



**VIRTUAL E-LEARNING SYSTEM DESIGN: AN
IMPROVED MORDERN SERVICES FOR
EDUCATION (A CASE STUDY OF SIERRA
LEONE’S PUBLIC UNIVERSITIES)**

M.Sc. THESIS

Joseph Palmer

Nicosia

February, 2024

JOSEPH PALMER **VIRTUAL E-LEARNING SYSTEM DESIGN: AN IMPROVED MODERN**
SERVICES FOR EDUCATION (ACASE STUDY OF SIERRA LEONE PUBLIC
UNIVERSITY) **MASTER**
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**NEAR EAST UNIVERSITY
INSTITUTE OF GRADUATE STUDIES
DEPARTMENT OF INFORMATION SYSTEM ENGINEERING**

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February, 2024

Approval

We certify that we have read the thesis submitted by Joseph Palmer titled “**Virtual E-Learning System Design: An Improved Modern Services for Education (A Case Study of Sierra Leone’s Public Universities)**” and that in our combined opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Information System Engineering.

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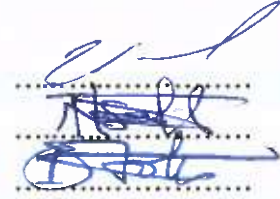
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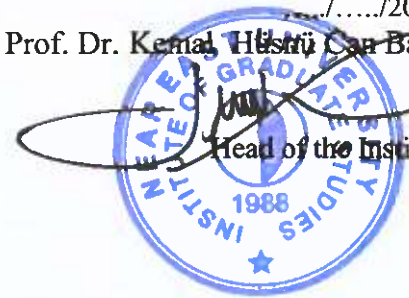
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Declaration

I hereby declare that all information, documents, analysis, and results in this thesis have been collected and presented according to the academic rules and ethical guidelines of the Institute of Graduate Studies, Near East University. I also declare that as required by these rules and conduct, I have fully cited and referenced information and data that are not original to this study.

JOSEPH PALMER

___/___/2024

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JOSEPH PALMER

Abstract**Virtual E-Learning System Design: An Improved Modern Services for Education (Case Study of Sierra Leone's Public Universities).****Joseph Palmer****Master, Department of Information System Engineering****Supervisor****February, 2024, 134 pages**

The transitory of academic information through distance learning with a virtual e-learning system has become a priority for most developing countries, even though some are facing challenges in implementing a system that will foster a situation for distance learning or e-learning. Several research studies have shown that virtual e-learning has positively impacted academic performance and delivery to privileged and underprivileged students. The coronavirus pandemic ravages many countries, and the United Nations estimated that over ten million students in West Africa were affected; they could not attend classes due to government isolation restrictions.

This study embarks on comprehensive exploration, explicitly focusing on some of the lapses and domain of educational information delivery via virtual e-Learning Systems, focusing on designing and enhancing eLearning systems within the context of Sierra Leone's Public Universities. Based on reviews and theories of online-based learning platforms, and to better understand the principle and issues faced by online learning with some public universities, an online survey was conducted using Google online forms, where respondents were selected randomly from three leading public universities namely: Njala University, Milton Maggai College of Education and Eastern Technical University. Of 400 respondents who participated, 206, which makes about 51.6%, consider e-learning to be efficient and effective and can also be merged with traditional face-to-face learning.

Based on the responses from the survey, the modelling and development of a virtual learning platform were done particularly for enhancing the delivery of academic lectures as well as learning material with special attention given to accessibility, security, adaptability and response time (Upload and Download) in diverse learning ways. The anticipated outcome of the system includes functionalities for an advanced e-learning system tailored to the educational landscape of Sierra Leone, with broader impacts for similar contexts globally.

Keywords: virtual e-learning, Likert-scale, degree of freedom (DF), uniportal, quantitative, qualitative, confidence level, covid-19

Özet

**Sanal E-Öğrenme Sistemi Tasarımı:
Eğitim için Geliştirilmiş Modern Hizmetler
(Sierra Leone Devlet Üniversiteleri Örnek Çalışması).**

Joseph Palmer

Yüksek Lisans, Bilgi Sistemleri Mühendisliği Bölümü

Süpervizör

Assist. Prof. Dr. John Bush IDOKO

Şubat, 2024, 134 pages

Akademik bilginin sanal bir e-öğrenme sistemi ile uzaktan öğrenme yoluyla iletilmesi, gelişmekte olan ülkelerin çoğu için bir öncelik haline gelmiştir; ancak bazıları uzaktan öğrenme veya e-öğrenme için bir durumu teşvik edecek bir sistemin uygulanmasında zorluklarla karşılaşmaktadır. Çeşitli araştırma çalışmaları, sanal e- öğrenmenin akademik performansı ve ayrıcalıklı ve ayrıcalıklı olmayan öğrencilere sunumu olumlu yönde etkilediğini göstermiştir. Coronavirüs salgını birçok ülkeyi kasıpkavuruyor ve Birleşmiş Milletler, Batı Afrika'da on milyondan fazla öğrencinin etkilendiğini tahmin ediyor; hükümetin izolasyon kısıtlamaları nedeniyle derslere katılamadılar.

Bu çalışma, Sierra Leone Devlet Üniversiteleri bağlamında e-Öğrenim sistemlerinin tasarlanmasına ve geliştirilmesine odaklanarak, sanal e-Öğrenim Sistemleri aracılığıyla eğitimsel bilgi dağıtımının bazı eksikliklerine ve alanlarına açıkça odaklanarak kapsamlı bir incelemeye girişmektedir. Sanal e-Öğrenim Sistemlerine ilişkin incelemelere ve teorilere dayanarak ve bazı devlet üniversitelerinde çevrimiçi öğrenmenin karşılaştığı bazı öz ve zorlukları daha iyi anlamak için, Google çevrimiçi formları kullanılarak çevrimiçi bir anket yürütüldü; burada yanıtlayanlar önde gelen üç kamu üniversitesinden rastgele seçildi. üniversiteler: Njala Üniversitesi,

Milton Maggai Eğitim Fakültesi ve Doğu Teknik Üniversitesi. Katılan 400 katılımcıdan 206'sı, yani yaklaşık %51,6'sı, e-öğrenmenin verimli ve etkili olduğunu ve ayrıca geleneksel yüz yüze öğrenmeyle birleştirilebileceğini doğruluyor.

Anketten alınan yanıtlara dayanarak, bu çalışma için sanal bir e-öğrenme sisteminin tasarımı ve geliştirilmesi yapılmıştır; bu sistem, erişilebilirlik, güvenlik, uyarlanabilirlik ve yanıt süresine (Yükleme ve İndirin) çeşitli öğrenme yollarıyla. Sistemin beklenen sonucu, küresel olarak benzer bağlamlar için daha geniş etkilere sahip, Sierra Leone'nin eğitim ortamına göre uyarlanmış gelişmiş bir e-öğrenme sistemine yönelik işlevleri içermektedir.

Anahtar Kelimeler : sanal e-öğrenme, likert ölçeği, serbestlik derecesi (DF), tek port, niceliksel, niteliksel, güven düzeyi, covid-19

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List of Abbreviations

SPSS	: Statistical Package for Social Scientist
AI	: Artificial Intelligence
WHO	: World Health Organization
CBF	: Collaborative Base Filtering
HF	: Hybrid Filtering
HTML	: Hyper Text Markup Language
CSS	: Cascading Style Sheets
XML	: Extensible Markup Language
VSAT	: Very Small Aperture Terminal
TAM	: Technology Accepted Model
UX	: User Experience
PU	: Perceived Usefulness
PEOU	: Perceived Ease of Usefulness
POFOD	: Probability of Failure of Demand
SQL	: Structure Query Language

CHAPTER I

Introduction

1.1 Introduction

In recent years, rapid technological advancements have transformed the education landscape, ushering in an era of unprecedented innovation. These advancements have given rise to novel approaches, such as virtual e-learning systems, which have proven to be transformative in education. The contemporary educational landscape is increasingly characterized by dynamic and interactive learning environments that transcend the confines of traditional classrooms. As Abdelaziz (2014) notes, e-learning represents a paradigm shift in education. The extensive utilization of various information systems, services, and technologies underpins this shift.

