# Creating a web portal for an online entrance exam and learning material

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Education systems have evolved extensively with the adoption of emerging technologies. In particular, traditional manual methods of examination have given way due to the spread of automation in the overall learning management system (LMS) and assessment.

The purpose of this project was to build a web portal for the automation of the manual entrance examination for a course "Preparatory studies of mathematics" at Laurea University of Applied Science. It is planned to deploy the portal within Laurea's internal network to allow students to take the test online.

The project started with researching on online examination systems and LMSs. By analyzing various similar platforms and alternatives, a deeper understanding about the necessity of online education system was achieved.

The web portal for the specified purpose has been developed with proper analysis and by following the appropriate development life cycle of software during this project. "WordPress" was used as the platform for the development process. The execution and the functionalities of the portal were well received by the client.

Contents

# 1    Introduction

Online examination system has become very popular and extremely useful around the world. The automation of the examination system provides digital platform to produce more accuracy and efficiency.

The Learning Management System (LMS) is widely used in corporate market for conducting training programs for the employees. The other focus of LMS is on modern education system. Introducing LMS in education system has empowered the teaching capabilities more interactive. The online examination system is a core part of LMS for the assessment of its users.

The COVID-19 pandemic situation has put a massive impact on education system around the world. The cancellation of classroom lectures, shutting down of the campuses, unavailability of the transportation and many other restrictions of the social life have brought the students in a very difficult phase to continue their study. The conventional assessment system of the students has become inaccessible in many parts of the world. Therefore, the online learning management and evaluation of the learners in real time have become indispensable representation of education system (Megha 2020).

Figure 1 provided by Megha (2020), gives a clear idea as a comparison between manual and digital examination system.
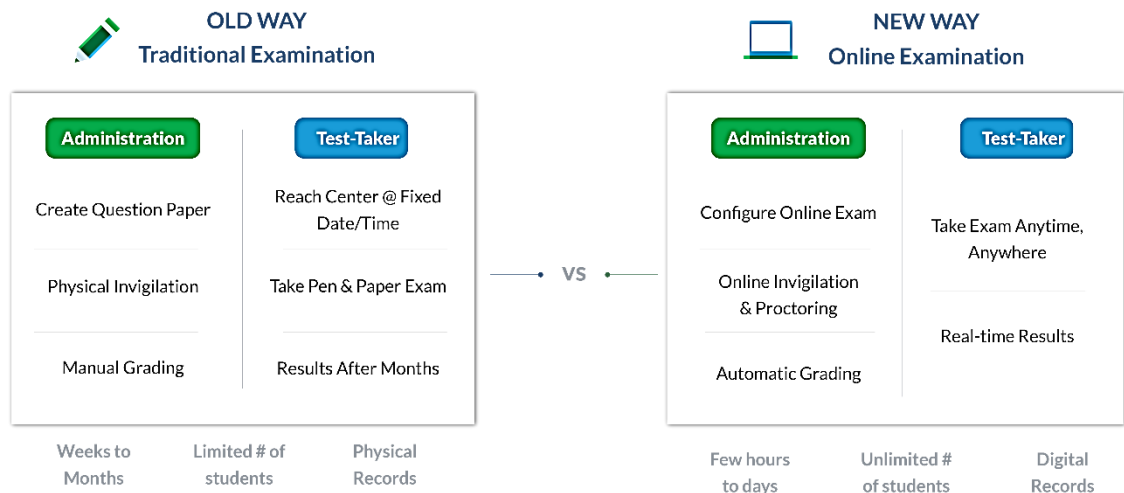
Figure 1: The comparison of manual and online exam system (Megha 2020)

In this project the overall necessity of online examination system will be described. A web portal might match the demand of the students and narrow down their anxieties of taking

exams in traditional ways. The practical outcome of the project is about creating that portal and justify its necessity.

## 1.1 Client

This is an internal project offered by Laurea university of applied science. The client is a senior lecturer of Laurea UAS. Among his several other courses, he is currently conducting a mathematics course for the nursing students at Tikkurila campus, located in Vantaa.

## 1.2 Project background

The client approached and provided the opportunity to work on this project in September 2020. The client as a teacher wants the course to be automated from manual learning process as it saves resources, such as time, human effort, logistic etc. The automation also gives more accuracy during evaluation and reduces the stress of the students. As manual examination system becomes inconsistence in some points and gives probabilities of more errors, the automation of the system might fix the issues and reduce the workload of the examiner.

## 1.3 Project objectives

The intent of this project is to research on the necessity of online examination system and to build a web application to conduct an entrance examination for the students to exempt the whole course. The students who pass the entrance exam, do not have to take part in weekly lessons. They may exempt from attending the whole course. The other will go through the learning material. The project also consists the research on the challenges and solutions for the online examination system.

## 1.4 Benefits and obstacles

Implementing the automation in any traditional system always bring some obstacles. A major focus of this project is to overcome those barriers to deliver a trouble-free product to the client.

### 1.4.1 Benefits

The system certainly saves resources such as time, cost, human effort, etc. as mentioned earlier.

To avoid several exam management procedures such as making questions, evaluating and publishing result, the automation of the system significantly reduces the task of the examiner and reduces expenses for the organization (Megha 2020).

The evaluation of the students can be done in real time and recorded digitally that ensures the accuracy and reliabilities. The virtual system provides the students less stress and narrows down the probabilities of cheating during taking test.

As the teacher is working on different campuses such as Tikkurila, Leppävära; the online system may centralize the overall learning processes.

### 1.4.2 Obstacles

The process of providing questions and analyzing answers for the individuals with their credentials certainly involves software utilities and backend functionalities simultaneously. Security is a vital issue for this purpose like any other web applications.

There are many cases came forward during this pandemic where in distance learning and examination system, the students get help from friends and family members to answer their questions. They also get the advantages of using other devices such as smart phones, tablets to search for the answers. It can be even done by the same device by browsing the search engines in different tabs.

There are many alternatives available to conduct online examination. Many third-party websites are providing the facilities of quality online examination system and learning materials. It is even easier to make quiz-based questions with built-in templates provided by various LMS platforms.

In some part of the world the infrastructure barriers may affect the implementation of online examination. The poor internet connection and inadequate supply of electricity may capsize the whole process.

### 1.4.3 Primary planning for overcoming the obstacles

There are some preliminary plans to face the obstacles which can be implemented during development phase of the project-

- An IT security framework will be used as a guideline during this project as a security observation.

- Multi steps authentication system can be provided for ensuring the identities.

- Despite having alternatives, the aim of this project is to develop an own secured digital application with student's credentials which are already provided by the school. A secured cloud platform can be used to deploy the application.

## 2 Theoretical background and knowledge base

The theoretical background of a research illustrates the concepts of the theories that related to the on-going research. This section creates a bridge between the objective and the attainment of the project.

The related literatures from various research papers and other articles need to be reviewed to understand the depth of the topic. During appraising the theories from various resources, the key topics that have been researched deeply are- LMS, online examination system and web portal.

### 2.1 Learning management system (LMS)

The implementation of using computer technology into study has a huge impact in overall education system. It has evolved rapidly and introduced the web-based education with the emerging technology of computer. LMS is a revolutionary product of electronic based learning system in modern era. A learning management system or LMS is a software application that is designed for the end users with a set of open-source learning materials and assessment procedures. In most cases the LMSs can be purchased for any educational organization or any company. The LMSs can be customized efficiently according to the requirements. The development of LMSs and the exigencies also have changed the way of teaching for the teachers. The teachers are required to use LMSs in some point even in classroom teaching.

Several LMSs have been gone through during this research to understand the deeper knowledge about the concept. The findings have clearly justified the necessity of developing online exam portal for the students.

### 2.2 Online examination system

The usefulness of online learning system and the automation of evaluating the students by examining in real time are intimately involved. It has been explained as- "Examinations are an inevitable part of the educational ecosystem. With evolving technologies, a globalized world, and an increasingly competitive educational landscape, it is necessary to keep up with the times. Along with ever-evolving teaching and learning methods, processes like examinations must also be examined. An online examination system is the product of such an analysis – it automates, digitizes, and flattens the process to become more accessible, inclusive and accurate compared to its previous avatar. At the same time, it does not eliminate best practices in student evaluation and examination that have been built over the years. Instead, the online examination system is a culmination of the old and familiar and the new and innovative" (Advantages & Disadvantages of Online Examination System 2019).

The thriving of the digitization is like the uninterruptedness expansion of the universe. It is expanding constantly to leverage the advanced benefits for the users. Thriving of the digitization influences the people to use modern technology and ensures the maximum benefits out of it. The automation of any technology facilitates the end users in several ways. It standardizes the user's activities by providing the advanced formation of the technology. The technological modernization has also affected the educational system to be evolved.  The students are provided many useful resources from digitized education system. The online learning materials are great source for the students that can even be available for free of costs. Many education organizations provide web applications for the registered students to interact with teachers and other fellow students. The students can use electronic return boxes to submit the assignments and can appear into the examination through the web application. This whole process of education certainly gives the most percentage of accuracy and arouses the interests of the students. Therefore, the automation of examination process is considered as ineluctable standard of modern education system.

