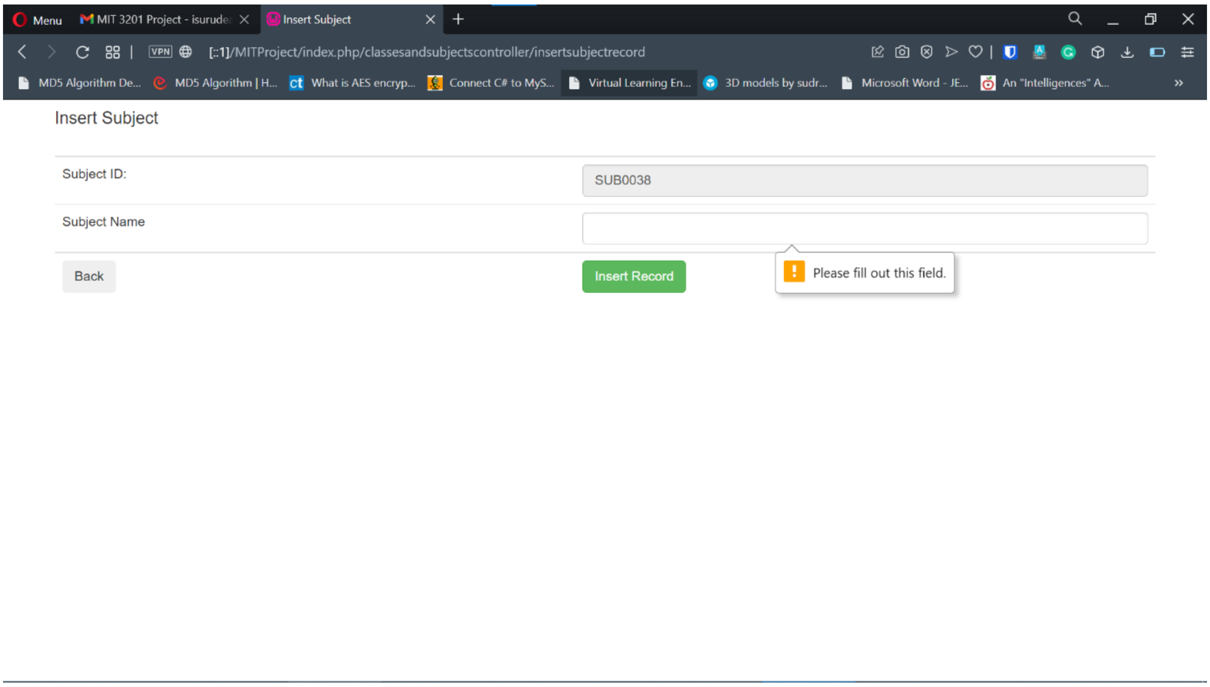


Record added Successfully! Please wait...

Insert Subject

Subject ID:	SUB0037
Subject Name	
Back	Insert Record

Figure 23: Insert Subject page - Subject add success



Insert Subject

Subject ID:	SUB0038
Subject Name	
Back	Insert Record

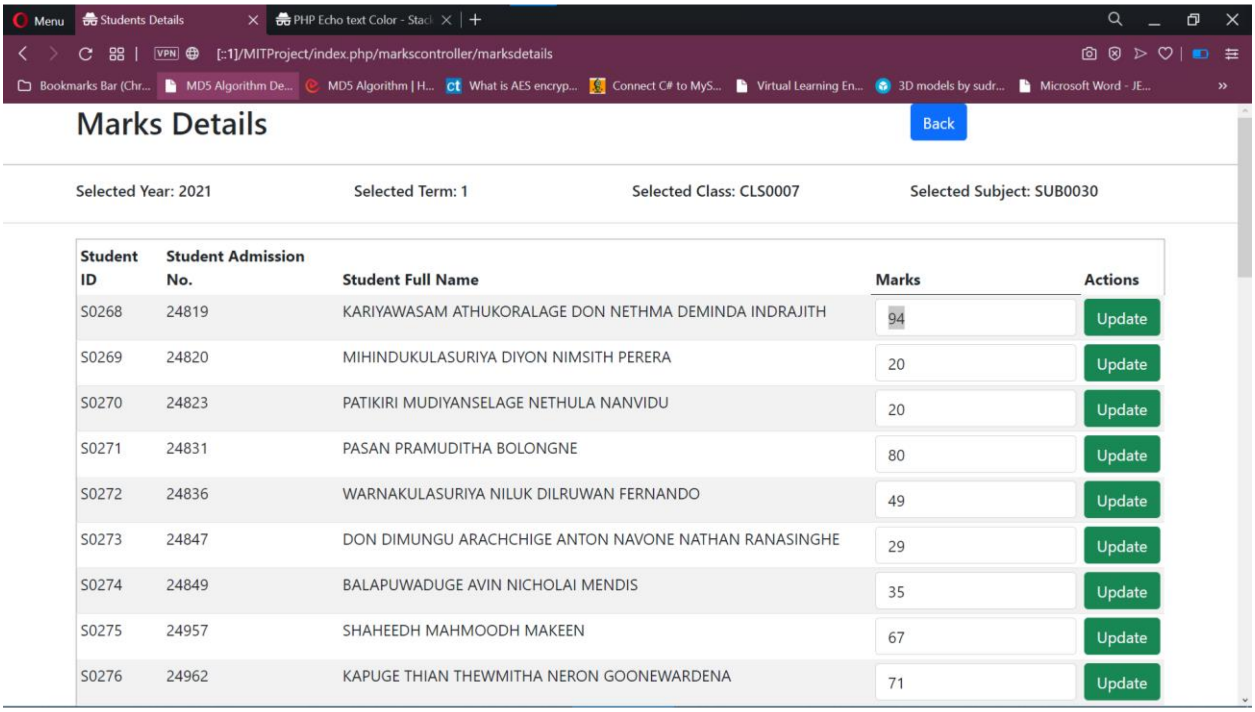
Please fill out this field.

Figure 24: Insert Subject page - Subject add unsuccessful

5.4.3 Exam Management function (Table 9)

Test Case ID		T003	
Test Component		Exam Management function	
Module Name		Marks	
Test Case		Updating Marks	
Expected Outcome		Update the mark value of a particular student.	
Test Case Description			
No	**Test Case**	**Actual Output**	**Status**
1	Mark Update	Display the updated mark on the results. *(figure 25)*	Ok
2	Record not found	Display the not updated mark. *(figure 26)*	Ok

Table 9: Test Case ID 3

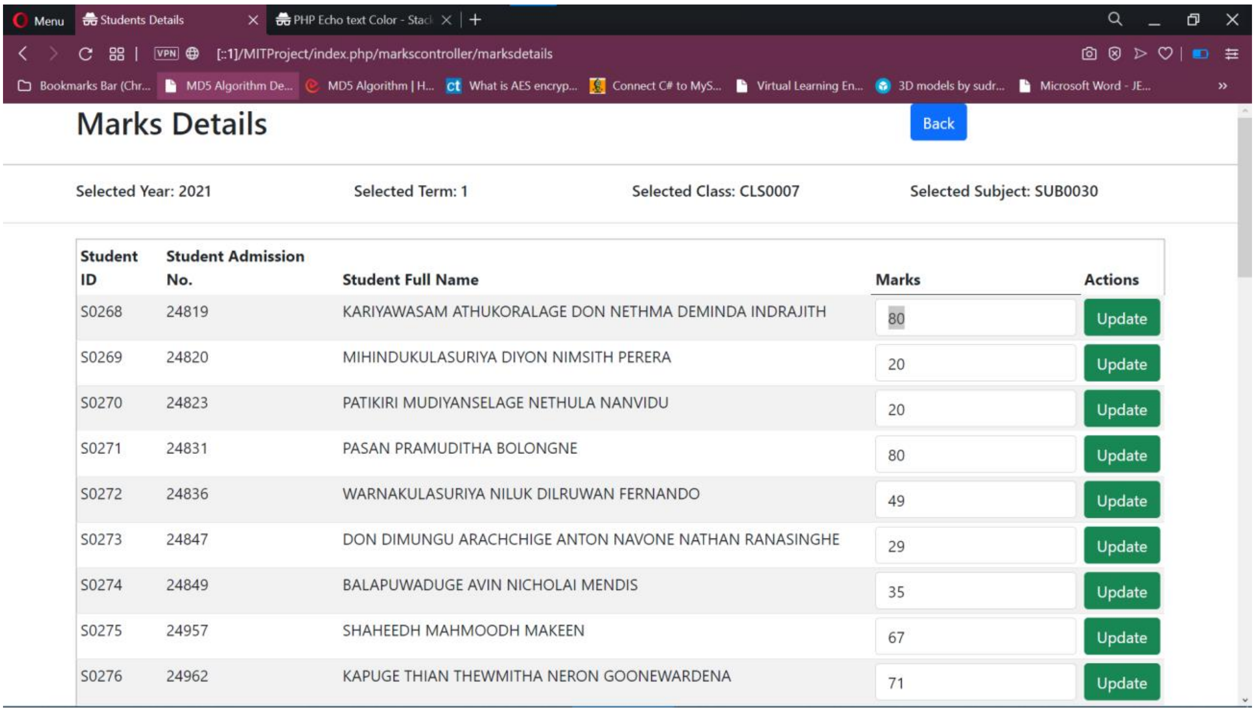


Marks Details

Selected Year: 2021 Selected Term: 1 Selected Class: CLS0007 Selected Subject: SUB0030

Student ID	Student Admission No.	Student Full Name	Marks	Actions
S0268	24819	KARIYAWASAM ATHUKORALAGE DON NETHMA DEMINDA INDRAJITH	94	Update
S0269	24820	MIHINDUKULASURIYA DIYON NIMSITH PERERA	20	Update
S0270	24823	PATIKIRI MUDIYANSELAGE NETHULA NANVIDU	20	Update
S0271	24831	PASAN PRAMUDITHA BOLONGNE	80	Update
S0272	24836	WARNAKULASURIYA NILUK DILRUWAN FERNANDO	49	Update
S0273	24847	DON DIMUNGU ARACHCHIGE ANTON NAVONE NATHAN RANASINGHE	29	Update
S0274	24849	BALAPUWADUGE AVIN NICHOLAI MENDIS	35	Update
S0275	24957	SHAHEEDH MAHMOODH MAKEEN	67	Update
S0276	24962	KAPUGE THIAN THEWMITHA NERON GOONEWARDENA	71	Update

Figure 25: Marks Details page - Updating Marks Success



Marks Details

Selected Year: 2021 Selected Term: 1 Selected Class: CLS0007 Selected Subject: SUB0030