Information systems, at the heart of e-learning, provide the digital infrastructure for creating, storing, and delivering educational content. These systems include Learning Management Systems (LMS) that centralize course materials, student progress tracking, and communication tools, making them indispensable for modern online education. E-learning services encompass a wide range of online tools and functionalities, from video conferencing platforms for live virtual classes to discussion forums that facilitate student collaboration and assessment systems for grading. These services are essential for fostering interactivity and engagement in the virtual classroom. Moreover, e-learning technologies encompass the hardware and software tools that make online learning possible, from personal computing devices to specialized software applications and virtual reality tools that enhance the learning experience.

Furthermore, the declaration of the COVID-19 virus as a pandemic by WHO (World Health Organization) further underscored the significance of e-learning in modern education. The pandemic disrupted educational institutions worldwide, compelling many to temporarily shutter their physical campuses to try and stop the virus from spreading as advised by the World Health Organization (WHO) (Aktay *et al.*, 2020). In this crisis, institutions with established virtual e-learning systems emerged as beacons of resilience, demonstrating the pivotal role of these platforms (Rahimi, 2020). These institutions seamlessly transitioned to online instruction,

allowing students to continue their education from the safety and comfort of their homes. The exceptional challenges posed by the pandemic have illuminated the adaptability and effectiveness of e-learning systems in ensuring the smooth continuity of learning even in such times of crisis.

1.2 Background of Study

The landscape of education technology is rapidly evolving, marked by the transformative influence of e-learning. E-learning, an abbreviation for electronic learning, finds its roots in the mid-20th century when the earliest forms of distance education emerged, leveraging radio and television for instructional programs. However, the internet's widespread availability in the late 20th century truly catalyzed the growth of e-learning. A web-based platform appeared in the 1990s, enabling educational institutions to experiment with online courses and virtual classrooms. The term "e-learning" gained prominence as institutions started incorporating technology to facilitate learning beyond the traditional classroom setting. The 21st century witnessed a rapid acceleration in e-learning adoption, driven by advancements in digital technologies, the ubiquity of personal computing devices, and the increasing connectivity afforded by the internet.

Bryant *et al.*'s (2020) report highlights the global trends in e-learning adoption, showcasing how countries have embraced this mode of education to varying extents. Notably, the COVID-19 pandemic served as a catalyst and a wakeup call to many learning institutions, accelerating the integration of virtual e-learning systems and underscoring their resilience in the face of unforeseen disruptions. The historical trajectory of e-learning is integral to understanding its current role in education technology. Initially seeking to bridge geographical gaps in learning, E-learning has become a ubiquitous force in education, revolutionizing traditional pedagogical approaches.

The onset of the COVID-19 pandemic brought about unprecedented disruptions in the global education sector. According to the World Economic Forum, approximately 147 million students did not have the chance for face-to-face teaching between 2020 and 2022, with a looming risk of educational dropout for many. The pandemic has led to prolonged school closures and introduced economic challenges, potentially setting back progress made on global development goals, especially in

education. Institutions equipped with virtual e-learning systems emerged as more resilient in navigating the challenges posed by the pandemic (Rahimi, 2020).

Shams *et al.*'s (2022) study on how e-learning was implemented and utilized in higher education during the pandemic emphasizes its success in mitigating the impact of the crisis. The research revealed that the usage of e-learning portals was comparable between both male and female student groups in learning institutions. This underscores the adaptability and effectiveness of virtual learning environments, particularly in times of crisis. The ability to seamlessly transition to online instruction ensures the continuity of education, addressing the disruptions brought by external factors, such as a global pandemic. Over the past 15 years, e-learning has transformed learning mediums in academic institutions. As defined by Laurillard (2004), e-learning involves the interaction where students use various ICTs in their learning processes. Following the declaration of coronavirus as a global pandemic by the World Health Organization (WHO), various academic institutions had to shut down their normal learning operations and shift to virtual online learning. While developed countries swiftly embraced virtual e-learning systems, many developing countries faced challenges in adopting this form of learning due to resource limitations. Gulati (2008) underscores the prevalent problem of resource constraints hindering the uptake of new technologies in learning.

In the case of Sierra Leone, the coronavirus pandemic halted academic affairs, exposing the need for standardized virtual systems for academic institutions. Despite efforts, the success of in-house and distance e-learning hinges on the availability of adequate resources and functional systems. The challenge persists as previously designed e-learning systems, for instance, the USL e-Learning System, faced issues of underuse and disuse, necessitating system enhancements and redesign for revitalized use. The overwhelming demand for university admission in Sierra Leone has prompted the urgency for a well-developed e-learning system capable of delivering lectures to students across various regions. These complexities underscore the importance of addressing resource challenges and designing effective e-learning systems, forming the focal points of this research study. The main aim of the study is to explore the design of a virtual e-learning system that acknowledges the global trends in e-learning adoption and considers the specific challenges faced in Sierra Leone, thereby contributing to the broader discourse on equitable and effective education technology implementation.

1.3 Problem Statement

The potential benefits of e-learning remain largely unrealized within public universities in Sierra Leone, where the absence of a robust e-learning system impedes the efficient delivery of education. Presently, the existing systems fall short of addressing the diverse needs of students and lecturers, hindering the seamless provision of education. Public universities in Sierra Leone currently lack a comprehensive and efficient e-learning infrastructure, relying on portals primarily designed for new student applications. This limited functionality exacerbates the challenges faced by lecturers, compelling them to travel to sub-campuses for in-person lectures due to congestion in university classrooms.

The inadequacies of the current systems create a pressing problem for both students and lecturers. Students experience difficulties accessing educational resources and participating in a dynamic and interactive learning environment. Lecturers, burdened with the challenges of physical presence across sub-campuses, face inefficiencies in their teaching practices. The limited capacity of the existing e-learning infrastructure not only constrains educational delivery but also poses challenges to the scalability and sustainability of academic programs.

This research seeks to address the systemic shortcomings in the e-learning systems of public universities in Sierra Leone. By focusing on the specific challenges faced by both students and lecturers, the study aims to determine the root causes and effects of such inefficiencies in learning systems and offer viable solutions. Through an in-depth examination of the existing systems and an exploration of best practices globally, this research aims to contribute practical insights to the development of a robust and effective e-learning system tailored to the needs of Sierra Leonean public universities.

1.4 Purpose of the Study

The primary goal of this research is to develop a proposed virtual e-learning system tailored to meet Sierra Leone public universities' unique needs. In response to the escalating demand for academic excellence and the evolving landscape of education, the study aims to design a comprehensive virtual learning platform that complements traditional face-to-face learning methods. This proposed system is envisioned to significantly improve the current infrastructure, providing students and lecturers with a more efficient, convenient, and technologically advanced tool for education delivery. As universities strive for academic competitiveness, implementing an advanced virtual e-learning system becomes integral to relieving academic staff from excessive pressures and enhancing overall service delivery. The proposed system is poised to reduce the dependence on conventional lectures, promoting a more balanced technology integration into the learning process. By doing so, the study aims to empower learners to engage in individualized study processes, fostering a more flexible and adaptive approach to education.

1.5 Specific Goals for this Research

- To study existing virtual e-learning systems to determine the current challenges and effectiveness in this field.
- To provide a reliable Virtual E-Learning System which can be accessed twenty-four hours seven days a week for public universities.
- To facilitate course registration and distance learning by student via virtual e-learning systems.
- To facilitate the access of information in learning institutions, including, course information and study materials, subject enrolment, student results, and interaction with lecturers and other students, among others.
- To reduce paper workload for lecturers especially in conducting mid-term and final assessment which can be easily done online with instant grade submission.
- Help to reduce congestion in classes and the spread of airborne disease.

1.6 Research Questions

These questions were developed with an emphasis on better insight to obtain answers for the study's goals.

1. What attitudes do the instructors and students have toward Virtual online learning in higher education in a developing nation?
2. How is Virtual e-learning viewed as essential to the teaching and learning process of education?
3. How can instructors and students manage the challenges faced by virtual online learning?
4. What sustainable framework technologies could be used to implement a virtual learning environment successfully?

