REPUBLIC OF TÜRKİYE
KIRŞEHİR AHİ EVRAN UNIVERSITY
INSTITUTE OF NATUREL AND APPLIED SCIENCES
DEPARTMENT OF ADVANCED TECHNOLOGIES

BUILDING A WEBSITE FOR THE ADMINISTRATION OF A VIRTUAL UNIVERSITY

IMAD FADHIL SABAH

MSc THESIS

KIRŞEHİR
2023

REPUBLIC OF TÜRKİYE
KIRŞEHİR AHİ EVRAN UNIVERSITY
INSTITUTE OF NATUREL AND APPLIED SCIENCES
DEPARTMENT OF ADVANCED TECHNOLOGIES

BUILDING A WEBSITE FOR THE ADMINISTRATION OF A VIRTUAL UNIVERSITY

IMAD FADHIL SABAH

MSc THESIS

SUPERVISOR

ASS. PROF. DR. GÜLSÜM AKKUZU KAYA

KIRŞEHİR

2023

KIRŞEHİR AHİ EVRAN UNIVERSITY

GRADUATE SCHOOL OF SCIENCE

MSc THESIS

ETHICS DECLARATION

In this thesis study, which I have read and understood the Kırşehir Ahi Evran University Scientific Research and Publication Ethics Directive and which I have prepared in accordance with the Kırşehir Ahi Evran University Institute of Science Thesis Writing Rules;

● I have obtained the data, information and documents I have presented in the thesis within the framework of academic and ethical rules,

● I present all information, documents, evaluations and results in accordance with scientific ethical rules,

● I have cited all the works I have benefited from in the thesis by making appropriate references,

● I have not made any changes in the data used and the results,

● This study, which I have presented as a thesis, is original,

Otherwise, I declare that I accept all legal actions to be taken against me in this regard and all loss of rights that may arise against me. ...../……./20….

Student

Imad Fadhıl Sabah

LIST OF CONTENTS

Page No

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to:

With immense pleasure and deep sense of gratitude, I wish to express my sincere thanks to my supervisors Ass. Prof. Dr. Gülsüm AKKUZU KAYA and Ass. Prof. Dr. Uğur BAŞARMAK, without their motivations and continuous encouragements, this research would not have been successfully completed.

Last but not the least, I wish to extend my profound sense of gratitude to my family for all the sacrifices and their prayeries they made during my research and also providing me with financial, moral support, and encouragement whenever required.

August, 2023 Imad Fadhıl Sabah

ÖZET

YÜKSEK LİSANS TEZİ

SANAL BİR ÜNİVERSİTE YÖNETİMİ İÇİN WEB SİTESİ KURMAK

Imad Fadhıl Sabah

KIRŞEHİR AHİ EVRAN ÜNİVERSİTESİ
FEN BİLİMLERİ ENSTİTÜSÜ
İLERİ TEKNOLOJİLER ANABİLİM DALI

Danışman: **Dr. Öğr. Üyesi Gülsüm AKKUZU KAYA**
Yıl: 2023 Sayfa: 88
Jüri: **Dr. Öğr. Üyesi AYLA KAYABAŞ**
Dr. Öğr.Üyesi YASİN YALÇIN

Bu çalışma sırasında, uzaktan eğitim ve sanal öğrenme ortamları kavramı tanıtılmış ve son yüzyılın altmışlı yıllarındaki radyo öğrenme gibi ilkel biçimlerin ortaya çıkışından bu yana gelişim aşamalarının tarihsel bir okuması sunulmuştur. Yüzyıl ve bu tür öğrenmenin ortaya çıkış ve gelişiminin ana nedenleri, onunla ilgili yazıların genel bir incelemesine ek olarak, uzaktan eğitim sürecinin boyutlarının gösterildiği, uygulanması için kullanılabilecek araçlar. Öğrenme süreci, kendisine verilen avantajlar ve vaatler, önündeki sorunlar ve engeller üzerinde de durulmuştur. Yukarıdakilerin hepsine dayanarak, başarılı bir eğitim sisteminin sahip olması gereken avantajları gerçekleştirmek amacıyla, literatür taramasından çıkarılan sanal bir öğrenme ortamı geliştirilmiştir, aşağıdaki noktalarda özetlenmiştir (erişilebilir, çekici, güvenilir, herhangi bir uzaktan eğitim sisteminin (programlama tarafıyla ilgili) temel sorunlarından kaçınmaya odaklanarak güvenli, yapılandırılmış). Bu hedeflere ulaşmak için sanal bir üniversitenin temel eğitim ve idari faaliyetlerini yönetecek bir web sitesi oluşturulmuş ve sürecin her boyutunun (insan boyutu-teknik boyut-verimlilik) özel işlevlerinin gerçekleştirilmesine özen gösterilmiştir. Üçüncü bölümde sistemin işlevsel gereklilikleri ve bunları gerçekleştirme mekanizması tartışılırken, dördüncü bölümde ise takip edilen teknik yöntemlere ışık tutan teknik bir tartışma yer aldı. Güvenilirlik, güvenlik ve erişilebilirlik ve diğerleri gibi sitenin her özelliğini elde edin. Sonunda, çalışma sonuç ve gelecekteki olası gelişme alanları gösterilerek özetlenmiştir.

Anahtar Kelimeler: Web, Eğitim, Uzaktan Eğitim, Sanal Üniversite

ABSTRACT

MASTER'S THESIS

BUILDING A WEBSITE FOR THE ADMINISTRATION OF A VIRTUAL UNIVERSITY

Imad Fadhıl Sabah

KIRŞEHİR AHİ EVRAN UNIVERSITY
GRADUATE SCHOOL OF SCIENCE
DEPARTMENT OF ADVANCED TECHNOLOGIES

Supervisor:	**Ass. Prof. Dr. Gülsüm AKKUZU KAYA**
	Year: 2023 Pages: 88
Juries:	**Ass. Prof. Dr. Ayla Kayabaş**
	Ass. Prof. Dr. Yasin Yalçın

In the course of this study, the concept of distance learning and virtual learning environments was presented, and a historical reading of its stages of development was presented since the beginning of the emergence of primitive forms, such as radio learning in the sixties of the last century, and the main reasons for the emergence and development of this type of learning, in addition to a general review of the writings associated with it, through which the dimensions of the distance learning process were shown, the means that can be used to implement the learning process, the advantages and promises made to it, and the problems and obstacles that stand in its way were also focused on. Based on all of the above, a virtual learning environment was developed In an attempt to realize the advantages that any successful education system should have, which was extracted from the literature review, it is summarized in the following points (accessible, appealing, reliable, secure, structured) with a focus on avoiding the basic problems of any distance learning system (related to the programming side). To achieve these goals, a website has been created to manage the basic educational and administrative activities of a virtual university, and attention has been given to realizing the special functions of each dimension of the process(the human dimension - the technical dimension - the efficiency of the educational process) using the most appropriate method, where the functional requirements of the system and the mechanism for achieving them were discussed in the third chapter, while the fourth chapter included a technical discussion that sheds light on the technical methods that were followed to achieve each feature of the site such as reliability, security and accessibility and others. At the end, the work was summarized through the conclusion and showing possible future areas of development

Keywords: Web, Education, Distance Education, Virtual University

LIST OF TABLE

Page No

LIST OF FIGURE

Page No

LIST OF ABBREVIATIONS

Abbreviations		Described
ICT	**:**	Information and Communication Technology
LMS	**:**	Learning Management System
AI	**:**	Artificial intelligence
USA	**:**	United States of America
UK	**:**	United Kingdom
VLE	**:**	Virtual Learning Environment
CAL	**:**	Computer Aided Learning
MVC	**:**	Model View Controller
CSS	**:**	Cascading Style Sheets
PK	**:**	Primary key
PID	**:**	Personal identification document
GPA	**:**	Grade point average
URL	**:**	Uniform Resource Locator
HTML	**:**	Hyper Text Markup Language
IP	**:**	Internet Protocol
PEP 249	**:**	Python Database API Specification v2.0
OpenCV	**:**	Open Source Computer Vision Library
WAF	**:**	Web application firewall
HTTP	**:**	Hypertext Transfer Protocol
URI	**:**	Uniform Resource Identifier
SQL	**:**	Structured Query Language
CSRF	**:**	Cross-Site Request Forgery
DBMS	**:**	Database management system
XSS	**:**	Cross-Site Scripting
IV	**:**	Interactive video

1. INTRODUCTION

We live in the twenty-first century, education is still a dream for many around the world, due to different reasons in different countries such as Afghanistan, While the literacy rate in Afghanistan is 28.1%. However, it suffers from a large gap between the percentage of literate males and females, where the literacy rate among males is 43.1%, while among females it is 12.6% (Baiza, 2013). Chad is considered one of the least populous countries, but in terms of funding education, it is among the worst countries at all. Only 39% of children from 4 to 15 years of age are enrolled in education. Literacy rate: 35.4%, 45.6% for males and 25.4 for females. In some cases, the high costs of education are a reason for a large number of young people to refrain from continuing their education, especially since in a large number of countries the level of formal education has decreased significantly and is no longer able to graduate individuals with sufficient qualifications to pursue higher education. The restrictions imposed by Traditional education is a barrier that prevents students from continuing their studies because of their preoccupation with their actual life activities, and their inability to attend lectures at the specified times. Hence the importance of distance education or virtual education, which is defined as:

Distance education, also known as distance learning, is the education of students who may not always be physically present at a school, or where the learner and the teacher are separated in both time and distance (Holmberg, 1977). Many students take a distance-learning [DL] course with certain expectations about its advantages and its disadvantages. The following are identified as some of the advantages of a distance-learning course compared to a traditional classroom course (Hannay and Newvine, 2006; Merisotis and Phipps, 1999).

Flexibility: The greatest rationale for the existence of most forms of DL is that students can do much of the work at times and places of their choosing.

Self-tailored learning: Within certain limits, distance learning may allow students to learn at their own pace, in their preferred medium, or in a more comfortable environment.

More choices: Distance learning courses allow student more choices in course offerings and times without fear of class conflicts (Wahlstrom et al., 2003).

Increased learner centeredness: Learners can study tutorials or add-on material at their own pace and at the appropriated time for them. This is particularly important for learners who suffer from not being able to follow the pace of the lectures, but who have

the capabilities of catching up and finding the missing information by studying on their own.

Instructors are able to combine lecture material with specific modules offering computer learning tools. This permits instructors to devote more time, if required, to covering concepts in class, while letting students learn the hands-on portion of the course on their own.

For institutions, it reduces operational costs.

Course standardization for courses in which there is a large number of potential learners; computer aided learning tools help achieve a certain level of standardization in the quality and quantity of material received by all learners.

Lower course development costs. By centralizing the development of some of the learning tools, institutions may free up time for instructors to focus on other important teaching or training matters (Belanger and Jordan, 1999).

1.1. Problem Statement

Distance learning has brought various advantages however the promises and obvious advantages to distance learning, there are problems that need to be resolved. These problems include the quality of instruction, hidden costs, misuse of technology, and the attitudes of instructors, students, administrators and security. Each one of these has an effect on the overall quality of distance learning as a product. In many ways, each of these issues relates to the others. This thesis examines each of listed issues.

How important is security for the virtual university?

Security is of paramount importance for a virtual university to ensure the protection of sensitive data, maintain the integrity of academic processes, and create a safe learning environment for students and faculty. Here are some key points regarding the importance of security for a virtual university (Jahan and Hoda, 2016).

1. Data Protection: Virtual universities handle vast amounts of personal information, including student records, financial data, and research materials. Robust security measures, such as encryption, firewalls, and access controls, are necessary to safeguard this data from unauthorized access, breaches, or theft.

2. Privacy and Confidentiality: Students and faculty must trust that their personal information and communication within the virtual learning environment will remain confidential. Privacy policies and secure communication channels are crucial to protect sensitive discussions, assignments, and assessments.

3. Intellectual Property: Virtual universities are home to research projects, scholarly works, and creative endeavors. Without proper security measures, intellectual property can be at risk of plagiarism, unauthorized use, or theft. Implementing copyright protections and secure file storage systems can help safeguard the intellectual property rights of individuals and the institution.

4. Academic Integrity: Maintaining academic integrity is vital to the credibility and reputation of a virtual university. Security measures like plagiarism detection tools and secure testing platforms help ensure fairness and prevent cheating in online assessments and exams.

5. System Availability: Virtual universities heavily rely on technology infrastructure, including servers, networks, and learning management systems. Adequate security measures, such as regular maintenance, backup systems, and disaster recovery plans, are essential to prevent system failures, data loss, or service disruptions.

Failure to implement proper security measures in a virtual university can have severe consequences (Yasin and Hashem, 2020).

1. Data Breaches: Without robust security, hackers may gain unauthorized access to sensitive information, resulting in data breaches. This can lead to identity theft, financial fraud, or reputational damage to the virtual university.

2. Academic Misconduct: Insufficient security can facilitate cheating, plagiarism, and unauthorized access to exam materials, compromising the integrity of academic programs and devaluing degrees.

3. Compromised Infrastructure: Security vulnerabilities can expose virtual university systems to malware, viruses, or cyber-attacks. Such incidents can disrupt operations, compromise data integrity, and lead to significant financial losses.

4. Loss of Trust: Inadequate security practices can erode the trust of students, faculty, and stakeholders in the virtual university. This may result in decreased enrollment, loss of funding, or a damaged reputation within the academic community.

To mitigate these risks, virtual universities should invest in robust security infrastructure, implement best practices for data protection, regularly update security protocols, and educate users about online security awareness and practices.

1.2. The Importance of Distance Learning Systems

The following points explain the importance of distance learning systems and the reasons that made them an urgent need at the present time (Moore and Kearsley, 2011):

1. The unprecedented rapid development of various scientific fields, which traditional education finds difficult to keep pace with due to the continuous need to develop and modify curricula, which is one of the biggest obstacles to developing traditional education.

2. The growing and accelerating population growth, which made the number of people in need of education very large and not accommodating in traditional education systems.

3. The need to develop skills and qualifications that motivate a large number of people to follow distance learning programs and courses during the exercise of their current jobs as a result of their desire for promotion and career advancement.

4. Restrictions resulting from the need for traditional education to be physically present during lectures and educational sessions, which prevent a large number of people from completing education due to their geographical isolation and the lack of appropriate transportation systems.

5. The age restrictions imposed by traditional education due to its inability to accommodate large numbers of learners, which pushes people who do not meet the age requirements to move towards distance learning because of its flexibility and eased restrictions.

6. Geographical isolation resulting from political, economic or social reasons, and the Corona virus pandemic can be one of the most important examples of this point, as social distancing and quarantine restrictions imposed on very large groups of people to stay in their homes. Several educational institutions were temporarily closed as a preliminary measure to stop the spread of the pandemic (Unesco, 2023), and during this period many companies turned To develop or invest remotely work systems, in addition to the trend of a large number of schools and universities to distance learning systems. Despite this, the epidemic had significant negative effects on the learning process, such as learning loss (Engzell et al., 2021) and exacerbated learning outcomes (Azevedo et al., 2021). Online barriers can be hindrances, including cost (Muilenburg and Berge, 2005), teachers' information and communication technology (ICT) skills and their demographic factors (Alazam et al., 2013), poor infrastructure of the university (Mashhour and Saleh, 2010; Aljaraideh and Al Bataineh, 2019), lack of online resources (Dube, 2020), classroom management in terms of student participation (Lukas and Yunus, 2021), and teachers' behavioral intentions in adopting online educational technology (Wen and Kim Hua, 2020).

In this work, we take all above points into consideration for developing a good education platform. The definition of good education was stated in the 17 United Nations goals for sustainable development that achieving good education not only aims to enable educational opportunities only, but also seeks to reduce poverty in the world (Katila et al., 2019). Although social networking sites have become very popular and have become a source of learning for many people, distance learning systems are still very popular because of their specialization in specific areas that attract those wishing to learn in these areas. What helped in the development of distance education systems was the explosion of the technical revolution in various fields, especially in web and computer technologies, which had a major role in developing the distance learning process and producing advanced systems called Learning Management Systems, which are known as:

A learning management system (LMS) is a software application that is used to plan, manage, and deliver elearning content (Oliveira et al., 2016). Distance education has many types, including educational videos, reference websites prepared by experts in different fields, learning through courses sent via e-mail. Figure (1) shows the different types of distance learning. The figure represents the customer training via an LMS which consist of seven branch (Davis et al., 2009).

1. Support guides: The technology might be changing, but so is the education and the procedure needs to be aware of the issues on that anterior.

2. Instant Messaging: is a way of established relation that permit you to send messages from one computer to another. The message appears immediately on the screen of the computer you send it to, provided the computer is using the service. The abbreviation IM is also applied.

3. Community of experts: A group of people who retain very high expertise in a particular field. They are subject matter experts and within an organization provide intellectual leadership

4. Onboarding: is one of the most common use cases for an LMS in a corporate environment. In this case, the LMS is used to help train new employees by providing opportunities to access training materials across various devices

5. Emails: Is the exchange of computer-stored messages by telecommunication, More plainly, e-mail is a message that may contain text, files, images, or other attachments sent through a network to a specified individual or group of individuals.

6. Blogposts and ebooks: A blog post is any article, news piece, or guide that's published in the blog section of a website. A blog post typically covers a specific topic or

query, is educational in nature, ranges from 600 to 2,000+ words, and contains other media types such as images, videos, infographics, and interactive charts, e-book, digital file containing a body of text and images suitable for distributing electronically and displaying on-screen in a manner similar to a printed book.

7. Webinars and interactive videos: A webinar is an online occurrence that is hosted by an organization and broadcast to a select group of individuals through their computers via the Internet, Interactive video (also known as "IV") is a shape of digital video that supports user interaction. Interactive videos provide the viewer the ability to click, on a desktop, or touch on.

Figure 1.1. Distance Learning Methods (Davis et al., 2009).

1.3. Research Objective

This thesis focuses on the software problems facing virtual education systems, through a literature review that includes the most important software problems, in addition to the basic features and functions that any successful virtual education system should have. So, the aims of this thesis are: as follows;

1. To design and implement a virtual learning environment, in an attempt to avoid the mentioned problems, and to achieve the basic functions of the successful educational system in its three dimensions (the human dimension, the design dimension, performance).

2. To analyis all factors that ensure the success of the virtual learning environment in the software field. The focus is on attractive design and compatibility with various types of devices, in addition to ease of use and access, and the possibility of direct interaction between the teacher and the learner.

3. To make a secure and protected platform from any types of potential intrusions.

1.4. Thesis Contribution

This thesis has many contributions to society and helps in assisting the educational aspects remotely in many respects, for example, it helps the learner in poor countries in education in addition to the disabilities by learning whether through electronic platforms on the Internet, as well as managing the teaching staff and students at the university site in a technical manner, especially in the case of pandemic diseases such as Covid 19. The main contribution of this thesis is develop a distance learning platform for kirkuk university. This means that thesis's work is unique work. There is no other platform for the university.

1.5. Thesis Layout

In the beginning of Chapter 1 the introductıon, problem statement, the importance of distance learning systems, research objective and its contributions are described. Then, Chapter 2 explain the lıterature revıew in details. Also, the recent studies of the related work, Electronic Services (E-Service) in online learning, general problems in distance learning, virtual learning environment have been demonstrated.

Next, Chapter 3 gives the work materials details and all system requirements. This chapter includes mainly the user, teacher, administrator, and student roles and their mechanism in addition to the functional requirements of each one of them.

Technıcal dıscussıon, privacy of files and documents, website protection, mass assignment vulnerability as described in Chapter 4. Finaly, the thesis is concluded with a summary in Chapte

1.6. Disadvantage Of Distance Learning

Lack of physical social interaction that is found in a typical, traditional classroom. Students can only engage and share opinions through virtual means in chatrooms or broadcasts, but are not able to physically interact with each other

It does not fit all types of learners. If you are someone who needs constant motivation and support from professors or instructors, then distance learning is not for you, since instructors are not always available to offer assistance in the same way that they would be in a traditional classroom

Some courses required to complete a degree may not be available online. Sometimes universities make many required courses online to give students a feel of their teaching methodologies, quality, and value. After you complete those courses, to get the degree you might be required to attend some classes in person. These classes will most likely be less affordable, or you will not be able to travel to the university to take them.