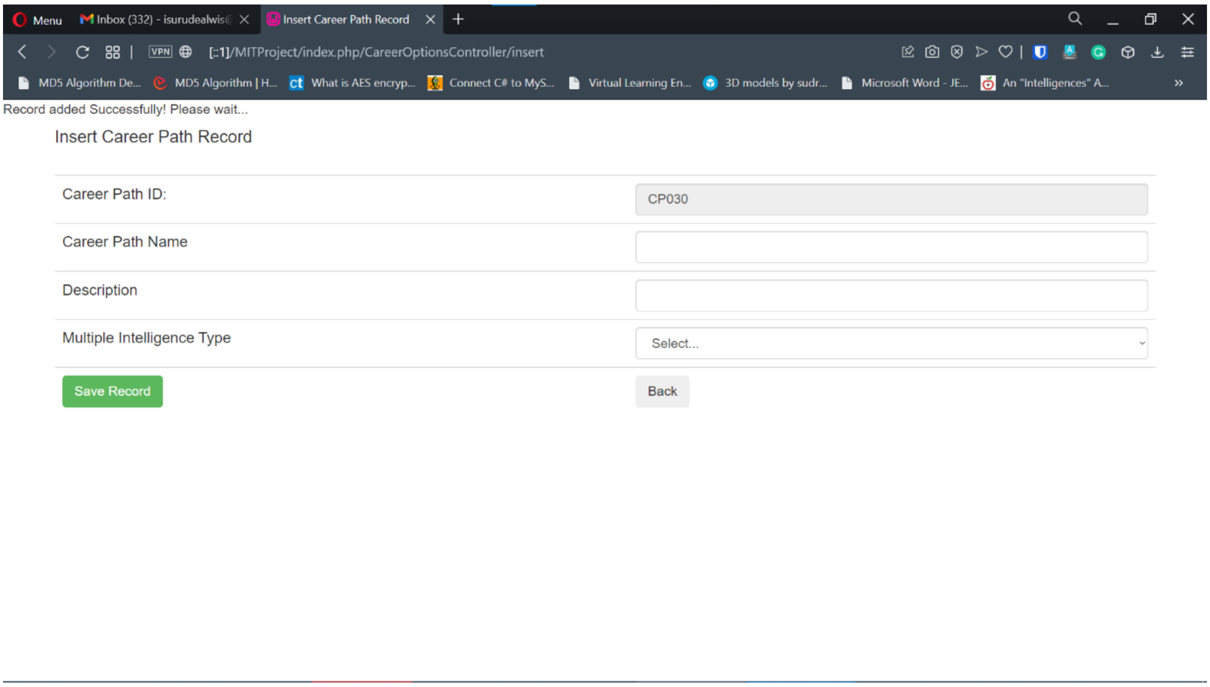
Student ID	Student Admission No.	Student Full Name	Marks	Actions
S0268	24819	KARIYAWASAM ATHUKORALAGE DON NETHMA DEMINDA INDRAJITH	80	Update
S0269	24820	MIHINDUKULASURIYA DIYON NIMSITH PERERA	20	Update
S0270	24823	PATIKIRI MUDIYANSELAGE NETHULA NANVIDU	20	Update
S0271	24831	PASAN PRAMUDITHA BOLONGNE	80	Update
S0272	24836	WARNAKULASURIYA NILUK DILRUWAN FERNANDO	49	Update
S0273	24847	DON DIMUNGU ARACHCHIGE ANTON NAVONE NATHAN RANASINGHE	29	Update
S0274	24849	BALAPUWADUGE AVIN NICHOLAI MENDIS	35	Update
S0275	24957	SHAHEEDH MAHMOODH MAKEEN	67	Update
S0276	24962	KAPUGE THIAN THEWMITHA NERON GOONEWARDENA	71	Update

Figure 26: Marks Details Page - Updating Marks Unsuccess

5.4.4 Multiple Intelligences Management function (Table 10)

Test Case ID		T004	
Test Component		Multiple Intelligences Management function	
Module Name		Career Paths	
Test Case		Assigning a career path to a multiple intelligence category.	
Expected Outcome		Save new record in the database.	
Test Case Description			
No	**Test Case**	**Actual Output**	**Status**
1	Save Success	Displaying a message "Record added successfully! Please wait…" *(figure 27)*	Ok
2	Empty Textbox / multiple intelligence type is unselected	Displaying a message "Please fill out this field." *(figure 28)*	Ok

Table 10 : Test Case ID 4

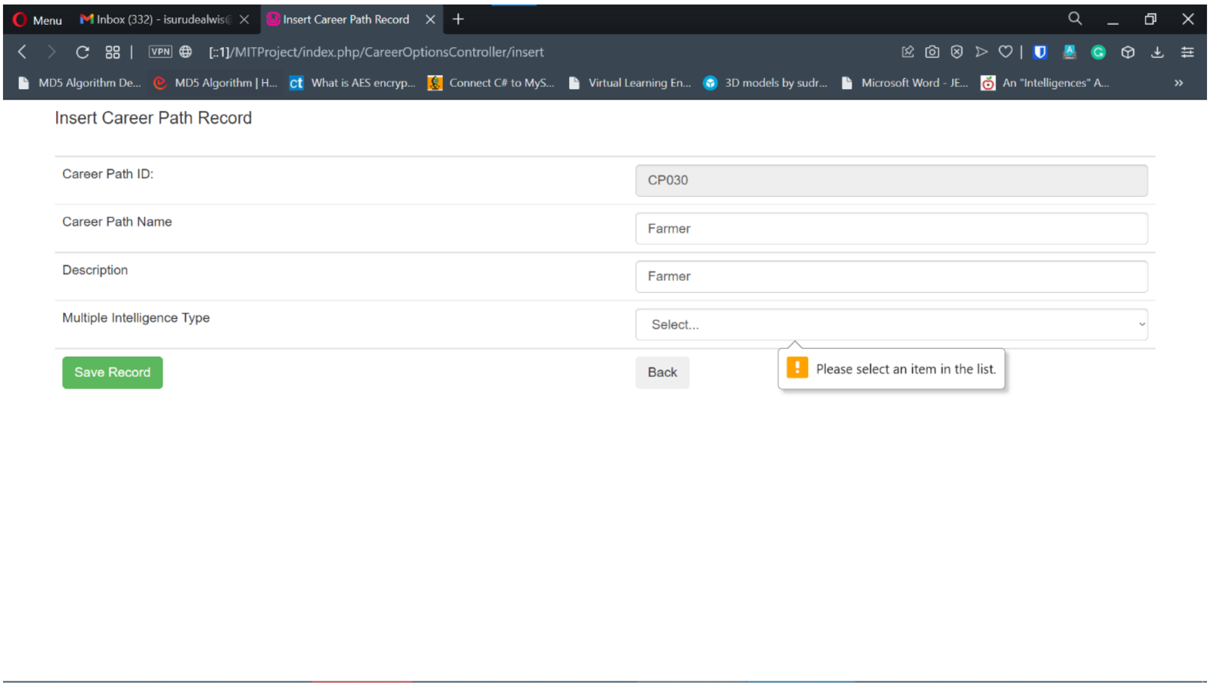


Record added Successfully! Please wait...

Insert Career Path Record

Career Path ID:	CP030
Career Path Name	
Description	
Multiple Intelligence Type	Select...

Figure 27: Multiple Intelligences - Assigning a career path success



Insert Career Path Record

Career Path ID:	CP030
Career Path Name	Farmer
Description	Farmer
Multiple Intelligence Type	Select...

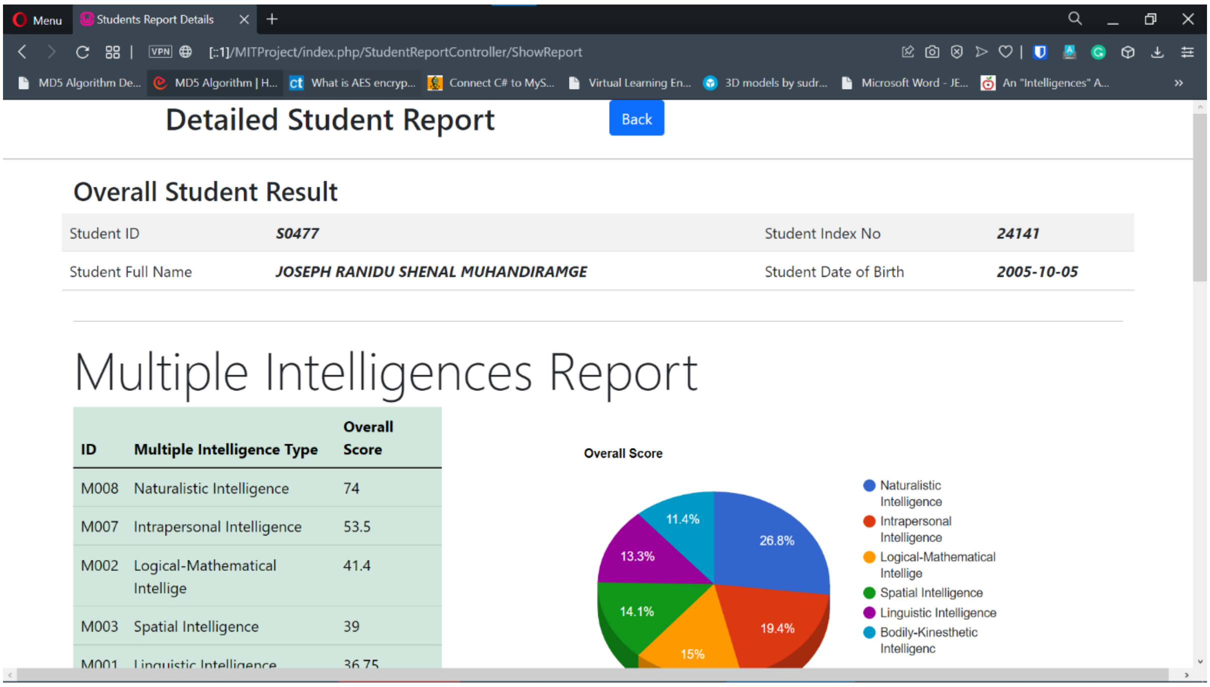
Please select an item in the list.

Figure 28: Multiple Intelligences - Assigning a career path unsuccessful

5.4.5 Reports Generation Function (Table 11)

Test Case ID		T005	
Test Component		Reports Generation function	
Module Name		Student Reports	
Test Case		Generating a student report by entering a student admission number.	
Expected Outcome		Display the report of the student.	
Test Case Description			
No	**Test Case**	**Actual Output**	**Status**
1	Entering valid student admission no.	Display the report. *(figure 29)*	Ok
2	Entering invalid student admission no.	Display a message "Cannot find student record." *(figure 30)*	Ok

Table 11 : Test Case ID 5



Detailed Student Report

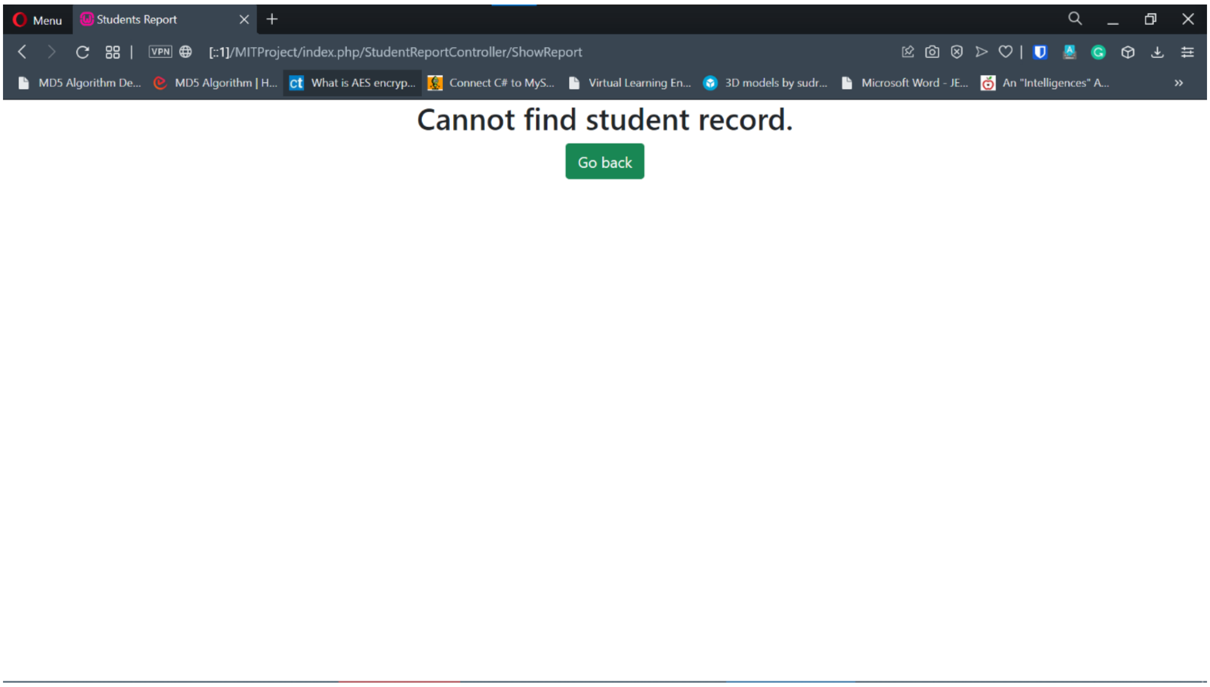
Overall Student Result

Student ID	***S0477***	Student Index No	***24141***
Student Full Name	***JOSEPH RANIDU SHENAL MUHANDIRAMGE***	Student Date of Birth	***2005-10-05***

Multiple Intelligences Report

ID	Multiple Intelligence Type	Overall Score
M008	Naturalistic Intelligence	74
M007	Intrapersonal Intelligence	53.5
M002	Logical-Mathematical Intellige	41.4
M003	Spatial Intelligence	39
M001	Linguistic Intelligence	36.75

Figure 29: Student Report - Entering valid student admission number



Cannot find student record.