1.7 Scope of the Study

Inclusive within this research is the meticulous design, development, and implementation of a virtual e-learning system intended to augment student and instructor interactions. The envisioned system encompasses various functionalities such as online lectures, streamlined course registration, assignment management, exam submission, transparent grade visibility, temporary transcript generation, and a conducive presentation environment. The technological features of the system are user-centric and responsive, ensuring compatibility with a variety of electronics devices, including laptops, tablets, and smartphones. This approach aims to promote flexibility and accessibility for both students and lecturers.

However, certain aspects lie beyond the purview of this study. The research will not extensively address challenges unrelated to the system design and functionality. Broader implementation challenges, policy and regulatory frameworks, sociocultural factors influencing the educational landscape, full-time management of student records, institution financial operation, and online application processes fall outside the study's focus. Additionally, the findings and recommendations will be tailored to the specific requirements of the designated case study without universal generalization.

1.8 Organization of the Study

The entirety of the paper follows a specific structure that facilitates easy navigation by the reader as well as understanding of the content; it is arranged as follows: the first chapter presents a brief overview of the study; followed by the second chapter that discusses related works and literature review; the third chapter includes a discussion of the key concepts of the research methodologies; while the fourth chapter shows and discusses the system architecture as well as a mini-SRS for the system, and the fifth chapter presents the comparison of the proposed system with other existing systems along with system testing using different methods such as performance test, and functionality test, among many others. Finally, chapter six covers the research's conclusion and presents additional recommendations for future developments of the system, followed by a presentation of the sources used during the review of related information in this research in the final chapter.

1.9 Limitations of the Study

The study was apparently in two phases to ascertain what should be the needful requirements and necessary components to archive the second phase of the project. However, this did not come easily since most of the respondents of the survey for the first face were busy for one reason to the other to give their views, also gathering of relevant information for the respective university with regards their existing systems was a bone of contentions at a certain point this is because every internal staff members spoke to or email to get first time information will seem to impossible since all staffs were protecting their job as the case maybe in our traditional institution setting. Since most of the questions were administered in person to get the facts, this also attracted some huge cost expenditure, some costs were disbursed to those who administered the questionnaire and also hosting of the entire project online was also incurred which at certain point was delayed the project at it final stage.

CHAPTER II

Literature Review

2.1 Overview

Virtual e-learning systems have gained significant popularity as a teaching method in the recent years (Alabbasi *et al.*, 2013). One of the main reasons for this increased adoption of remote learning, especially since the 2019 coronavirus pandemic, which notably led to many learning institutions and a few other organizations adopting virtual e-learning and communication systems (Kumar & Singh, 2021).

The review presented in this chapter primarily examines the developments and trends in virtual e-learning system design from 2010 to 2019 as well as from 2020, following the declaration of the coronavirus outbreak as a pandemic up to 2023. The review largely focuses on the challenges and opportunities associated with the virtual approach to education.

2.2 Virtual E-Learning System Design

In 2010, researchers and practitioners focused on developing practical virtual e-learning system design principles that could enhance student engagement and learning outcomes. The focus was on developing user-friendly interfaces, effectively incorporating multimedia and social networking features to facilitate peer-to-peer learning and support (Baran & Correia, 2014). The researchers explored the impact of virtual e-learning systems on various learning factors such as learner engagement and motivation as well as learning outcomes. In the following years, virtual e-learning systems became more sophisticated, and researchers explored the latest technology, including cutting-edge advancements (Garrison & Vaughan, 2013). Incorporating technologies such as virtual, augmented, and artificial intelligence can bring significant benefits. E-learning systems to improve student engagement, enhance learning outcomes, and provide personalised learning experiences (Lai & Chen, 2015). Utilising augmented and virtual reality in virtual e-learning systems was explored, with researchers identifying the potential of these technologies to create immersive learning environments (Lee *et al.*, 2014). A central key research area in virtual e-learning system design during this period was the development of personalised learning paths

using artificial intelligence and machine learning algorithms. These systems utilized data analytics and machine learning algorithms. Analyze students' performance and pinpoint areas of weakness. This enables instructors to provide targeted support and feedback to individual students (Al-Rahmi *et al.*, 2017).

In the years that followed, research on virtual e-learning systems continued to evolve. In 2018, gamification in virtual e-learning systems gained popularity, with researchers exploring the potential of game-based learning in enhancing learner engagement and motivation (Kapp *et al.*, 2013). Another concentrated area in the past decades has been the integration of social networking and collaboration tools into virtual e-learning systems. These tools enable students to collaborate with their peers, share resources, and support one another, creating a more interactive, engaging, and a better learning experience in general (Wang *et al.*, 2019). In addition to these advancements, researchers also explored using chatbots and conversational interfaces in virtual e-learning systems to provide personalised support to students. Chatbots enable students to receive immediate feedback, reducing the time lag between completing an assessment and receiving feedback (Aldowah & Al-Samarraie, 2018).

In recent years, the 2019 coronavirus pandemic has led to a significant shift towards the adoption of distance learning, further accelerating the adoption of virtual e-learning systems (Kumar & Singh, 2021). The attention has now turned towards the creation of systems that are more advanced and efficient. They are scalable and accessible to a broader audience, addressing accessibility issues and the digital divide (Gupta *et al.*, 2021).

Another area of focus in virtual e-learning system design has been the development of intelligent tutoring systems that can provide personalised support to students. In order to analyze data, these systems employ machine learning algorithms. Student data and provide targeted student support (Huang *et al.*, 2021). Adaptive learning technologies have also gained popularity, with researchers exploring these systems' potential to provide students with personalised learning experiences. The purpose of these systems is to function efficiently and effectively using data analytics and machine learnin

2.3 Importance of Virtual E-Learning

Internet development and other digital technologies have changed and impacted a lot of aspects of the modern lifestyle, including learning. Virtual e-learning systems are now an essential for the delivery of education in the digital age. During this period, virtual e-learning systems began to gain popularity as a teaching method. Researchers focused on e-learning systems' benefits, flexibility, accessibility, and cost-effectiveness. One of the key advantages of virtual e-learning systems is their ability in delivering education to a broader audience, including students who live in remote areas or cannot attend traditional brick-and-mortar institutions (Ally, 2011).

Virtual e-learning systems also offer students more flexibility, allowing them to learn on an appropriate schedule. This flexibility can be particularly beneficial for adult learners juggling work, family, and other commitments. Research during this period also focused on the potential of virtual e-learning systems in improving learning outcomes. Research has shown that online-based learning system can be as effective as traditional classroom-based education (Clark & Mayer, 2011; Mayer & Clark, 2010).

In the years that followed, the importance of virtual e-learning systems continued to grow, particularly in light of the COVID-19 pandemic. Research during this period centered largely on the benefits of online-based learning systems in the context of remote learning. Virtual e-learning systems have become essential for delivering education during the pandemic, enabling students to continue their studies while adhering to social distancing guidelines (Hodges *et al.*, 2020).

Another significant development during this period was the emergence of novel technologies, like VR (virtual reality), AI (artificial intelligence), and gamification, into virtual e-learning systems. Artificial intelligence algorithms can personalize learning experiences, providing targeted feedback and support to individual students (Kizilcec *et al.*, 2013). Virtual reality and gamification can create more engaging and immersive learning environments, improving student engagement and motivation (Dicheva *et al.*, 2015; Wu & Wu, 2012).

In addition to these benefits, research during this period also focused on the challenges of virtual e-learning systems. A major demerit is ensuring that students have the required resources, such as technology and internet connectivity, to engage and participate effectively in virtual e-learning (Ally & Prieto-Blázquez, 2014).

Another challenge is maintaining student engagement and motivation in a virtual environment, particularly for students who struggle with self-directed learning (Means *et al.*, 2014).

The coronavirus pandemic has caused a substantial shift towards distance learning, further highlighting the importance of virtual e-learning systems. Research during this period has focused on addressing the challenges associated with remote learning, including accessibility issues and the digital divide. Efforts have been made to ensure that virtual e-learning systems can be accessed by every student, irrespective of their physical locality or socio-economic status (Daniel, 2020). Another significant development during this period has been the adoption of chatbots and conversational platforms in virtual e-learning systems. These tools can provide personalised support to students, enabling them to receive immediate feedback and reducing the time lag between completing an assessment and receiving feedback (Bigham *et al.*, 2014; Wan *et al.*, 2018).