Some experts still disagree the ineluctability of distance or online learning system. Some teachers prefer to teach the students face to face as they think the mind of the students cannot be read from being away. It has been found according to the article (Yle Uutiset 2020), that there is a significant number of school dropouts that has taken place in Finland during the coronavirus epidemic because of applying mandatory distance learning system.

The online learning and examination system still have scope to overcome this kind of unwanted circumstances. Adopting Artificial Intelligence (AI) into online education system may play as a catalyst to understand the psychology of the students. According to Mark (2019), AI has the capability to personalize every individual student's demand as it can provide individual oriented learning facilities that may increase the interaction of the students in distance learning.

Though the online examination system can be provided through many third-party websites or LMS, the intension for this project is to develop an independent web portal for conducting the online test. It has become an important issue at this stage how an online examination system works. Zhao and Li (2014) researched on online examination system and mentioned about three major functions of it as- Question Management, Paper Generating and Test Online. The 'Question Management' module deals with creating questions and maintaining them. The exam papers according to the specific requirements are generated in 'Paper Generating' module and the last module 'Test Online' is about providing the interface to the students to appear the test (Zhao & Li 2014).

After going through various alternatives, the goal of this project is to create a 'web portal' for the students to take the exam online inside school network.

## 2.3 What is web portal

A web portal is a web-based platform and itself a website where the contents are more categorized and customized. A web portal is usually created for certain members of an organization or for certain target group of a society. The members need to log in to the portal with certain credentials. The content of a website is equally visible for all the users; contrastingly the content's views are different for different users in web portal. The Admin and the member would not see the same contents in web portals. The privilege of the members can be categorized as well.

There are two major types of web portals- internet portals and intranet portals. The internet web portals are available in the web and anybody can get into the home page; anybody can go further with credentials. Some examples of internet web portals are the websites of the banks, stock exchanges, health services. These are designed for wide range of customers. On the other hand, intranet web portals are designed and kept in a certain network for certain members. The number of users can be high, but all the users need to be members of the organization.

A web portal may contain contents from many different sources. It may contain external links for providing more required information.

The aim for the development of this project is therefore to create an intranet web portal for the students of Laurea UAS only. The students will be authenticated by their own credentials given by the school authority. The students of a certain course will be able to appear their exam online through the portal.

## 3 Methodology

This project had the scope to understand the deeper knowledge of the online learning system and to build a usable outcome as a deliverable. The project was alienated in two parts that are research and development.

## 3.1 Research methodology

Qualitative method was used for this phase. The method usually uses set of collected and reviewed data from various topic related sources. According to Hennink, Hutter and Baily (2020), this is a process of experiencing clint's and user's needs by communicating them in various ways and the process certainly beneficiates the researcher to identify the core issue of the research topic.

The other option was Quantitative research that usually get used to test and confirming a theory, where Qualitative research allows understanding the topic enormously. Therefore, for getting deeper knowledge about the topic the qualitative methodology of research had been selected.

The demand of online examination method widely depends on the examinee. Their experience and desire are key points to be understood for the research. As it was a client-oriented project, the requirements of the client needed to be collected and measured in a regular basis.

The communication with the client mainly took place through email and 'Zoom' meeting. Zoom is a communication software that provides video telephony and online chatting. The key notes from every meeting were kept and maintained. The notes were the useful resource for designing the deliverable.  Table 1 shows the communication data that have been gathered from Zoom meetings and emails.

| Date of meeting | Contacts | Topic | Notes |
|---|---|---|---|
| 25.09.2020 | Client | Approaching project | • Expected delivery time: 15.11.2020<br>• Page should contain-<br>  ✓ Online exam<br>  ✓ Timer<br>  ✓ Instructions |
| 29.09.2020 | Thesis teachers | Thesis proposal | • Advices:<br>  - Need to check other alternatives (LMS)<br>  - Security measurement |
| 13.10.2020 | Supervisor | Platform for the development of the project | • Wordpress |

| 29.10.2020 | Client | Project demo | • An initial version of the project has been shown.<br><br>• Client's satisfaction earned<br><br>• Some small modifications needed<br><br>   - Sample page should be named as 'Instructions Page' |
|---|---|---|---|

Table 1: Notes from the 'ZOOM' meetings

## 3.2    Development methodology

This is the methodology of splitting the software development process into segments to be completed part by part. There are two major types of this methodology- Waterfall and Agile. The Waterfall methodology was chosen for this project as Agile consisted continuous repetition process that would not be ideal for an individual researcher.

### 3.2.1    Waterfall methodology

The development part of this project was entrusted with waterfall model. The tasks were required to be completed sequentially in every step. The initiation of one step was followed by the completion of the previous one.

Waterfall framework is a traditional way of developing software. The approach has sequential steps from beginning to the end and in every step a part of the development is defined and accomplished (Lotz 2018).

Figure 2 shows how the waterfall methodology was taken place for this project during development phase.
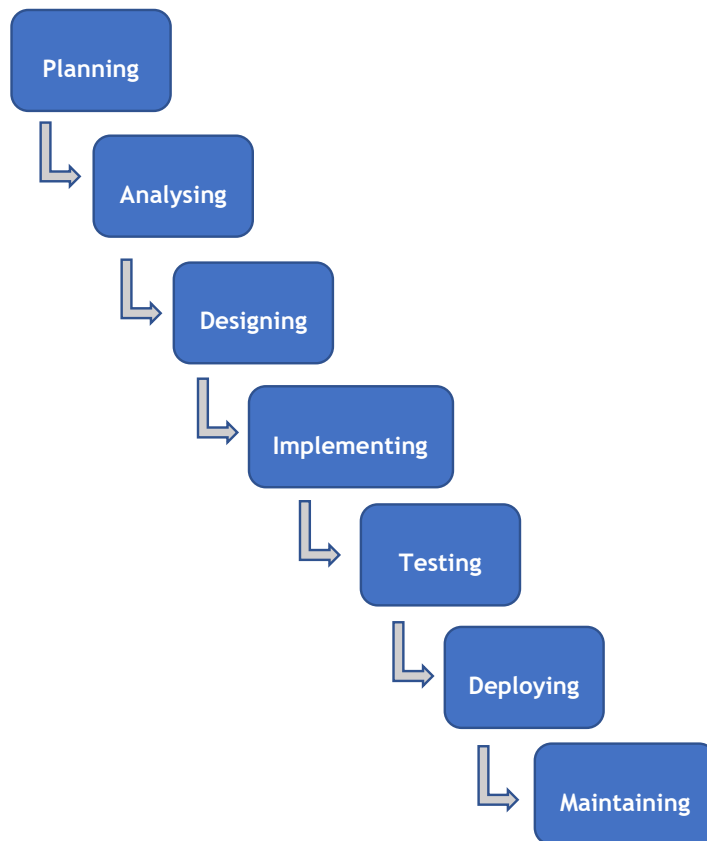
Figure 2: Waterfall framework

4    Development of online exam web portal

This implementation phase of the development has appeared after theoretical research has been done. This is the phase where the goal of the project can be achieved as a deliverable. The task is to develop a software that is totally practical workflow relating to a series of sequential steps as mentioned earlier. The steps have already been disclosed in development methodology part as- planning, analyzing, designing, implementing, testing, deploying and maintaining. In the whole development process of this project, each phase has depended on the deliverables from the previous one to finalize a united product at the end.

4.1    System planning

The planning has been correspondently done with the client from the very beginning. The client has approached with his desire to have a functional online examination system including related instructions and a timer. All the planning of the project has complemented and tried to fulfill each requirement provided by the client.

### 4.1.1 Client requirement

The client has sent his requirements through email. There has been regular communication through Zoom with the client. The ultimate requirement was to create a simple and functional web portal that can conduct online examination for the client's students. The portal should be informative and should include clear instructions about taking exam. The exam should have a timer. The evaluations of the students must get recorded in the backend database. The question paper should be flexible to modify for reuses.