Figure 30: Student Report - Entering invalid student admission number

5.5 Test Results

After conducting tests for all the functions, the results were summarised and published below. *(Table 12)*

Main function	***Test Cases Planned***	***Test Cases Executed***	***# of Passed Tests***	***# of Failed Tests***
Student/Teacher Management	16	16	16	0
Subject Management	8	8	8	0
Examination Management	12	12	12	0
Multiple Intelligences Management	8	8	8	0
Reports Management	8	8	8	0
	52 **Total Test Cases Planned**	**52** **Total Test Cases Executed**	**52 (100.00%)** **Total Test Passed**	**0 (0.00%)** **Total Test Failed**

Table 12: Summary of the Test Results

5.6 User Evaluation

User evaluation has been conducted for this program. Several users (teachers) were selected and allowed to use this program and asked to provide their feedback through an online questionnaire.

The evaluation of this project was focused on four subject areas, namely, appearance, usability, functionality and performance. In the analysis, a measure against the Likert scale was used to measure the feedback. (Refer to Appendix B for the questionnaire.) A list of prepared criteria, with some practical testing, allows the software evaluator to verify that the project objectives have been met.

5.7 Results of the Evaluation

After analysing the feedback, the below results were obtained, and several conclusions were highlighted.

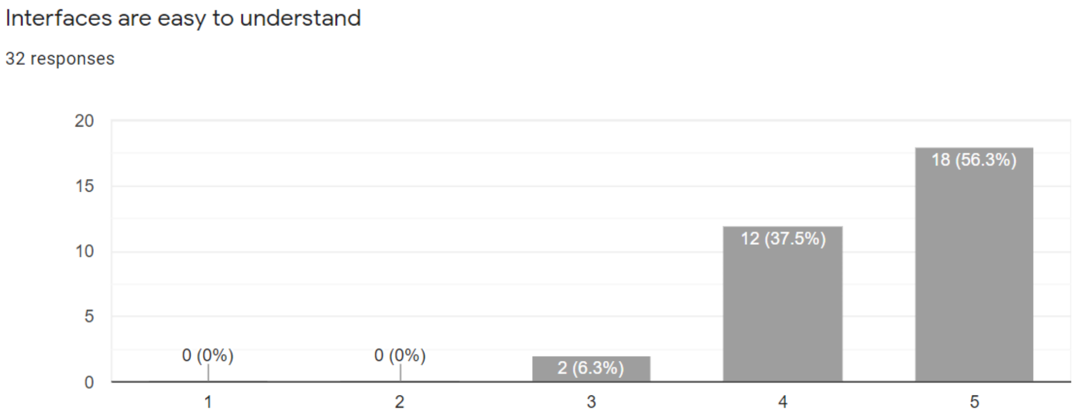


Figure 31: Testing Results Q1

With the above results *(Figure 31)*, the users are comfortable with the program's appearance, as many have selected the highest ('Strongly Agree') option.

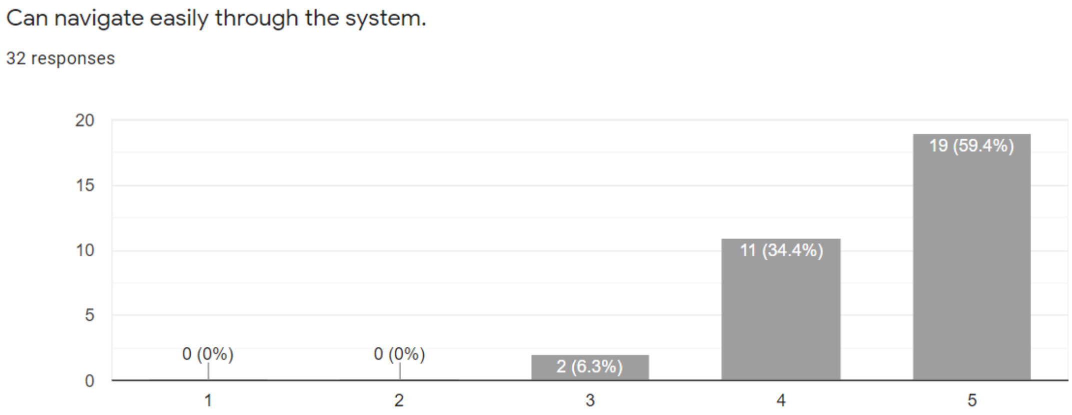
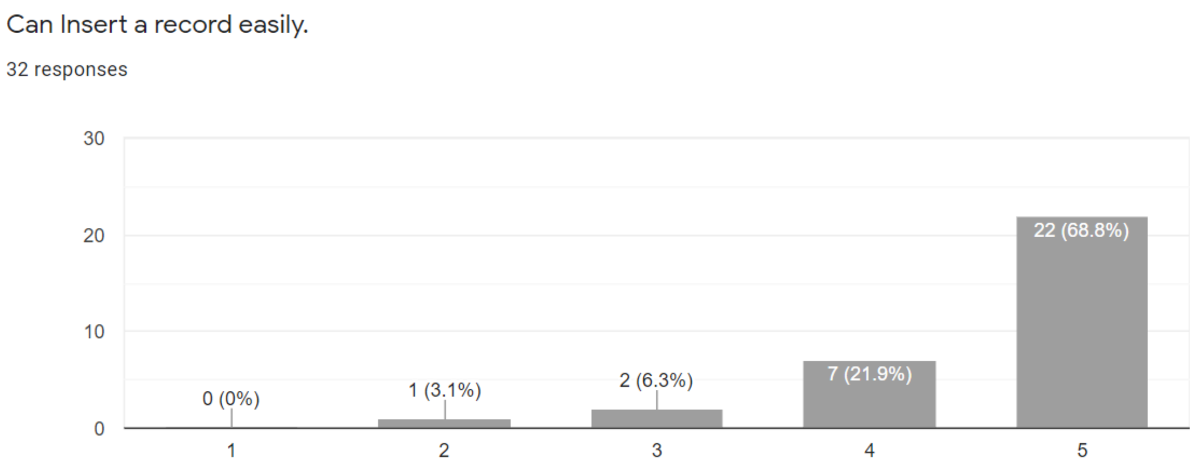
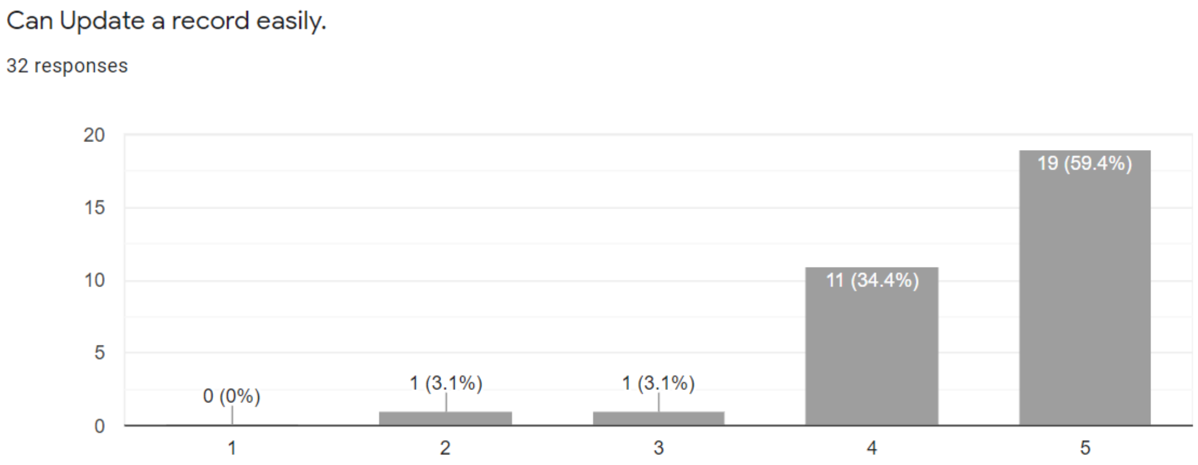


Figure 32: Testing Results Q2


Can Insert a record easily.

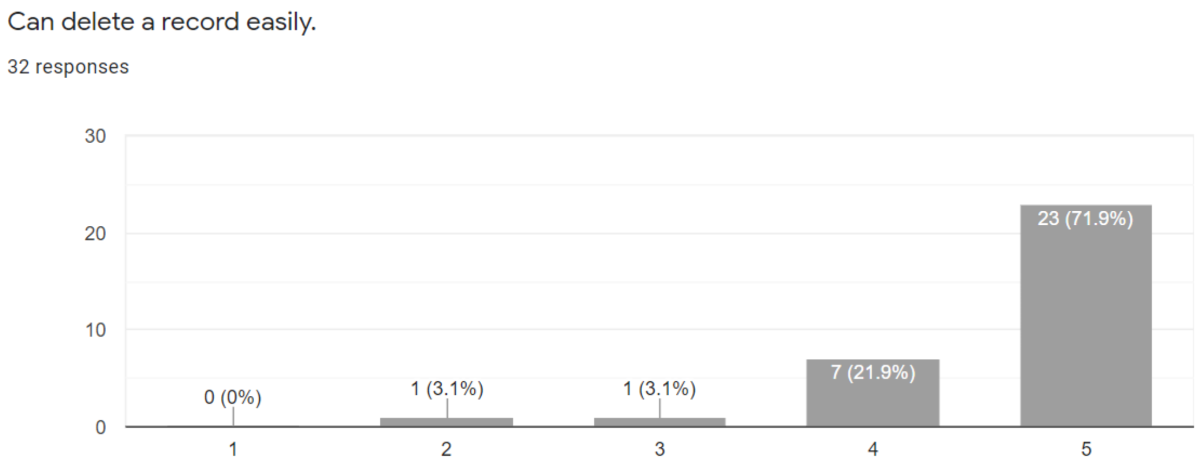
32 responses

Figure 33: Testing Results Q3


Can Update a record easily.

32 responses

Figure 34: Testing Results Q4


Can delete a record easily.

32 responses

Figure 35: Testing Results Q5

The usability was measured by obtaining the opinion of the users *(Figures 32, 33, 34 and 35)*. By observing the above results, it clearly defines that there is higher usability of the system.

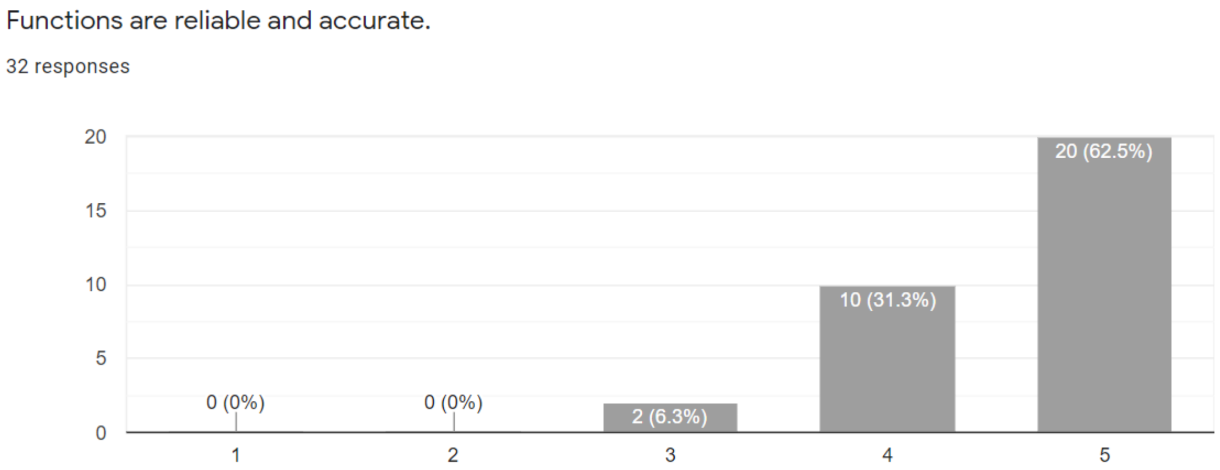


Figure 36: Testing Results Q6

The graphical representation of the above question analysis *(Figure 36)* implies that the system's functionality is at a stable stage, and users are experiencing no issues with the functions when using the program.