You need to be technologically savvy. If you are a person who is not as comfortable to working with technology, then distance learning will not suit you. Distance learning requires students to be able to operate with at least a minimum knowledge of different chat rooms, online examinations, and interaction, and many people do not feel comfortable if they do not even have physical material to study from.

2. LITERATURE REVIEW

2.1. Introduction

A large number of research articles and scientific studies have dealt with the subject of distance learning since the seventies of the last century, as it is not one of the emerging topics in the scientific arena, where the two researchers (Keegan, 1980) touched upon in their analytical study the definition of distance education and the classification of its systems, including the organization of exams, the correspondence study model, consulting studies, and the use of multimedia as teaching methods, and clarified the relationship and difference between distance education and traditional postgraduate systems. It was referred to as correspondence education / study or independent study in the USA, while in Australia it was called 'external studies whereas it was called distance teaching' or teaching at a distance in the UK, tale - enseignement in France, Fernstudium/Fernunterricht in Germany, education a distancia in Spain, and, teleducaclo in Portugal (Bashir and Warraich, 2023; Johansen, 23).

In general, the term distance learning can be applied to all forms of study at all levels when it is not subject to direct and immediate supervision by teachers and lecturers who are present with their students in lecture rooms or in the same place while actually giving lectures. However it is nevertheless subject to direction and planning by an educational organization.

In this chapter, we evelueted research works which are related to distance learning. We start from a general view of distance learning. We then discuss advantges and disadvantges of distance learning.

2.2. Related Work

2.2.1. Electronic Services (E-Service) In Online Learning

E-Service-learning (electronic service-learning) combines service-learning and online learning to enable the delivery of instruction and/or service to occur partially or fully online. E-Service-Learning allows students anywhere, regardless of geography, physical constraints, shelter-in-place requirements, work schedule, or other access limitations, to experience service-learning (Dapena et al., 2022; Culcasi et al., 2022). It also offers online learning a powerful tool for engaging students and supporting community partners. The main advantages of distance education are separating the teacher from the learner, planning and supervising an educational organization, use of

technical means to serve the educational process, provide a two-way communication that allows interaction between the teacher and the learner, the possibility of holding regular or private meetings when needed.

The idea of distance learning began to spread in the seventies of the last century, when the eleventh global conference of the International Council for Correspondence Education was held in New Delhi - India in November 1978 (Bunker, 2003). The attendes was representatives of educational institutions from thirty-seven countries. At the same time, a conference hold by the Open university on distance adult education in Birmingham - England in 1979 in the presence of representatives of fifty-one countries (Hardie, 2022; Rudofsky, 2023). However, research studies in this field have not stopped to this day, and the reason for this is due to the importance of distance learning and the promises and advantages it provides compared to traditional learning on the one hand. In addition to the rapid and continuous technical development, which opens every day new technical areas that can be employed in developing and improving the distance learning process.

Distance education processes can be classified into two basic types based on the method of giving and attending lectures, which are synchronous education and asynchronous education, where in synchronous education the trainees are present in real time (Offir et al., 2008). While the lecturer is giving his lecture students can interact with the lectures directly during video conferencing or live broadcasting services. This type has many advantages, as the interaction of the teacher with the learners through lectures and text chats has a great effect on strengthening the relationship between them, which will positively affect the results of the educational process (Martin and Bolliger, 2018). Whereas, the asynchronous education relies on recording lectures and providing them later to the trainees through video clips, postings, or any other possible media, and this is what the researchers explained in the comparative study they made to the open distance education systems at Chinese Open University (Bunker, 2003). The study included the main reasons that prompted learners to follow the distance education system, which are life commitments such as work and housework, age, scarcity of formal educational institutions, poverty, distance, and other social and economic factors. The study compared the different methods of the educational process, as it showed that online learning is the most popular, and ranked first. For a second, educational videos are one of the most popular methods of distance learning, yet traditional education is still very popular and has not lost its place so far. The study showed that distance learning in China went through

three basic stages, the first stage was based on correspondence-based education, and that was before the eighties, when the second stage began to appear, which is television-based education, while the third stage began at the beginning of the nineties, which is accredited education (Chen and Guo, 2005; Wang et al., 2009). On information technology and the Internet and is still continuing today and constantly evolving.

Allama Iqbal Open University is a public university in Islamabad, Pakistan. It is named after Allama Iqbal. The university is the world's second largest institution of higher learning, with an annual enrollment of 1,121,038 students (as of 2010), the majority are women and course enrollment of 3,305,948 (2011) (Langer-Crame et al., 2019), Students can gain admission in Matriculation, Intermediate, Bachelor, Master, MPhil and Ph.D.

Established in 1974, it is Asia's first open university with a strong emphasis on providing distance education in philosophy, natural science and social sciences (Sunardi, 2019; Deacon, 2009; Gaikwad and Adkar, 2019). It has the most applicants per year of any university in Pakistan. AIOU offers extensive undergraduate and post-graduate programs in academic disciplines (Lutz, 2001). After witnessing the success of the Open University in the United Kingdom, AIOU was established as a public university in 1974, (Langer-Crame et al., 2019) AIOU is noted for its cost-effective policy to provide higher and lifelong education to people learning from their homes and places of work at a minimum cost through a specialized fund managed by the government (Langer-Crame et al., 2019; Sunardi, 2019). AIOU is open to everyone and provides education to all without any discrimination (Sunardi, 2019).

2.2.2. General Problems In Distance Learning

The researcher in (Valentine, 2002) began his study by defining the distance learning process and reviewing its history and development, and the promises it offers, but he focused mainly on the problems facing this process, as he showed that the hopes placed on the future of distance learning cannot be fulfilled. It can only be achieved by focusing on the current problems facing this process, which are represented in the following points;

1. The quality of teaching: where the researcher explained that the quality of teaching is mainly related to the management style and the way teachers deal with the educational process, the main problem here is that the administration and teachers believe that technology alone will solve all teaching problems, which is incorrect and not applicable, it could be true that technology is effective in solving a large number of

problems, but the role of administration and teachers and the way of dealing with educational materials and with students has a major role in the success of the teaching process, which is called educational support or learning support in the education system (Zwanch and Cribbs, 2021). In order to study this point, a study was conducted in 1999 by Elliot Inman and Michael Kerwin to survey the opinions of teachers during the first educational session they offer it remotely, where statistics show that teachers have conflicting attitudes about the experience, as most of them were willing to take a second educational cycle, but they rated the quality of teaching as equal or less than the quality of teaching in the traditional education system.

2. Cost-effectiveness: The researcher stated that the first look at the distance learning process appears to be cost-effective, while in reality, and in practical application, many costs appear that were not taken into account. These costs put the management of the educational system in front of two options, either to reduce the quality of teaching to maintain the required profits, or to provide the educational process with the required quality at the expense of profits or at the expense of learners, which leads in many cases to the preference of learners to the traditional method as it is less expensive (Jung and Rha, 2000).

3. Misuse of technology: This problem is considered one of the most important problems facing distance learning. Teachers believe that technology alone can solve all problems, but that does not happen. The distance education process needs qualified teachers trained in the use of technology, and not only that. Rather, teachers must change their teaching method to suit the method of distance learning, and a number of other factors fall under this problem, such as the use of inappropriate equipment, or not making the required use of the existing equipment, which affects the quality of the educational process, which are common technical problems (Mather and Sarkans, 2018).

4. The role of technicians: is thought that the role of specialized technicians is limited to the design and delivery of the required software and the design and installation of the technical infrastructure necessary to operate it. Many overlook the non-technical role of technicians, which requires continuous communication with people using technology, and the need to direct them in the correct manner to use it, especially teachers, where the researcher stated that he found that only 5 of the 11 teachers were able to adapt their teaching style to the techniques used, and what distinguished most of them was their openness to communicate with technicians and to inquire about any problems or

requirements they needed and the technical solutions that could be used to solve them (Valentine, 2002; Furkatovna and Furkatovna, 2022).

5. Problems in the equipment: The researcher stated that the technical problems in the equipment are one of the most important problems of distance learning, because if one of the equipment stops working, it may lead to the disruption of an entire class for an indefinite period, and if problems in the equipment are repeated, this will lead to frustration for both the teacher and the learner. To compare this with the traditional teaching method, if the projector stops working suddenly, the lecture can be completed simply through the traditional explanation and writing on the board, while if the connection is lost during the distance learning lecture, the alternative cannot be found until the problem is fixed, and in a study conducted for students from Mississippi Gulf Coast Community College, more than 58% of students stated that they believe that the equipment is not working properly, and a solution must be found to this problem because it is directly reflected in the quality of the educational process.

In addition to the previous problems, a large number of teachers and learners had a prior negative attitude towards the distance learning method, in addition to their fears resulting from the feeling that this system would not provide the required level of learning, or their lack of competency and technical skills to benefit from the educational system (Masrom, 2007), are among the main obstacles that must be overcome to develop the distance learning process. All of the mentioned problems can be avoided, and as a result of natural development, costs will decrease, and technological progress contributes continuously to improving the educational process, and thus he believes that the future of distance learning is a promising one.

The two researchers (Mueller and Strohmeier, 2010) conducted a comprehensive study of all previous researches related to the creation of Virtual Learning Environments during twenty years (1989-2009) in order to determine the basic characteristics that play the largest role in the success of virtual learning environments. To achieve that, a team of experts, specialized in the sciences related to the field of study (computer science, psychology, pedagogy, management science) was formed. The team included 13 international experts from different affiliations. The goal was to determine the characteristics of the most appropriate design for virtual learning systems as a starting point. Under the supervision of experts, an opinion survey was organized and published on the Internet in 2009, another team of 5 independent researchers evaluated the test results, and it was found that the characteristics that proved their importance are

(accessible, appealing, reliable, secure, structured), and on the basis of the results of the first stage, the thirteen specialists were asked to rank the resulting characteristics during this stage, starting from most important to least significant by applying calculating means and standard deviations of the respective rank positions as depicted in Table 2.1 (Mueller and Strohmeier, 2011; Müller, 2013).

Table 2.1. VLE Design Characteristic

A. System-Related	
Reliable	A1. 3.08 (1.44)
Secure	A2. 4.38 (3.52)
Learning-Process-Supportive	A3. 4.46 (3.13)
Interactive	A4. 4.77 (3.11)
Appealing	A5. 5.08 (2.25)
Transparent	A6. 5.15 (2.79)
Structured	A7. 5.92 (2.22)
Standard-Supportive	A8. 6.46 (2.79)
Accessible	A9. 6.85 (2.15)
Platform-Independent	A10. 7.62 (2.90)
B. Information-Related	
Understandable	B1. 2.23 (1.48)
Consistent	B2. 2.92 (1.66)
Credible	B3. 3.23 (1.30)
Challenging	B4. 3.54 (1.51)
Multimodal	B5. 4.00 (1.78)
Enjoyable	Enjoyable

2.2.3. Virtual Learning Environment

The concept of the virtual learning environment was clarified, and then delved into the characteristics of this environment to determine its dimensions and limits, and focused on information technology courses specifically, because students and teachers in the field of information technology are the first to adopt modern technologies, and they represent the bulk of users of virtual learning environments (Mather and Sarkans, 2018). This study explained the main features that distinguish education via the web primarily from traditional methods of education, and the difference between it and computer aided learning (CAI) (Devitt and Palmer, 1999; Hudson, 2004) which is a similar concept to distance learning, but on a smaller scale, then the basic components of the distance learning process were identified, which include three basic dimensions: the human dimension (comprised of the learner and the teacher), and the design dimension (consisting of a set of tools and methods that include the learning model, the technology

used, the content provided and the method of interaction between the teacher and the learner), and the third dimension is the effectiveness of the educational process (which includes performance and statistics related to the educational process). During this study, a VLE was built on the Internet, dedicated to information learning techniques, with a focus on providing options for learners to control some aspects of the educational process to suit their needs, for example, a full-time learner can follow courses more quickly than a learner who has other obligations (Song et al., 2004). Therefore, the learners were given the freedom to attend advanced lectures commensurate with their free time. A comparison was made in terms of the efficiency of the educational process and learners' satisfaction, between the aforementioned system and the traditional system. At first, it was found that the learners by the virtual learning environment clearly outperformed their counterparts in the exam results, but after conducting many studies and comparisons, it was not found that there is a clear difference in the efficiency of the educational process in the virtual environment, but it was found that the learners' satisfaction through the traditional method with the educational process was greater than the learners through the virtual method. In addition, a study conducted by 12 researchers concluded that excessive electronic access can expose students to negative psychological effects that affect their mental health, social life and general behavior (Browning et al., 2021), and may even lead to negative effects on teachers as well, it characterized by the increasing stress and anxiety (Fernández-Batanero, 2021) so special attention must be paid to ensuring the quality of distance education and adherence to the controls that would achieve this quality, which can be summarized in seven basic principles (Chickering, 1989):

- Emphasizing on communication between students and the teaching staff.
- Emphasizing on achieving cooperation and teamwork among students either through joint projects or during lectures.
- Emphasizing that interactive learning is achieved through the educational system.
- Establishing a system that achieves the possibility of providing feedback at all times To avoid mistakes in time.
- Emphasize time on task.
- Communicate high expectations.
- Respecting the different talents of students and their various ways of learning, and trying to develop software systems in line with it.

In a questionnaire that is considered the largest of its kind in terms of the studied sample that included more than 37,000 participants selected from 83 educational institutions in the United Kingdom, the study showed that 75% of students rely on virtual learning environments to support their educational programs (Langer-Crame et al., 2019), while a similar survey showed that 72% of higher education students rely on virtual learning environments to perform their coursework (Langer-Crame et al., 2019).

2.3. Summary

Related research works which are related to this work have been disscussed in this chapter. Advantages of distance learning from each work have been noticed and taken into consideration. In the field of e-learning for the service, there was a common factor between our studies in creating a website for the virtual university in terms of providing the service in whole or in part over the Internet without a direct human factor and without the worker. Geographical conditions, weather conditions, physical difficulties, housing, transportation, and others. We have included the advantages of distance learning in the previous chapter, the Department of Previous Studies. We have classified remote service into two categories: synchronous education and asynchronous education in the synchronous type. The parties are required to attend for the session, and in asynchronous education the student can review the lecture at a later time than giving it. It depends on the recording of lectures. The reason for this type of education is the obligations of daily life and some difficulties. We also talked about distance learning applied in China and the three stages it went through (correspondence, television and accredited).

As for the problems related to these methods and distance learning, these methods have faced many problems that we have previously talked about, such as: 1- Teaching quality: mainly related to the management style and the way teachers deal with the educational process, and the main problem here is that the administration and teachers believe that technology alone will solve . All teaching problems, which are incorrect and not applicable, Second: The cost-effectiveness problem: The distance learning process appears to be cost-effective, while in reality and practical application many costs appear that are not taken into account, Third: The misuse of technologies: from The most important problems facing distance learning. Again, educators believe that technology alone will solve all problems, but this does not happen. The process of distance education needs qualified teachers trained in the use of technology, and teachers must change their teaching method to suit the method of distance learning. Fourth: The role of technicians:

so that the role of specialized technicians is not limited to designing and delivering the required software and designing and installing the technical infrastructure necessary for its operation, but here as another role that requires continuous communication with people who use technology, and the need to direct them in the correct way to use it. Fifth: Problems related to equipment: so that If one of the equipment stops working, it could disrupt a complete disconnection indefinitely. period, and if equipment problems are repeated, it will lead to frustration of both the teacher and the learner and this is not found in the traditional method of teaching.

In addition to the previous problems, a large number of teachers and learners had a previous negative attitude towards the method of distance learning. In addition to their fears resulting from the feeling that this system would not provide the required level of learning, or their lack of learning The two researchers conducted a comprehensive study of all previous research related to the creation of virtual learning environments during twenty years and found that the characteristics that have proven their importance are (accessible, attractive, reliable, secure, structured). For the virtual learning environment, the concept of the virtual learning environment was clarified, and then delved into the characteristics of this environment to determine its dimensions and limits. The main features that distinguish education via the web mainly from traditional methods of education and the difference between them and computer-aided learning, a concept similar to distance learning, were disscussed. But on a smaller scale, the scale defines the basic components of the distance learning process, which includes three basic dimensions: the human dimension (the component of the learner and the teacher), the design dimension (consisting of a set of tools and methods that include the learning model, the technology used, the content provided, and the method of interaction between the teacher and the learner) and the third dimension. It is the effectiveness of the educational process (which includes performance and statistics related to the educational process).

During this study, a Virtual Learning Enviroment [VLE] was built on the Internet, dedicated to informational learning technologies, and no clear difference was found in the efficiency of the educational process in a virtual environment, and it was found that excessive electronic access can expose students to negative psychological effects that affect their mental health, social life and general behavior. We mentioned that in order to ensure the quality of distance education, there are seven basic principles.

We note that the method proposed by our study is an optimal method for learning, especially from a distance, as it meets the needs, takes into account all the conditions and ensures the achievement of the goal to the fullest through many of the advantages it has the quality assurance in the educational process, as it provides comfort in terms of commitment. The obstacles associated with the person and his daily life no longer prevent him from completing his education, as he is able to study at the time he deems appropriate.

The studied method transcends problems related to technical problems. It is a software base built on a platform run by many engineers and programmers, which is monitored around the clock and avoids network errors and interferences.

3. MATERIALS AND METHOD

3.1. Introduction

During this project, the practical part of this work is on building a web-based virtual learning environment, VLE, in an attempt to achieve the features required for the success of the virtual learning environment. We proceed in the analysis of the project from the functional requirements that it must fulfill. Laravel is a free and open-source PHP framework that provides a set of tools and resources to build modern PHP applications. With a complete ecosystem leveraging its built-in features, and a variety of compatible packages and extensions, Laravel has seen its popularity grow rapidly in the past few years, with many developers adopting it as their framework of choice for a streamlined development process (Sunardi, 2019). Laravel provides powerful database tools including an ORM (Object Relational Mapper) called Eloquent, and built-in mechanisms for creating database migrations and seeders. With the command-line tool Artisan, developers can bootstrap new models, controllers, and other application components, which speeds up the overall application development.

Laravel Framework is adopted to build the website, because of its high flexibility, libraries and additional packages that provide many functions that can be included easily, in addition to its reliance on the Model View Controller (MVC) model that allows speed in development and flexibility in the presentation of user interfaces and the separation between the programmatic logic and the user interface. MVC is an architectural modality usually used in web-based applications. It supply 3 main layers; model, view, and controller. Most of the developers use MVC as a standard web-design pattern. It is a complete framework. Most of the languages like Java, PHP, Python, C#, etc. use this pattern to develop the applications. In Java, it is known as Spring-MVC framework, in PHP it is known as cake PHP, Microsoft introduced a framework called ASP.Net MVC and so on (Deacon, 2009).

Laravel Framework is adopted to build the website, because of its high flexibility, libraries and additional packages that provide many functions that can be included easily, in addition to its reliance on the MVC model that allows speed in development and flexibility in the presentation of user interfaces and the separation between the programmatic logic and the user interface. The Bootstrap CSS Framework will be used to make the site fully responsive on all types and sizes of display devices (Gaikwad and Adkar, 2019).

Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. Its high-level built in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together. Python's simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages, which encourages program modularity and code reuse. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms, and can be freely distributed (Lutz, 2001).

As for the virtual classroom, Python language is used, due to its ease of dealing with input and output devices and the use of the camera and microphone, in addition to its ease of integration with websites. In order to achieve this point, Flask web framework is used, which provides useful tools and features in creating web applications using Python language, thus, it is easy to integrate between the university website and the virtual classroom, so that students can access their accounts on the university website and the virtual class from the same device, via a web browser, and on the same server.

3.2. System Requirements

The functional requirements of any system are the main point for developers, as these requirements determine the functions that the system must achieve, and accordingly, the stages of the development process can be planned and organized. We gradually display the functional requirements of our system and the way to achieve them.

3.2.1. User Roles

• Initially, the system must normally include users with different roles. For a virtual university site, users can fall under one of the following roles:

• Administrator: He is a member of the university administration who can manage and organize the general and basic functions of the university.