### 4.1.2 Outcome of the plan

After reviewing all the requirements of the clients and analyzing some existent examples, the outcome of the planning has matched as Zhao and Li (2014) have described the functions of an online examination system. Figure 3 defines the planned outcome of the system (Zhao & Li 2014).
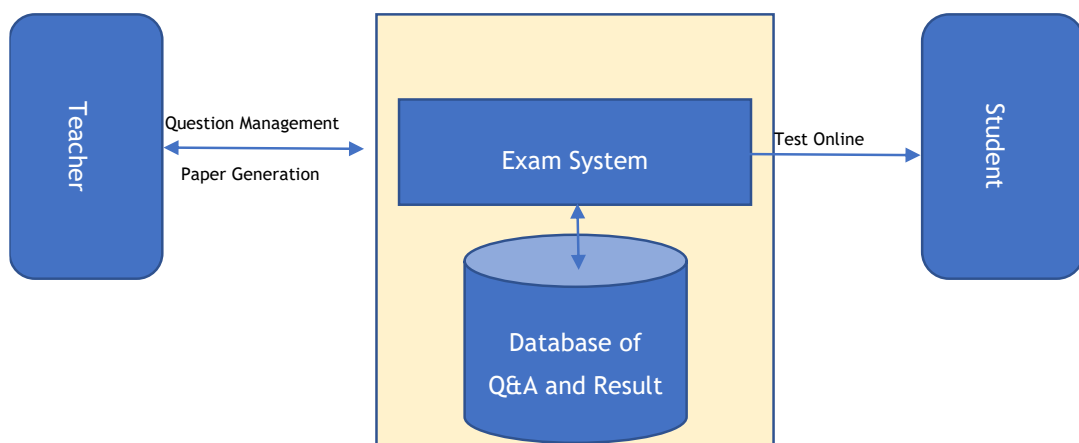
Figure 3: Planning of online exam functions

### 4.2 System analysis

System analysis for software development is a process to understand the method of identifying the project's goal and to build the system to achieve that goal.

The SWOT analysis and SDLC model have been analyzed and applied for the development process in this stage.

### 4.2.1 SWOT

SWOT analysis is a planning process to identify the capabilities for a person or an organization. This strategic process helps to start a project in an acquainted way.

The SWOT analysis for this project is shown in table 2.

| S | W | O | T |
|---|---|---|---|
| STRENGTHS | WEAKNESS | OPPORTUNITIES | THREATS |
| **Self:**<br><br>• Inquisitiveness<br><br>• Communication skill | • Multitasking | • Enlightenment of the skills | • Time management |
| **Project:**<br><br>• Infrastructural availabilities<br><br>• Adequate resources | • Lack of face to face meeting with supervisor and client because of pandemic | • Completion of the graduation<br><br>• Usable in future job hunt | • Time management |

Table 2: SWOT Analysis

After SWOT analysis the management of time has become a genuine threat. The Covid-19 pandemic condition might cause a role to make it even lengthier. To overcome this obstacle a self-monitoring process has been implemented to observe the timing of the progress. Figure 4 illustrates the self-monitoring process.

## Project Self-Monitoring

| PROJECT NAME | Creating web portal for entrance exam | | | PROJECT MANAGER | A H Wasim Sayeed | | | |
|---|---|---|---|---|---|---|---|---|

| ACTION | ASSIGNED TO | PRIORITY | STATUS | Report written | START DATE | END DATE | DURATION in days | NOTES |
|---|---|---|---|---|---|---|---|---|
| Research on necessity | Manager | High | Complete | ☒ | 29.09.20 | 06.10.20 | 7 | - The objectives have been identified<br>- First draft of thesis returned |
| Review alternatives | Manager | High | Complete | ☒ | 06.10.20 | 09.10.20 | 3 | - Reviewed other research and platforms |
| Mockup, Design | Manager | High | Complete | ☒ | 16.10.20 | 20.10.20 | 4 | - Shown to supervisor |
| Gathering required tools (SW) | Manager | High | Complete | ☒ | 14.10.20 | 16.10.20 | 2 | - WordPress and plugins<br>- Required data from client |
| Implementation | Manager | High | Complete | ☒ | 16.10.20 | 03.11.20 | 18 | - Shown to client |
| Applying fancy outlook | Manager | Low | Complete | ☒ | 3.11.20 | 05.11.20 | 2 | - More CSS works<br>- Not required by client |
| Testing | Manager | High | Complete | ☒ | 10.11.20 | 13.11.20 | 3 | - Done with feedback |
| Deploying | Manager & Client | High | Not started | ☐ | | | | - Under process |
| Presentation | Manager | High | Upcoming | ☐ | 17.11.20 | | | |

Figure 4: Self monitoring chart

### 4.2.2    SDLC

SDLC stands for Software Development Life Cycle that is a framework or model of building software. The process is continuous and consists of designing, developing, testing and deploying of a software. This life cycle even continues to maintenance phase for further continuity and enhancement of the product.

SDLC has been used for this project as the framework. There are no fixed number of phases for SDLC. The number of phases simply depend on the requirement of the project.

Figure 5 represents the graphical view of SDLC phases that has been used for this project.
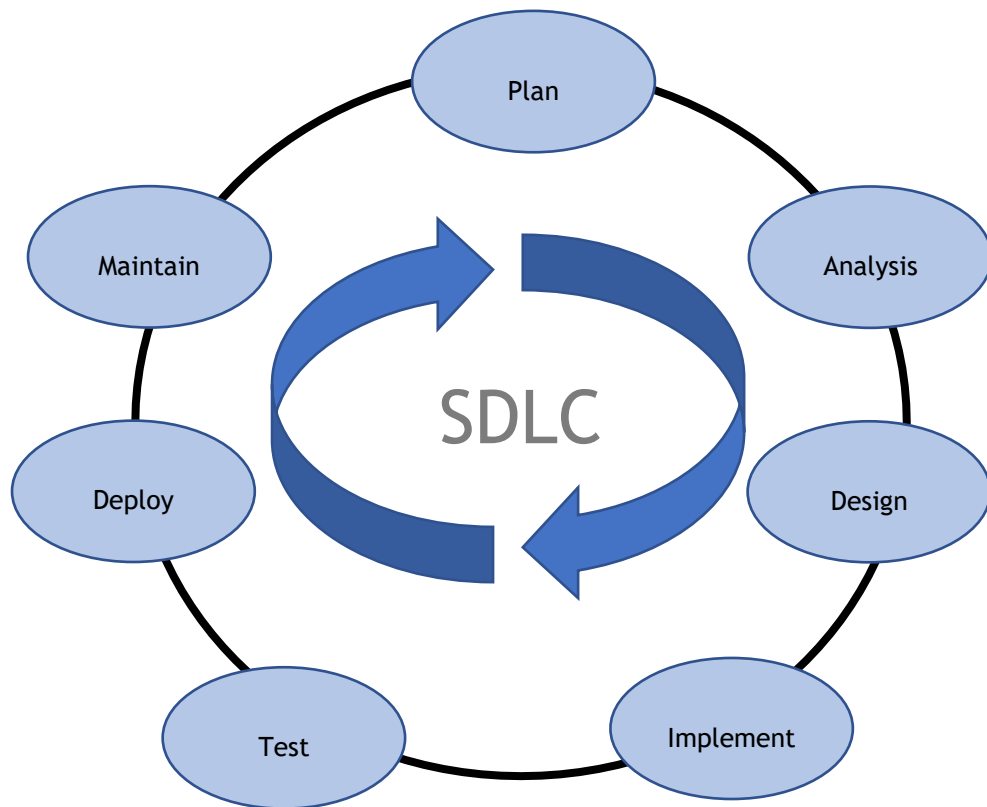
Figure 5: SDLC Framework

The detailed explanation about various models of SDLC framework have been discussed (Software experts: SDLC Models Guide 2017); some of those popular models are:

- Waterfall model

- Iterative model

- Spiral model

- V-shaped model

- Agile model

- Big bang model

The waterfall model has been implemented in this project that is mentioned earlier. As the project has been run by a single researcher, the step by step integrated process has assured the furtherance and accuracy of the outcome.

### 4.2.3 Checking alternatives

CANVAS is a newly launched intranet learning platform for Laurea students. It has the capability to provide learning material and conducting examinations for courses. The scope for the researcher still seems to be narrow as it has already been created.

Creating an independent web portal has provided the maximum scope for researching on the topic. It has also opened the door to develop technical skills that can be useful for future in job searching.

### 4.3 Designing

Designing phase of a software development consists of creating a technical blueprint of the deliverable. This designing is commonly called 'Wireframing' in web development. Wireframing of a web portal is used to lay out its contents and functions. The design represents how the workflow goes in the portal.

Wireframe can be done manually with pen and paper or digitally with various software tools. In this project both of those ways have been applied.

### 4.3.1 Sketch

The sketching of wireframe is considered as manual brainstorming for software design. These sketches show the innovativeness of the designer.