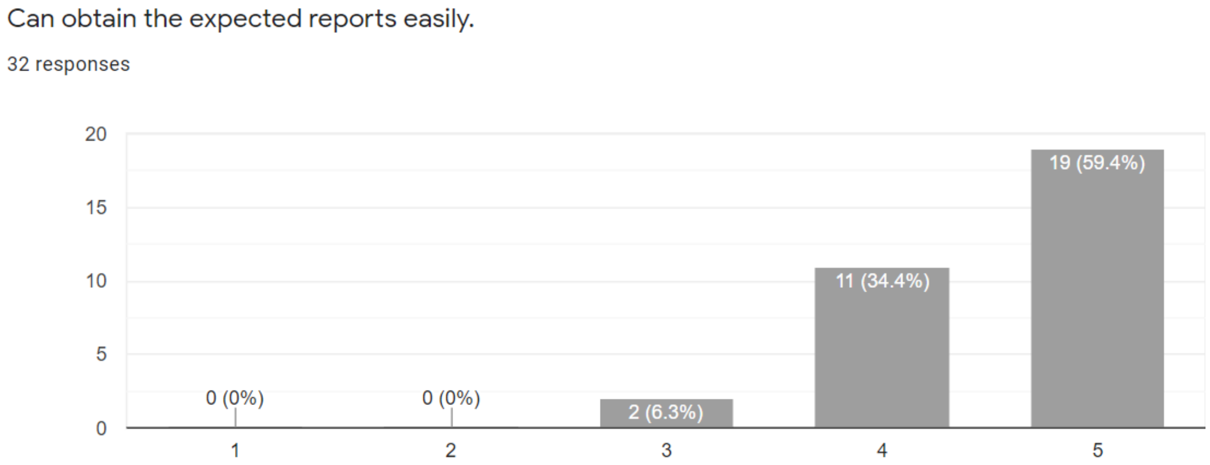
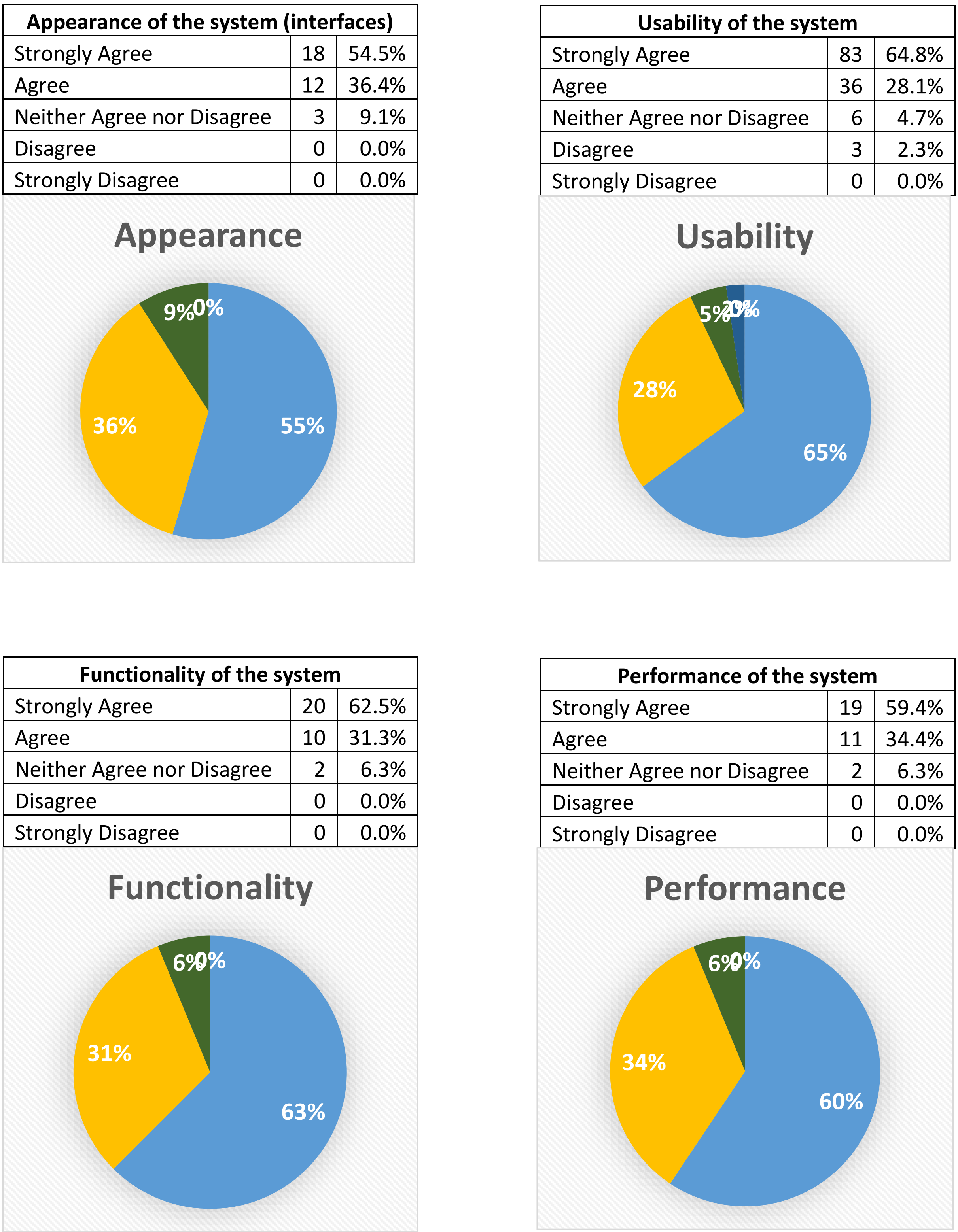


Figure 37: Testing Results Q7

The above question is based on performance *(Figure 37)*. Higher results of the answers imply that the users are experiencing a sound performance of the system.

5.8 Conclusion of testing results

In conclusion, the user evaluation results can be categorised and indicate as below. *(Figure 38)*



Appearance of the system (interfaces)		
Strongly Agree	18	54.5%
Agree	12	36.4%
Neither Agree nor Disagree	3	9.1%
Disagree	0	0.0%
Strongly Disagree	0	0.0%

Usability of the system		
Strongly Agree	83	64.8%
Agree	36	28.1%
Neither Agree nor Disagree	6	4.7%
Disagree	3	2.3%
Strongly Disagree	0	0.0%

Functionality of the system		
Strongly Agree	20	62.5%
Agree	10	31.3%
Neither Agree nor Disagree	2	6.3%
Disagree	0	0.0%
Strongly Disagree	0	0.0%

Performance of the system		
Strongly Agree	19	59.4%
Agree	11	34.4%
Neither Agree nor Disagree	2	6.3%
Disagree	0	0.0%
Strongly Disagree	0	0.0%

Figure 38: User Evaluation Results

With the user evaluation results, it is clear that the entire testing results signify the project's objectives have been met, and the significant characteristics of the system were able to be captured by the users. Hence, the system is in the completed stage and ready to deliver for the client.

5.9 Summary

An essential phase of the project, the testing phase, is visibly explained in this chapter. Initially, the testing types were introduced and explained how it was used to test the system. Next, a comprehensive test plan is described, and sample test plans of each function are shown. Then, sample test cases and results were included in the chapter to indicate how the actual tests were conducted. Then the summary of test results was included, which indicates that all the tests are passed.

The results then were categorised and summarised and included in this chapter. Moreover, the details of the user evaluation conducted during the test phase are also included here. Thus, the results infer that the system functions correctly and met its objectives and scope.

Chapter 6 - Conclusion

6.1 Introduction

This chapter intends to convey the conclusions obtained from the study's findings in the previous chapter, see whether the objectives have been encountered, and then give recommendations for further system improvements.

6.2 Critical Evaluation

The prime objective of this project is to develop a system to identify students’ higher education and career options using the examination records, behavioural and other achievements, followed by Howard Gardens’ Multiple Intelligences Theory. A study was conducted to identify students’ requirements and the divergences of current systems to obtain the gap. The conditions are then listed to which includes in the proposed system. A new system was developed which covered the requirements listed and was tested. With the test results and the analysis done in the previous chapter, the users (teachers and administration) have accepted this project's solution. Hence, it is clear that the objectives of this project have been met by implementing this system.

6.3 Problem Encountered

Following issues were encountered during the project period.

- The current COVID-19 pandemic has influenced this project significantly in copious ways. Obtaining requirements from students and proposed system users (teachers/administrators) were challenging due to the above event.
- In addition, attaching to a precise timeline was also a vast challenge due to the pandemic.
- During the development phase, adapting to the new development tools was also a problem as new versions sometimes demise the use of old versions’ functionalities.
    - Ex: The new CodeIgniter 3 does not support the JavaScript class library now and is deprecated. (Anon., 2019)
- Furthermore, since the system is entirely based on a database, writing SQL lines to generate accurate reports from many tables was a complicated role, especially when adding and updating students' marks.
- In the designing phase, using Bootstrap is the ideal blend. However, it was also challenging for a novice programmer when creating interfaces.

- Obtaining the charts for reports was also considerably doubtful as some charts were not displayed correctly.

However, despite all the challenges, the new system was designed and implemented to meet the project's objectives.

6.4 Lessons Learnt

From the beginning to the end of the project, developing the new system is a challenging process. Amidst all the challenges, it was set successfully as per the objectives. Developing such systems helps both societies and developers to experience and learn new theories and subject matter. Listed out below are some examples of what the developers gained throughout the project.

- Finding alternative solutions for objectives.
- Designing UML diagrams.
- The structure of the MVC architecture and how the components are connected.
- Using SQL functions when obtaining data from the database.
- The use of Bootstrap in the designing phase.
- Implementing a helpful testing method to identify issues of the system and analyse testing results.

6.5 Future Enhancements

Although the system meets its objectives, it can be further developed to enhance usage and productivity.

- The ‘marks’ function can be further developed to store marks obtained by students for the mid-term/other examinations.
- The students' details table can enhance to store parents details so that the system can contact parents directly.
- The ‘teachers’ table can be improved by storing their contact details to receive updates from the system.
- Reports generation can be further developed to display the term results of students.
- A new function can be added to the system to connect with higher educational institutions and universities to reach students directly and help them pursue their paths.
- The entire system can be further upgraded to use over the internet to manage the data from anywhere.

References

Anon., 2019. *Javascript Class — CodeIgniter 3.1.11 documentation.* [Online]
Available at: https://codeigniter.com/userguide3/libraries/javascript.html?highlight=ajax
[Accessed 28 August 2021].

Atela, R., Othuon, P. & Agak, O., 2019. Relationship Between Types of Intelligence And Career Choice Among Undergraduate Students Of Maseno University, Kenya. *Journal of Education and Practice,* 10(33), p. 87.

Bellet, C., De Neve, J.-E. & Ward, G., 2019. *Does Employee Happiness have an Impact on Productivity?.* [Online]
Available at: https://ssrn.com/abstract=3470734
[Accessed 21 January 2021].

Cognii, I., 2021. *Cognii - Artificial Intelligence for Education and Training.* [Online]
Available at: https://www.cognii.com
[Accessed 01 February 2021].