In the modern world, digitalization is taken into account and researched in various fields like arts, biotechnology, physics, psychology, and philosophy, among others. Particular characteristics of VR include its development, realism, independence, and interaction. As it involves subject-object relationships, the training process itself is virtual. Education has been virtualised as a result of the given method.

A collection of information resources, the virtual learning environment offers sophisticated technological and methodological assistance for managing the educational process and enhancing its quality. Consequently, a virtual learning environment serves the following purposes: administration, communication, control, and information and training (Kerimbayev, 2016). E-learning is the systematic application of networked, multimedia digital technology with the purpose of enhancing learning, empowering students, connecting students, as well as individuals with corporate goals and resources that support their requirements (Goodyea & Ellis, 2010). Virtual learning environments now serve several purposes. This system implements pedagogic, informative, and methodological technologies, relevant knowledge resources (eLearning materials, data and information support, as well as libraries, among others), and contemporary programs. There are numerous parallels between remote learning and virtual education. In contrast, the interaction between a subject and an object occurs in real-time through direct engagement between the teacher, student, and things being examined. The instructor can also be used as a tool; for example, a digital media, computer program, or other entity can take the position of the teacher (Stacey & Gerbic, 2007).

Many scholarly studies thoroughly represent the global experience with virtual learning. A fresh approach to using digital media in teaching is reported by Rune Baggetun and Mjelstad (2006), who created and tested an elearning tool dubbed eLoggthat could be used in lower secondary and elementary schools.

A set of students' experiences with VLEs may have been shaped by several discourses, according to Burnett's (2011) investigation. In her study, Burnett (2011) looks at the student identities connected within digital spaces and the power dynamics that seem to shape the way they see themselves (or believed they were seen) as learners.

A study by Michail Kalogiannakis (2004) examines the new responsibilities of French physics professors in the classroom when they utilise ICT. The implementation of ICT in the learning environment impacts the instructors' roles and methods of instruction. Kaufmann *et al.* (2000), Bouta and Retalis, and others have examined the use of virtual reality in math instruction (2013). A learning management system is tied to contemporary technological learning (LMS). In their 2014 article, Lyashenko and Frolova emphasize how crucial it is to understand the unique characteristics of human growth while implementing IGL policies in learning. Nagy (2014) researches the use of a learning management system in subjects like business and economics in Hungary higher education institutions. She examines all LMS applications for teaching business math to Hungary undergraduates from the teachers' perspective. Her research, which aligns with other studies, demonstrates that instructors frequently utilize LMS to communicate via text and provide text-based learning resources.

The process and outcome of communication between participants in the educational process online is known as virtual learning. The following benefits of virtual learning set it apart from traditional education: flexibility and interaction of the learning environment, remote learning, and availability of informational and educational materials. Virtual learning aims to pinpoint a person's location and direct them to reach and achieve their goals in the actual world while using their virtual component.

Virtual training incorporates multimedia learning creation in the form of digital learning materials. The educational process arrangement depends on digital educational resources, including interactive modelling and virtual reality items, maps, sound recordings, business graphics, symbolic objects, and other training materials. As an information item, the digital educational resource is regarded.

We assume that virtual training presents a certain educational quality. In that case, the student's primary goal is learning to utilize information as a basis of intelligence while simultaneously learning to utilize the provided information, which is frequently unstructured, disorganized, and undesirable.

All manner of multimedia technologies, including personal computers and mobile gadgets, started to deeply permeate all elements of people's lives as information technology and network communications infrastructure developed and became more established. People started looking for technologies (like VR) that gives them the impression that they are actually in particular settings in addition to being satisfied with the way things looked and worked. With virtual displays and associated interactions, Wei *et al.* (2019). VR offers consumers a unique experience that transcends temporal and geographical constraints.

The entertainment industry has extensively used virtual reality, but as technology has advanced and costs have fallen, these constraints have been removed. Corporations use it in various sectors, including manufacturing, retail sales, manufacturing, education, and medicine. In instructional applications, it demonstrates a unique and significant potential. Virtual reality (VR) not only addresses the drawbacks of traditional teaching environments but also enhances the communication of educational and training content, Sportillo *et al.*, (2018) and helps students comprehend curriculum materials, improving learning effectiveness. It demonstrates how VR technology is now a promising educational advancement trend. Since VR technology for teaching can facilitate accessibility, entertainment, dynamic interaction, the effect of flow, exploration, and direct visual feedbacks, contextual instruction can be designed to simulate real-world situations.

Additionally, learner-centered learning models can be provided to support their exploration of learning (Rupp *et al.*, 2019). As a result, in the field of education, virtual reality not only makes learning enjoyable but also improves concepts and knowledge acquisition to facilitate learning by making the process simpler like playing, and by breaking the geographical limitations of classroom for both learners and teachers. This also allows students to practice and revise easier, which increases the students' learning attention. The results of the Sportillo *et al.* (2018) and Zhang *et al.* (2017) study revealed that learners may more readily engage in self-directed and active learning through VR technology, increasing their learning intention and, thus, their learning effectiveness.

The main aim of this study is to understand better the factors that influence learners' intention to utilize VR for online learning to fulfil their learning objectives.

2.4 Challenges Face Managing E-Learning System

The holistic approach distinguishes between global, national, institutional, curriculum programs, and micro-level interactions between students, professors, courses, and technology.

Circumstances at the global level determine the scope of online education outside national borders. Only standardised technological platforms (like the Internet), the closing of the digital divide, accommodating different languages and cultures, standardised curricula, and standardised evaluation procedures will allow for the globalization of online education.

Institutional factors can also spell the end for the program, for instance, inadequate knowledge of online teaching methods and learning techniques, lack of managerial support for e-learning and the program marketing, the number of enrolled learners, the faculty qualifications, tuition costs, or the interval of the program (Kentnor, 2015). Moreover, Popovich and Neel (2005) looked into different institutional traits connected to online programs and classes at AACSB-certified business schools. They listed drawbacks like potentially lower educational quality, higher faculty training, resistance from the faculty, financial support restrictions, company predisposition against online degrees, inappropriateness for various topics and courses, higher costs of technological updates, program setup costs and challenges, potential lower learner-instructor interaction, irrelevant use of prior location advantages, and likely intellectual property (IP) infringement.

E-learning is a promising form of edification that has garnered popularity in recent years. With new technologies surfacing and the Internet, e-learning has become a viable option for students and educators. However, managing e-learning systems poses many challenges, and it is prudent to be knowledgeable to ensure a robust and better outcome for e-learning initiatives.

According to Surry, Ensminger, and Haab (2005), there may be several obstacles to the integration of instructional technology in learning environments, including the infrastructure of the technology, student competency, technological satisfaction, and teacher motivation. Regardless, it will only accomplish something with competent application. Several institutions of higher learning have collapsed due to inadequate strategy, expensive technology, reluctance to adapt to changing conditions, rivalry, and subpar course delivery (Elloumi, 2004; Saadé, 2003).

According to Liu, Liu, Lee, and Magjuka (2015), maintaining learner engagement is perhaps the main challenge of managing e-learning systems. In a traditional classroom setting, students have one-on-one interactions with their teachers and colleagues, which can help keep them engaged.

However, in e-learning environments, learners might feel isolated and disengaged. To deal with this challenge, instructors must create a sense of community within the e-learning environment. This can be achieved using discussion forums, collaborative projects, and other interactive tools.

Another challenge faced in managing e-learning systems is the need for technical support (Sun & Zhang, 2015). E-learning systems are heavily reliant on technology, and technical issues can arise anytime. Dissatisfaction and reduced productivity may result from this for both instructors and students. To address this challenge, institutions must provide adequate technical support to ensure that e-learning systems run smoothly. This can be achieved through help desks, online tutorials, and other support mechanisms.

According to Hsu and Chen (2016), another challenge faced in managing e-learning systems is the need for effective assessment strategies. Instructors can quickly assess student learning through exams, quizzes, and other assignments in a traditional classroom setting. However, in an e-learning environment, it can be challenging to assess student learning accurately. To overcome this challenge, instructors must develop effective assessment strategies that consider the unique features of e-learning environments. This can be achieved through online quizzes, peer assessments, and other innovative assessment tools.