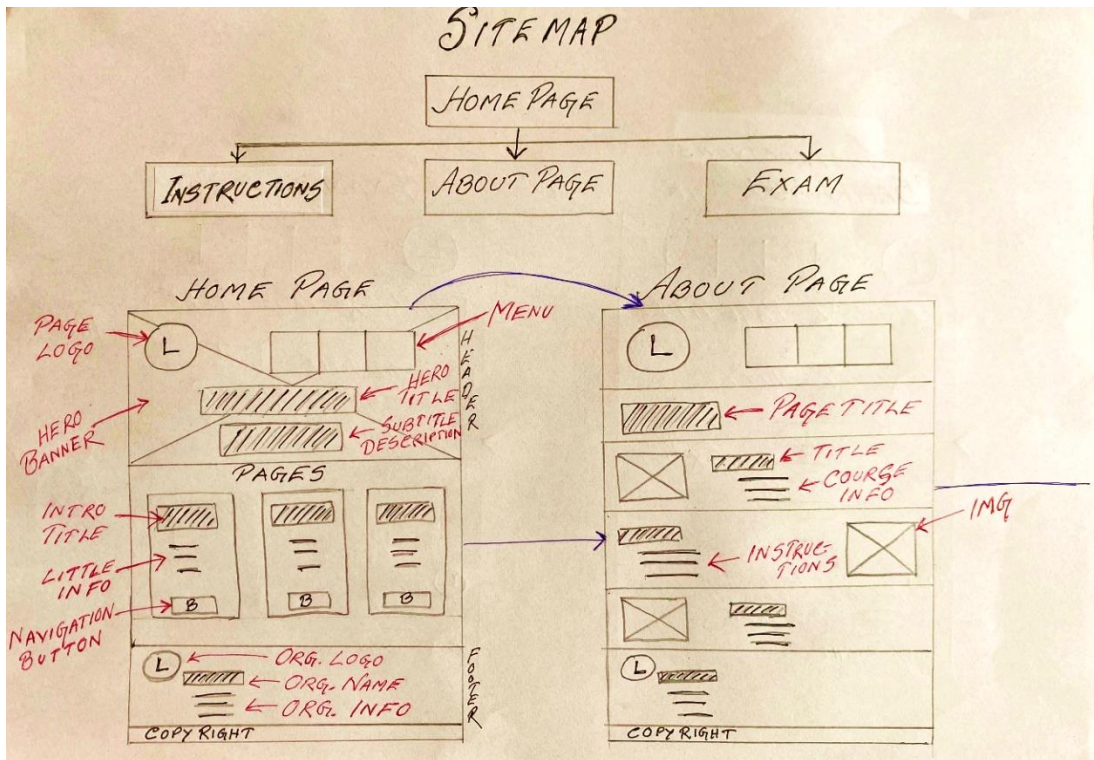Figure 6 and figure 7 are the manual blueprint of the web portal of this project.
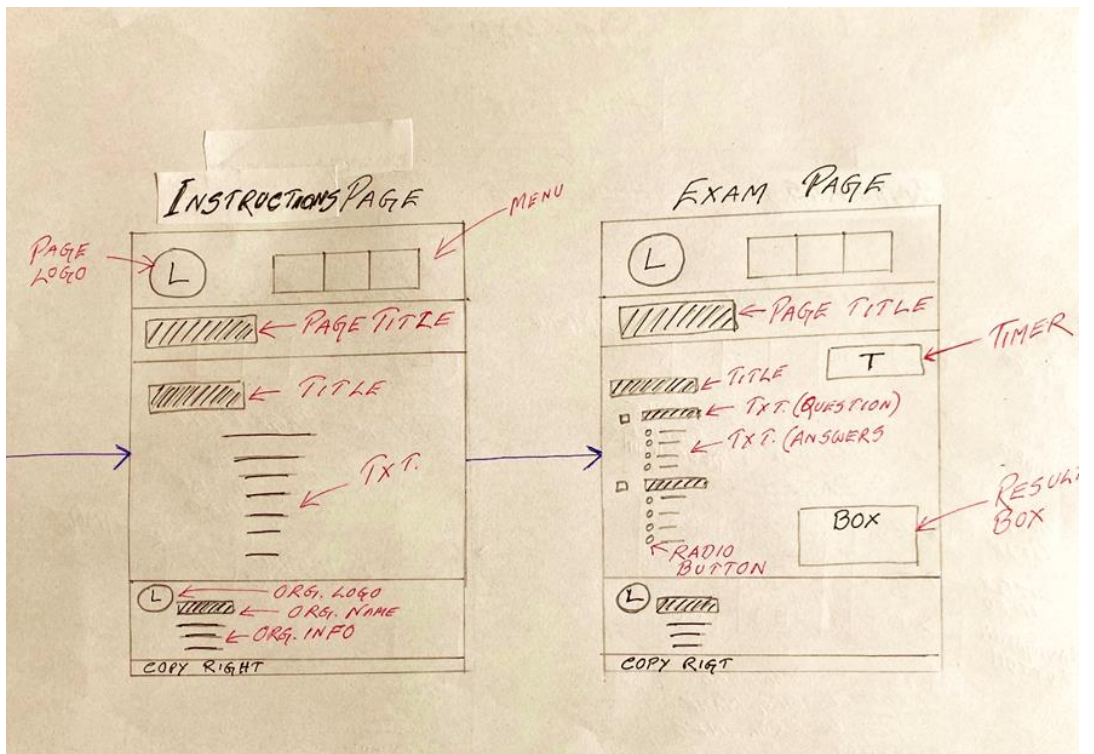
Figure 6: Sketch wireframe 1



Figure 7: Sketch wireframe 2

### 4.3.2    UI wireframes

User interface (UI) design is the digitized version of the sketched wireframes that are used to ensure the intuitiveness of the prototypes.

FIGMA is a third-party website that provides the facilities of digital prototyping or User Interface (UI) designing for free of cost. This is a cloud-based tool with online storage. It has collaboration feature that helps to build cooperation for teamwork.