DOONDO, 2021. *Java design patterns (1): overview of design patterns, UML diagrams, design principles - 编程知识.* [Online]
Available at: https://cdmana.com/2021/04/20210428184720247p.html
[Accessed 08 May 2021].

Edu-One, 2021. *Edu-One - The first ever total career guidance platform in Sri Lanka.* [Online]
Available at: https://eduone.lk/lobby
[Accessed 02 February 2021].

Farouk, R., 2016. *Entity relationship diagram.* [Online]
Available at: https://learnandpracticeblog.wordpress.com/2016/02/03/data-modeling-using-entity-relation-shipmodel/
[Accessed 08 March 2021].

Gardner, H. & Hatch, T., 1989. Multiple Intelligences Go to School: Educational Implications of the Theory of Multiple Intelligences. *Educational Researcher,* 18(8), p. 4.

OUELLETTE, A., 2021. *What is Bootstrap: A Beginner's Guide.* [Online]
Available at: https://careerfoundry.com/en/blog/web-development/what-is-bootstrap-a-beginners-guide/
[Accessed 02 May 2021].

Skills, E., 2021. *Essential Skills Educational Software.* [Online]
Available at: https://essentialskills.com
[Accessed 01 February 2021].

Software, S., 2021. *SEQTA Analyse | SEQTA Software.* [Online]
Available at: https://seqta.com.au/seqta-analyse
[Accessed 01 February 2021].

Sommerville, I., 2016. *Software Engineering, Global Edition.* 10th ed. NOIDA: Pearson Education Limited.

Spaplatform.com.au, 2021. *SPAStandard.* [Online]
Available at: https://www.spaplatform.com.au/spastandard.html
[Accessed 01 February 2021].

TutorialsPoint, 2021. *MVC Framework - Introduction.* [Online]
Available at:
https://www.tutorialspoint.com/mvc_framework/mvc_framework_introduction.htm
[Accessed 22 May 2021].

Appendix A – Design Documentation

1. USE CASE Diagrams (for each function)

1.1 Student/Teacher Management Use Case *(Figure 39)*

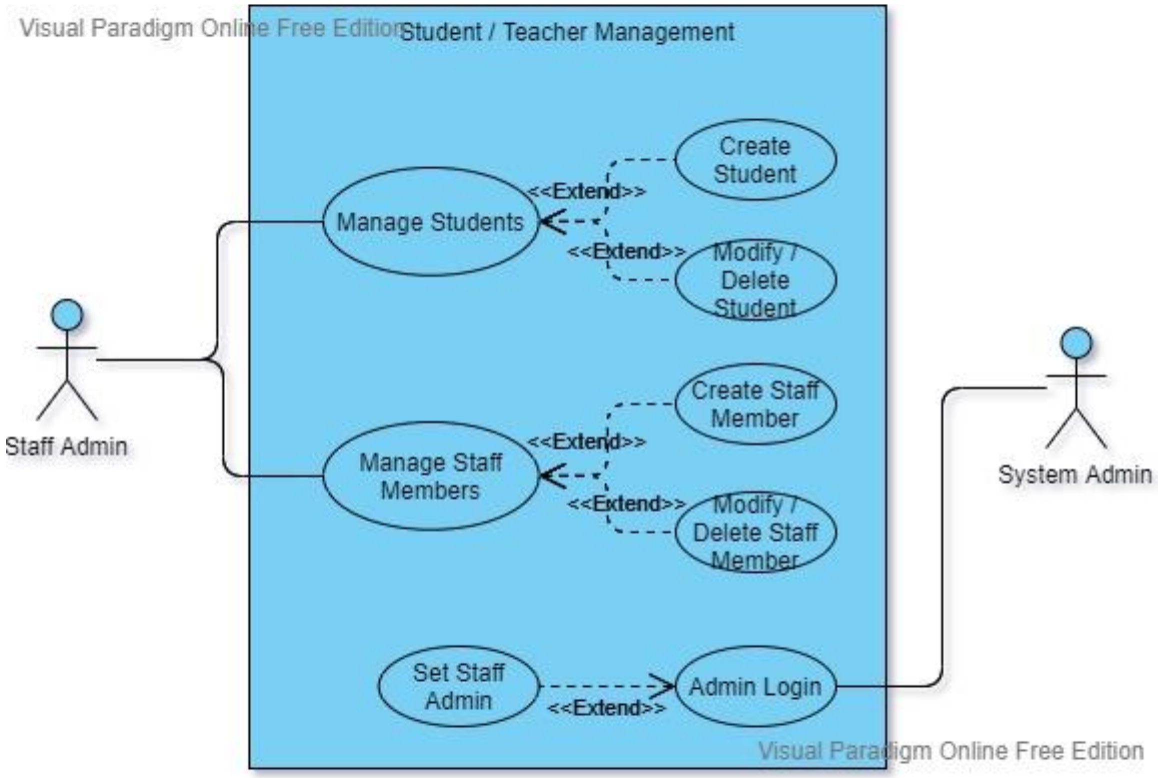


Figure 39 - Use Case 1 - Student/Teacher Management

1.2 Subject Management Use Case *(Figure 40)*

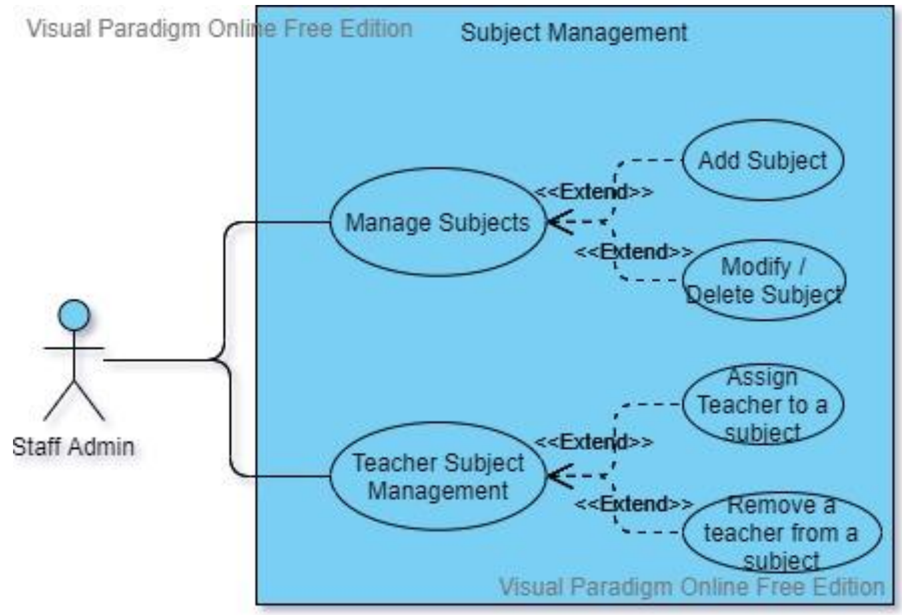

Visual Paradigm Online Free Edition
Subject Management
Add Subject
<<Extend>>
Manage Subjects
<<Extend>>
Modify / Delete Subject
Staff Admin
Assign Teacher to a subject
<<Extend>>
Teacher Subject Management
<<Extend>>
Remove a teacher from a subject
Visual Paradigm Online Free Edition

Figure 40 - Use Case 2 - Subject Management

1.3 Examination Management Use Case *(Figure 41)*

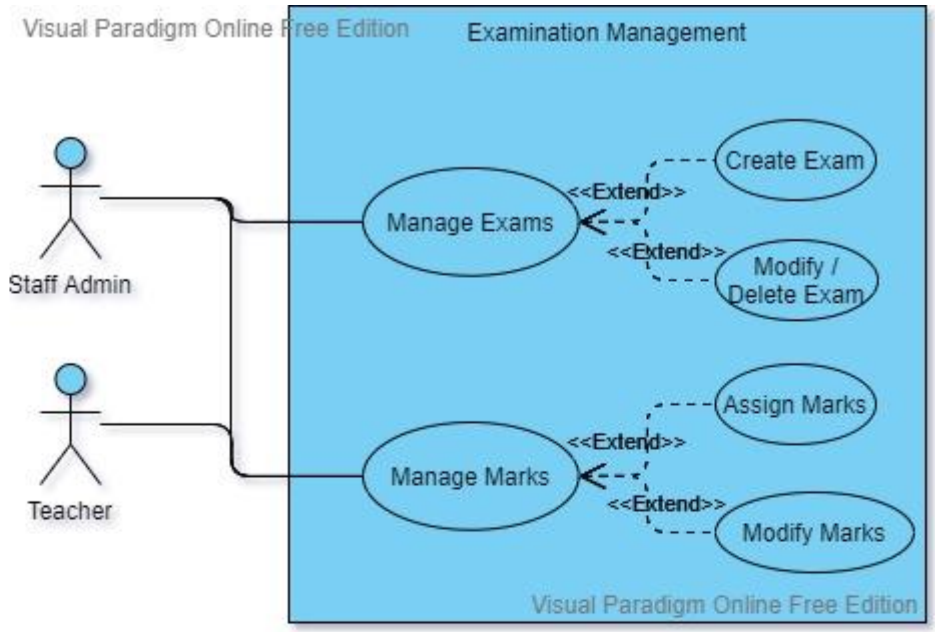


Figure 41 - Use Case 3 - Examination Management

1.4 Multiple Intelligences Management Use Case *(Figure 42)*

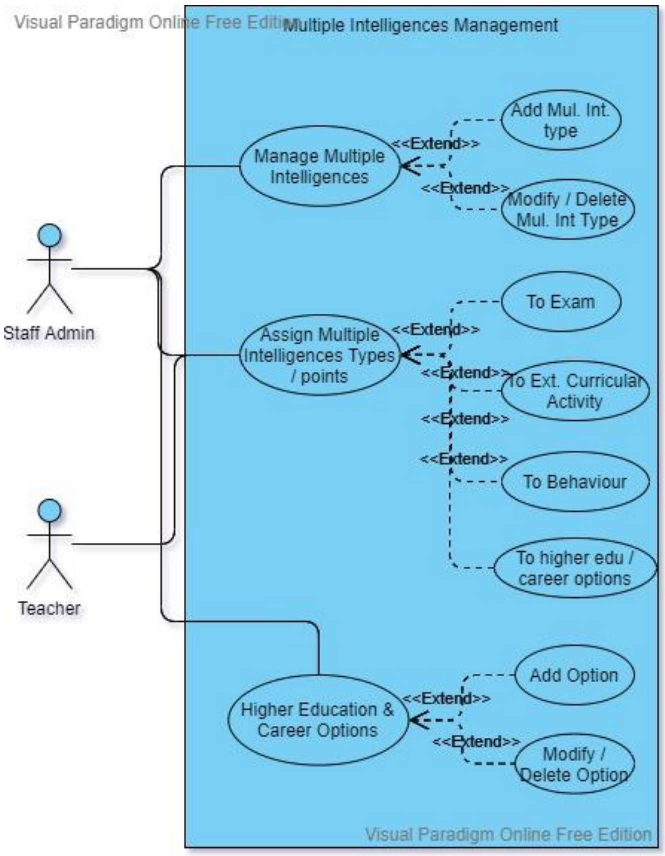

Visual Paradigm Online Free Edition
Multiple Intelligences Management
Manage Multiple Intelligences
<<Extend>>
Add Mul. Int. type
<<Extend>>
Modify / Delete Mul. Int Type
Staff Admin
Teacher
Assign Multiple Intelligences Types / points
<<Extend>>
To Exam
<<Extend>>
To Ext. Curricular Activity
<<Extend>>
<<Extend>>
To Behaviour
To higher edu / career options
Higher Education & Career Options
<<Extend>>
Add Option
<<Extend>>
Modify / Delete Option
Visual Paradigm Online Free Edition