• Editor: He edits articles, circulars and advertisements that are published on the university's website.

• Teacher: responsible for giving lectures on specific subjects to learners.

• Student: He is who receives lectures.

- Student Affair: He is one of the employees in the Student Affairs Department.
- Exam Affair: He is one of the employees in the examination department.

We note that the data to be stored for all user roles is the same, except for student data, as we need to store additional data related to the student's educational status, financial status, and a different set of other data. This can be achieved in more than one way, but we found it best to use one table to store the data of all users, with a role_type field that specifies the type of the user role, in addition to that, there is a need for another table that is specialized in storing additional data for students, associated with the main users table with a foreign key, which is achieved through the two tables shown in Figure 3.1. We note the basic data that is stored for each user in the Users table, and their details are shown in Table 3.1: . In Table 3.2 We note that there is detailed information about each student, as the table contains an abbreviation for the name of each information and an explanation corresponding to this abbreviation. For example, there are details about the student's grades, stady status, average, and year of graduation if he/she graduated, in addition to a lot of necessary information that must be available about the student.

The method mentioned in the tables and the illustration, in addition to the attached figure, shows the method of linking tables through the main key, but there are several other ways, including: Creating one table independent of the user information table for students so that the student table shows the financial and academic information for each student and this table is linked With the employee table with a key that can be the identification number of each person, (ID). Or by creating one table, but this table contains empty fields for students so that these fields are not filled in. The inquirer's referral was a student and his financial and academic information appears, and in the case of the user being a normal person (not a student), a special phrase is shown, for example (the field is for students' category).

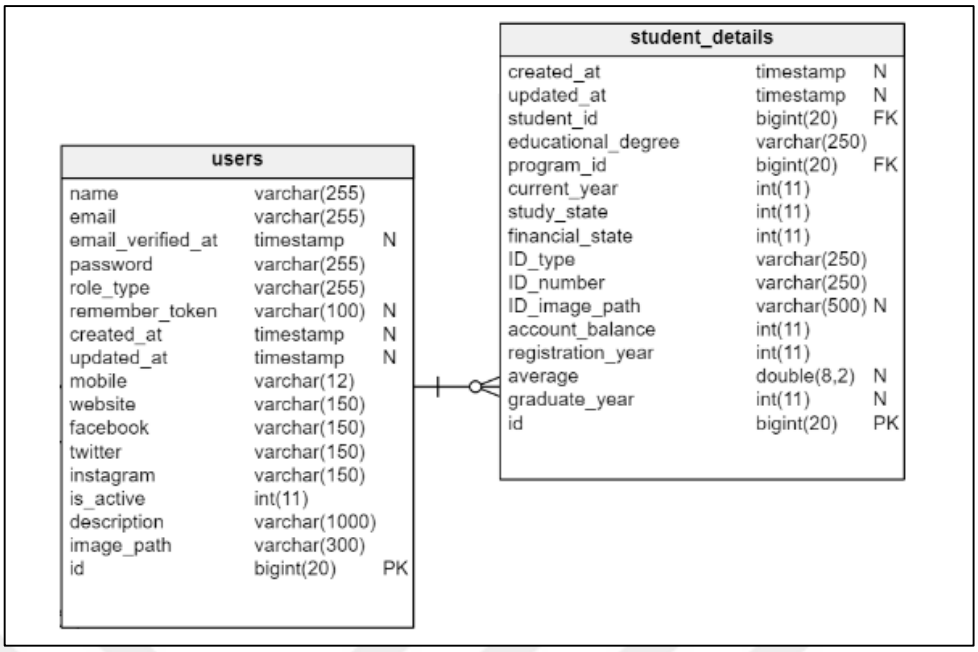


Figure 3.1. Users details

Table 3.1. Users details

Users table	
Name	Full username
Email	The user's email that will be used to log in
Email_verified_at	Timing of the email confirmation process
Password	User's password
Role_type	User role type
Remember_token	It is used if the user chooses the (remember me) option while logging in
Created_at	When to create a user account
Updated_at	When was the user account data last modified
Mobile	
Website	
Facebook	User's social media accounts
Twitter	
Instagram	
Is_active	User account status (active/locked)
Description	General description of the user
Image_path	The user's personal photo storage address
id	User ID which is the master key PK

Table 3.2. Student details

Student details	
Created_at	Record creation time
Updated_at	The time when the record was last modified
Student_id	A foreign key belonging to the student in the users table
Educational_degree	The highest academic degree obtained by the student
Program_id	The course followed by the student
Current_year	The student's current year in his academic program
study_state	The current academic status of the student (active - exhausted – graduated)
financial_state	Student's financial situation (acquitted – overdue)
ID_type	The type of the student's personal identification document PID (personal card – passport)
ID_number	PID serial number
ID_image_path	A photo of the PID
account_balance	The current amount of money deposited in the student's account with the university
registration_year	The year in which the student was enrolled in his academic program
average	Student's grade point average GPA
Graduate year	The year the student graduated from the university

In this way, the user's role is recognized during the login process, which is managed through the Auth/LoginController.php controller. This controller sets the login mechanism and initially checks the validity of the login data, as well as checking the status of the account and the type of user role it represents. Accordingly, the login process is executed as shown in the diagram in the Appendex (1).

3.3. The Mechanism Of Separating The Roles Of Users Within The System

In order to separate the mechanism of the users and the system roles. It is not enough to redirect the user to the dashboard corresponding to his role to perform the process of internal separation between users. In addition to that, a mechanism should be provided to prevent any user from logging into pages belonging to other user roles. That means, in case any user attempts to visit a page not corresponding to his role, by attempting to use the URL of that page, he should be denied, and only users with authorized roles can access it. This was done by defining the URLs of all website pages in the routes/web.php file, and by grouping all the URLs assigned to each of the user roles into a single group, and by applying a specific Middleware on each set of them that checks the role of the user trying to visit the page and takes the appropriate action, where, Laravel

Middleware, acts as a bridge between a request and a reaction. It is a type of sifting component.

For example, we can include pages that only the editor is allowed to view, as shown in the following example as shown in Figure 3.2.

```
Route::group(['middleware' => 'role:Editor'], function() {
    Route::get('/editor_dashboard', 'App\Http\Controllers\Editor\DashboardController@index');
    Route::get('/editorProfile','App\Http\Controllers\Editor\DashboardController@profile');
    Route::post('/updateArticle','App\Http\Controllers\Editor\DashboardController@updateArticle');
       .
       .
       .
});
```

Figure 3.2. Editor role routes

In this case, visiting the pages included in this group such as (www.KVU.com/editor_dashboard) is only possible for users with the role of Editor. We note that by defining each Route, the controller that will implement the programmatic logic when visiting the page: (App\Http\Controllers\Editor\DashboardController) is specified, and the method belonging to this controller and within which the code (index) will be executed is defined.

3.4. Functional Requirements For The Administrator Role

The user with the role of Administrator must be able to control the general settings of the university, in addition to controlling users (except for students who are controlled by the Student Affairs Department), as well as controlling the educational programs taught at the university, and the subjects that fall under each teaching program. The functional requirements for this role can be described as follows:

1. Able to modify his personal information in his profile.
2. Able to add/modify/delete users.
3. Able to add/modify/delete tutorials.
4. Able to add/modify/delete educational subjects.
5. Able to identify the teacher competent to give any of the subjects.
6. Able to control the general settings of the university, which include:

- The maximum number of subjects by which a student can fail and be raised to the following year.

- The minimum number of questions to be added within the question bank for each academic subject annually.

- The number of questions in automated exams.

- The starting and end time of registration period at the university at the end and beginning of each academic year.

- The termination of the current academic year and moving on to a new academic year.

These settings and their implications for the educational process is clarified later in this chapter. Through the mentioned requirements, it becomes clear the need for a number of additional tables within the database, which are the educational programs table, the study subjects table, and the general configurations table. The structure of these tables is shown in Figure 3.3. Table 3.3., 3.4, and 3.5.

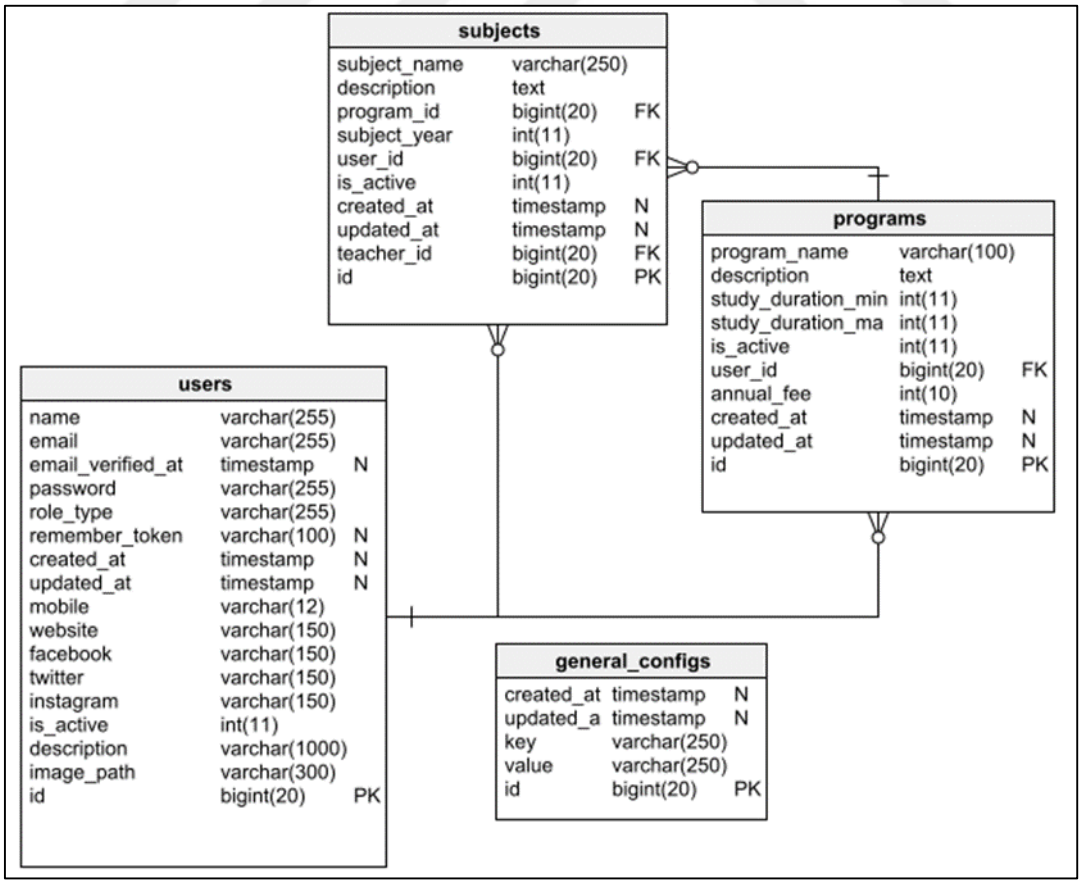


Figure 3.3. The administrator role

Table 3.3. Programs table

Programs table	
id	Course ID
program_name	Course name
description	Course description
study_duration_min	Study duration (YEARS)
study_duration_max	The maximum number of years allowed to be spent in the program before exhaustion
is_active	Current program status (active/locked)
user_id	ID of the user who created this program
annual_fee	annual installment
created_at	Program creation time
updated_at	The time it was last modified

Table 3.4. Subjects table

Subjects table	
id	Subject ID
subject_name	Subject name
description	Subject description
program_id	ID of the program to which this subject belongs
subject_year	The academic year in which this subject is given within the academic program years
is_active	Subject status (active/locked)
user_id	ID of the user who created this subject
created_at	Subject creation time
updated_at	The time it was last modified
teacher_id	ID of the teacher who teaches it

Table 3.5. General configs

General configs	
id	Settings item ID
created_at	creation time
updated_at	The time it was last modified
key	Item name
value	Item value

The Subjects table (Table 3.4) contains information related to the subject, such as the name, description, academic year in which this subject is given, the status of the subject, whether it is currently being taught or not. The table also contains foreign keys associated with the use who created this subject, the program to which this subject belongs, and the teacher who teaches this subject.

The General configs table is not linked to any tables and contains information about the tools. Each tool has a name, value and identifier, as shown in Table 3.5.

The general settings table was created in the form of Key:value pairs in order to make this table flexible so that any required settings can be easily added, and then the appropriate code is added to the required controller to apply these settings within the programming logic of the site. This table currently includes the following elements:

- **Number Of Failed Subjects To Fail The Year:** The value assigned to this element indicates the number of subjects that the student is allowed to fail, however, he or she can be raised to the next academic year at the end of the current year. If the student fails a number greater than this value, he has to repeat the current year and will not be promoted.

- **Current Year:** The value assigned to this item represents the current academic year, and at the end of this year the user with the role of Administrator can press the (End Academic Year) button from his control panel, thus performing a set of actions shown in diagram (2) in Appendix (1) The end of which leads to the transition to a new academic year.

- **Min Quiz Bank Size:** The value assigned to this element indicates the number of questions that the teacher of each subject must add annually to the question bank for his subject before the end of the academic year. For example, if the value is (35), each teacher must add 35 questions to the question bank for each subject he teaches each year. Over time, the question banks for all subjects are expanded.

- **Exam Quiz Size:** The value assigned to this item indicates the number of exam questions that randomly picks by the system in each exam session.

- **Can Register:** The value assigned to this element indicates the registration status at the university for new students. If its value is open, this indicates that the registration is open and those wishing to join educational programs can register, and in this case the new student's registration button will appear in a prominent place on the main page, while if its value is closed, then it indicates that the academic year has started, and registration for new students has been closed this year, and the students registration button will disappear from the main page.

The general configs are considered one of the sensitive areas within the site, because any modification in it reflects in the various activities and events of the university, so, the modifications page in the Administrator dashboard includes a warning in the form of an Alert notification emphasizing to pay attention while making any modification in these settings, in addition to a confirmation request in the form of a Checkbox that the user is aware of the importance and sensitivity of modification in these settings. The user must check this confirmation in order for the modifications to be applied. In addition, a special controller has been allocated to handle the procedures associated with these modifications, which is (App\Http\Controllers\Admin\ GCController.php).

The routes are included in it are associated with the routes included in one group under the protection of the Administrator middleware in order to restrict access to these links to users with the Administrator role. All methods included in it are associated with routes included in one group under the protection of the Administrator middleware in order to restrict access to these links to users with the role of Administrator only.

3.5. Functional Requirements For The Editor's Role And The Mechanism

The editor's role is limited to editing university news and publishing its circulars and announcements to be displayed on the home page of the site. Thus, the functional requirements for this role are:

- To be able to modify his personal information in his profile.

- To be able to add/modify/delete articles.

To achieve these requirements, we need a special table to store the article data as shown in Figure (3.4) and Table (3.6) show the data stored in the articles table.

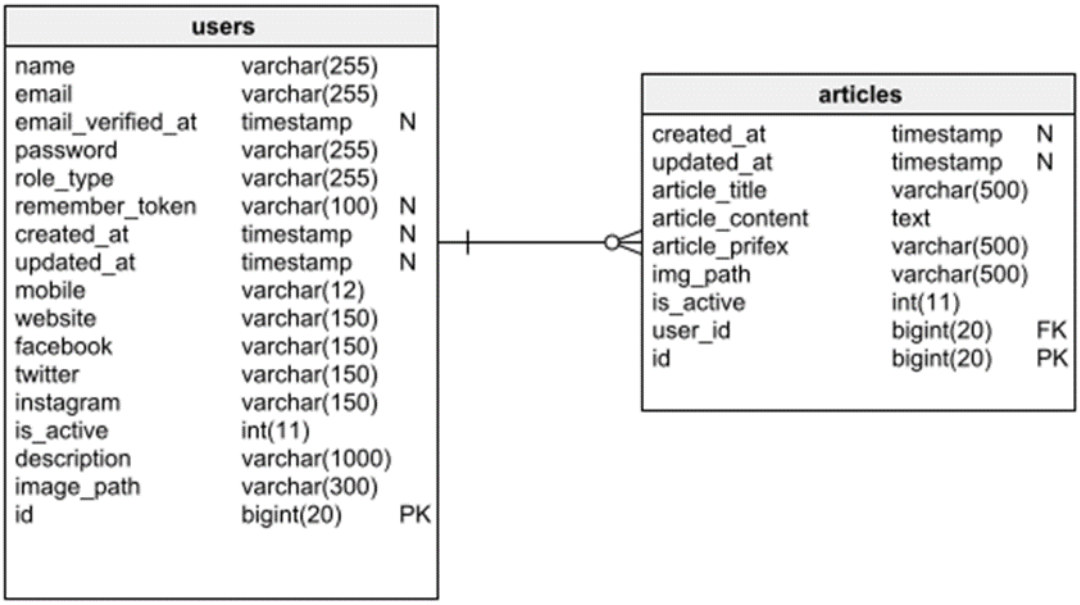


Figure 3.4. Articles table

Table 3.6. Articles table

Articles table	
id	Article ID
created_at	Article publication time
updated_at	The time when the article was last modified
article_title	Article title
article_content	Article content in HTML format
article_prifex	An explicit text clip from the beginning of the article to be published on the home page
img_path	Address of the image attached to the article
is_active	Article status (published/deleted)
user_id	ID of the editor who published the article

3.6. Functional Requirements For The Role Of Student Affair And The Mechanism

The work of users who hold the role Student Affair is based on a set of functions related to students, and therefore they must have full access to the profiles data of all students registered in the university, in addition to that, these users are responsible for the process of registering new students at the university, through checking their data during registration and review and examination of all documents submitted by them. When completing the necessary papers and conditions, the mentioned users complete the students' data and activate their accounts on the university's website so that they can start the learning process. This mechanism is carried out according to the following steps:

1. When the university administration opens the registration for new students, the registration button appears on the main page.

2. The student enters the registration page by pressing the mentioned button, where he/she is asked to enter his/her full name and e-mail and choose his/her own password.

3. After entering these data, an account is created for him/her as a student at the university, but the account is not activated, and a message appears asking him to communicate with the Student Affairs Department to complete the data and identification papers required to complete the registration process, and at the same time an indicator appears in the users' dashboard for Student Affairs Users indicating that there are new students who have started the registration process and are waiting to complete their papers, as shown in Figure (3.5) where we notice in the figure some information that appears for student affairs, such as the number of active students and the number of students who are waiting in order to complete the registration process. They also show the number of graduated students and the number of students arrested due to violations or any procedures against them.

4. New students contact the Student Affairs Department and upon completing all the required papers and documents, the Student Affairs staff enters the rest of the data after verifying its validity (the highest academic degree obtained by the student, the study program he/she wishes to follow at the university, the type of identification document he/she submitted, its number, and a photocopy of it).

5. When the Student Affairs User completes these data, the student's account is activated and registered in the first year of the educational program he has chosen, and an invoice is sent with a notification requesting payment of the annual installment to the new student's account.