The manual sketches of the portal that have been drawn earlier are converted into digital version (by using Figma) as figure 8, figure 9, figure 10 and figure 11.
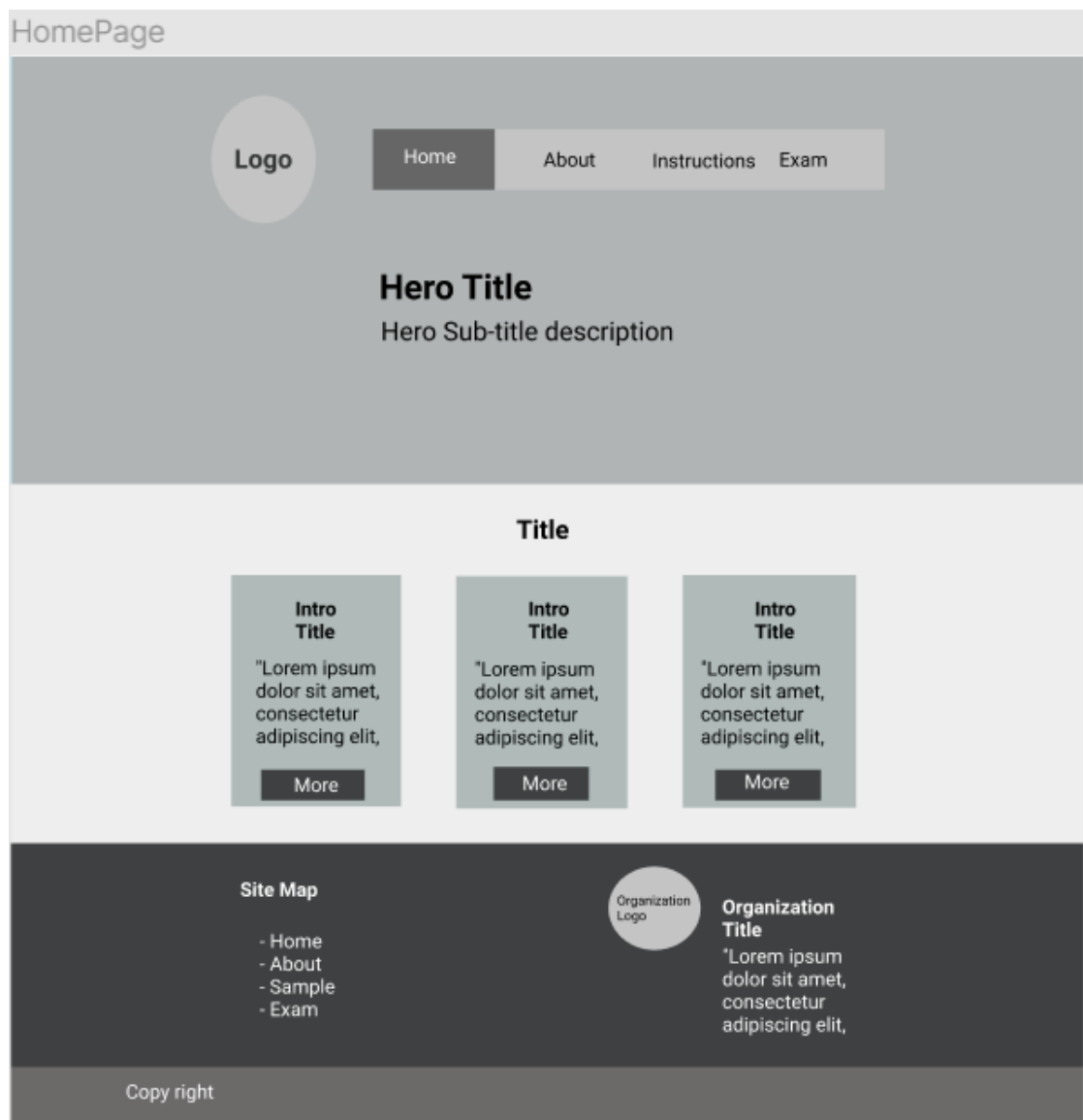
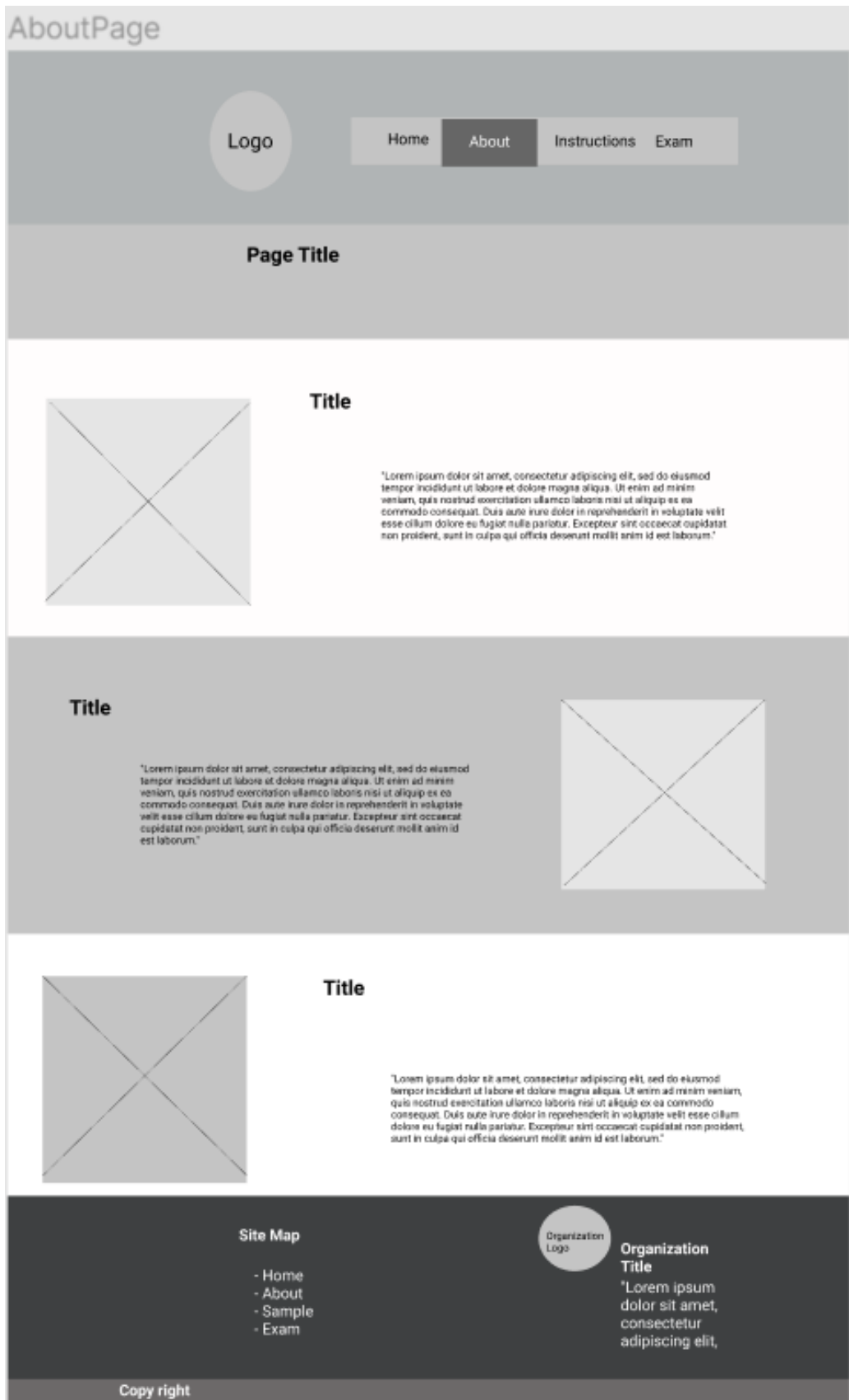

Figure 8: UI wireframe of Home Page
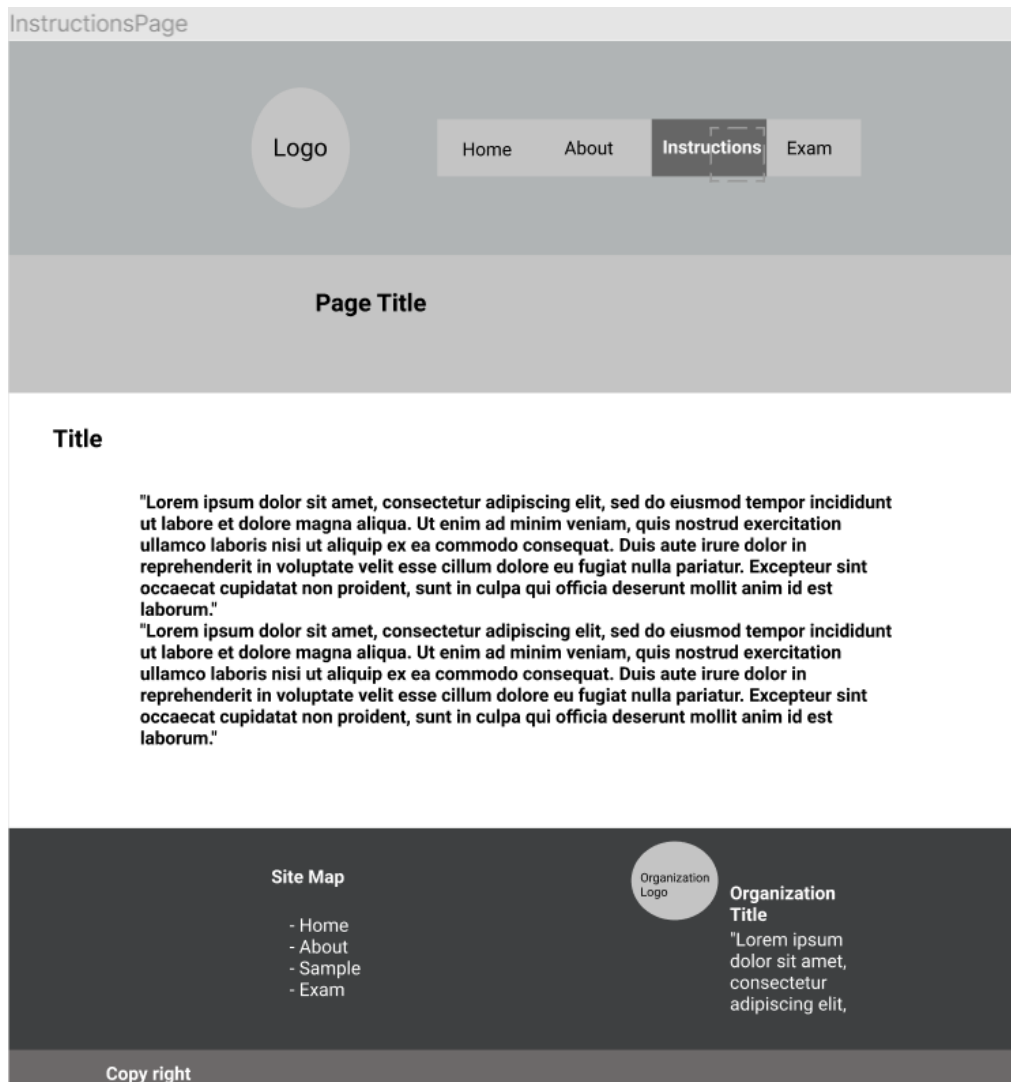
Figure 9: UI wireframe of About Page
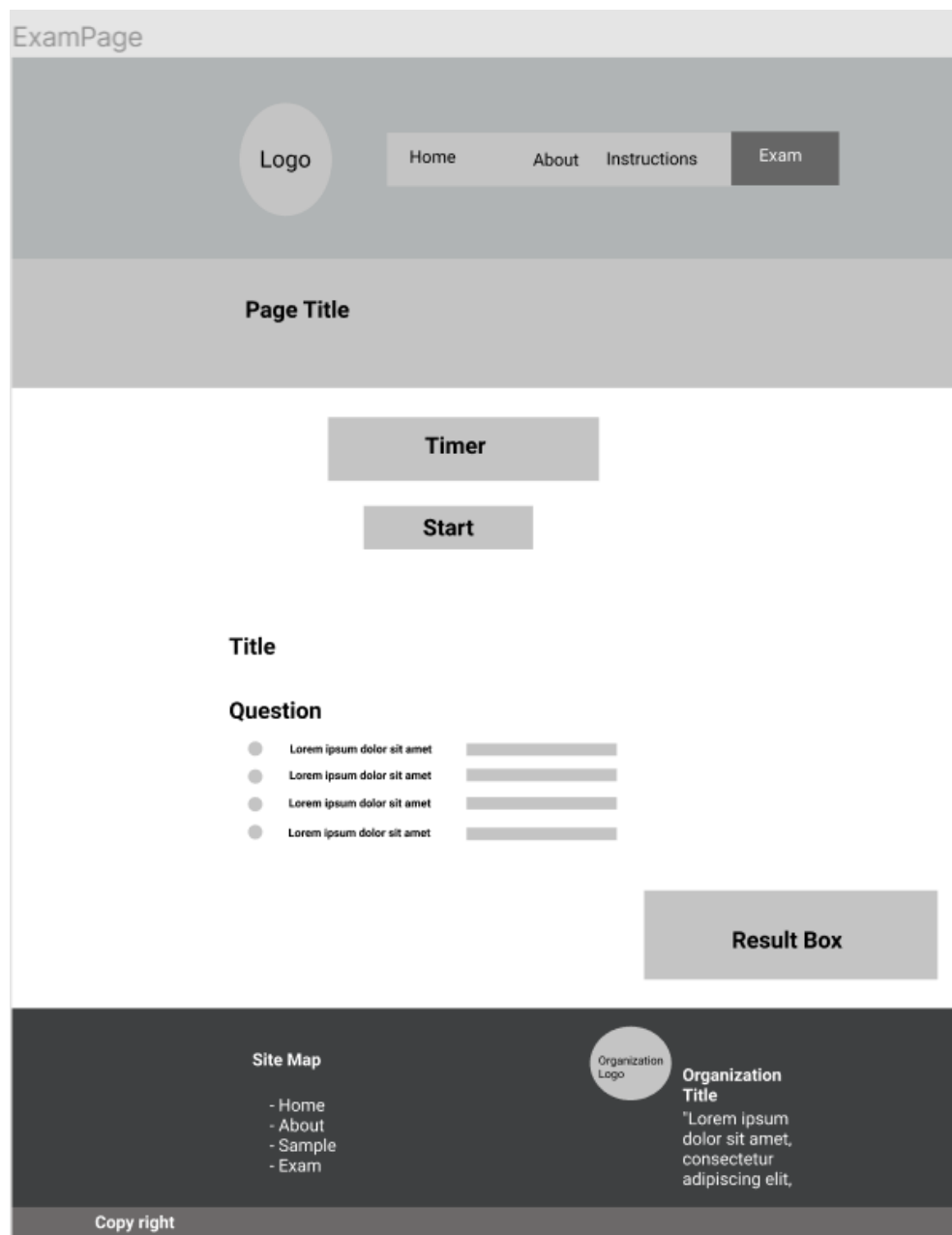
Figure 10: UI wireframe of Instructions Page