Figure 42 - Use Case 4 - Multiple Intelligences Management

1.5 Reports Generation Use Case *(Figure 43)*

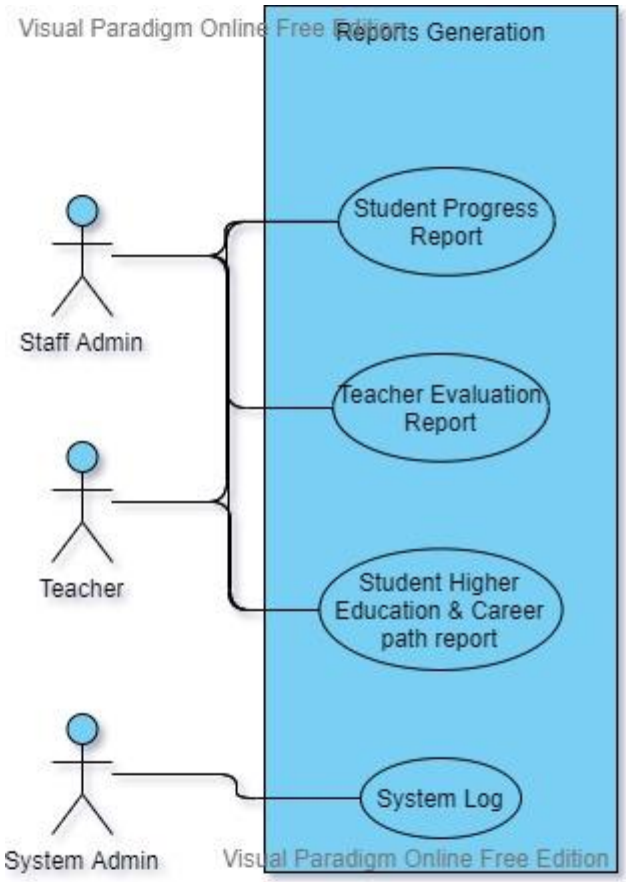

Visual Paradigm Online Free Edition
Reports Generation
Student Progress Report
Teacher Evaluation Report
Student Higher Education & Career path report
System Log
Staff Admin
Teacher
System Admin
Visual Paradigm Online Free Edition

Figure 43 - Use Case 5 - Reports Generation

2 Use Case Scenarios

A Use Case Scenario is a description of each use case. The primary use case represents the standard flow of events in the system, and alternative paths describe variations to the behaviour. The Use Case Scenario is a single path through the Use Case. Below are five (05) selected Use Cases taken from the Use Case Diagram.

2.1 Use Cases Related to the System Admin *(Table 13 and Table 14)*

Use Case Name	System Admin login to the system *(Figure 44)*
Use Case ID	01
Primary Business Actor	System Admin
Pre-Condition	The Server is on. System Admin PC must have a connection with the server.
Main Flow	1. Open the web browser 2. Type the system IP address 3. The system will ask for the admin username and password. 4. System Admin should give his username and password. 5. The system does the authentication. 6. System Admin homepage will display.
Alternative Flow	4. (a) If authorisation fails, 4. (a) 1. A message will display "Incorrect Username or Password". 4. (a) 2. The System Admin will be asked to re-enter the username and the password.
Post-Condition	The System admin will get access to the Admin page.

Table 13 - Use Case ID 01

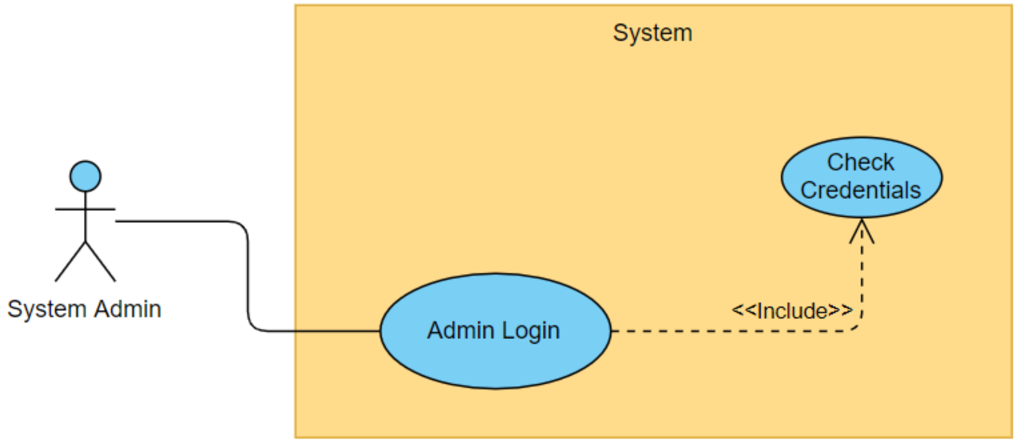


Figure 44: Use Case ID 01

Use Case Name	Adding Staff Members to the system *(Figure 45)*
Use Case ID	02
Primary Business Actor	System Admin
Pre-Condition	The Server is on. The System Admin must be logged into the system.
Main Flow	1. The System Admin go to the Admin Homepage. 2. Click the 'Staff Members' option from the menu. 3. Select the 'Add Staff Member' option. 4. A form will be displayed to enter the information. 5. He will enter the relevant details into the form. 6. Once he enters the relevant information, he will press the 'submit' button. 7. The system will cross-check with the database whether the details exist already. 8. A message will be displayed on the screen "User Created Successfully!".
Alternative Flow	6. (a) If any records are incorrect / not in the relevant format, 4. (a) 1. A message will display "Incorrect data/format. Please check and press the submit button". 4. (a) 2. The System Admin will be asked to re-enter the details correctly.
Post-Condition	The system will display the Users List.

Table 14 - Use Case ID 02

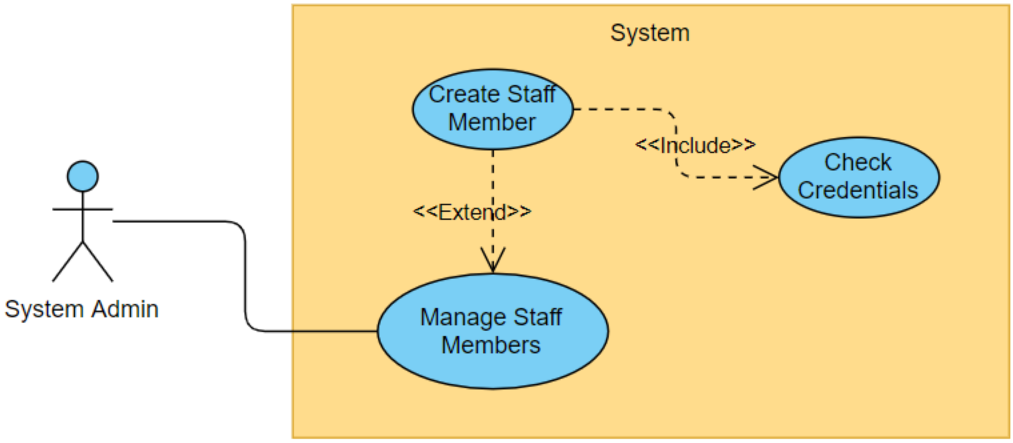


Figure 45: Use Case ID 02

2.2 Use Cases related to the Staff Administrator *(Table 15)*

Use Case Name	Adding Examinations *(Figure 46)*
Use Case ID	03
Primary Business Actor	Staff Administrator
Pre-Condition	The Server is on. The Staff Administrator must be logged into the system.
Main Flow	1. The Staff Admin go to the Staff Admin Homepage. 2. Click the 'Examinations' option from the menu. 3. Select the 'Add Examinations' option. 4. A form will be displayed to enter the information. 5. Staff Admin will enter the relevant details into the form. 6. Once he enters the relevant information, he will press the 'submit' button. 7. A message will be displayed on the screen "Exam added Successfully!".
Alternative Flow	6. (a) If any records are incorrect / not in the relevant format, 4. (a) 1. A message will display "Incorrect data/format. Please check and press the submit button". 4. (a) 2. The Staff Admin will be asked to re-enter the details properly.
Post-Condition	The system will display the Marks details list.

Table 15 - Use Case ID 03

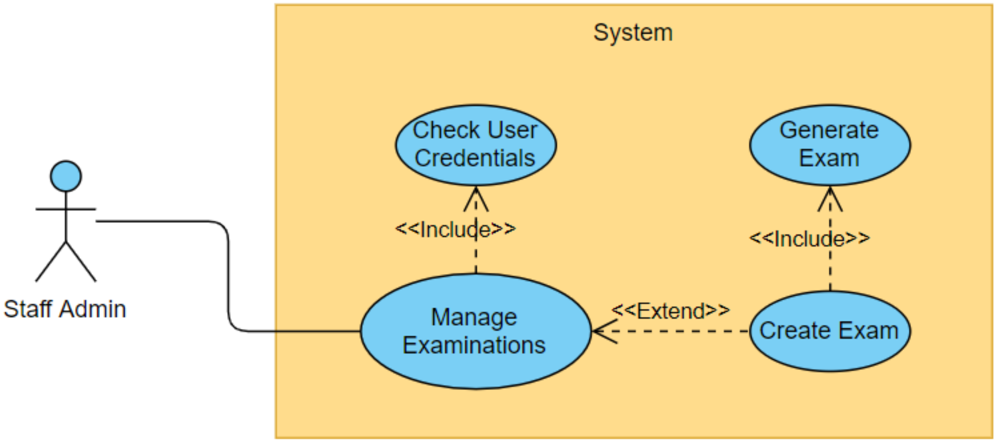


Figure 46: Use Case ID 03

2.3 Use Cases related to the teacher *(Table 16 and Table 17)*

Use Case Name	Examination Marks Entering *(Figure 47)*
Use Case ID	04
Primary Business Actor	Teacher
Pre-Condition	The Server is on. The teacher must be logged into the system.
Main Flow	1. The teacher go to the Teacher Homepage. 2. Click the ‘Examinations’ option from the menu. 3. Select the ‘Add Marks’ option. 4. A window will pop up to select the relevant exam. 5. Teacher selects the exam and click the ‘next’ button. 6. A form will be displayed to enter the marks of the students. 7. Teacher will enter the relevant marks into the form. 8. Once he enters the relevant information, he will press the ‘submit’ button. 9. A message will be displayed on the screen “Marks saved Successfully!”.
Alternative Flow	6. (a) If any records are incorrect / not in the relevant format, 4. (a) 1. A message will display “Incorrect data/format. Please check and press the submit button”. 4. (a) 2. The teacher will be asked to re-enter the details properly.
Post-Condition	The system will display the Examinations List.

Table 16 - Use Case ID 04

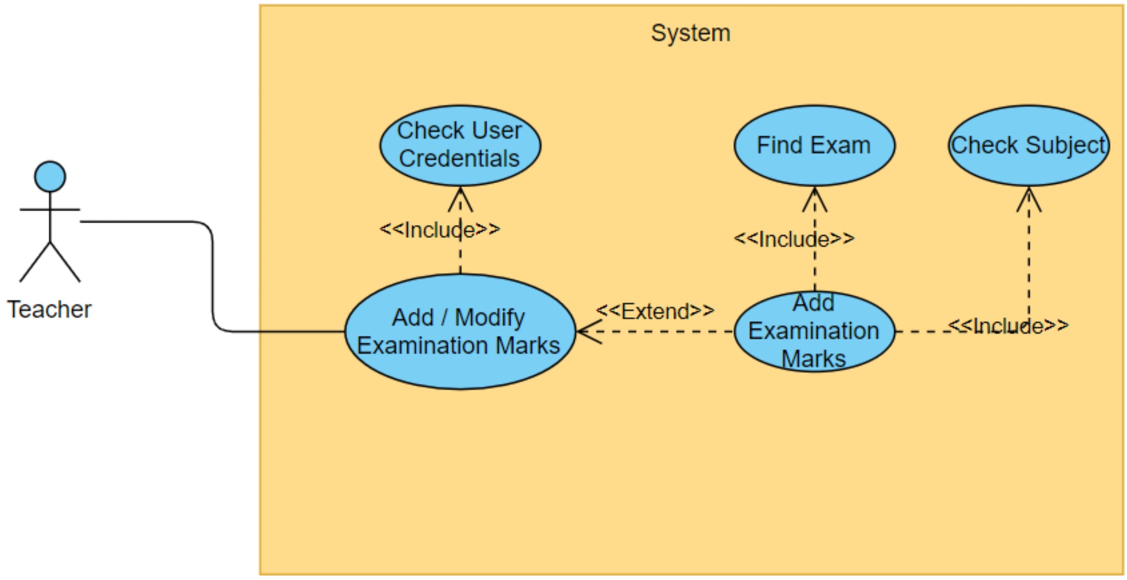


Figure 47: Use Case ID 04

Use Case Name	Assign Multiple Intelligences types *(Figure 48)*
Use Case ID	05
Primary Business Actor	Teacher
Pre-Condition	The Server is on. The teacher must be logged into the system.
Main Flow	1. The teacher go to the Teacher Homepage. 2. Click the ‘Multiple Intelligences’ option from the menu. 3. Select the ‘Add Multiple Intelligences’ option. 4. A window will pop up to select the relevant option (Exam / Behaviour / Skills). 5. Teacher selects the relevant option and click the ‘next’ button. 6. A form will be displayed to enter the multiple intelligences level type and the level points for the selected category. 7. Once he enters the relevant information, he will press the ‘submit’ button. 1. A message will be displayed on the screen “Intelligence Type Assigned Successfully!”.
Alternative Flow	6. (a) If any records are incorrect / not in the relevant format, 4. (a) 1. A message will display “Incorrect data/format. Please check and press the submit button”. 4. (a) 2. The teacher will be asked to re-enter the details properly.
Post-Condition	The system will display the Multiple Intelligences page.