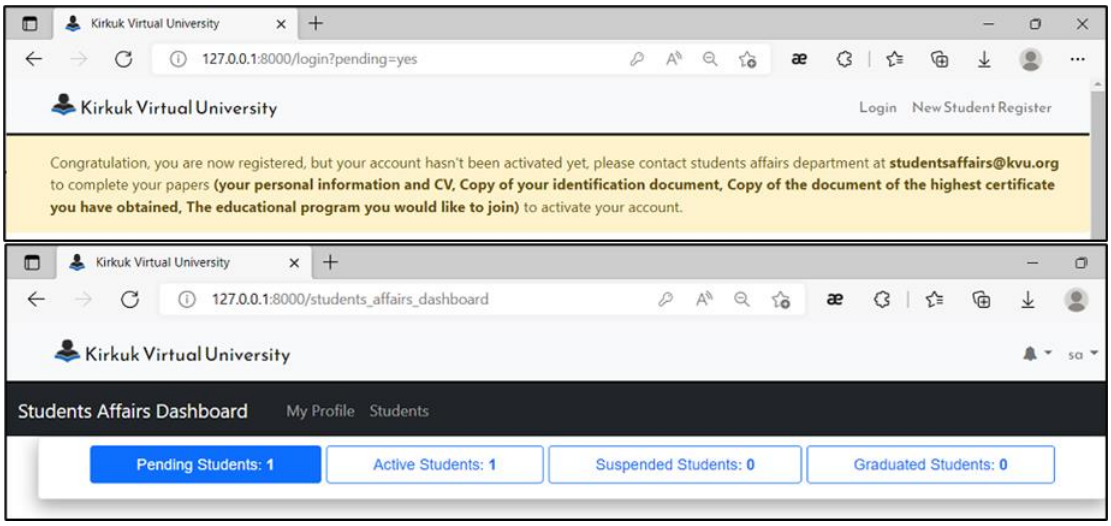


Figure 3.5. New student registration

3.7. Functional Requirements For The Role Of The Teacher And The Mechanism

The role of teachers is one of the basic roles in the traditional and virtual education environment. Although the advanced technologies in the virtual learning environment provide many facilities and advantages that serve the development of the education process, the role of the teacher is no less important than the role of these technologies, and it is still the main guide and motivator for the educational process. Therefore, it is necessary to provide all the tools that serve the role of the teacher and help him in performing his tasks. Next are the basic functional requirements that the system must provide for the teacher:

- To be able to modify his personal information in his profile.

- To be able to review the scientific subjects he teaches and view their profiles.

- To be able to record asynchronous lectures for the subjects he teaches and upload them to the site with attachments and references he believes appropriate.

- To be able to broadcast synchronous lectures that students can join and interact with, record these lectures and upload them to the site with any attachments or references he believes appropriate.

- To be able to add exam questions to the exam question banks for all the subjects he teaches.

- To be able to impose home assignments for the subjects he teaches and submit them to the university website.

- To be able to review student reports submitted for assignments and put the appropriate degree on each report.

- To achieve these requirements, a set of tables must be added to the system (lectures table, exam questions bank table, assignments table, assignment reports table). The details of these tables will be illustrated in Figure (3.6), the data stored in these tables are detailed in the tables (3.7-3.8-3.9-3.10).

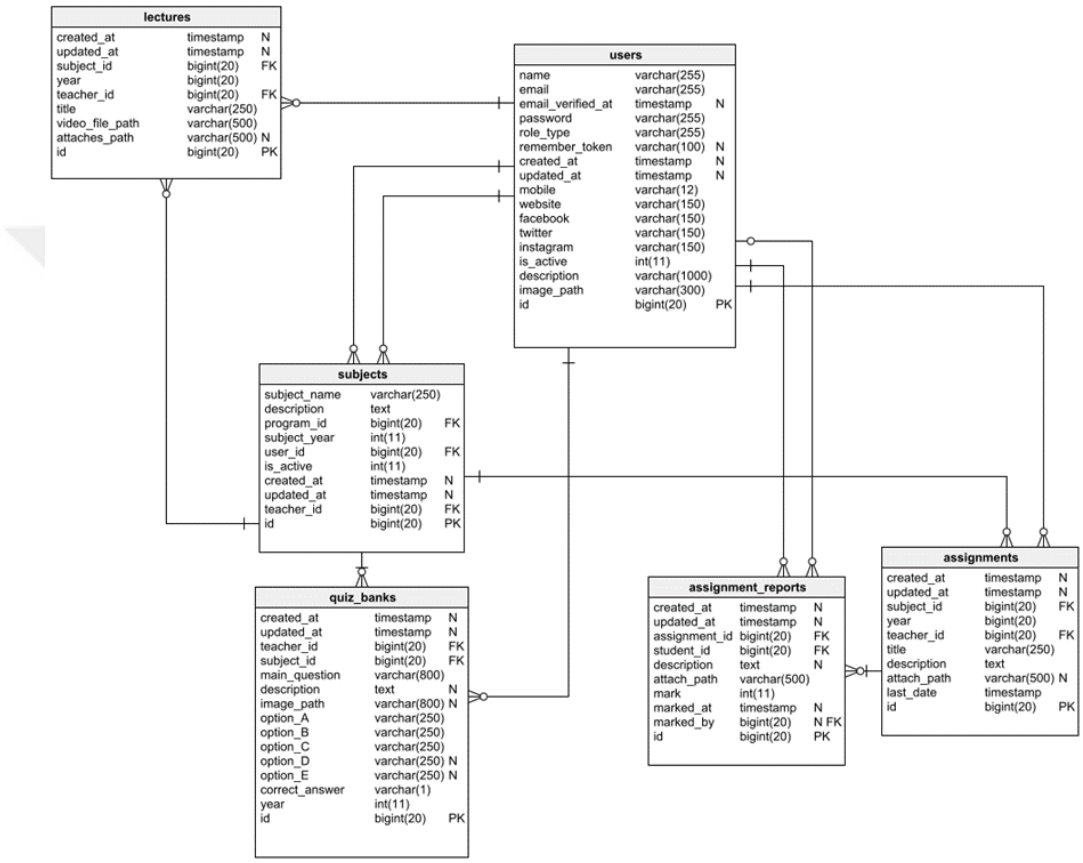


Figure 3.6. Teacher role tables

Table 3.7. Lectures table

Lectures table	
id	Lecture ID
created_at	The time the lecture was uploaded to the server
updated_at	The time the lecture was last modified
subject_id	The identifier of the subject to which the lecture belongs
year	The year the lecture was published
teacher_id	The ID of the teacher who published the lecture
title	Lecture title
video_file_path	Path of the video file of the lecture
attaches_path	Path of the attached file containing lecture attachments and references

Table 3.8. Assignments table

Assignments table	
id	Assignment ID
created_at	The time the assignment was uploaded to the server
updated_at	The time the assignment was last modified
subject_id	The identifier of the subject to which the assignment belongs
year	The year the assignment was published
teacher_id	The ID of the teacher who published the assignment
title	Assignment title
description	An explanatory description of the assignment and the work required of it
attach_path	The path address of the attached file that contains illustrative and assignment-assisted attachments
last_date	Deadline for submitting the assignment report

Table 3.9. Assignment reports table

Assignment reports table	
id	Report ID
created_at	When the report was uploaded to the server
updated_at	The time when the report was last modified
assignment_id	The ID of the assignment to which the report is associated
student_id	ID of the student who submitted the report
description	Student's explanation of the report contents
attach_path	The path of the attached file containing the results of the assignment execution
mark	The mark given by the teacher to the report after reviewing and evaluating it
marked_at	Time of awarding the mark for the report by the teacher
marked_by	ID of the teacher who evaluated and graded the report

Table 3.10. Quiz banks table

Quiz banks table	
id	Question ID
created_at	The time when the question is added to the question bank
updated_at	The time it was last modified
teacher_id	ID of the teacher who added the question
subject_id	The identifier of the subject to which the question belongs
main_question	Main question text
description	Additional explanation about the question
image_path	The Path of the attached image if existed
option_A	First choice to answer
option_B	second choice to answer
option_C	third choice to answer
option_D	fourth choice to answer
option_E	fifth choice to answer
correct_answer	The correct answer
year	The year this question was added

We note that the (year) field has been added to the tables (lectures, assignments) to specify the year in which the lecture was added. Thus, when the student enters to view the lectures or assignments of a particular subject, the lectures and assignments that were added during the current year is displayed, and the lectures and assignments of previous years is not displayed. As for the (quiz_banks) table, it also contains a (year) field in order to know the number of questions that the teacher added for each subject during the current year. (As it is of are mentioned), the university system requires each teacher to add a predetermined number of questions for each subject annually, and this number can be modified by the university administration from the general configurations modification page, so that the teacher keeps informed permanently about the number of questions that he must add for each subject, An indicator is displayed in the teacher's dashboard showing the number of subjects that still need to be completed in the number of exam questions. In addition, when the teacher reviews the subjects he is teaching, he will find a Q_bank field for each subject. The field includes the percentage of completion of the exam questions for this subject, and is marked in red if not completing the required number of questions as shown in Figure (3.7), In addition, when an exam date for a subject is set by the Exam Affair User, the system checks the percentage of completion of the exam questions for that subject during this year, If the teacher has not completed the required number of questions, a notification is sent to him informing him of the date of the exam, asking him to complete the number of questions required for this subject.

As it is a for mentioned, the questions that are included in the exam are randomly selected by the system from the question bank, which includes questions that have been added over previous years, but this mechanism ensures that the question bank is constantly expanded and updated.

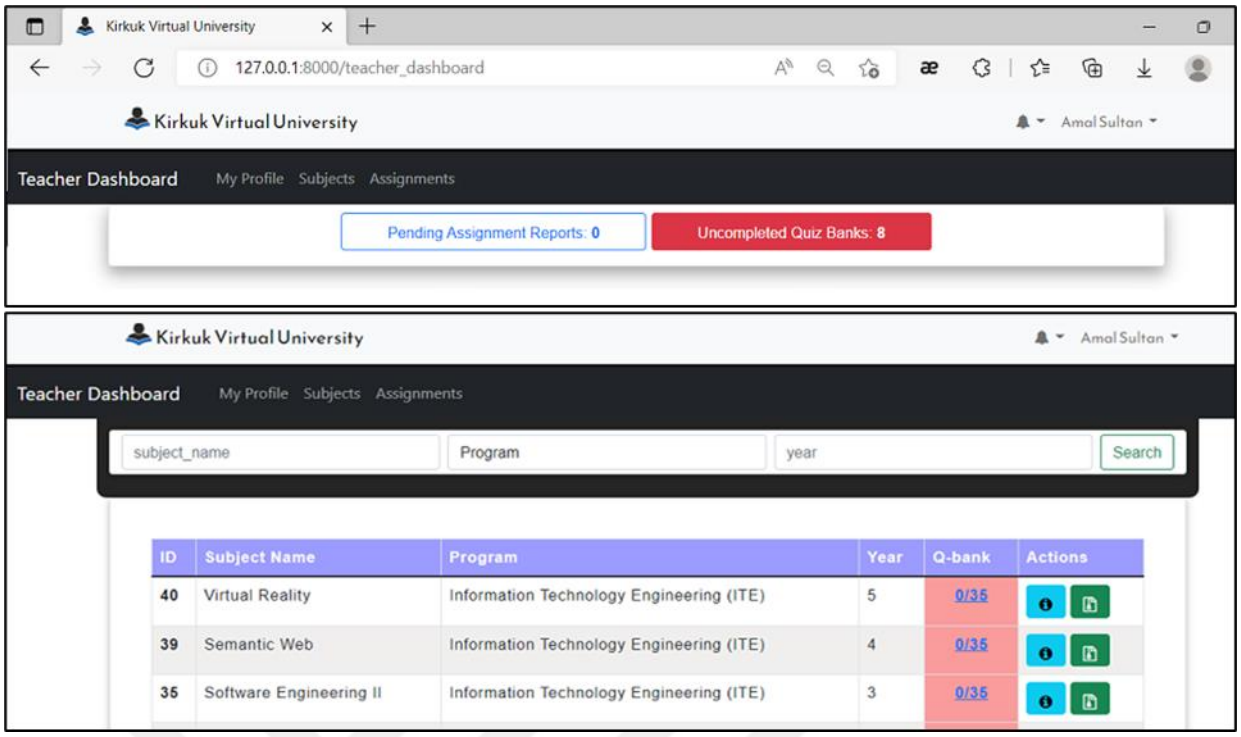


Figure 3.7. Uncompleted quiz banks

3.8. Functional Requirements For The Role Of Exam Affair And The Mechanism

The primary task of the Examination Department staff is to organize the examination process and ensure that it runs correctly. Exams can be implemented during virtual learning environments in different ways. In some virtual universities, students can take the exam from wherever they are, and in some cases, students can take exams at Unscheduled appointments, in order to give flexibility to students who have other life commitments to take the exam at a time that suits them, while students in other virtual universities must be present in specific exam centers affiliated to the university to take the exam through computers designated for this purpose, in order to be able to monitor the progress of the exam process by staff observers at the university. In this case, a special mechanism is set up to ensure that students do not take the exam from outside the university's centers. This is done by one of two mechanisms. The first includes a list of IP addresses assigned to networks of exam centers, so that the system checks the IP address of each student trying to take the exam, and in this way it is possible to prevent any student from entering the exam from outside the specified exam centers, and it is known that this mechanism can be easily bypassed through the process of IP spoofing, so the second mechanism is often used, where a token is generated for each exam, and this is done a few minutes before the start of the exam, then the mentioned token is distributed

in any way possible to the exam centers for the observers to distribute it to the students taking the exam, when students try to enter the exam, the system asks them to enter the exam token to allow them to enter. If the aforementioned token is not entered by the student, he is not allowed to apply for the exam. In this project, we implement the second mechanism, where the Exams Department employee, at the exam start time, gives the order to start the exam from within his account, which falls under the role of Exam Affairs, and this process will lead the system to generate a special token for the exam and shows it to the exam department employee, then the system selects a specific number of random questions related to the exam subject from the question bank.

As we mentioned previously, the number of exam questions can be determined by the university administration staff, and when selecting the exam questions, they will be listed in the exam_questions table dedicated for saving the questions for each exam, and the system changes the exam status from pending to started, and at this stage the start exam button appears in the students' accounts, and they will be able to take the exam after entering its token. When any student enters the exam, a record will be inserted to the student_joined_exams table. The purpose of this is to ensure that the mentioned student has taken this exam, and to facilitate the process of awarding grades to all students taking the exam, in addition to determining the status of this student for this exam, after the student presses on The Exam Finish button, his status is modified for the exam to become finished, so the student is not allowed to enter again for the same exam from inside or outside the exam center (because he knows the exam token (.

When the student presses the Finish Exam button, the system calculates the grade due to the student and store it in the student_marks table. When the exam time ends, the system will modifis the exam status to become finished and calculate the grades of students who have been forcibly suspended from continuing the exam and store it in the student_marks table. At this stage, a special button appears in the Examinations Department staff. Pressing it causes the system to verify that all students who have taken the exam or had to take the exam have their scores calculated and stored in the student_marks table. At this stage, the system identifies the students who had to take the exam and did not take the exam and gives them a zero mark, which is stored in the student_marks table too, and the state of the exam is modified from finished to marked, then the functional cycle of that exam is completely finished.

When the exam starts, students can move between the exam questions that the system chosed and were recorded in the exam_questions table, and they can pin their answers to these questions, which in turn is stored in the student_answers table. The purpose of this is to enable the system to calculate the mark due for each student, and being able to review the student's answers to the exam questions at any later time by the Examinations Department staff in the event of a complaint or a request for review.

One of the limitations related to the exam, which must be determined before starting the exam, is the exam duration. The system must finish the exam on time and stop the students from continuing the exam. To achieve this purpose, a special command was created in the laravel environment called finish:Exams. This command, when executed, checks all exams that have the state started, (i.e. the exams are running), and compares the duration field for each exam with the date Time field, which specifies the moment the exam started, and the current time of the server. If it turns out that the exam period has ended, the order ends the exam by changing the exam's state to finished.

In order for this command to work properly, it must be executed repeatedly. To achieve this, we have added this command to the method of scheduled tasks in the kernel.php file with the repetition timed every minute so that it will check the status of the running exams every minute and terminate any exam that has expired, as shown in the Figure 3.8 has following code:

```
protected function schedule(Schedule $schedule)

{
    $schedule->command('daily:updates')->daily();
    $schedule->command('finish:Exams')->everyMinute();
}
```

Figure 3.8. Scheduled tasks

In order to ensure that students stop continuing the exam after the specified period has expired, the exam status is tested with each student transition between one question to another, If the exam state is started, the student is allowed to move to the next question, but if the exam state is finished, the system needs to force ending the exam, calculate the grade due and record it in the student_marks table as shown Figure 3.9.

```php
class finishExams extends Command

{
    protected $name = 'finish:Exams';
    protected $signature = 'finish:Exams';
    protected $description = 'finish all started exams if duration ended';

    public function __construct()
    {
        parent::__construct();
    }

    public function handle()
    {
        $showExamsDataquery = DB::table('exams')->where('status','=',1)->get();
        if(!$showExamsDataquery->isEmpty())
        {
            foreach($showExamsDataquery as $anExam)
            {
                $examDurationInMinutes=$anExam->duration;
                $start_date = new Carbon($anExam->dateTime);

                if($start_date->diffInMinutes(Carbon::now()) > $examDurationInMinutes)
                {
                    Exam::where('id','=', $anExam->id)
                    ->update([
                        'status' => '2'
                     ]);
                }
            }
        }

    }
}
```

Figure 3.9. Functional Requirements' code block'

From the above, we see that the basic functional requirements for the staff of the Examination Department are:

- To be able to modify his personal information in his profile.

- To be able to review the pre-set previous, current and future exam data.

- To be able to schedule upcoming exams for various educational subjects.

- To be able to give an order to start the exam.

To achieve these requirements in addition to the requirements of the exam process, we need a set of tables shown in Figure 3.10 while Table 3.11, Table 3.12, Table 3.13, and Table 3.14 shows the data stored in the tables for the exams.

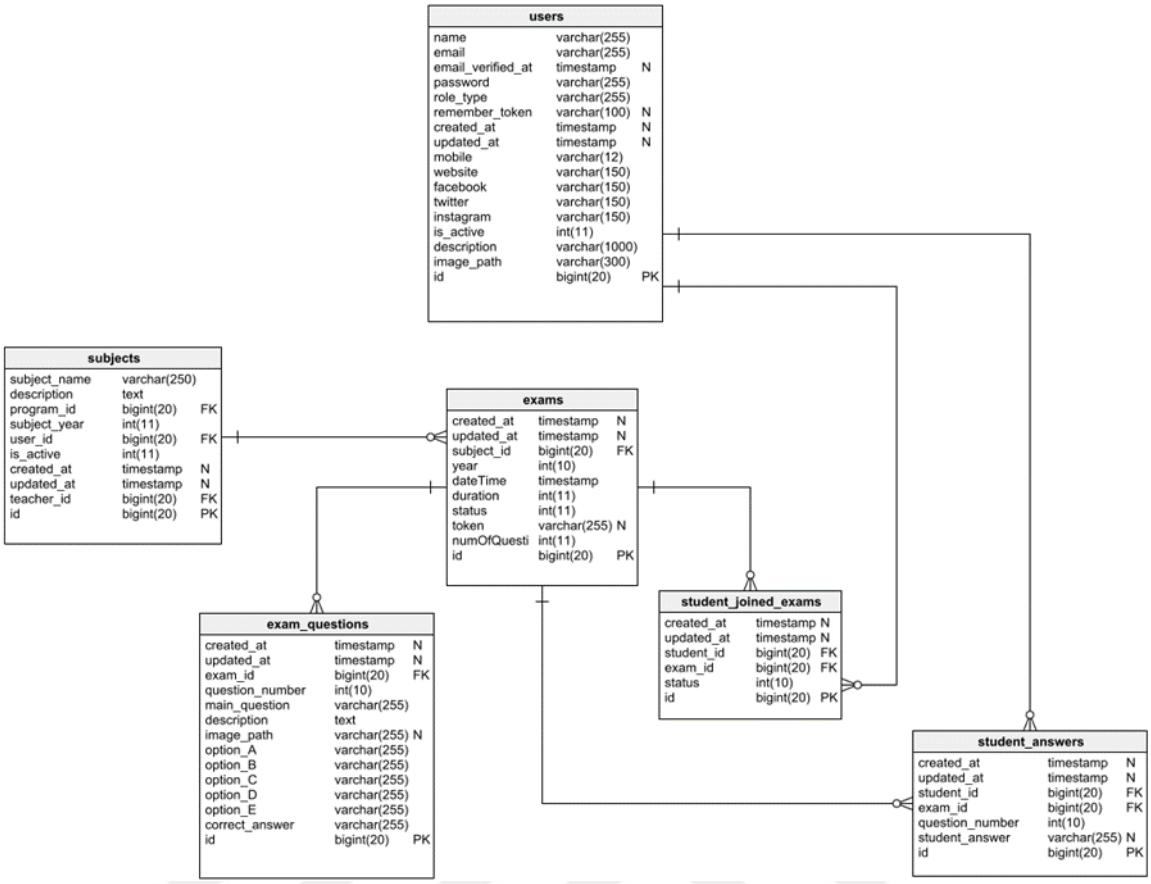


Figure 3.10. Exams tables diagram

Table 3.11. Exams table

Exams table	
Id	Exam ID
created_at	Exam time posted on the website
updated_at	The time it was last modified
subject_id	Exam subject identifier
Year	The year in which the exam was taken
dateTime	Exam start date and time
Duration	Exam duration in minutes
Status	Exam status (pending - started - finished – marked)
Token	Exam token
Num Of Questions	Exam number of questions

The exams table is dedicated to store exam data. The employee of the exams department sets the exam date for one of the subjects. The system stores the initial data for the exam in the exams table. The presence of the year field in the exam schedule to determine the year in which the exam is held (the current year by default) and then exams for the current year is shown only to students and teachers.