ExamPage

| Logo | Home | About | Instructions | Exam |

**Page Title**

**Timer**

**Start**

**Title**

**Question**

○ Lorem ipsum dolor sit amet
○ Lorem ipsum dolor sit amet
○ Lorem ipsum dolor sit amet
○ Lorem ipsum dolor sit amet

**Result Box**

**Site Map**

- Home
- About
- Sample
- Exam

Organization Logo

**Organization Title**
"Lorem ipsum dolor sit amet, consectetur adipiscing elit,

**Copy right**

Figure 11: UI wireframe of Exam Page

## 4.4    Developing

This is the construction phase of the project. A portal for online examination system can be created in multiple ways. There were two options in the beginning-

❖  HTML/CSS page with PHP script and MySQL DB

❖  WORDPRESS

Both the options were reviewed and WORDPRESS was found proper for this project as the maintenance is flexible for future continuity. The purpose of choosing this CMS (Content Management System) is to ensure less complicacy for managing and generating the exam at any minute. WordPress as a CMS does not require any coding for creating and modifying any content.

### 4.4.1 Tools and technology

A content management system or CMS is a software tool for building and managing digital contents. It has earned popularity in an extensive level because of its uncomplicated operating methods. It allows the users to publish any content in the web page without any coding or programing. Some popular and well-known CMSs are:

- WordPress

- Joomla

- Drupal

WordPress holds the major portion of the graph. This is the most popular and useful CMSs used around the world that can make any kind of webpages. In a survey (Terada 2017), it has been mentioned that approximately 75 million websites are managed by WordPress CMS.

WordPress is scripted in PHP and uses MySQL or MariaDB as backend database.

The selection of WordPress for this project not only has facilitated building the portal, but also has provided the scope to research on this most popular CMS. A plenty of usefulness of using WordPress has been mentioned (Web expert: What is WordPress? Explained for the Beginners 2020), where some reasons have been indicated why a user should select WordPress as a platform for developing a site. The mentioned key reasons are as following -

    I.    Mostly free of cost

   II.    No programing needed

  III.    Huge resource of Plugins and Templates

  IV.    Easy installations

   V.    Flexibilities

  VI.    Easy to customize

 VII.    Availabilities of help

As the portal is about online examination system, few alternative plugins related to quiz making have been checked during the construction of the 'Question Management' and 'Paper Generating' functions. The alternatives are-

- HD Quiz

- mTouch Quiz

- Quiz Maker

The outlook and functionality of all three of these plugins have been demonstrated to the client. The 'Quiz Maker' plugin has satisfied the client's desire for its more professional look and standard functionalities than others.

'Elementor' has been used as an editor that provides templates with Header, Footer and Blocks. The integral features of this editor are distinct and standard. The features can be customized with full flexibilities.

For developing the portal all the platforms, plugins, editors have been used that are free of cost. The 'PRO Version' of these products provide more features for the developers. Though there have been certainly some limitations and restrictions with the free versions, it has provided a wide range of technical skills which has become an asset for this project.

During the research and checking out the alternatives it has been found that a web portal of an examination system needs few different pages consisting information, instructions, and execution. Four different pages have been built for this project as following-

**Home Page**: This page simply describes the definition and objective of the portal. The portal has been named "eExam" and a logo has been created for the uniqueness of the page where 'eExam' stands for electronic examination. A blue & white theme has been used to match the Laurea's web theme.
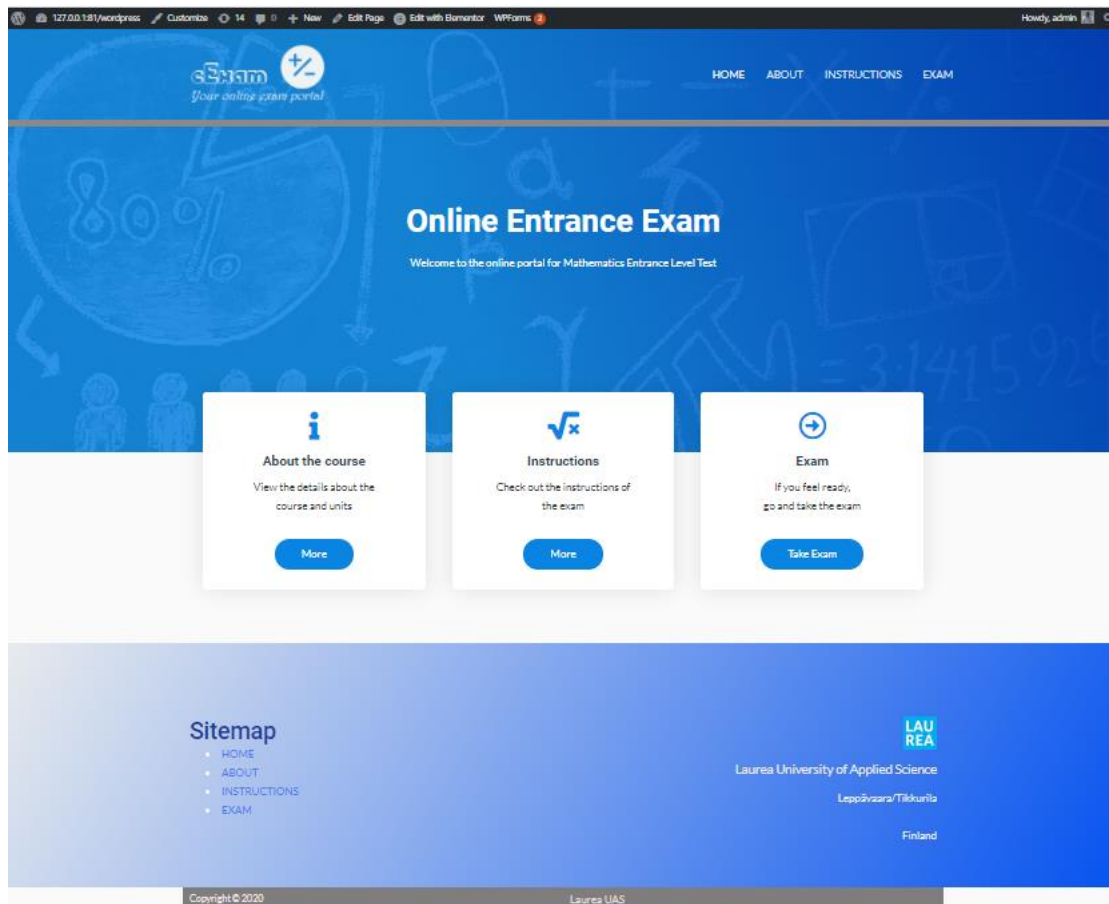
Figure 12: Home page