Another challenge faced in managing e-learning systems is the need to address the diverse needs of learners (Rahman, 2017). E-learning systems may be used by students from diverse backgrounds and with varying levels of prior knowledge. Instructors must develop e-learning content that is accessible and engaging for all learners. This can be achieved through multimedia tools, adaptive learning technologies, and other strategies that address the diverse needs of learners.

According to Chauhan and Chauhan (2019), another challenge in managing e-learning systems is ensuring data security and privacy. E-learning systems rely heavily on collecting and storing sensitive information, such as student data and assessment results. Institutions must ensure that these data are protected from unauthorized access and use. This can be achieved using secure data storage mechanisms, encryption technologies, and other strategies that ensure data security and privacy. In Marbouti, Fathian, and Mehraban (2021) submission, another challenge faced in managing e-learning systems is the need for effective communication between instructors and students. Instructors can easily communicate face-to-face with their students in a traditional classroom. However, in an e-learning environment, effective communication can be challenging.

Instructors must develop effective communication strategies that consider the unique features of e-learning environments. This can be achieved through online chat rooms, video conferencing, and other communication technologies.

2.5 Framework for Virtual E-Learning Specifications

With the help of this long-standing e-learning system, Ali *et al.* (2021) recognize the challenge of choosing the best resources for learning based on users' needs and preferences. They need this platform because it could be beneficial to them in overcoming some of the difficulties they face in online virtual learning environments, especially those who have yet to become familiar with or possess inadequate experience with advanced internet tools available in developing nations. The researchers suggest an intelligent system to address this problem that correctly predicts the best resource selection for user needs based on the user perspective,

improving the quality of online education and acquainting users with a cutting-edge digitized online learning environment. Content filtering and collaborative-based filtering (CBF) enhance former user experience and present user information, correspondingly, and help students identify necessary materials and knowledge. Another significant concern, according to the scholars utilizing hybrid filtering (HF), is the daily virtual help for new learners in overcoming challenges. This combination of collaborative-based filtering and content filtering, this tailored choice, and calculations for correctly resolving word mismatch problems in semantic analysis. Semantic basis prediction exceeded the current method and considerably enhanced the visualization of surroundings based on the pertinent selection of the user's preferences.

According to Jabr & Al-Omari (2010), a web service-based framework for a virtual learning system that includes client scripting support for cross-browsers integrates various databases. The framework speeds up accessibility to the essential data facilities and enables learners to control their learning experience and facilities. As former e-learning systems have based their developments on HTML (Hypertext Markup Language), a more dynamic manner of transforming web content could also enhance user experience with the use of XML (Extensible Markup Language), which can help in providing better online experience for standard web page development. The proposed framework increases the effectiveness and depth of collaborative learning concerning Reusability, Accessibility and Modularization. There is considerable access and use to the Internet by Then again, the resolution to learn new things was not because of inadequate primary education (Siddiqui *et al.*, 2012). individuals.

It has been a priority for several Gulf and Asian countries, such as Egypt, India, and Saudi Arabia, which are geographically extensive and have more population, to ensure every child receives a primary, upgraded education.

An Interactive system for e-learning was presented by Siddiqui *et al.* (2012); which has a specific didactic satellite that is in charge of distributing e-learning materials to the learning institutions

connected to it, enhancing performance. That is accomplished by employing a satellite which uses VSAT terminal-supported spot beam technology. By relaying information from important locations and transmitting it through satellite, the university website, which students can access via Web and mobile applications, receives all the information. A typical effective virtual e-learning is characterized by the components used to build it, such as previously developed e-learning systems like Moodle. It helps many teachers greatly in conceptualizing the different courses, curriculum, and the course structures, hence facilitating interactions with others students online. The entire Moodle framework was built using HTML and CSS; although it is believed to be one of the most utilized e-learning platforms due to its support of extensive tools and flexibility, it also lacks some vital features necessary for an e-learning system, for instance, it lacks key features such as whiteboard, video, and audio inclusion. With recent and updated front-end technologies like React, Node.js and Java Script, which are very adaptive in any browser as a server-side language, they are swift in loading and more secure. Connectivity to a database is a paramount issue as it concerns holding all necessary and relevant information; hence, storing the database in an environment that slows down downloading and uploading learning materials should be considered. A database stored on a local dedicated server with a smaller memory will have scalability and connecting issues; as some university populations are supposed to be 40,000, institutes must adopt a service-oriented approach to have cloud-based hosting.

One main goal of the Virtual E-learning application's product positioning is to create a mobile- and device-compatible online teaching tool. Establishing a cross-platform E-learning platform through browser implementation is the ideal alternative because the browser is suitable for various systems and hardware (Qitong, 2018). A system code is provided for the server, which allows requests to only be made to the server from the user interface. After feedback is obtained from the server, the E-learning system is tested by use of a cross-platform browser. With this outcome, both desktop and smartphone platforms can utilize the system's features.

Dual platforms, however, offer a superior user experience. E-learning content providers can focus more on creating instructional materials despite variations in the front end. The multi-platform V-E-learning system renders it simpler for anyone to work with the system and enables them to register from anywhere and at any given time. The virtual learning approach gets around time and location restrictions so that teachers may dedicate more time to instruction and learners in rural regions can easily access the latest and quality learning resources.

2.6 Structure of Virtual E-Learning Applications

Two implementations have been widely employed in creating networked applications, each with unique characteristics and applications. One conventional and widely adopted approach is the client and server structure, a cornerstone in many software systems' architecture. In this model, the client and server end are assigned specific tasks concurrently, aiming to distribute the workload and minimize the system's reliance on constant communication.

The client-server architecture operates on a fundamental principle where the client and server are co-dependent but perform distinct roles in the system. The client's responsibilities include managing user interfaces, software operations, and user interactions. Concurrently, the server is tasked with functions crucial for system operation, including managing, exchanging, and maintaining the integrity of system data. This collaborative approach allows for a streamlined and efficient system operation, leveraging the strengths of both the client and server components.

As part of the client-server architecture, users actively participate in the management and execution of operations through the client end. This direct involvement empowers users to interact with the system, control software functions, and engage in company operations, enhancing the overall user experience. The simplicity of installation and operation further contributes to the widespread adoption of the client-server architecture in various software systems.

In contrast, an advanced architecture gaining prevalence in virtual e-learning applications is the Browser-Server (B/S) architecture. Particularly prevalent in browser-based applications, the B/S architecture centralizes much of the processing and functionality on the server side with the client end.

The primary responsibility is to create and display the user interface and does facilitate user interactions. This model aligns with the evolving landscape of web applications and offers advantages in terms of accessibility and maintenance.

Figure 1 shows the delineation of roles and responsibilities between the client and server components. This visual representation elucidates the seamless interaction and interdependence between the two, forming a robust foundation for the structure of virtual e-learning applications.