Table 17 - Use Case ID 05

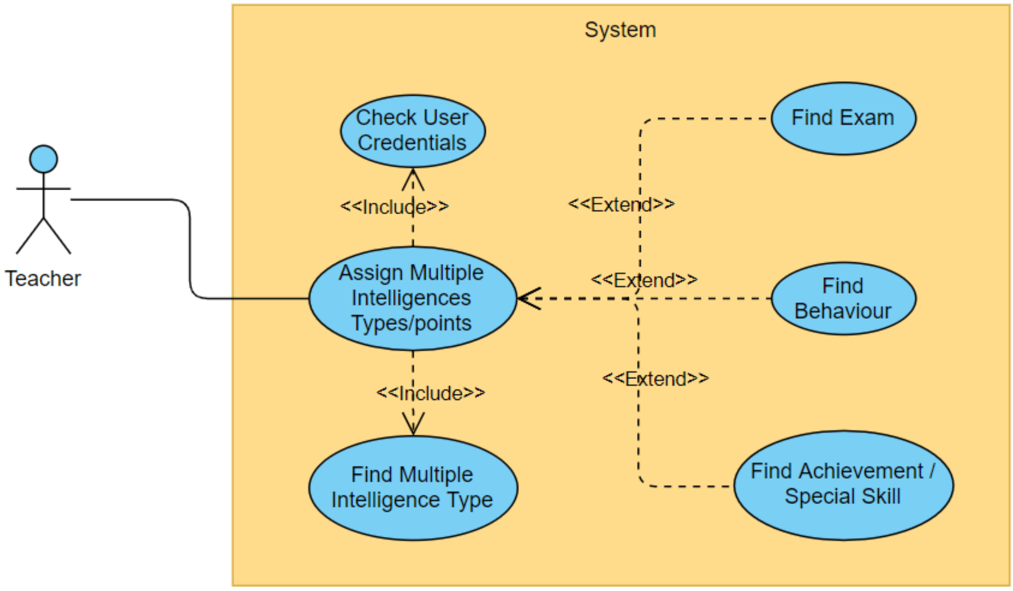
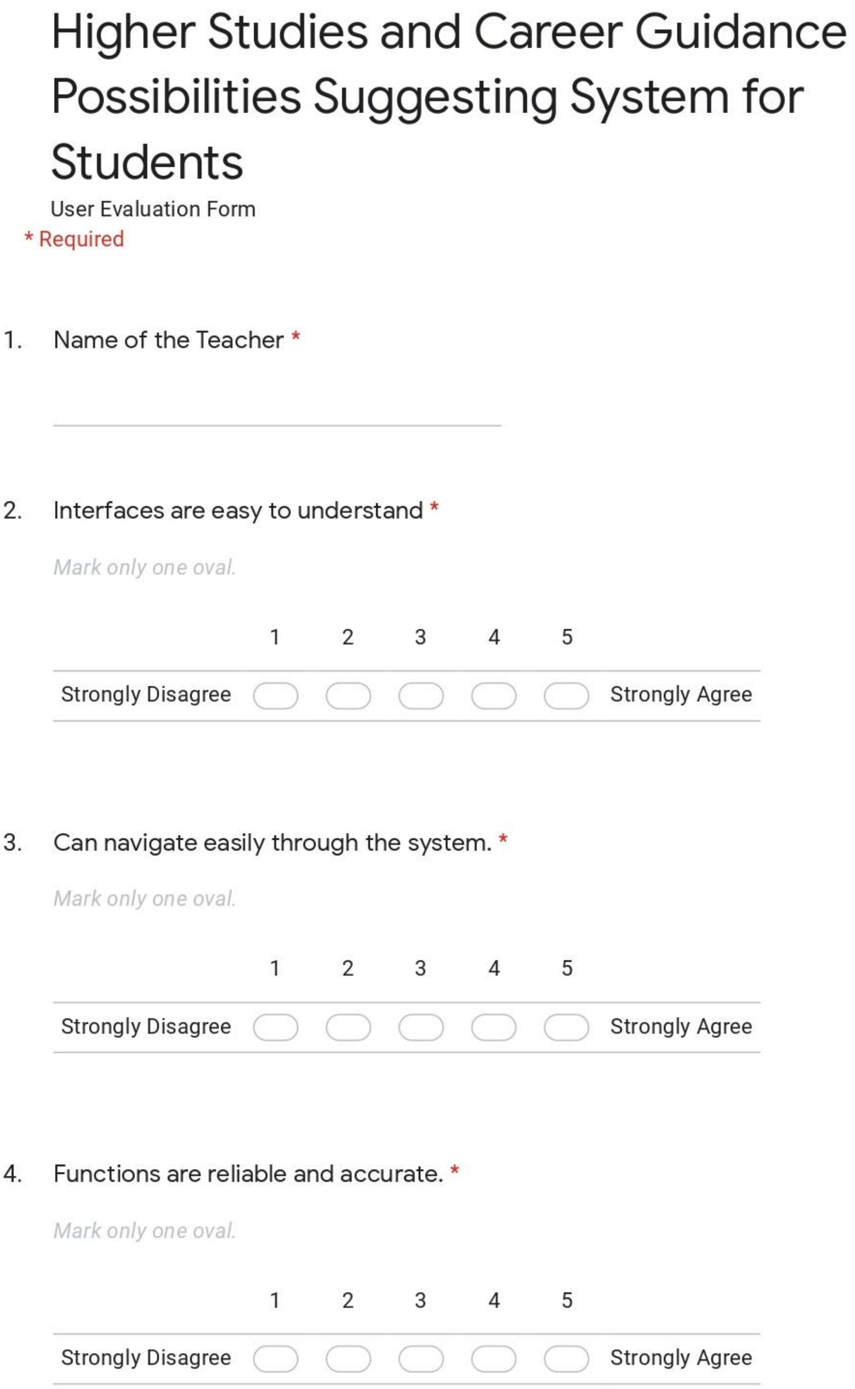


Figure 48: Use Case ID 05

Appendix B – User Evaluation Questionnaire Form



Higher Studies and Career Guidance Possibilities Suggesting System for Students

User Evaluation Form

* Required

1. Name of the Teacher *

____

2. Interfaces are easy to understand *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

3. Can navigate easily through the system. *

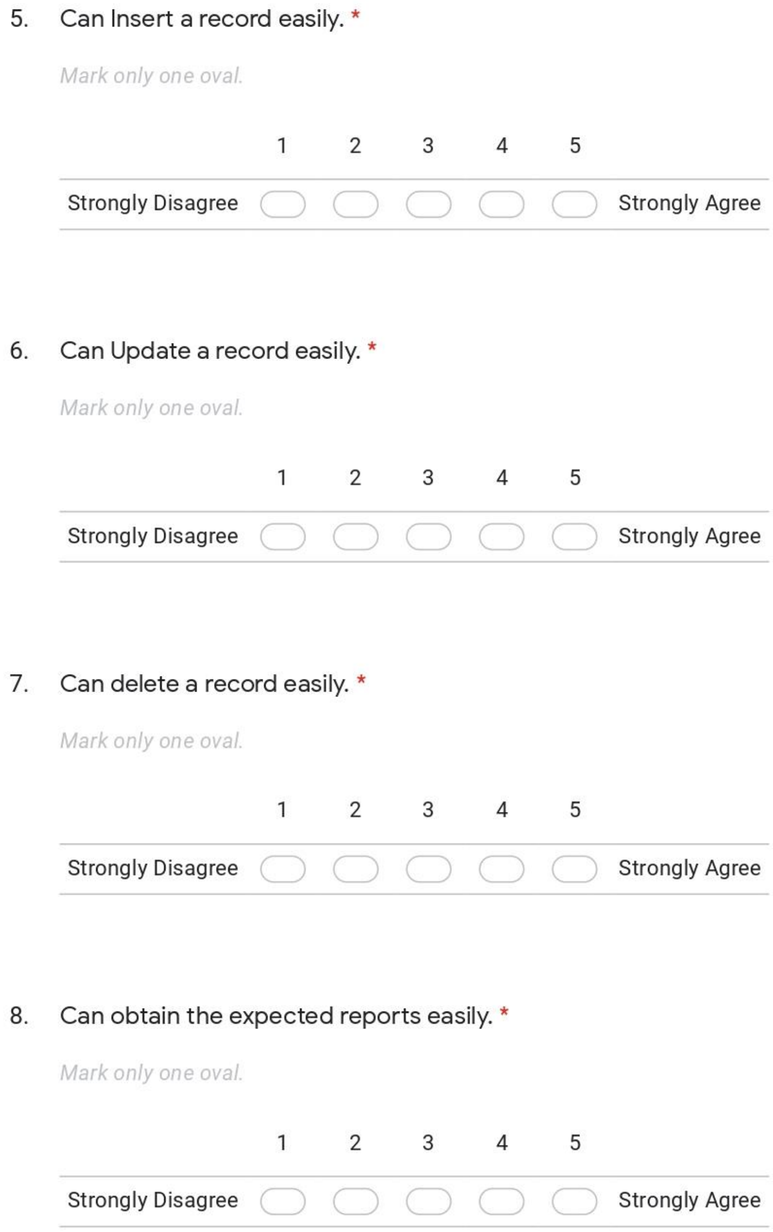
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

4. Functions are reliable and accurate. *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree



5. Can Insert a record easily. *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

6. Can Update a record easily. *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

7. Can delete a record easily. *

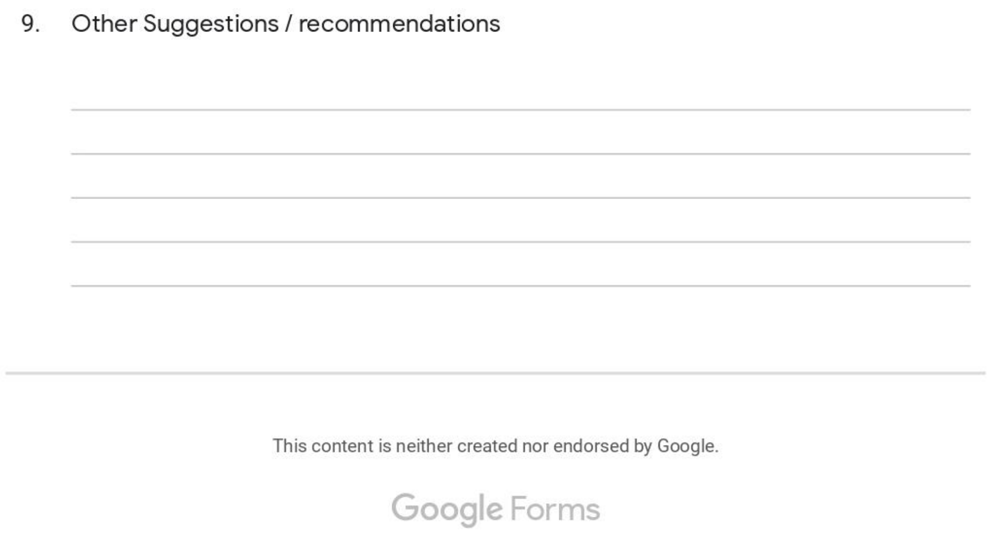
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