In addition, the token field is empty (null) , and as soon as the new exam data is stored, the system checks the number of exam questions that have been added to the question bank and that pertain to the study subject related to the exam during the current year, if the number is less than the required number previously specified by the university administration, a notification is sent to the subject teacher informing him of setting the exam date for this subject and asking him to complete the minimum number of exam questions in order to ensure that the bank of exam questions is continuously expanded and updated.

Table 3.12. Exam questions table

Exam questions table	
id	Exam Question ID
created_at	The time the exam question was added
updated_at	The time it was last modified
exam_id	Exam ID to which this question is related
question_number	The serial number of the question within the exam
main_question	Main question text
description	Additional explanation to clarify the question
image_path	Path of the illustration image of the question, if existed
option_A	First choice to answer
option_B	The second answer option
option_C	The third answer option
option_D	The fourth answer option
option_E	Fifth answer option
correct_answer	The correct answer

The purpose of creating the exam_questions table is to store the random questions that the system has selected for this exam, so that it is possible to refer to the questions of any exam held previously at any time, in addition to that, the questions are presented to students taking the exam during the exam from this table and not from the general question bank. The constraint not null was added to the first three options and the teacher was left with the freedom to add the fourth and fifth options to any question.

That is, the questions, as we notice in the table, are questions of the type of answer choice, and as a minimum, each question has three answers, and each question is related to one or more exams. The table contains information about the question number, description, question text, options, and the correct option.

Table 3.13. Student joined exams table

Student joined exams table	
id	Serial ID
created_at	The time the record was added
updated_at	The time the record was last modified
student_id	Student ID
exam_id	Exam ID
status	Student status for this exam (active, completed)

Student joined exams table contains students who are taking an exam and their status whether they have finished the exam or are still taking it. The table contains a foreign key associated with a particular exam and the foreign key, which is the ID of the student, which is associated with the users table.

Table 3.14. Student answers table

Student answers table	
id	Answer ID
created_at	Answer time
updated_at	The time the answer was last modified
student_id	ID of the student who answered
exam_id	ID of the exam whose questions are answered
question_number	The serial number of the question within the exam
student_answer	The answer given by the student

3.9. Functional Requirements For The Role Of Student And The Mechanism

The role of the student is considered one of the most important roles in the virtual learning environment, as all components of this environment have been built to provide the learning process for the student, and the main criterion that will be taken into account while assessing the quality of the educational process and the efficiency of the educational system is how much the student benefits from the virtual environment, and the comparison between The traditional method and the virtual environment in terms of students' results and their satisfaction with the educational process they obtained. Therefore, the success of any virtual educational environment depends mainly on providing all the functions that the student needs, and the tools that can help him to make optimal use of the educational process. The basic functions that should be available for the student are:

- To modify his personal data in his profile.

- To view his study profile, containing his study status, exam results, grades awarded for the assignment reports he submitted, and the subjects he passed, in addition to the subjects he fails.

- To view the study subjects that fall within the educational program he is following and the profiles of these subjects in his current year and previous years.

- To view and aownload the lectures given in the study subjects that fall within his educational program and download the attachments and references for these lectures.

- To enter the virtual classroom and interact with the teacher simultaneously while giving synchronized interactive lectures.

- To view the assignments that have been imposed by the teacher for the subjects that fall within his educational program, and the ability to submit the reports required in these assignments to the server before the expiry of the time limit specified for each assignment.

- To see the exam dates that are set by the Examinations Department for the subjects that fall within his educational program.

- To attend the exams that fall within his educational program on the dates specified for each exam and according to the examination system followed by the university, and the ability to fix his own answers to each exam question, and the ability to finish the exam at any time.

- To view his financial state (acquitted / overdue) and all the invoices issued against him with the details of the invoices and the dates of their issuance and payment dates.

- To charge his financial balance on the university's website, and pay the bills required of him through this balance.

A large number of the mentioned requirements were discussed in the tables required to achieve them previously. As for carrying out the functions, it was done programmatically through the website. To achieve the remaining functions, we need to create new tables (invoices, student_marks, failed_student_marks.)

Figure 3.11 shows the structure of these tables and the relationships associated with them, While the table 3.15, table 3.16 and 3.17 list an explanation of the fields contained in these tables. The student_marks table was used to determine the student's current score in each subject that falls under the educational program he follows, and the grades stored in it indicate his current status, and we note that the (year) field is omitted in this table because the grades stored in it indicate the last mark obtained by the student in each subject, and whether he passed this subject or not. When the student view his academic file, the information will be fetched from this table for the subjects he follows in the current year and for the subjects he followed in previous years.

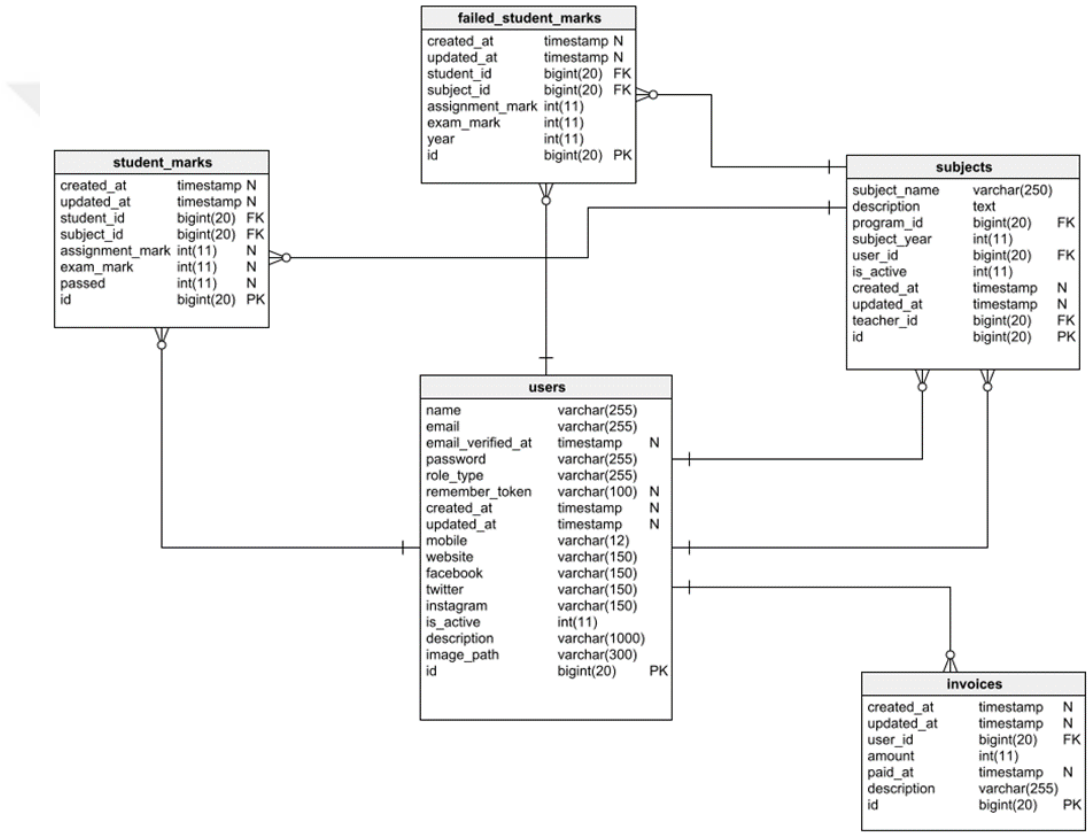


Figure 3.11. Tables for student role functional requirements

Table 3.15. Invoices table

Invoices table	
id	Invoice ID
created_at	Invoice issuance time
updated_at	The time it was last modified
user_id	ID of the student in whose name the invoice is issued
amount	Invoice amount in dollars
paid_at	Bill payment date and time
description	Explanation of invoice details

Table 3.16. Student marks table

Student marks table	
id	Serial ID
created_at	Record creation time
updated_at	The time it was last modified
student_id	ID of the student who was awarded the marks
subject_id	Subject ID
assignment_mark	Assignment mark given by the teacher
exam_mark	exam mark
passed	An indicator if the student passes or fails the subject

When the student fails a subject, two fields of the table (assignment_mark, exam_mark) belonging to that subject get empty, and the value (passed=0) will be left to indicate that the student failed this subject. The exam mark and assignment mark will be moved to another table, which is the (failed_student_marks) table, which includes the (year) field to indicate the year in which the student failed this subject, so that the student and the staff of the Student Affairs Department can view the student's final results in each subject, listed in the student_marks table, and they can view his results of the subjects he failed previously and the year of failure listed in the (failed_student_marks) table. If the student failed the same subject for more than one year, we will find more than one record for the same student and the same subject in this table.

Table 3.17. Failed student marks table

Failed student marks table	
id	Serial ID
created_at	Record creation time
updated_at	The time it was last modified
student_id	ID of the student who was awarded the marks
subject_id	subject ID
assignment_mark	Assignment mark
exam_mark	exam mark
year	The year of failure of the subject

3.10. The Virtual Classroom and Synchronous Lectures

Some virtual learning environments rely on asynchronous lectures only, these lectures are characterized by the lack of direct interaction between the teacher and the learner. As lectures are recorded offline by various means, such as videos, audios and pdf files, then uploaded to the server, so that students can view and download it, while other

virtual environments offer the feature of synchronous lectures, in which appropriate techniques are used to provide the teacher's communication with the learners at the same time, thus, the teacher gives the lecture with the possibility of interaction between the teacher and the learners. Most virtual environments offering the feature of synchronous lectures, provide the feature of asynchronous lectures, where the teacher records the lecture during its presentation, and then uploads it to the server, so that students who were not able to attend the lecture on time can view and download it. We found that it is important for the success of our virtual learning environment to provide the feature of synchronous lectures, or what is known as virtual classroom which is an online learning environment that allows teachers and students to communicate, interact, collaborate, and explain ideas.

The functional requirements of the virtual classroom are as follows;

- The ability of the teacher to start a lecture in the virtual classroom.

- The ability of the teacher to broadcast video from his webcam or from his screen to the virtual classroom, with his voice broadcast through the microphone.

- The ability of the teacher to know the students who joined the lecture.

- The student's ability to enter the virtual classroom and watch the video being broadcasted by the teacher.

- The student's ability to communicate with the teacher during the lecture for discussion or inquiry.

- The student's ability to see the questions or inquiries of his colleagues during the lecture.

To achieve the previous requirements, we created an experimental virtual classroom, meaning that it achieves the basic functions of the system and works in accordance with the university’s website. But in order to generalize this experience to all teachers, it needs to be developed in terms of developing a control panel for virtual classrooms that assigns special ports to each teacher, so that, teachers can give lectures at the same time. This requires an additional table in which the port assigned to each teacher is stored, so that, the system reads this port during broadcast playback, and while students enter the lecture.

3.11. Advantages Of The Developed Virtual Classroom

- The virtual classroom works on the same server with the website, and it can be logged in by teachers and students through their same data stored in the website database.

- The virtual classroom works with web technology and can be visited from any browser and is fully responsive so that it can be visited using even mobile browsers.

- The teacher can start the lecture by running the service on the server, which requires either the teacher physically entering the server, or entering it through a remote account.

- The system broadcasts the teacher's video camera to the web page, along with the teacher's voice taken from his microphone.

- The teacher and students can communicate through the live text chat system, in which students send their inquiries during the lecture, and the teacher can view and answer them, as the questions and answers appear for all students, in addition to that, the chat window includes events that show the students joining the virtual classroom.

3.12. Virtual Classroom Development Mechanism:

Python was chosen for programming the virtual classroom, due to the flexibility of this language and the great capabilities it provides in dealing with computer-related devices such as the camera and microphone, in addition to the ease of audio and video transmissions through it. It was chosen to work within the Python virtual environment so that the virtual classroom would operate independently and isolated from any other programs may be using

Python language and running on the same server, as despite the great advantages of the python language, its use can expose the developer to dependency management problems, since the pip command downloads all the external packages required to run any project and stores them in one folder: site-packages/, which leads to a lot of problems, for example, the problems of Linux and macOs, where a version of python is installed during the installation of the operating system, because the operating system uses python to perform some of its internal tasks, so when the user downloads additional packages for python, these packages are installed in the same place with the packages of the operating

system. The coexistence of these packages together can lead to undesirable side effects resulting from conflicting work of these packages. In addition to that, updating the operating system deletes the additional packages that the user has downloaded, thus, the programs using these packages will stop working. The most common reason for using Python virtual environment is that a developer might need different versions of the same package to use in different programs, each requiring a specific version, and if packages are installed in one place, it is not possible to install more than one version of the same package. Python virtual environment resolves completely this problem.

In order for the virtual classroom to work in the same environment as the website, flask framework was used, since Flask is a small and lightweight Python web framework (micro framework) that provides useful tools and features to make creating web applications in Python easier. As a result, when the teacher runs the flask service, the service uses port 5000 by default, and it can be visited by visiting the address http://domain-name:5000. Thus, the web pages included in the templates folder can be visited by defining a route for each page, as it is explained later. The virtual classroom includes a group of files shown in Figure 3.12. It works as follows:

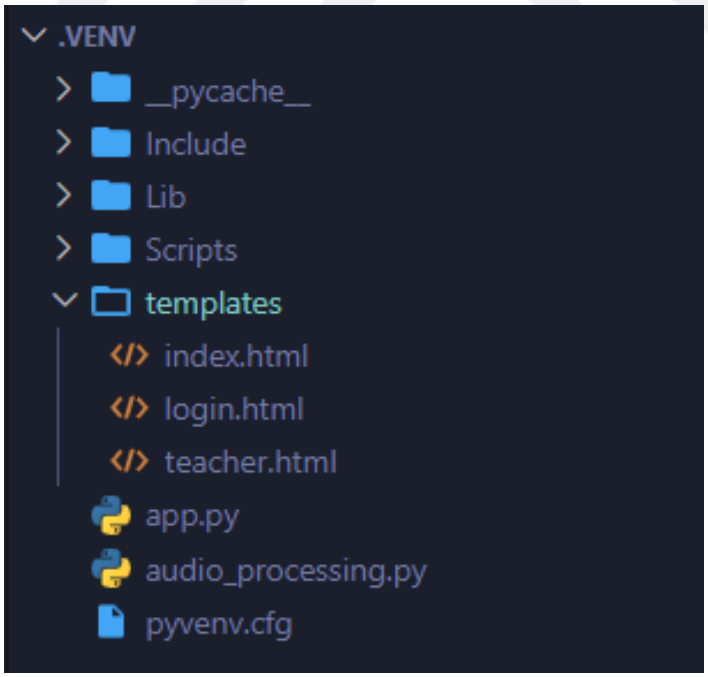


Figure 3.12. Virtual classroom files

The file app.py is the kernel of the virtual classroom. In this file, a set of packages and libraries that serve the project's work are used. The first package is flask, the purpose

of which is enabling the display of the output of the code across web pages. The second library used is PyMySQL, which is a pure-Python MySQL client library, based on PEP 249, which enable us to connect to the website database to log into the virtual classroom by defining the connection string and then using the appropriate queries as shown in the following code as shown in Figure 3.13:

```
import pymysql

#database connection
connection = pymysql.connect(host="localhost", user="root", passwd="xxxx",
database="kvu")
cursor = connection.cursor()

@app.route("/", methods=['GET', 'POST'])
def login():
    if request.method == 'POST':
       stmt = "SELECT count(id) FROM users where id= %(id)s and email=%(email)s"
       with cursor() as cursor:
           cursor.execute(stmt, {
              'id': request.form['sid'],
              'email':request.form['email']
            })
       rows = cursor.fetchall()
        cell=rows[0][0]

        if cell != 0:
           stmt2 = "SELECT role_type,name
                    FROM users where id= %(id)s and email=email=%(email)s"
           with cursor() as cursor:
           cursor.execute(stmt2, {
               'id': request.form['sid'],
               'email': request.form['email']
            })

            rows = cursor.fetchall()
            cell=rows[0][0]

            if cell=='Student':
                return render_template('index.html',stdName=rows[0][1])
            if cell=='Teacher':
                return render_template("teacher.html")
    return render_template("login.html")
```

app.py Virtual class login process

Figure 3.13. Virtual class login process

Through the previous code, we note that we included the library pymysql and then defined the connection string that includes the address of the server that Mysql is running on, which, in our case, is localhost, with the username and password to connect with the database, and the name of the database to which we must be connected, named kvu, and then we've created a cursor connection with the database.

The next step is to define a route to allow users to access the virtual classroom, which is (/) the root for the flask service, where users can visit it through the browser by going to http://domain:5000. Two types of requests (GET, POST) are defined for the mentioned route. In case that the said address is requested from the browser, a Get Request will be sent, resulting in the display of login.html page, then the system asks the user to enter his email and id (a password or a token dedicated to each user can be used instead of the id), when you press the submit button, a POST Request that includes the user's login data is sent. At this stage, the system verifies the login data, and if it is correct, it verifies the type of user trying to log in. If the user holds the role of Teacher, he displays the teacher's page teacher.html, which includes a small window displaying current events in the classroom (students entering the classroom), in addition to the interactive text messages that students send during the lecture, as shown in Figure 3.14.

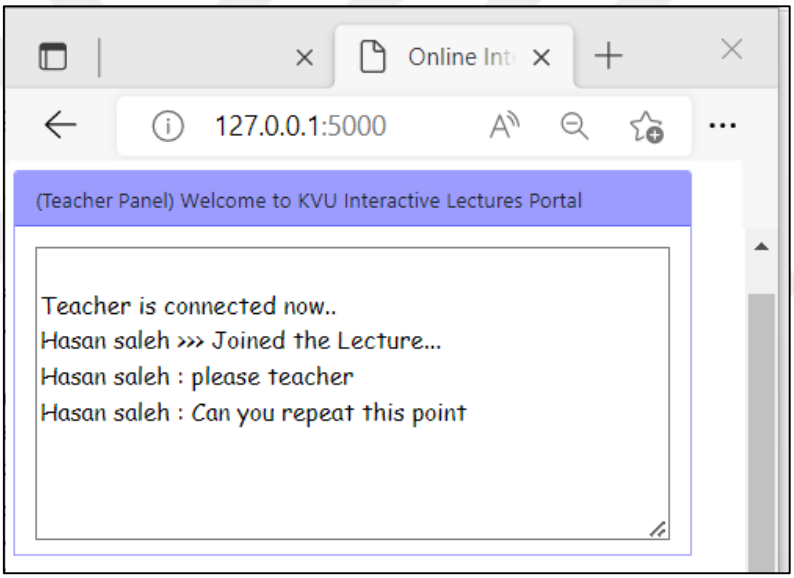


Figure 3.14. Virtual classroom-teacher page

If the user requesting entry to the classroom holds the role of Student, the system displays the page dedicated to students index.html, which includes the video broadcast sent from the teacher's computer, with a window of events and messages, and the ability to send messages and inquiries as shown in Figure 3.15.