**About Page**: This page shows the details of the course and the reason of taking this online entrance test. According to the demand of the client the link of the course material will be added in this page in future.
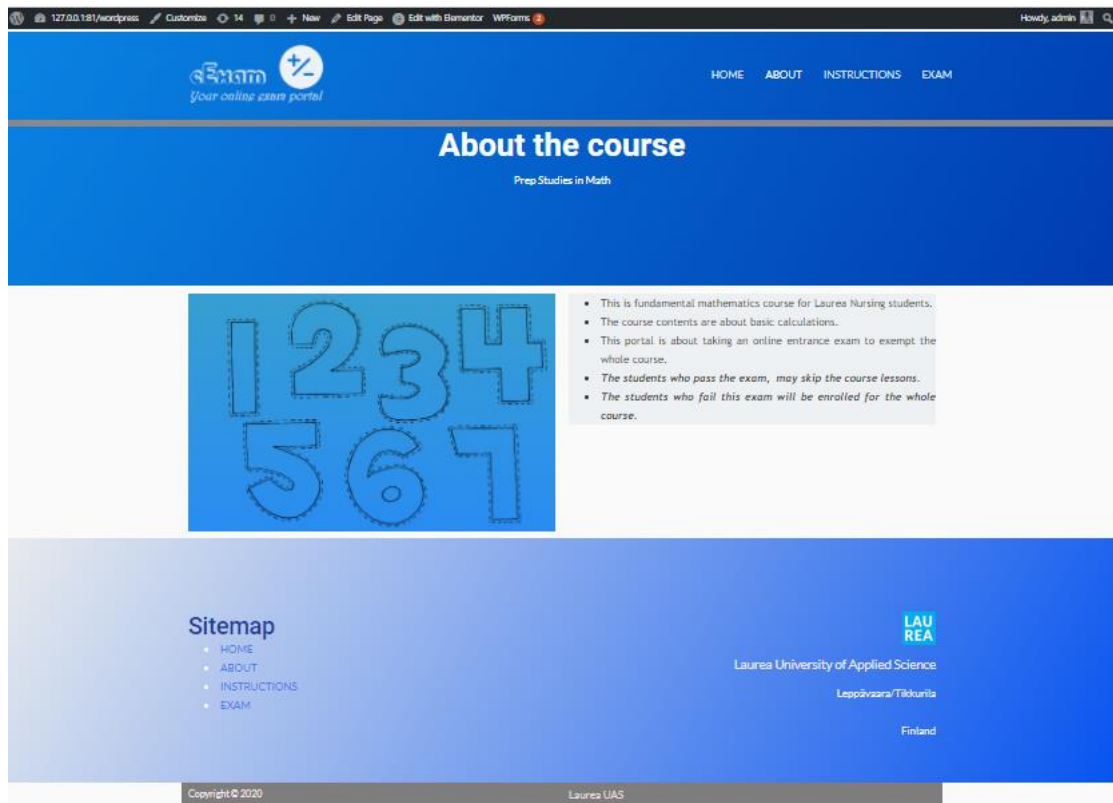
Figure 13: About page

**Instructions Page**: As the questions and answers are stored in a customized way, the students need to know how accurately they must match the requirements. A set of instructions has been provided in this page. There are some restrictions and suggestions for taking this exam that are indicated in this page.

Figure 14: Instructions page

**Exam Page**: This is the main execution page of the portal. The students can take the online exam and get their assessment instantly through this page.
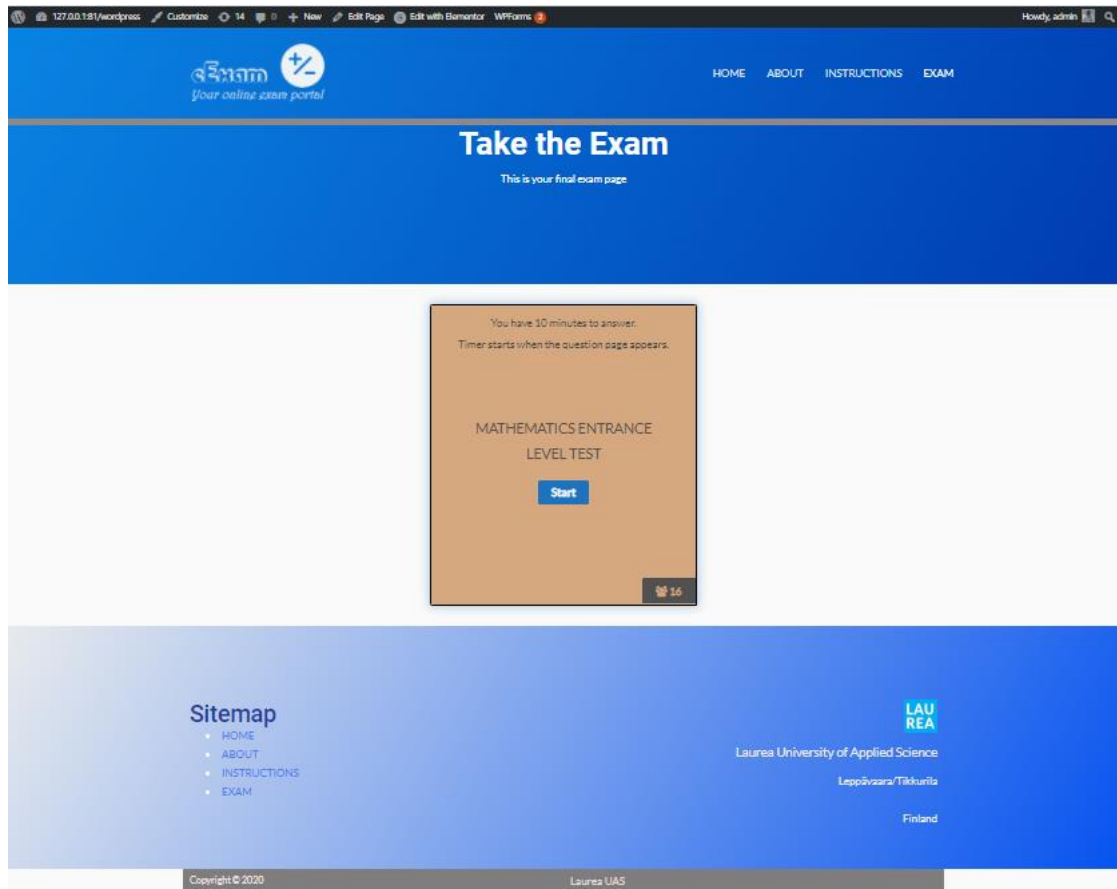
Figure 15: Exam page

## 4.5 Security measurement

Security is a key concern for any web-based platform. This portal is being planned to be adopted within intranet network of Laurea UAS. The privacy policy of Laurea UAS will be completely applied on this case.

Some major security issues related to this project have been researched and planned to be applied. The CIA model and BSI IT-Grundschutz security framework have been gone through to find out the possible vulnerabilities and to achieve the security solution for them.

### 4.5.1 CIA Triad

CIA stands for Confidentiality, Integrity and Availability. It is also called CIA Triad. CIA model is usually applied inside an organization for ensuring information security.

Margaret (2020) has described confidentiality as privacy, integrity as consistency and availability as ability of performance and maintenance.

The CIA model can be precisely described as following (Margaret 2020)-

**Confidentiality:** The information is kept confidential to unauthorized users and only be visible for the authorized users.