8. Can obtain the expected reports easily. *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree



9. Other Suggestions / recommendations

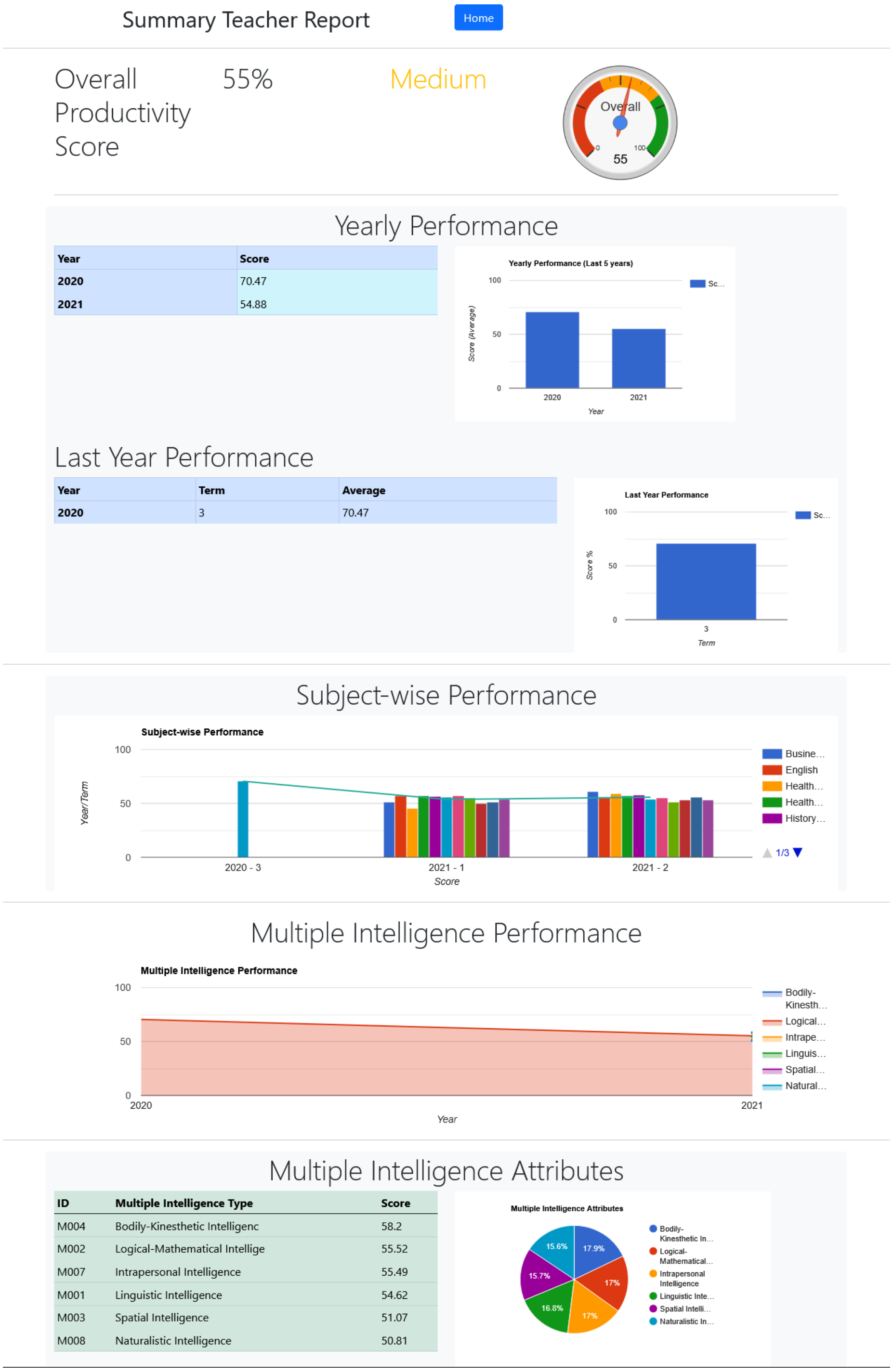
This content is neither created nor endorsed by Google.

Google Forms

Appendix C – Management Reports

Overall Teachers Report

The overall teachers' report presents the summary of all the teachers' progress. The *Yearly performance table* shows the yearly academic performance of the teachers, while *Last Year performance* showed the overall score of the last three terms last year. Subject-wise performances are also shown in a chart. Furthermore, the *Multiple Intelligence details* of all the teachers and the progress are shown in this report *(Figure 49)*



Summary Teacher Report

Overall Productivity Score 55% Medium

Yearly Performance

Year	Score
2020	70.47
2021	54.88

Last Year Performance

Year	Term	Average
2020	3	70.47

Subject-wise Performance

Multiple Intelligence Performance

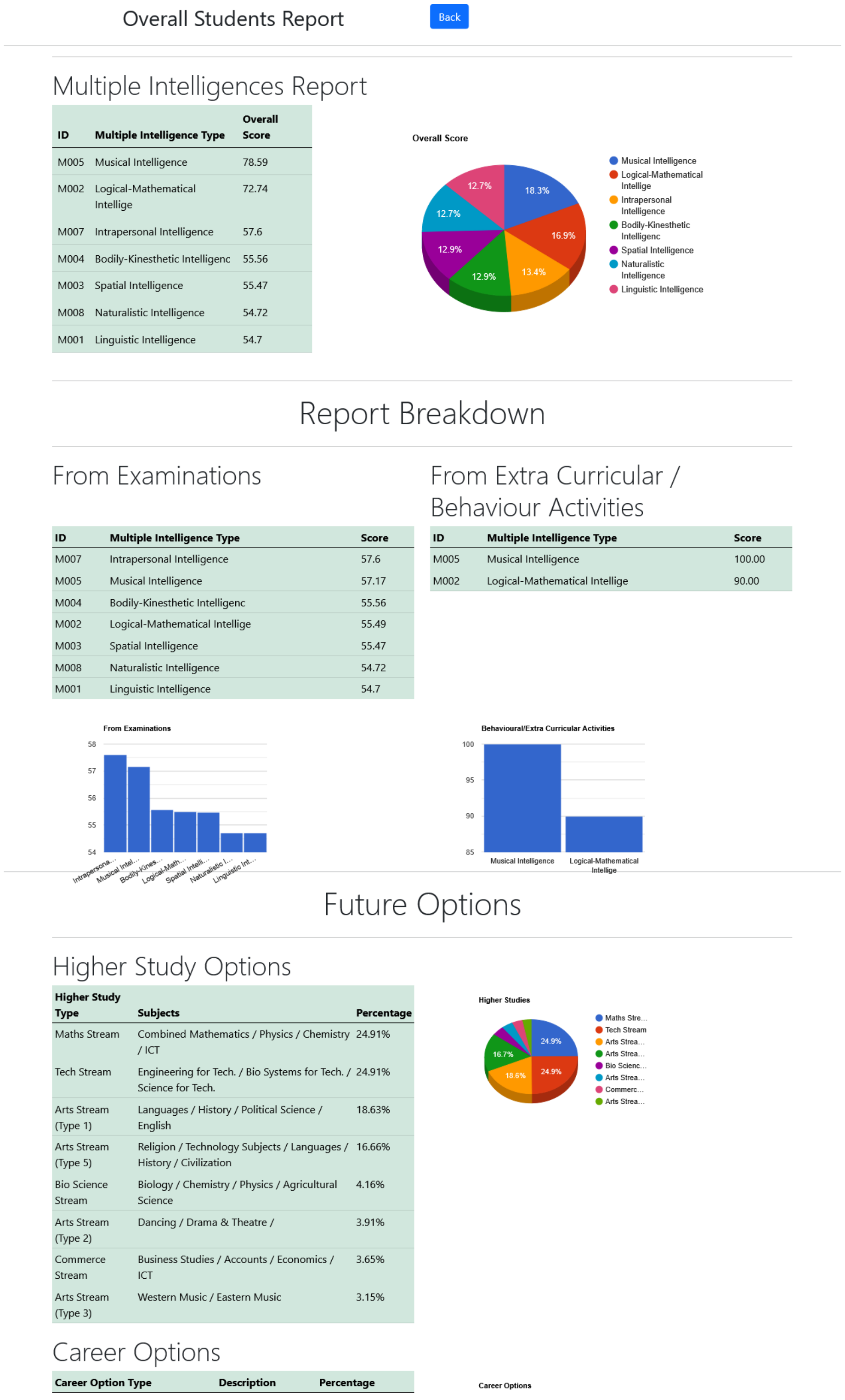
Multiple Intelligence Attributes

ID	Multiple Intelligence Type	Score
M004	Bodily-Kinesthetic Intelligenc	58.2
M002	Logical-Mathematical Intellige	55.52
M007	Intrapersonal Intelligence	55.49
M001	Linguistic Intelligence	54.62
M003	Spatial Intelligence	51.07
M008	Naturalistic Intelligence	50.81

Figure 49: Summary Teacher Report

Overall Students’ Report

The Overall Students’ Report shows the summary evaluation of all the students in the school. It clearly shows the Multiple Intelligence Progress of all the present students, how they have scored from examinations and other activities, the higher studies options, and the future career options. The school administration can make further long-term decisions by referring to these management reports *(Figure 50)*



Overall Students Report

Multiple Intelligences Report

ID	Multiple Intelligence Type	Overall Score
M005	Musical Intelligence	78.59
M002	Logical-Mathematical Intellige	72.74
M007	Intrapersonal Intelligence	57.6
M004	Bodily-Kinesthetic Intelligenc	55.56
M003	Spatial Intelligence	55.47
M008	Naturalistic Intelligence	54.72
M001	Linguistic Intelligence	54.7

Overall Score
18.3%
16.9%
13.4%
12.9%
12.9%
12.7%
12.7%
Musical Intelligence
Logical-Mathematical Intellige
Intrapersonal Intelligence
Bodily-Kinesthetic Intelligenc
Spatial Intelligence
Naturalistic Intelligence
Linguistic Intelligence

Report Breakdown

From Examinations

ID	Multiple Intelligence Type	Score
M007	Intrapersonal Intelligence	57.6
M005	Musical Intelligence	57.17
M004	Bodily-Kinesthetic Intelligenc	55.56
M002	Logical-Mathematical Intellige	55.49
M003	Spatial Intelligence	55.47
M008	Naturalistic Intelligence	54.72
M001	Linguistic Intelligence	54.7

From Extra Curricular / Behaviour Activities

ID	Multiple Intelligence Type	Score
M005	Musical Intelligence	100.00
M002	Logical-Mathematical Intellige	90.00

Future Options

Higher Study Options

Higher Study Type	Subjects	Percentage
Maths Stream	Combined Mathematics / Physics / Chemistry / ICT	24.91%
Tech Stream	Engineering for Tech. / Bio Systems for Tech. / Science for Tech.	24.91%
Arts Stream (Type 1)	Languages / History / Political Science / English	18.63%
Arts Stream (Type 5)	Religion / Technology Subjects / Languages / History / Civilization	16.66%
Bio Science Stream	Biology / Chemistry / Physics / Agricultural Science	4.16%
Arts Stream (Type 2)	Dancing / Drama & Theatre /	3.91%
Commerce Stream	Business Studies / Accounts / Economics / ICT	3.65%
Arts Stream (Type 3)	Western Music / Eastern Music	3.15%

Career Options

Career Option Type	Description	Percentage

Figure 50: Overall Students Performance Report