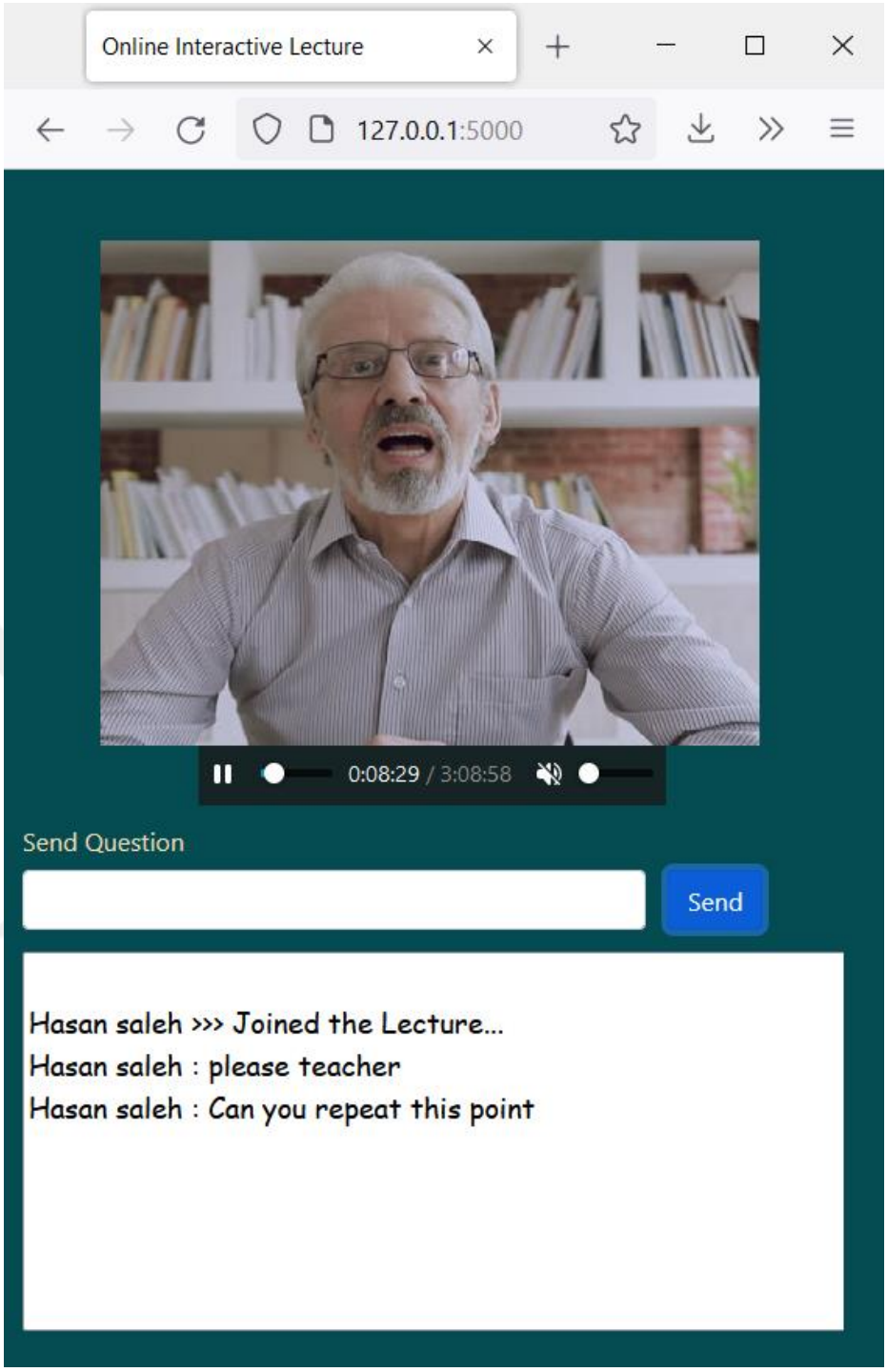


Figure 3.15. Virtual classroom-student page

The OpenCV library was used to capture video from the webcam connected to the teacher's device, which is a great tool for image processing and performing computer vision tasks. It is an open-source library that can be used to perform tasks like face detection, objection tracking, landmark detection, and much more.

We have specifically used the function called cv2, which is intended for capturing video from the webcam connected to (or built into) the computer, and flask was used to broadcast the capture result to the index.html web page by defining a special route to send video frames and then displaying the result in an html element of type <img> in the index.html page, and the audio is captured using pyaudio and then sent by defining another route that is meant to transport the audio and rendered by the html element of type <audio> in index.html, as shown in the following code as depicted in figure 3.16:

```
<div id="showLecture" class="row justify-content-center" style="visibility:
hidden;">

    <div class="col-md-8">

        <div id="" style="text-align:center;  " >
            <img src="{{ url_for('video') }}" width="80%" />

            <input type="hidden" id="hid1" name="{{ url_for('audio') }}" />

            <audio id="audio1" controls  >
                <source  src="" type="audio/x-wav;codec=pcm" autoplay>
            </audio>

        </div>
    </div>
</div>
```

Index.html

Figure 3.16. Index.html

To add the ability to instant messaging in order to enable students to interact with the teacher and send their queries and input during the lecture, the SocketIO library was used, which is a library that enables real-time, bidirectional and event-based communication between the browser and the server. Thus, the basic functions of the virtual classroom have been achieved, and in its current situation, the program broadcasts the webcam connected to the teacher's device to the virtual classroom. One of the tools dedicated to work with the webcam can be used to display the teacher's screen instead of the webcam, as an example of these tools we mention Fake Webcam, which includes a set of options to display instead of the webcam, where the teacher can choose a specific window from his screen, display his entire screen, or display a moving window that follows the cursor with optional dimensions (for example, 600 * 600 pixels), this option was tested on a group of devices at the same time (Six devices: 3 computers and 3

mobiles), the result was satisfactory. Of course, when working on a project of such size, the issue of performance must be taken into account, especially since hundreds of students can be present in virtual classrooms at the same time, and this needs a special study to evaluate the equipment's necessary to achieve this purpose, and the appropriateness of the software tools used to achieve it.

```
@app.route('/video')

def video():
    return Response(generate_frames(),
    mimetype='multipart/x-mixed-replace;  boundary=frame')

@app.route('/audio')
def audio():
    # start Recording
    def sound():

        CHUNK = 1024
        sampleRate = 44100
        bitsPerSample = 16
        channels = 2
        wav_header = genHeader(sampleRate, bitsPerSample, channels)

        stream = audio1.open(format=FORMAT, channels=CHANNELS,
                        rate=RATE, input=True,input_device_index=1,
                        frames_per_buffer=CHUNK)
        print("recording...")
        #frames = []
        first_run = True
        while True:
           if first_run:
               data = wav_header + stream.read(CHUNK)
               first_run = False
           else:
               data = stream.read(CHUNK)
           yield(data)

    return Response(sound())
```

app.py Routes for Video and Audio

Figure 3.17. Routes for video and audio

There are many ways to stream video to browsers, and each method has its own advantages and disadvantages. The method that works well is to stream a series of independent images. This way is used by many IP security cameras. This method has lower latency, but the quality is not the best.

İn figure 3.17 Routes for Video and audio you can see a surprisingly simple yet complete web app that can render a Motion stream in def video. The application has two paths. The /video path serves the video page Where the function of generate_frames() accomplished. The second path /audio serves the audio page Which contains the necessary information in order to implement the function def audio used to record the sound in streaming way.

In this function the following parameters are used:

"sampling rate" the number of frames per second

"CHUNK" is the number of (randomly chosen) frames the (potentially very long) signals are split into.

Each frame will contain 2 samples as "CHANNELS = 2", but the term "samples" is rarely used in this context (because it's confusing). To start recording the sound, a stream containing the required parameters was opened, as shown in the previous figure when using the stream =audio1.open() instruction.

To read the audio data from the stream was used stream.read().

3.13. Common Functional Requirements For All Users

After presenting the functional requirements for each of the user roles, we list the common functional requirements that must be fulfilled for all users, which are:

- Being able to log in with his personal account.

- Being able to confirm his e-mail through an e-mail message he receives after creating his account.

- Being able to change his password.

- Being able to reset his password by e-mail in case he forgot the password.

- Being able to receive notifications about matters of interest to him within the mechanism of the site's work.

- Being able to browse and read new and old notifications.

- Being able to view all matters of interest to his job role from the main page of his dashboard.

These requirements were provided through the website code, and the creation of the required additional tables (notifications, password_resets). Figure 3.18 shows the structure of these tables and the relationships that link them, and table 3.18 and table 3.19 describe the data stored in them.

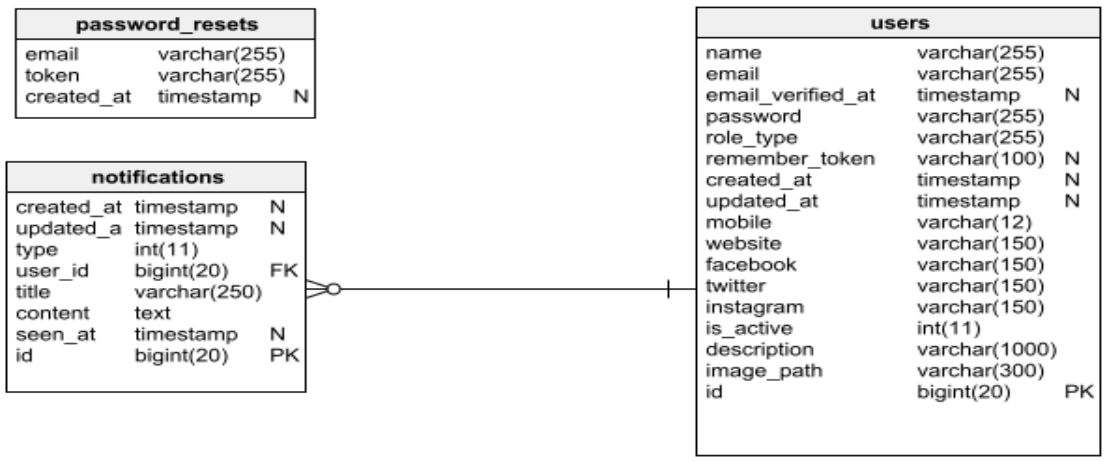


Figure 3.18. General requirements tables

Table 3.18. Notifications table

Notifications table	
id	Notification ID
created_at	Notification time
updated_at	The time it was last modified
type	notification type (learning-financial-general)
user_id	ID of the user to whom the notification was directed
title	notification title
content	notification content
seen_at	When the user sees the notification

Table 3.19. Password resets table

Password resets table	
email	The email of the user to whom the password reset token was sent
token	password reset token
created_at	Token release time

The notifications are divided into three types (learning-financial-general) and in the Navigation bar inside each user's account, a drop-down list appears, and next to it the number of total new unread notifications. When the list is opened, the types of

notifications and the number of unread notifications of each type appear, where the user can log in to any type of notification to read the new or old notifications that they have seen.

Notifications were used for important events within the site, such as:

- Determining an exam date for one of the subjects leads to sending a notification to the subject teacher and to all students who are supposed to take this exam.

- Issuance of a payable invoice to a user leads to sending him a notification informing him of the issuance of the invoice.

- The success of a student from one year to another, his failure in the same year, his graduation from the university, or his exhaustion of his academic opportunities, and all similar events, lead to sending notifications to the intended students.

When the user forgets his password, he can press the (forgot your password) button on the login page, as a result, the system asks the user to enter his email, and this leads to the generation of a special token associated with the email valid for only 60 minutes, and storing this token with the address e-mail in the password_resets table, and sending an email from the university mail address (kvu4us@gmail.com) created for this purpose, to the user's e-mail. The sent mail Figure 3.19 includes a password recovery button that is valid for 60 minutes, starting from sending moment. Clicking this button leads to the opening of the following link:
http://domain-name/password/reset/token?email=xxxx@xxx.xxx

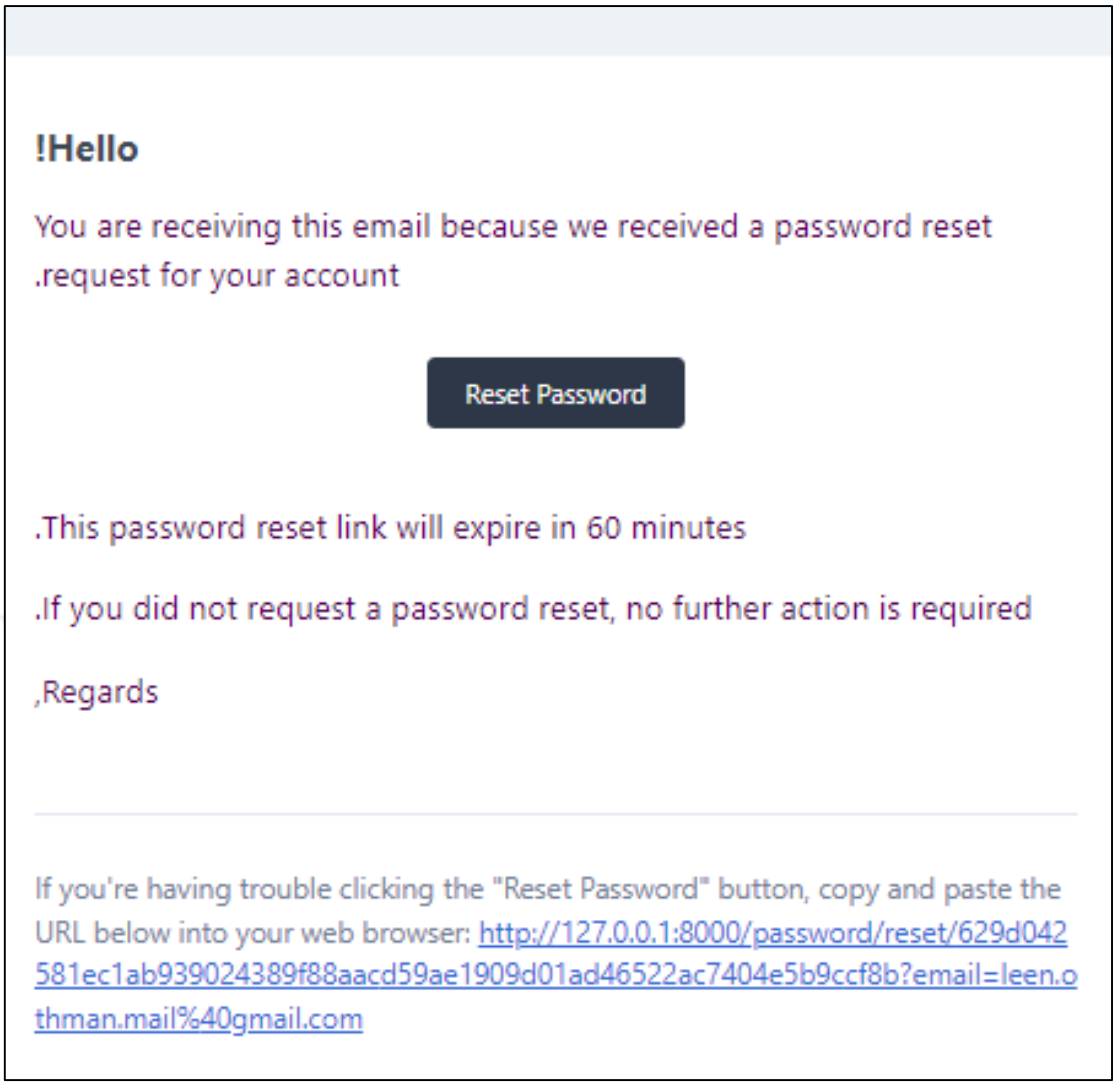


Figure 3.19. Password reset email

In order for the link to function properly, its routes have been defined as shown in the following code as shown in Figure 3.20:

```
    public function resetPassword()

    {
        return function () {
            $this->get('password/reset',
'Auth\ForgotPasswordController@showLinkRequestForm')
            ->name('password.request');

            $this->post('password/email',
'Auth\ForgotPasswordController@sendResetLinkEmail')
            ->name('password.email');

            $this->get('password/reset/{token}',
'Auth\ResetPasswordController@showResetForm')
            ->name('password.reset');

            $this->post('password/reset', 'Auth\ResetPasswordController@reset')
            ->name('password.update');

        };
    }
```

Figure 3.20. Password reset routes

We note that the link that the button leads to include the token and the e-mail address xxxx@xxx.xxx, and pressing the button sends this data to the showResetForm in the Auth\ResetPasswordController Controller, and there, it is checked, at first, that there is a registered user on the site that his e-mail is xxxx@xxx.xxx, and then will be verified that there is a record in the password_resets table for the mentioned email that has not been created more than 60 minutes ago, which means that this user has already submitted a request to reset his password. If it is the case, the token sent from the user is compared with the token listde in the password_resets table, the matching of these two values confirms that this user is the owner of the real account, so he is directed to the password reset page to choose a new password for his account.

As for the main page of the dashboard, a special care is taken to provide all the important information for each user on this page, so that, upon entering his account, he can see what he needs. Figure 3.21 shows the main page of the student dashboard.

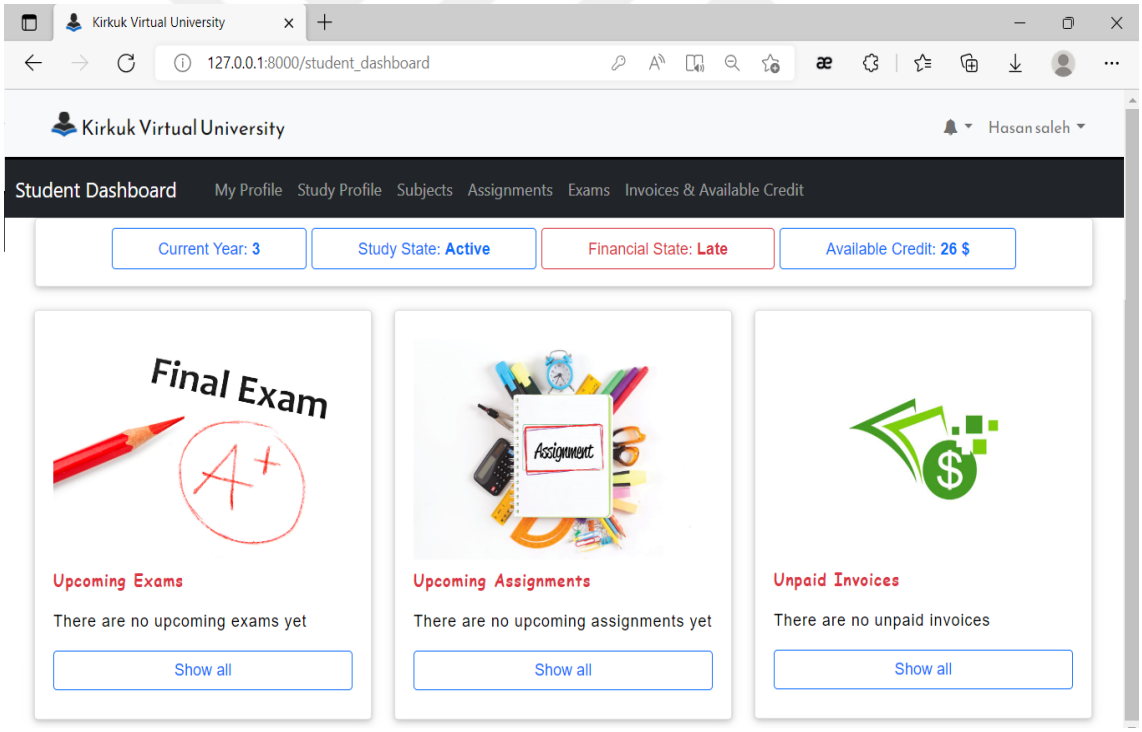


Figure 3.21. Main dashboard page for Student Role users

It is showed that the page contains a basic Navigation bar that includes the user name and a list of basic account options (change password - log out - go to the main dashboard page), and next to it we find a list of notifications. In addition, we find a secondary navigation bar that includes links to the basic functions dedicated for the student (student profile - academic profile - study subjects and their lectures - tasks and

assignments - exams - invoices and financial status). Then we find the general indicators bar (the current year - educational status - financial status - available balance) followed by a list of the first three upcoming exams, the first three assignments that must be delivered, and the last three unpaid invoices). Similarly, the dashboard for the rest of the user roles is built according to the most important data for each role.