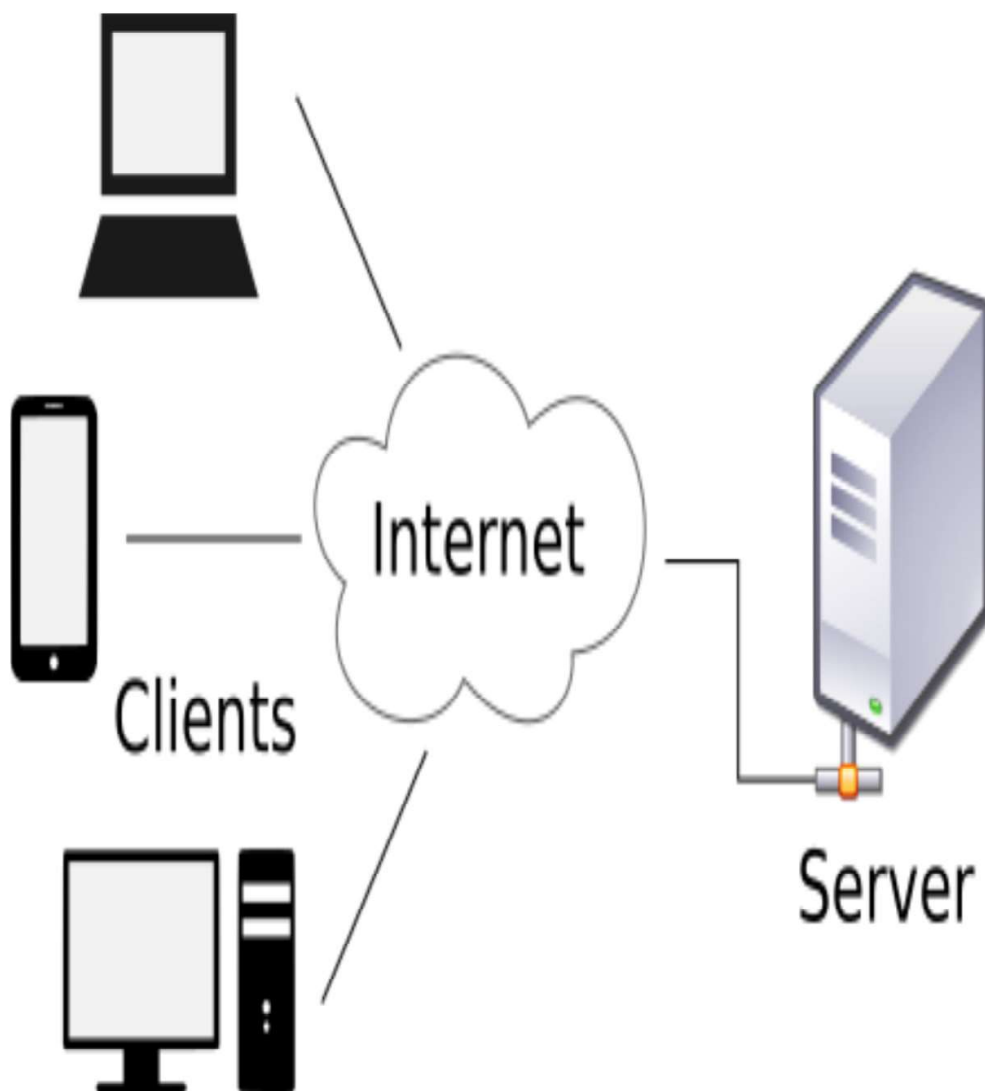


Figure 1: Client Server Architecture

CHAPTER III

METHODOLOGY

3.1 Overview

This research adopts a comprehensive methodology to inform the design and functionality of the virtual e-learning system. Key components include defining the research design, identifying the study population, determining sample size and employing appropriate sampling techniques. Types of data crucial for system design will be collected using varied instruments, and data validity and reliability will be rigorously tested. Ethical considerations will guide the research process, ensuring participant privacy and informed consent. Data analysis techniques will be applied to derive meaningful insights, with the overarching goal of systematically gathering, analyzing, and validating information essential for developing an effective virtual e-learning system.

3.2 Research Design

To ensure the e-learning system's effectiveness and user acceptance, this research will collect data from university students and lecturers in Sierra Leone across three public universities, utilizing a comprehensive questionnaire. The study strategically incorporates the User Experience (UX) Framework and the Technology Acceptance Model (TAM) as theoretical foundations to inform the design of the e-learning system. The UX research process, encompassing objectives, hypotheses, methods, process, and synthesis, will meticulously guide the data collection and analysis phases.

Acknowledging the pivotal role of user acceptance in technology utilization, the research references literature highlighting Perceived Usefulness (PU), Perceived Ease of Use (PEOU) collectively are critical determinants influencing technology adoption (Nov & Ye, 2008). The TAM framework, rooted in the theory of reasoned action, elucidates how users accept and use technology based on their perceptions of usefulness and ease of use (Bryan & Zuva, 2021). The four main constructs of TAM, PU, PEOU, Attitude toward using (A), and Behavioral Intention to use (BI) will guide the development of our questionnaire. TAM, renowned for its efficacy in understanding and predicting users' acceptance and usage of diverse technologies (Saleh *et al.*, 2022), will be leveraged in this study to comprehend users' perceptions and intentions in the context of the designed e-learning system.

In a holistic approach to the design and development of the e-learning system, this research integrates the UX and TAM frameworks. The UX research process ensures a user-centric focus, while the TAM framework provides a theoretical lens to comprehend and predict user acceptance, guiding the overall research methodology. Together, these frameworks offer a structured basis for understanding user needs, attitudes, and the critical factors influencing the acceptance and adoption of the virtual e-learning system.

3.3 Perceive Usefulness (PU)

Perceived Usefulness (PU) represents the user's evaluation of how technology will enhance their performance or help them attain specific goals. It gauges the practical utility and benefits a user expects from adopting a particular technology. Dhingra and Mudgal's (2019) research underscores the significance of PU as a determinant influencing consumer attitudes and intentions in various domains, such as online shopping, internet marketing, software usage, social media advertising, e-banking, education, and healthcare. Their study establishes PU as a pivotal factor cutting across diverse fields, providing a robust foundation for future research into adopting emerging technologies. PU proves critical in shaping users' attitudes and intentions in technology adoption. Users gravitate towards technologies perceived as valuable in fulfilling their tasks or objectives. Applying PU to e-learning lets us comprehend how users perceive the virtual platform's utility in enriching their learning experience. This insight can be gleaned, for example, through questionnaire-based inquiries that probe whether students believe the e-learning system contributes to enhanced comprehension, engagement, and knowledge acquisition.

3.4 Perceive Ease of Use (PEOU)

Perceived Ease of Use (PEOU) pertains to the user's judgment of the effort needed to operate a technology, evaluating their perception of the system's complexity and ease of use. Dhingra and Mudgal's (2019) research emphasizes PEOU as a determinant influencing consumer attitudes and intentions across a spectrum of applications, including online shopping, internet marketing, software usage, social media advertising, e-banking, education, and healthcare. Their study underscores the pivotal role of PEOU in various fields, providing a robust foundation for future research on its impact on the adoption of emerging technologies. The influence of PEOU extends to shaping users' attitudes and intentions regarding technology adoption. Users exhibit a higher propensity to adopt technologies perceived as easy to use, requiring minimal effort in their operation.

In the realm of e-learning, applying PEOU allows for an assessment of how students and instructors perceive the ease of navigating the virtual platform, accessing learning materials, and engaging in various educational activities.

3.5 Attitude to Wards Using (A)

Attitude toward Using (A) mirrors the user's favorable or unfavorable sentiments regarding adopting a specific technology, influenced by their perceptions of usefulness and ease of use. Recent research by Huang (2023) has demonstrated that a positive attitude toward using a system positively impacts users' intention to use it. Stands as a pivotal construct that mediates the influence of Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) on users' intentions to employ technology. Positive attitudes foster heightened acceptance and adoption. In the realm of e-learning, comprehending the attitudes of students and instructors toward using the virtual platform offers valuable insights into the overall acceptance of the system. It serves as a predictor of their intentions to actively engage with the platform.

3.6 Behavioral Intention to Use (BU)

Behavioral Intention to Use (BI) represents the user's planned or intended future use of a specific technology, acting as a direct precursor to actual system usage. Fitrianie *et al.* (2021) discovered that behavioral intention and facilitating conditions effectively explain use behavior. BI serves as a robust predictor of actual technology adoption and usage. Users harboring positive behavioral intentions are more inclined to translate these intentions into actual usage. In the context of e-learning, evaluating the behavioral intentions of students and instructors regarding using the virtual platform yields valuable insights into the likelihood of sustained and meaningful engagement with the system. A comprehensive understanding of BI aids in predicting the successful adoption and continued use of the e-learning platform.

3.6.1 Types of Data and Data Collection

The type of data used in this inquiry is primary data. Researchers can get primary data in various ways, such as through questionnaires, experiments, and other methods, including surveys, interviews, and so on. Mainly obtained directly from the data source, primary data is regarded as the most significant data source in research. (Hewson & Laurent, 2012).