**Integrity:** Any modification or customization from unauthorized user is not allowed.

**Availability:** The information is available in required time to the authorized users for using.

In simple words how CIA can be attributed for this specific portal-

- The teacher and students will be authorized to get into the frontend. (Confidentiality)

- The teacher will only be authorized into backend for maintenance. (Integrity)

- The frontend will be available for students with all functionalities. (Availability)

- The front and back both ends will be available with all functions for the teacher. (Availability)

As the portal is being planned to be deployed inside Laurea's intranet network, a certain model of CIA Triad has been designed to determine the protection requirements that is illustrated in table 3.

| Object's name | Value | Requirement level | Reason |
|---|---|---|---|
| Student's authentication | Confidentiality | Very high | Unauthenticated user may cause phishing |
| | Integrity | Very high | Authorized users must have access |
| | Availability | Very high | Inaccessibility may reduce trustworthiness |
| Local data<br>- Information<br>- Instructions<br>- Questions | Confidentiality | Normal | May not cause any harm |

| | Integrity | High | Admin will be able to modify the data |
|---|---|---|---|
| | Availability | Very high | Without availability of these data, the system would not function |
| Database<br><br>- Question & answer storage<br><br>- Student's assessment record | Confidentiality | Very high | Unauthorized access to DB may cause a total damage of the system |
| | Integrity | Very high | Only the admin is authorized |
| | Availability | Very high | Only to admin |
| Network<br><br>- Laurea's intranet network | Confidentiality | Very high | As an intranet network of Laurea, any outsider may cause a fatal damage of the system |
| | Integrity | High | All authorized members (teachers and students) must have access for the continuity |
| | Availability | High | Need to be available to ensure the execution |

Table 3: Design of CIA Triad for the portal

### 4.5.2 GDPR

If the client conducts the exam outside of European Union, then the GDPR (General Data Protection Regulation) will be observed. GDPR ensures the protection of data that is transferred outside the EU (European Union) and EEA (European Economical Area) areas.

### 4.5.3 BSI IT-Grundschutz

This German based security framework has been used as the source for the safeguards and threats observations of the security issues that might be required for the online examination portal.

In an early assignment, a similar security observation had been gone through to find out the threats and safeguards for developing a mobile application (Mark et al. 2015). This previous personal experience has guided researching security on this project. The new version of the catalogue has been observed for current research about the security measurement of the portal. Table 4 shows the security measurement of this project according to the observation (Security experts: IT-Grundschutz -Catalogues 2015).

| No. | Safeguard | Reference 'S' is Safeguard serial no. | Protection level | Clarification | Related threat and Threat reference 'T' is Threat reference |
|---|---|---|---|---|---|
| 1 | Assignment of access right | S 2.8 | Very high | Ensures certain limits to the certain users | User can be spoofed, information can be tempered, changing access right can also be a reason of manipulating of data (T 5.2) |
| 2 | Preventing unauthorized acquisition of administrated rights | S 4.21 | High | SU (Super user right for the admin) | Admin panel can be misused (T 5.9) & (T 5.19) |

| 3 | Controlling access to DB system | S 2.167 | High | Suitable mechanism to authenticate users into DBMS | Data can be modified or lost (T 4.28) |
|---|---|---|---|---|---|
| 4 | Establishing access rights | S 2.64 | High | Proper access right to multiple users | Inappropriate authorization may cause mis use or poor use of administration tasks (T 2.67) |

Table 4: Analysis of possible threats and safeguards requirements from BSI IT-Grundschutz

## 4.6   Testing

Testing an implemented software is an important phase of SDLC. This phase finds out the vulnerabilities of a product and ensures the functional existence. This phase is the gateway for deployment of the software.

The STLC method has been applied for testing the portal.

### 4.6.1   STLC

STLC stands for Software Testing Life Cycle which is an inherent part of SDLC that only being executed during testing phase of a software. There is a sequence of activities for a tester or a testing team.

The testing phase for the web portal of this project has followed the certain software testing criteria. Rajkumar (2020) has stated that there are six major phases of STLC as requirement analysis, test planning, test design, test environment setting, test execution and test closure.

The phases mentioned above have been covered in this project as following-

**Requirement analysis**: In this phase the team that consists of developer and the client, have determined what needs to be tested. As the portal is an online examination system, the execution of the test and functionalities of all the components need to be tested. Some key points to be tested are- whether the 'timer' is working, whether the user can edit the answers, whether the records of assessment are stored properly, etc.

**Test planning**: This is the phase to calculate the effort and cost of testing. The client as a teacher has planned to arrange few students who can take the test. The vulnerabilities can be found instantly by going through this arrangement.

**Test design**: The test has been designed in two ways- practical testing with the students as mentioned above and creating a survey report by the student's feedback.

**Test environment setting**: As the portal exists in "localhost", it has become difficult to arrange the students in a same place to test the portal because of the ongoing pandemic circumstance. The plan has been changed according to the situation.

**Test execution**: The test has gone through according to plan 'B'. The examination system of the portal has been tested with some friends and family members instead of students. The test users have been chosen among them who have procedural knowledge about web activities.

The testing has been done with five different users. All the components have been tested and found flawless.

**Test closure**: The findings from the testing process have been satisfactory. All the components have been functioning as required. This satisfaction has influenced the developer and the client to deploy the portal.

4.6.2   Survey/ Feedback from the users

It is always good to have feedbacks from the users and clients for software developments. Feedbacks can provide scope for the developers to improve the product.

An online survey has been implemented at this stage and shared with the test users. The Google form is a popular tool that provides online survey form for various occasion. The Google Form has been used for collecting the feedbacks of the testing.

Figure 16 shows the outlook of the survey form.

Figure 16: Survey form after testing

The online survey form has been sent to the test users through email. It can be filled up and submitted back instantly. The responses can be recorded simultaneously.

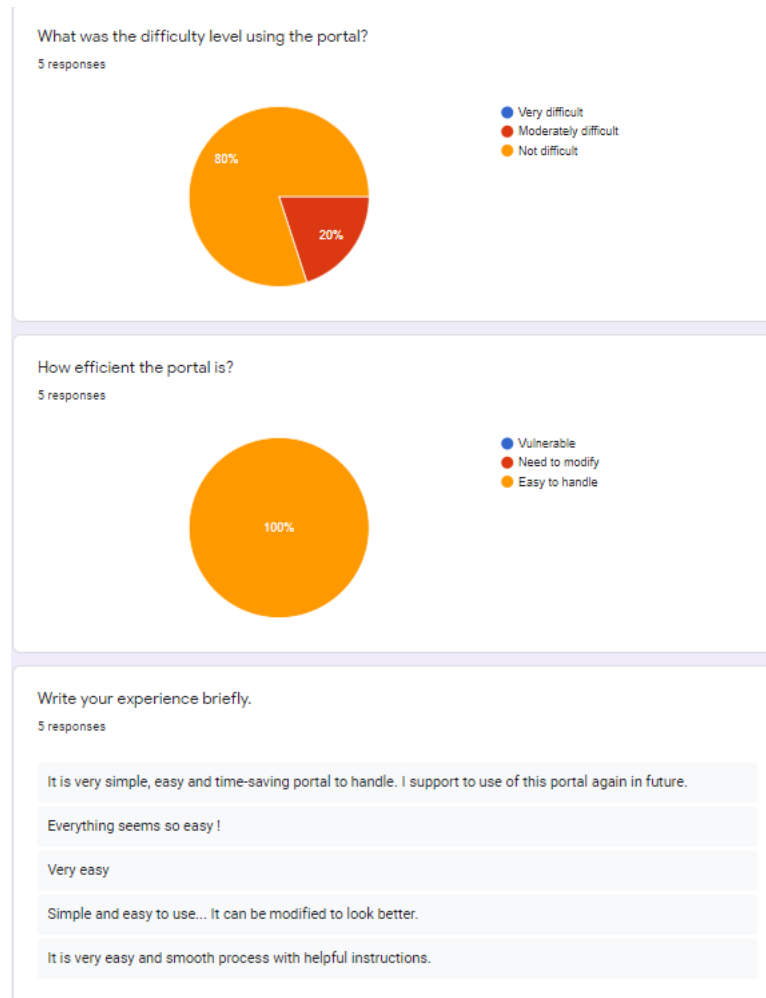Figure 17 shows the summary from the test responses sent by the users-

Figure 17: Summary from the test users feedback

## 4.7 Deploying

The deployment of the portal is under process. The plan is to deploy it through Microsoft Azure. The portal will only be accessible inside Laurea's intranet network.

The client is responsible for the deployment as it must go through a formal process which is required for the school's administration.

## 4.8 Maintenance

A user guide has been created for the client. The guide informs everything that is required to modify the questions, add or remove new exam papers, change the timing and other functionalities.

The instructions in the guide are uncomplicated and easy to follow to handle the WordPress dashboard.

The plugin itself has a set of integrated instructions that can be accessed through the dashboard.

## 5 Conclusion

This project has provided a wide range of opportunities to research on. The theoretical knowledge of digital education system has strengthened the root to go on to the furtherance of the project. The practical implementation part of this project has heightened the skills of web development. It also has given the scope to observe the security measurements. A standard security framework has been gone through during the implementation of the portal. The possible vulnerabilities have been identified and the suggested safeguards have been reviewed to overcome those obstacles.

This overall research and development have certainly fulfilled the objectives of the researcher and the desire of the client. It has definitely enriched the skills and the knowledge that can be carried out in future as an asset.

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Figures

Tables