3.14. Kirkuk University Questionnaire

The following is an example of a Kirkuk University survey that could be taken by students, teachers and staff, and its aim is to evaluate the university and improve its system:

Title: University of Kirkuk System Feedback Questionnaire

Section 1: Personal Information (To be filled by all participants)

1. Name:

2. Role (Student/Teacher/Staff):

3. Department/Faculty:

4. Email:

Section 2: System Evaluation

Please rate the following statements on a scale of 1 to 5, where 1 represents "Strongly Disagree" and 5 represents "Strongly Agree."

1. The University of Kirkuk's system is user-friendly.

2. The system provides relevant and up-to-date information.

3. The system effectively meets the needs of students, teachers, and staff.

4. The system enhances communication and collaboration among different stakeholders.

5. The system is accessible and responsive on different devices (desktop, mobile, etc.).

6. The system adequately supports online learning and teaching activities.

7. The system has a robust security framework to protect user data.

8. The system's interface is visually appealing and easy to navigate.

9. The system provides timely technical support and issue resolution.

10. Overall, I am satisfied with the University of Kirkuk's system.

Section 3: System Improvement Suggestions

Please provide your suggestions for improving the University of Kirkuk's system. Feel free to share any specific features or functionalities you would like to see implemented.

Section 4: Additional Comments

Please use this section to provide any additional comments or feedback regarding the University of Kirkuk's system.

In order to achieve the greatest benefit, the questionnaire was conducted online in order to achieve the greatest amount of results by asking a large number of people, as the face-to-face interviews will be limited and require a lot of time. The number of people who submitted the questionnaire ranged from about 255 people, their ages ranged between 18 and 55 years, and the answers varied due to different ages, but in the end the questionnaire achieved satisfactory and encouraging results as expected from the university.

Thank you for taking the time to complete this questionnaire. Your feedback is valuable to us in improving the system and enhancing the university experience.

4. FINDINGS AND DISCUSSION

In this chapter, we show a set of technical notes that were taken into account during the design and implementation of the website, and which play a key role in the success of the functions offered by this website:

4.1. Privacy Of Files And Documents

One of the important points that must be taken into account while building any website is the privacy of the files and documents that are uploaded to the server. It is known that the normal way to upload images and documents is to store them in one of the subfolders under the root folder of the server, which is open to public access, meaning that, it is possible to view images and download files and documents by simply visiting their URL from any browser. But if the site requires saving files and maintaining their privacy, and only allowing specific people to access them, so, special methods should be adopted to store these files on the server, and this is what we implemented in our website concerning lectures and their attachments, student reports, copies of student identification documents and any other documents that need special storage. This was implemented by uploading these files to the storage folder within the Laravel project, which is not a public-accessed folder. Any one wants to view any image or download any document located within this folder, must use one of the routes defined specifically for this, in order to execute one of the programming methods included in a controller. Since we can specify the permissions to access to any route by applying a special middleware to it, we have set a permission to access all documents stored within the storage folder. As an example, we can show the mechanism of displaying photos of students' personal identification documents, as shown in the following code (Figure 4.1).

```
public function imageDisplay($filename)

{
  $profile_path = storage_path('app/'. $filename);
  return response()->file($profile_path);
}
```

app\Http\Controllers\Students_affairs\StudentsController.php - → imageDisplay($filename)

Figure 4.1. Image display

It is noted from the code that accessing the images of students' personal documents is restricted to a method within the controller Students_affairs\ StudentsController.php, and the content of this method is executed by the route called

imageDisplay, which is governed by the middleware named role: Students Affairs, so only the employees in the Student Affairs Department can have access to the students' personal documents. Trying to access these documents by visiting their URL will not succeed, and all documents and files that need authorized access have been dealt with in this way, including lectures and their attachments.

4.2. Website Protection

The protection of the site against various types of intrusions is one of the most important points on which the success of the site's work depends. Protection is achieved by different ways and at different levels. Part of the procedures followed for this purpose relies on the equipments used, and it is necessary to use WAF (web application firewall), which protects web applications from attacks by filtering traffic based on specific rules. For example, we can filter any part of the web request, such as IP addresses, HTTP headers, HTTP body, or URI strings. This allows us to block common attack patterns, such as SQL injection or cross-site scripting. The task of WAF is to filter, monitor, and block any malicious HTTP/S traffic traveling to the website, it prevents any unauthorized data from leaving our website. It does this by adhering to a set of policies that help determining what traffic is malicious and what traffic is safe. In addition, operating system settings and web server settings also play an important role in protecting the website. Even with the use of WAF, and ensuring that all security related settings are set correctly in the operating system and in the web server, the principle defense in depth requires that, in addition to what mentioned, all possible measures should be taken to reduce the possibility of penetration, and not rely on a single line of defense. Therefore, a set of methods and means have been applied, that greatly reduce the possibility of hackers being able to use various hacking methods to damage the website.

4.2.1. Mass Assignment Vulnerability:

Mass assignment vulnerability is known as a computer vulnerability where an active record pattern in a web application is abused to modify data items that the user should not normally be allowed to access such as password, granted permissions, or administrator status.In order to secure our website against this type of vulnerability, during the definition of the basic website models, all the fields that can be filled in naturally by the user, and the fields that must be dealt with in strict confidence and prevent hackers from trying to forge them, are specified. As shown in the Figure 4.2 that shows USER Model:

```php
class User extends Authenticatable

{
    use HasApiTokens, HasFactory, Notifiable;

    /**
     * The attributes that are mass assignable.
     *
     * @var array<int, string>
     */
    protected $fillable = [
        'name',
        'email',
        'password',
        'mobile',
        'website',
        'facebook',
        'twitter',
        'instagram',
        'is_active',
        'description',
        'role_type',
        'image_path',
    ];

    /**
     * The attributes that should be hidden for serialization.
     *
     * @var array<int, string>
     */
    protected $hidden = [
        'password',
        'remember_token',
    ];

    /**
     * The attributes that should be cast.
     *
     * @var array<string, string>
     */
    protected $casts = [
        'email_verified_at' => 'datetime',
    ];
}
```

Figure 4.2. User model class

4.2.2. Cross-Site Request Forgery (CSRF)

CSRF is known as an attack that forces an end user to execute unwanted actions on a web application in which they're currently authenticated (Azevedo et al., 2021). With a little help of social engineering (such as sending a link via email or chat), an attacker may trick the users of a web application into executing actions of the attacker's choice. If the victim is a normal user, a successful CSRF attack can force the user to perform state changing requests like transferring funds, changing their email address, and so forth. If the victim is an administrative account, CSRF can destroy the entire website.

To illustrate how to exploit CSRF, we can show the following example (Muilenburg and Berge, 2005). Suppose we have in the website /user/email route that accepts a POST request to change the authenticated user's email address. Most likely, this route expects an email input field to contain the email address the user would like to begin using. Without CSRF protection, a malicious website could create an HTML form that

points to our application's /user/email route and submits the malicious user's own email address.

```
<form action="https://our-application.com/user/email" method="POST">

    <input type="email" value="malicious-email@example.com">
</form>

<script>
    document.forms[0].submit();
</script>
```

CSRF HTML Form

Figure 4.3. CSRF HTML Form

In the previous figure, there is an example of an HTML code that contains a post-type request, in which the user's email is sent, which he is supposed to enter in the field for the email that corresponds to the code as “input type =”email” ”, but as an example of CSRF, the email that the user will enter will not go into the request, but The email that the owner of the malicious site stored in its code, which corresponds to our example “value =”malicious-email@example.com” “.

If the malicious website automatically submits the form when the page is loaded, the malicious user only needs to lure an unsuspecting user of our application to visit their website, and their email address is changed in our application.

To prevent similar hacks, we have to investigate every request of type (POST, PUT, PATCH, or DELETE).

Fortunately, Laravel makes it easy to protect against CSRF operations because it automatically generates a CSRF token for each active user session managed by the application. This token is used to verify that the authenticated user is the person actually making the requests to the application. Since this token is stored in the user's session and changes each time the session is regenerated, a malicious application is unable to access it, all we have to do is include this token in every form that uses any of method types (POST, PUT, PATCH, or DELETE) and this is what has already been implemented on our website.

4.2.3. SQL Injection

SQL injection attacks are a type of injection attack, in which SQL commands are injected into data-plane input in order to affect the execution of predefined SQL commands (Alazam et al., 2013).

An SQL injection attack consists of insertion or (injection) of an SQL query via the input data from the client to the application. A successful SQL injection exploit can read sensitive data from the database, modify database data (Insert/Update/Delete), execute administration operations on the database (such as shutdown the DBMS), recover the content of a given file present on the DBMS file system and in some cases issue commands to the operating system.

Avoidance of this type of attack is ensured by using Fluent Query Builder or Eloquent, which are two tools provided by Laravel for dealing with databases, and the two mentioned tools are immune to injection attacks by making prepared statements which are going to escape any user input that may come in through our forms. If hackers add a new input to a form, they may try to insert a quote and then run their own custom SQL query to damage or read our application database. However, this cannot work since we are using Eloquent. Eloquent is going to escape this SQL command and the invalid query will just be saved as text into the database.

4.2.4. Cross-Site Scripting

Cross-Site Scripting (XSS) attacks are a type of injection, in which malicious scripts are injected into otherwise benign and trusted websites. XSS attacks occur when an attacker uses a web application to send malicious code, generally in the form of a browser side script, to a different end user. Flaws that allow these attacks to succeed are quite widespread and occur anywhere a web application uses input from a user within the output it generates without validating or encoding it.

The first procedure to stop this type of attack is to perform a user input validation process on both the server and client sides. The second procedure is to use Laravel's syntax which performs an operation Escaping for any HTML objects that are a part of a view variable.

4.3. Responsive Web Design

Responsive web design is based on designing a website compatible with all types of devices, as it appears well on screens of different sizes, so that the dimensions of the site elements are adjusted according to the size of the display screen. This was implemented using Bootstrap on all pages of the website and private web pages in the virtual class, so the display of the mentioned pages appears well even on small mobile screens.

4.4. Evaluation

One of the main assurance activities for any project is requirements evaluation. Requirements must be evaluated by several people with varying experience, in order to identify incorrect, vague and incomplete requirements. System Requirements Review (SRR) is one way to accomplish this evaluation. A fundamental question for requirements evaluation is: How well do the requirements accomplish the system and sub-system objectives? This question provides a framework within which to consider the specific requirements.

4.4.1. Functional Requirements Evaluation

In this paragraph, the job requirements for this project will be evaluated and to ensure that all requirements have been successfully met or not. In table 4.1: we evaluated the functional requirements of this thesis. The evaluation is done on success of each requirements.

Table 4.1. Functional requirements evaluation

Functional requirements	Evaluation
Functional requirements for Administrator Role	successful
Functional requirements for the role of Student Affair and the mechanism	successful
Functional requirements for the role role of the Teacher and the mechanism	Partially successful
Functional requirements for the role of the editor's and the mechanism	successful
Functional requirements for the role of Exam Affair and the mechanism	successful
Functional requirements for the role of Student and the mechanism	Partially successful
Functional requirements for all users	successful
Functional requirements for the virtual classroom	Partially successful

Founded in 1958, Tianjin Open University (TOU) is an institution of higher education under the Tianjin Municipal Government and under the academic guidance of the Open University of China. TOU was the first university in China to offer education via radio and correspondence. TOU now has 8 colleges, 21 campuses, and 15 learning

centers with 60,000 students and 2,449 full-time and part-time faculty members. The university has established a distance education network covering all eighteen provinces and counties under the municipality and has become an important base for modern distance learning and learning about life in Tianjin, China. TOU has a 10-gigabit campus network, satellite data reception system, and a two-way video distance education system. TOU's Distance Learning Public Service Center is able to manage enrollment for ten million people and provide real-time service to more than one hundred thousand online learners. TOU operates a system based on open education with academic development in both a degree program and a non-degree programme. It offers open education programs at both the undergraduate and junior levels for adult learners. In 1986, TOU began offering associate degree courses for adults, and in 2000 higher professional education programs were launched. Open education programs to award bachelor's and related degrees began in 1999 (TJU, 2023).

Through the above and compared to my work, we find that the main requirements regarding distance education in the Chinese University have been accomplished in this project, but the Chinese University differs in that it is more extensive, meaning that it can deal with a large number of users, as it offers courses and courses with accredited certificates and a method of reception by satellite.

4.4.2 Comparison Of Several Virtual Universities

4.4.2.1. Kirkuk Virtual University

The University of Kirkuk was established in 2003. The university currently contains 18 faculties, 816 teachers, and 30,712 students. It also contains 52 departments (KVU, 2023). The university provides an electronic system to serve all its employees and students in all departments. The system provides a website for each college of the university. The system provides management A high level of safety and ease. It also offers training courses and master’s programs in several specializations. The system enables teachers to create online lectures, so that a direct session is opened between the teacher and students, and students submit their assignments through the system, as well as get their grades through it.

The system provides several services, including the electronic library, exam dates, a special section for scientific affairs, student affairs management, a section for postgraduate studies, and discussion forums for the improvement of the university. The

system contains a section for teachers, as well as a section for qualification and employment courses? What age groups visit the site? What are the devices used to access the university? In the end, we note that the system is comprehensive and large and contains a large number of details and services to serve the large number of colleges in the university.

4.4.2.2. Syria Virtual University

Syria virtual university was established in 2002. To this day, the university includes 29,716 students and 521 teachers (SVU, 2023), in which the system provides electronic teaching works remotely with all its requirements, through the use of the latest technical means, including the provision of virtual classes, an electronic library, and electronic student services, on the basis of curricula with constantly updated electronic content that can be published on The global information network, as well as providing various electronic curricula at the levels of intermediate and technical education, undergraduate studies, postgraduate studies, qualification and specialization studies, providing administrative services to university students to guide, guide and register them in the various specializations offered by the university, providing academic and technical support services to university students through a selected virtual network Among the Syrian, Arab and foreign scholars and professors who work in scientific institutions and various Arab and foreign universities. The system provides a scientific and technological virtual oasis that exchanges and transfers knowledge and accelerates the process of building a knowledge economy and increasing its returns. The system provides a process of continuous education, lifelong learning, and intensive specialized training, and facilitates its provision to workers in their workplaces and residences without having to move and in line with the rapid changes in professions, sciences, and the needs of the labor market. Compared to the University of Kirkuk, we find that although the system of the Syrian Virtual University is large, the Kirkuk University system is more diverse because it includes a large number of departments and colleges for all specializations.

4.4.2.3.Tianjin Open University

Tianjin Open University (TOU), founded in 1958, is a higher education institution under the Tianjin Municipal Government and with academic guidance from The Open University of China (TOU, 2023). TOU was the first university in China to offer education by radio and correspondence.

TOU now has 8 colleges, 21 campuses and 15 education centers with 60 thousand students and 2,449 full time and part time faculty members. The University has created a distance education network covering all 18 districts and counties of the municipality and has become an important base for modern distance learning and life-learning in Tianjin, China.

TOU has a ten-gigabit campus network, satellite-data-receiving system, and two-way video distance education system. The Public Service Center for Distance Education at TOU is capable of managing registration for ten million people and providing real time service for more than one hundred thousand online learners.

TOU operates a system based on open education with academic development in both degree program and non-degree program. It offers open education programs at both undergraduate and junior-college level for adult learners.

4.4.2.4. Allama Iqbal Open University In Pakistan

Allama Iqbal Open University was Established in 1974, is a public university in Islamabad, Pakistan. It is named after Allama Muhammad Iqbal. The university is the fifth largest higher education institution in the world, with an annual student enrollment of 1,121,038 (as of 2010), the majority of whom are women, and a course enrollment of 3,305,948, 2011 (AIOU, 2023). Students can get admission in high school diploma, intermediate, bachelor's, master's, master's, and doctoral degrees.

Here are some of the key aspects of the AIOU system:

Course management: LMS allows instructors to create and manage online courses, including organizing course materials, assignments, and assessments.

Online Content Delivery: Course materials such as lecture videos, readings, and other resources are provided to students through an LMS. Students can access these materials at their own pace.

Submitting and grading assignments: A Learning Management System (LMS) provides a platform for students to submit assignments online. Teachers can access and rate student submissions, provide feedback, and assign grades through the system.

Discussion Forums: The system typically includes discussion forums where students can participate in academic discussions, ask questions, and seek clarification from teachers and peers.

Announcements and Notices: The Learning Management System (LMS) allows teachers to make important announcements and send notifications to students, ensuring effective communication.

Online Assessments: The AIOU system may offer online quizzes and exams, allowing students to test their knowledge and understanding of course materials remotely.

Progress Tracking: LMS provides tools for students to monitor their progress, track completed coursework, and view grades and feedback from instructors.

Student Support: The system may include features such as online tutorials, FAQs, and support forums to assist students in navigating the online learning environment and resolving technical issues.

In conclusion, after getting acquainted with the systems of several universities, we note that there are many similarities, including the following:

1. Universities have the same essence and provide the necessary services for distance education.

2. Universities provide an electronic library for visitors.

3. All universities offer training courses for students in various fields.

4. All universities offer electronic lectures, while providing discussion forums and home jobs.

5. In each of the previous universities, many master's programs are available in various fields.

There are more similarities that we just mentioned the most important. But they differ in terms of capacity until we find that Allama Iqbal Open University in Pakistan is one of the largest universities in the world, as well as Tianjin Open University, which has a large and strong infrastructure to serve its system, as it has been developed and linked by satellite. Universities may also differ in terms of policies The interior that you adopt in the educational process.

.

5. CONCLUSION AND FUTURE WORK

5.1. Conclusıon

At the beginning of this study and during the second chapter, the main factors that contribute to the success of any virtual learning environment were described. And based on these factors, the construction of a virtual learning environment was initiated in an attempt to achieve the mentioned factors.

The two main types of the distance learning process have been achieved, synchronous lectures and asynchronous lectures, and a great emphasis was placed on attaining the reliability of the website and protecting the information that is stored in its files and in the databases associated with it.

The site was built with a fully responsive design to appear in the best shape on various types and sizes of electronic devices, all in order to achieve the basic factors for the success of virtual work environments, and to avoid the problems that were also mentioned in the chapter 2. In fact, a large number of the mentioned factors and problems are not only related to the software aspect, but are largely related to the equipment used, and to the educational and administrative staff of the university. On the other hand, the created system can not be accurately assessment - like any software system - unless it has been put into actual service in integration with all the mentioned factors. At that time, any problem or failure can be noticed to be recoverd and avoided later, and the benefits and effective advantages that prove its effectiveness are shown as well.

5.1.1. The Aim Of This Study

• Providing the concept of distance learning and virtual learning environments.

• Present the main reasons for the emergence of this type of study

• Simulating the distance education system in international universities by realizing the basic functions in the distance education process.

• Clarify the requirements that managers must perform regarding distance education.

• Explain the benefits and consequences of distance learning.

• Develop the virtual learning environment to achieve the highest levels of security, reliability and availability.

• Create a website to manage the basic educational and administrative activities of a virtual university

5.1.2. The Method: Complete The Work?

In this work, the standards that the virtual university must achieve were searched for, and many virtual universities around the world that adopt distance education technology were reviewed, after study and analysis. We have reached the most important requirements of the job that the university must be achieved, and we have completed them sequentially, and we tested each part of it before we start the second part of it, and so on until all the requirements have been implemented. After completing and evaluating the requirements, we compared our work with the Chinese university, and we noticed that the difference lies in the capacity of the university and its modern technologies used and available in China, such as network strength and the ability of servers to carry a large number of users. Other than that, we have achieved a virtual university environment that supports the operations of students, teachers and administrators.

5.1.3. The Conclusion And Discussion

At the end of this work and with the achievement of the goals that we aspire to achieve according to the work mechanism that we have followed, we will have built an integrated environment for a virtual university based on distance education technology, remote exam submission technology, full remote communication between students, their teachers and student affairs. Compared to many universities by default, for example, we find that the Chinese University of Tianjin adopts all the technologies that we mentioned, but it does not provide online tests for its students, but it has other advantages such as the large number of students and a great diversity of employees. As another example, the Syrian Virtual University offers Distance education technology provides the possibility of conducting online lectures so that the students and the lecturer discuss together from behind their computers, but it does not provide the advantage of providing exams remotely, but rather provides HomeWorks and tests and they are delivered to the supervising professors and they are the ones who correct them and send the grades of each student to him. There are many universities around the world, and the advantages offered by each university differ from the other, but they are compatible in essence.