In order to attain the objective of this research, qualitative and quantitative data analysis methods were implemented as they will provide accurate results that will be derived from various research methods (McKinney *et al.*, 2002). Since assessment feedback will come mainly from students and lecturers actively engaged in the Virtual E-Learning process, quantitative and qualitative methods are used for the assessment feedback; these are essential elements in determining the framework of online learning (McKinney *et al.*, 2002). Information regarding the effectiveness and use of virtual e-learning can be obtained from different sources on the internet; however, this study is mainly focused on a few public universities in Sierra Leone; the quantitative methodology will be mainly an online application (google questionnaire) from selected students and lecturers from different public universities, a brief explanation of the questionnaire will be made to the respective participant. The Application and use of quantitative methodological research enhances a broader scope of study with more parameters enabling outcome simplification. (Foreman, 2017). The stages of this research methodology are diagrammatically demonstrated below diagrammatically demonstrated below:

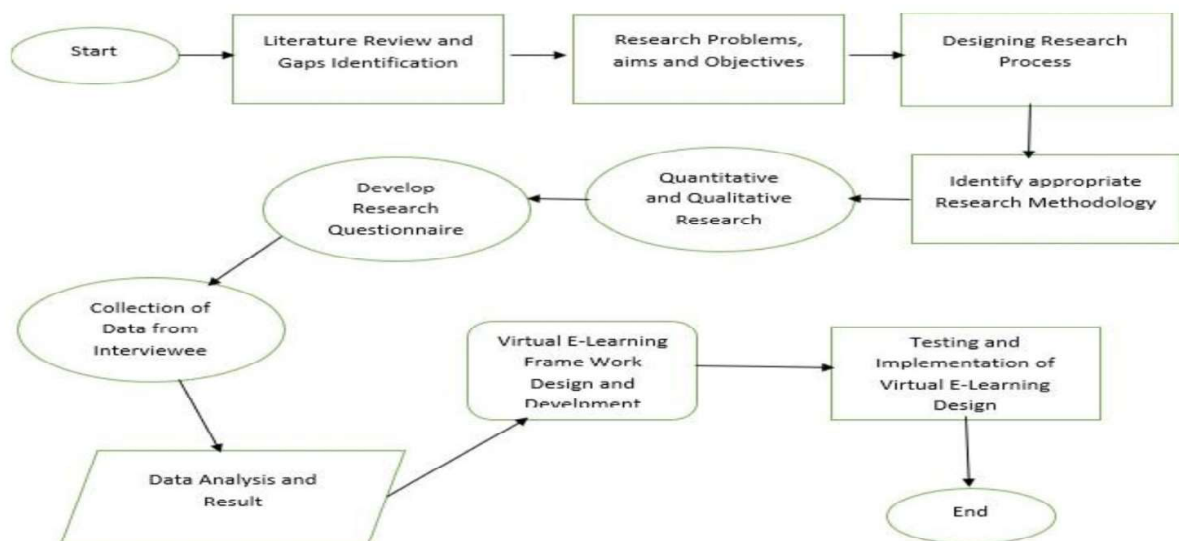


Figure 2: Research Process Stag

3.6.2 Population of The Study

The study encompasses university students and staffs from three institutions: Njala University, Milton Margai Technical University, and Eastern Technical University of Sierra Leone. Njala University, established in August 2005, is situated across two campuses: Njala Campus and Bo Campus. Bo Campus, located just outside Bo City, houses three schools: Education, Community Health Services, and Social Sciences. Njala Campus, located east of Freetown, has the other three schools - Agriculture, Environmental Sciences, and Technology. Milton Margai Technical University originated in 2001 through the merger of Milton Margai College of Education, Freetown Technical Institute, and Hotel Tourism Training Institute. The university has three campuses: Goderich Campus, Congo Cross Campus, and Brookfield Campus, each specializing in different faculties. Eastern Technical University of Sierra Leone, initially established in 1924 as a training center, evolved through mergers and transformations. Currently located at Kenema, Bunumbu, and Woama, the university spans three districts and has diverse campus sizes. As of the 2022-2023 academic year, all three universities collectively host a student population of 40,500. The study collected data from 400 students through a closed-end questionnaire administered in English. The data will be entered and analysed using the Scientific Package for Social Science (SPSS) statistical software package.

3.6.3 Data Collection for Analysis and Participants Selection

Obtaining information from a geographically dispersed population, as is the case with this research involving students and lecturers from Njala University, Milton Margai Technical University, and Eastern Technical University of Sierra Leone, presented a logistical challenge. Due to the absence from the research location, an innovative approach was adopted to gather relevant information for this research. As highlighted earlier, a multifaceted method was employed, combining primary data collection using designed questionnaires and leveraging existing information from previous research on virtual e-learning. To underpin the research questions with robust evidence, insights from diverse sources were considered.

Questionnaires were meticulously crafted in alignment with the User Experience (UX) and Technology Acceptance Model (TAM) frameworks, as detailed in the research design section.

These frameworks informed the construction of questions based on their specific constructs, ensuring a comprehensive exploration of users' perceptions, attitudes, and intentions towards the virtual e-learning system. The design of the questionnaire, detailed in Appendix B, intricately considered the aspects

and variables identified in the research design section. Questions were framed to capture diverse dimensions related to user experience and technology acceptance, providing a nuanced understanding of participants' perspectives.

The questionnaires were disseminated through various channels to maximize participation. Specifically, they were shared on official university WhatsApp groups accessible to both students and lecturers. Recognizing the importance of flexibility, the questionnaire links were also prominently displayed on announcement boards across diverse campuses of the participating universities. This approach allowed individuals to conveniently scan the QR codes posted and access the questionnaire pages.

3.7 Research Instrument

Responses to the survey were categorized into a point Likert scale format with the options; “1=Strongly Disagree”, which implies that an item exclusion has not affected the adequate measure of virtual learning; on the other hand, an item with a rating of “5=Strongly Agree”, implies there is a detrimental measure toward effective virtual e-learning. An element with a rating of “2 = Disagree” may indicate a possible measure that impacts virtual e-learning, and “4 = Agree” can be considered an influential factor in facilitating virtual e-learning. In contrast, an item with a rating of “3 = Neutral” may not be considered because it has little bearing on the outcome.

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Virtual E-Learning Support: <i>We have all the necessary support and advice on e-learning course content.</i>					

Table 1: Shows an example question

3.7.1 Sample Size

To determine the sample size, Yamane's (1967: 886) formulae were used. The estimated formulas are given below:

$$n = \frac{N}{(1 + N(e)^2)}$$

Where

population proportion $P = 0.5$,

E margin of error = 0.05

Population size $N = 45,000$.

$$n = 45,000 / (1 + 45,000(0.05)^2)$$

Sample size = 400

Z Scores = 1.96,

Therefore:

$$n = \frac{45,000}{(1 + 45,000(0.05)^2)}$$

$$n = 400$$

Hence, the sample size used for this study is rounded to 400, providing a more rounded and practical figure for our analysis.

Confidence Level: The Probability that a parameter's value falls within the specified range of values. The Confidence level is set below the table.

Confidence Level	Z-Value
90%	1.645
95%	1.960
99%	2.576

Table 2 : Confidence Level

3.8 Data Analysis Technique

The analysis of the collected data in this research will be conducted using the Statistical Package for Social Sciences (SPSS version 25.0). The mean and standard deviation are two examples of descriptive statistics, for instance., will be employed for continuous data to provide a comprehensive understanding of the dataset. For categorical variables, the Chi-Square test, a non-parametric statistical test, will be executed to examine associations and dependencies. The Chi-Square test will specifically be applied to discern relationships among various categorical variables, investigating, for instance, the correlation between user satisfaction and system usability. Information derived from statistics, such as the Pearson correlation coefficient, will also be employed to measure the strength and direction of linear correlations between continuous variables. This analysis approach is designed to unravel nuanced connections within the dataset, offering insights into the interplay between different factors. Every statistical test will be run through a significance level of 0.05, ensuring the dependability and validity of the findings data analysis process.

3.8.1 Descriptive Statistics

In this research, descriptive statistics are employed to briefly present and summarize data about the utilization of virtual e-learning in higher education. Descriptive statistics offer a condensed overview of data frequencies and serve as a summary of the collected information. Using SPSS V.25, the study quantifies the data, providing short descriptive coefficients describing the population sample and the specific dataset under examination. Two fundamental types of descriptive statistics, namely variability measurements and central trend measures, are utilized in this study, focusing on providing insights into the mean and standard deviation of the data. The measurement of data distribution information is facilitated through the application of SPSS V.25, enhancing the clarity and depth of the data analysis process.