5.2. Future Work

As for the points that can be developed in the future in this project, it begins with the development of the virtual classroom and the design of a special control panel that is controlled by the university administration that allows more than one teacher at the same time to start synchronous lectures, and that, as we mentioned, needs a software management mechanism for the ports that will be used by each teacher. In addition, during this project, no focus was given to all financial aspects of the university, the financial transactions of the students were only conducted, while this experiment could be expanded to include the public financial system of the university, which can be managed by the university administration, which includes (teachers' salaries, The costs and bills paid for the consumption of electrical energy and Internet subscriptions, any costs that the university may incur in exchange for renting real estate, means of transportation, or any tools it needs to ensure the proper functioning of the work, the costs of developing, modernizing and maintaining the equipment used. Thus, the educational site could include Accurate financial statistics about all financial transactions of the university and the profit index resulting from its work. Through this study, we hope that we have provided a useful experience in the field of virtual learning environments that can be relied on and developed continuously in line with the continuous technical development in the service of the education field.

6. REFERENCES

Alazam, A. O., Bakar, A. R., Hamzah, R., & Asmiran, S. (2013). Teachers' ICT skills and ICT integration in the classroom: The case of vocational and technical teachers in Malaysia. *Creative Education, 3*(8), 70-76.

Aljaraideh, Y., & Al Bataineh, K. (2019). Jordanian Students' Barriers of Utilizing Online Learning: A Survey Study. *International Education Studies, 12*(5), 99-108.

Azevedo, J. P., Hasan, A., Goldemberg, D., Geven, K., & Iqbal, S. A. (2021). Simulating the potential impacts of COVID-19 school closures on schooling and learning outcomes. *The World Bank Research Observer, 36*(1), 1-40.

AIOU. (2023). Allama Iqbal Open University (AIOU) Official Website. https://www.aiou.edu.pk/ Date Accessed: 01.06.2023

Baiza, Y. (2013). *Education in Afghanistan: Developments, influences and legacies since 1901*. Routledge.

Bashir, F., & Warraich, N. F. (2023). Systematic literature review of Semantic Web for distance learning. *Interactive Learning Environments, 31*(1), 527-543.

Belanger, F., & Jordan, D. H. (1999). *Evaluation and Implementation of Distance Learning: Technologies, Tools and Techniques: Technologies, Tools and Techniques*. Igi Global.

Browning, M. H., Larson, L. R., Sharaievska, I., Rigolon, A., McAnirlin, O., Mullenbach, L., & Alvarez, H. O. (2021). Psychological impacts from COVID-19 among university students: Risk factors across seven states in the United States. *PloS one, 16*(1).

Bunker, E. L. (2003). *The history of distance education through the eyes of the International Council for Distance Education*. Handbook of distance education, 49-66.

Chen, D., & Guo, W. (2005). Distance learning in China. *International Journal of Distance Education Technologies (IJDET), 3*(4), 1-5.

Chickering, A. W. (1989). Seven Principles for Good Practice in Undergraduate Education: Faculty Inventory. *Institutional Inventory*.

Culcasi, I., Russo, C., & Cinque, M. (2022). E-service-learning in higher education: Modelization of technological interactions and measurement of soft skills development. *Journal of Higher Education Outreach and Engagement, 26*(3), 39-56.

Dapena, A., Castro, P. M., & Ares-Pernas, A. (2022). Moving to e-Service Learning in Higher Education. *Applied Sciences, 12*(11), 5462-5482.

Davis, B., Carmean, C., & Wagner, E. D. (2009). *The evolution of the LMS: From management to learning*. Santa Rosa, CA: e-Learning Guild, 24.

Deacon, J. (2009). *Model-view-controller (mvc) architecture*. John Deacon Computer Systems Development. https://www.academia.edu/download/50526307/MVC.pdf Date Accessed: 01.06.2023

Devitt, P., & Palmer, E. (1999). Computer-aided learning: an overvalued educational resource. *Medical Education, 33*(2), 136-139.

Dube, B. (2020). Rural online learning in the context of COVID 19 in South Africa: Evoking an inclusive education approach. *REMIE: Multidisciplinary Journal of Educational Research, 10*(2), 135-157.

Engzell, P., Frey, A., & Verhagen, M. D. (2021). Learning loss due to school closures during the COVID-19 pandemic. *Proceedings of the National Academy of Sciences, 118*(17).

Fernández-Batanero, J. M., Román-Graván, P., Reyes-Rebollo, M. M., & Montenegro-Rueda, M. (2021). Impact of educational technology on teacher stress and anxiety: A literature review. International journal of environmental research and public health, 18(2), 548-561.

Furkatovna, A. N., & Furkatovna, A. F. (2022). Problems of quality of distance learning online. *Ta'lim va rivojlanish tahlili onlayn ilmiy jurnali*, 89-91.

Gaikwad, S. S., & Adkar, P. R. A. T. I. B. H. A. (2019). A review paper on bootstrap framework. *IRE Journals, 2*(10), 349-351.

Hannay, M., & Newvine, T. (2006). Perceptions of distance learning: A comparison of online and traditional learning. *Journal of online learning and teaching*, *2*(1), 1-11.

Hardie, S. E. (2022). *A study of the civil parish of Meare in the Poor Law Union of Wells in the County of Somerset with emphasis on the forces leading to decisions to either stay or to migrate from the parish in the period 1851 to 1891* (Doctoral dissertation, University of Leicester). https://figshare.le.ac.uk/ndownloader/files/37373230 Date Accessed: 01.06.2023

Holmberg, B. (1977). *Distance education: A survey and bibliography*.

Hudson, J. N. (2004). Computer-aided learning in the real world of medical education: does the quality of interaction with the computer affect student learning. *Medical education, 38*(8), 887-895.

Jahan, S., & Hoda, R. (2016). Security Issues in E-Learning Environments: A Survey. *Journal of Information Systems Education, 27*(2), 149-158.

Johansen, K. (2023). Challenges regarding digital distance learning of operationally-oriented professions, due to Covid-19 pandemic. International *Journal of Educational Research Open, 4*, 1-9. https://doi.org/10.1016/j.ijedro.2023.100225

Jung, I., & Rha, I. (2000). Effectiveness and cost-effectiveness of online education: A review of the literature. *Educational Technology, 40*(4), 57-60.

Katila, P., Colfer, C. J. P., De Jong, W., Galloway, G., Pacheco, P., & Winkel, G. (2019). *Sustainable development goals*. Cambridge University Press.

Keegan, D. J. (1980). *On the Nature of Distance Education*. ZIFF Papiere 33.

KVU. (2023). Kirkuk Virtual University Official Website. https://www.uokirkuk.edu.iq/ Date Accessed: 01.06.2023

Langer-Crame, M., Newman, T., Beetham, H., Killen, C., & Knight, S. (2019). Digital experience insights survey 2019: *Findings from students in UK further and higher education. Jisc [online]*. https://www.voced.edu.au/content/ngv:87147 Date Accessed: 01.06.2023

Lukas, B. A., & Yunus, M. M. (2021). ESL Teachers' Challenges in Implementing E-learning during COVID-19. *International Journal of Learning, Teaching and Educational Research*, *20*(2), 330-348.

Lutz, M. (2001). *Programming python*. O'Reilly Media, Inc. https://sisis.rz.htw-berlin.de/inh2006/1233986.pdf Date Accessed: 01.06.2023

Martin, F., & Bolliger, D. U. (2018). Engagement matters: Student perceptions on the importance of engagement strategies in the online learning environment. *Online learning*, *22*(1), 205-222.

Mashhour, A., & Saleh, Z. (2010). Evaluating E-learning in Jordanian institutions: Why is it lagging?. *Quarterly Review of Distance Education*, *11*(4), 269.

Masrom, M. (2007). Technology acceptance model and e-learning. *Technology*, *21*(24), 81-90. (Mueller and Strohmeier, S. (2010)

Mather, M., & Sarkans, A. (2018). Student perceptions of online and face-to-face learning. *International Journal of Curriculum and Instruction*, *10*(2), 61-76.

Merisotis, J. P., & Phipps, R. A. (1999). What's the difference: Outcomes of distance vs. traditional classroom-based learning. *Change: The Magazine of Higher Learning*, *31*(3), 12-17.

Moore, M. G., & Kearsley, G. (2011). *Distance education: A systems view of online learning*. Cengage Learning.

Mueller, D., & Strohmeier, S. (2010). Design characteristics of virtual learning environments: An expert study. *International Journal of training and development*, *14*(3), 209-222.

Mueller, D., & Strohmeier, S. (2011). Design characteristics of virtual learning environments: state of research. *Computers & Education*, *57*(4), 2505-2516.

Muilenburg, L. Y., & Berge, Z. L. (2005). Student barriers to online learning: A factor analytic study. *Distance education*, *26*(1), 29-48.

Müller, D. (2013). *Evaluation of VLE Design Characteristics. Design Characteristics of Virtual Learning Environments: A Theoretical Integration and Empirical Test of Technology Acceptance and IS Success Research.* Springer, 75-183.

Offir, B., Lev, Y., & Bezalel, R. (2008). Surface and deep learning processes in distance education: Synchronous versus asynchronous systems. *Computers & Education*, *51*(3), 1172-1183.

Oliveira, P. C. D., Cunha, C. J. C. D. A., & Nakayama, M. K. (2016). Learning Management Systems (LMS) and e-learning management: an integrative review and research agenda. *JISTEM-Journal of Information Systems and Technology Management, 13*, 157-180.

Rudofsky, B. (2023). *Nat Alcock.* https://www.cambridge.org/core/services/aop-cambridge-core/content/view/CBE354CED6171284BDAB9FCD1B769A69/stamped-9781800106819c8_p149-178_CBO.pdf/discovering_warwickshires_vernacular_architecture.pdf Date Accessed: 01.06.2023

Song, L., Singleton, E. S., Hill, J. R., & Koh, M. H. (2004). Improving online learning: Student perceptions of useful and challenging characteristics. *The internet and higher education, 7*(1), 59-70.

Sunardi, A. (2019). MVC architecture: A comparative study between laravel framework and slim framework in freelancer project monitoring system web based. *Procedia Computer Science, 157*, 134-141.

SVU. (2023). Syria virtual university Official Website. https://svuonline.org/ Date Accessed: 01.06.2023

TJU. (2023). Tianjin Radio and TV University-Researching Virtual Initiatives in Education. http://come.tju.edu.cn/info/1357/6779.htm Date Accessed: 01.06.2023

TOU. (2023). Tianjin Open University Official Website. https://tju.at0086.cn/ Date Accessed: 01.06.2023

Unesco, (2023). *Education: From disruption to recovery*. https://en.unesco.org/covid19/educationresponse. Date Accessed: 01.06.2023.

Valentine, D. (2002). Distance learning: Promises, problems, and possibilities. *Online journal of distance learning administration, 5*(3), 1-11.

Wahlstrom, C., Williams, B. K., & Shea, P. (2003). *The successful distance learning student*. Cengage Learning. ISBN: 978-0534577124.

Wang, Q., Zhu, Z., Chen, L., & Yan, H. (2009). E-learning in China. *Campus-Wide Information Systems, 26*(2), 77-81.

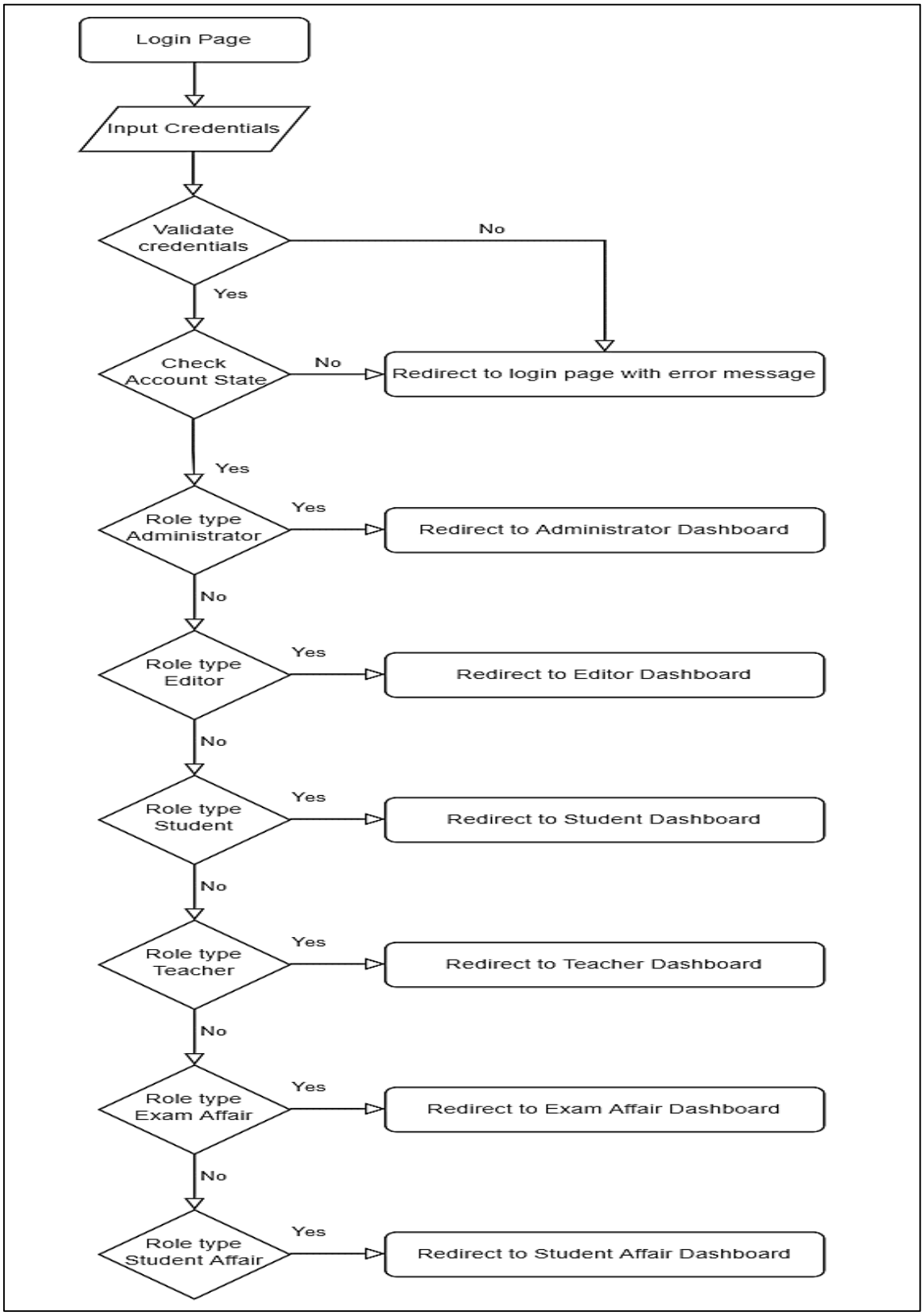
Wen, K. Y. K., & Kim Hua, T. (2020). ESL Teachers' Intention in Adopting Online Educational Technologies during COVID-19 Pandemic. *Journal of Education and E-learning Research, 7*(4), 387-394.

Yasin, A.S.M., & Hashem, I.A.T. (2020). Security Threats in E-Learning Systems: A Comprehensive Review. *Journal of Ambient Intelligence and Humanized Computing, 11*(5), 2069-2084.

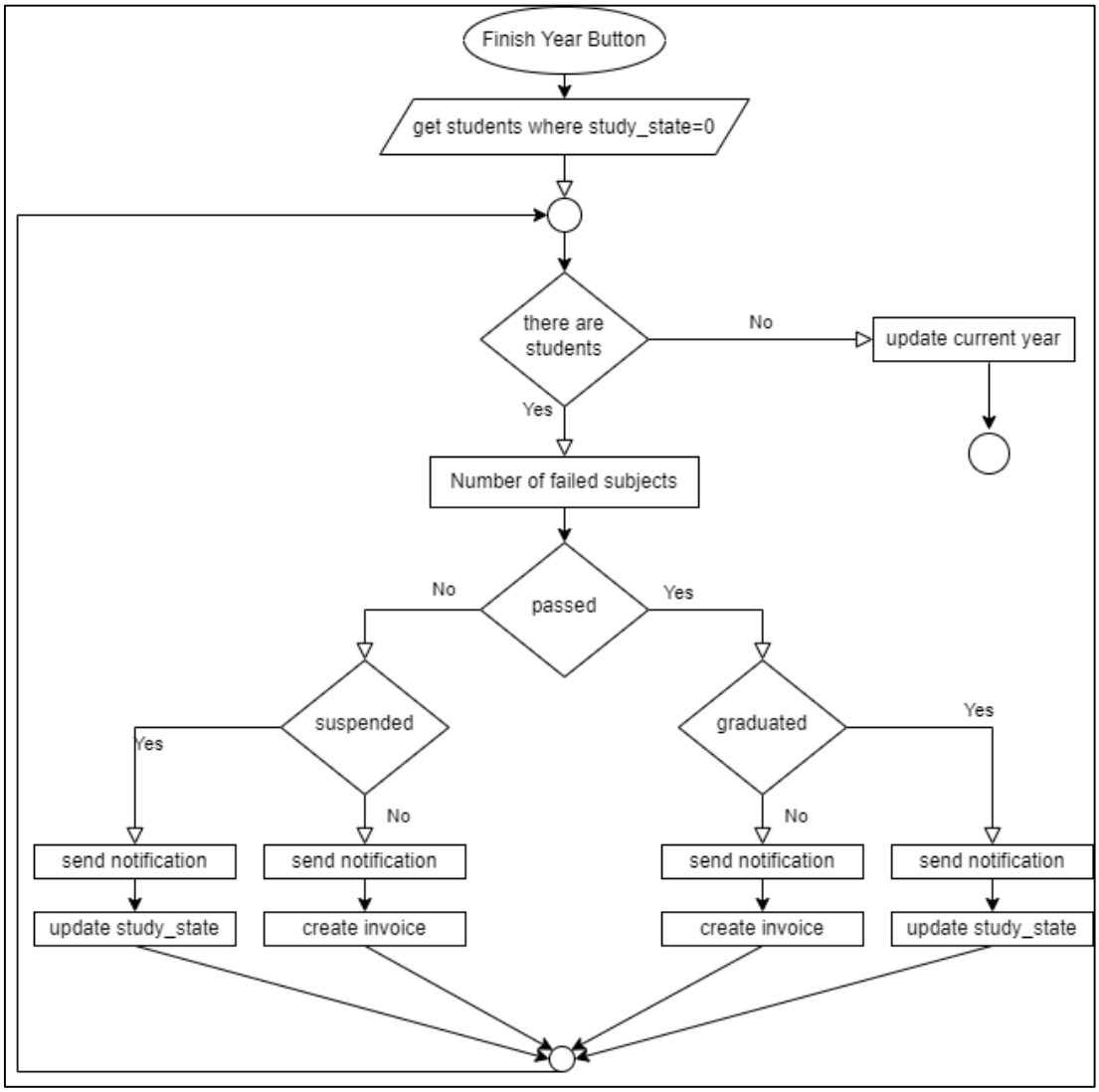
Zwanch, K., & Cribbs, J. (2021). A Study of Motivation and Engagement in Teacher Education: Students' Perceptions of Moving to Online Instruction in Response to a Pandemic. *Journal of Technology and Teacher Education, 29*(1), 91-119.

APPENDIXES

Appendıxes -1: Login process



Appendıxes -2: Finish current academic



CURRICULUM VITAE

Student Information	
Name/Surname:	Imad Fadhıl Sabah
Nationality:	Iraq
Orcid No:	0000-0003-4768-0085

School Information	
Undergraduate Study	
University	
Faculty	
Department	
Graduation Year	
Graduate Study	
University	Kırşehir Ahi Evran University
Institute	Graduate School Of Scıence
Department	Department Of Advanced Technologıes
Graduation Year	2023

Articles and Papers Produced from the Thesis