3.8.2 Ethical Consideration

In conducting this research, ethical considerations were meticulously integrated to safeguard the well-being and rights of the participating individuals. The respondents were provided with clear and comprehensive information, emphasizing that the study was solely for academic purposes, promoting transparency in the research endeavor.

To guarantee the safety and privacy of the gathered information., Google Forms, accompanied by secured QR codes, was employed, and access was restricted solely to the principal investigator. Moreover, stringent measures were implemented to guarantee the voluntary participation of respondents, free from coercion, manipulation, or exploitation. The questionnaire and communication utilized clear and neutral language, emphasizing the voluntary nature of participation. Confidential information, such as names, was kept undisclosed to protect the respondents' anonymity further. Continuous monitoring and adherence to ethical guidelines and regulations were prioritized throughout the research, reinforcing a commitment to maintaining trust and upholding the ethical standards integral to research involving human participants.

3.8.3 Data Analysis and Statistical Result

Data for the analysis was gathered through an online questionnaire administered via Google Forms across three prominent public universities: Njala University, Milton Margai, and Eastern Polytechnic. The questionnaire consisted of two distinct sections. The first part gathers demographic data, encompassing non-sensitive personal information, educational levels, and respondents' familiarity with eLearning technology. The second part delved into specific questions aligned with the User Experience (UX) and Technology Acceptance Model (TAM) frameworks. This comprehensive approach explored users' perceptions, attitudes, and intentions regarding the virtual e-learning system.

The collected data was subsequently analyzed using SPSS, and the results are categorized under the following sections:

3.8.4 Respondent Analysis

The statistics and summary information for respondents, including gender, age group, and educational level, are presented in Tables 3, 4, and 5 below.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	female	130	32.5	32.5	32.5
	male	270	67.5	67.5	100.0
	Total	400	100.0	100.0	

Table 3: Gender Analysis

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 18-25 years	220	55.0	55.0	55.0
26-35 years	114	28.5	28.5	83.5
36-45years	2	.5	.5	84.0
Over 45 years	64	16.0	16.0	100.0
Total	400	100.0	100.0	

Table 4: Age Group Analysis

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Certificate	91	22.8	22.8	22.8
Degree	160	40.0	40.0	62.8
Diploma	96	24.0	24.0	86.8
Master's	44	11.0	11.0	97.8
PhD	9	2.3	2.3	100.0
Total	400	100.0	100.0	

Table 5: Education Level Analysis

The data presented in Table 2 indicates a higher participation of male respondents, constituting 67.5% (270 participants), compared to female respondents, who comprised 32.5% (132 participants) of the total population. As illustrated in Table 3, the age distribution spans from 18 to over 45 years. The age group of 18-25 years emerged as the most populous, representing 55.0% (220 respondents), primarily consisting of teenagers. Respondents aged 26-35 also demonstrated significant interest, accounting for 28.5% (115 participants). On the other hand, participants aged 36-45 years and over 45 years were less represented, indicating a lower level of interest in the survey. Table 4 delves into the respondents' academic levels, revealing that degree students constituted the majority, with 40% (160 participants) of the total population. Diplomas and certificates also contributed substantially, with 91 and 96 respondents representing 22% and 24%, respectively. The data suggests a diverse interest in eLearning implementation, with younger students showing heightened enthusiasm. The survey collected responses from 400 participants across various academic levels.

3.8.5 Forms of E-Learning

As discussed in section 3.5.4, descriptive statistics have been employed to succinctly summarize data pertaining to the utilization of e-learning across the three higher institutions surveyed. The data has been analyzed using SPSS V.25, providing both percentages and frequency summaries. In the first section of the questionnaire, respondents were asked about their regular use of specific e-learning applications. The statistical results, detailing the forms of e-learning applications commonly used by the users, are presented in Table 5 and Figure 3 below:

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Google Class Room	94	23.5	23.5	23.5
Skype	19	4.8	4.8	28.3
WhatsApp	22	5.5	5.5	33.8
Zoom	265	66.3	66.3	100.0
Total	400	100.0	100.0	

Table 6: Forms of e-learning applications

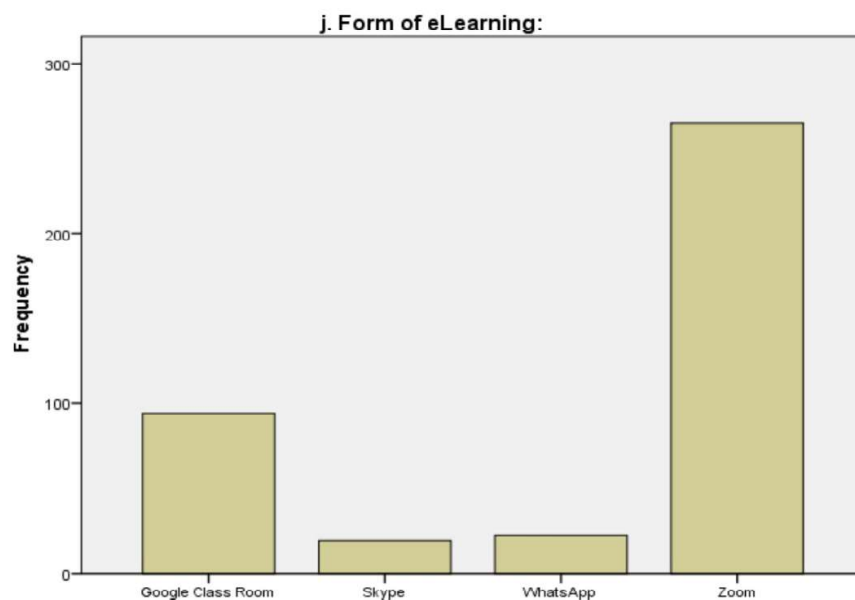


Figure 3: Frequency visualization of the forms of e-learning applications

The result presented in Table 5 and illustrated in Figure 3, reflecting the responses of the participants, highlights that a significant proportion, 94 responses or 23.5% of the total, favoured the use of Google Classroom. Zoom online lectures emerged as the predominant choice among respondents, with 265 responses constituting 66.3% of the total. In contrast, a smaller percentage of students opted for Skype and WhatsApp, accounting for merely 5.5% and 4.8%, respectively, of those surveyed. The data indicates that Zoom and Google Classroom stood out as the most commonly used e-learning tools among users across their respective institutions.

3.8.6 Efficiency of E-Learning

The effectiveness of the e-learning instrument is assessed through eighteen questions designed within the Technology Acceptance Model (TAM) framework and User Experience (UX). These questions delve into users' perceptions, experiences, attitudes, the ease of perceived usefulness, intentions, and interactions with the e-learning platform. The TAM framework explores users' attitudes and intentions toward adopting the technology. In contrast, the UX framework ensures a comprehensive understanding of users' experiences and interactions with the virtual e-learning system. The questionnaire employs a 5-point Likert scale, encompassing responses such as Disagree (D), Strongly Agree (SA), Strongly Disagree (SD), Neutral (N), Agree (A), and Strongly Agree (SA). Table 6 below not only presents the responses but also displays the average value for each question item, offering insights into the overall effectiveness of the e-learning system based on user feedback.

No	ITEM	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean	σ	Decision
1	Can e-learning substitute traditional teaching and learning methods?	12 (3.0)	18 (4.5)	128 (32.0)	206 (51.5)	36 (9.0)	3.59	0.833	High Perception
2	Would you recommend e-learning for tutoring at your university?	0 (0.0)	24 (6.0)	202 (50.5)	126 (31.5)	48 (12.0)	3.50	0.782	Low Perception

3	Can an e-learning platform provide the academic resources to learn accordingly?	0 (0.0)	42 (10.5)	55 (13.8)	243 (60.8)	60 (15.0)	3.80	0.819	High Perception
4	The eLearning platform design would provide relevant use and information for learners and instructors, easily accessible via the website address.	0 (0.0)	42 (10.5)	73 (18.3)	243 (60.8)	42 (10.5)	3.71	0.791	High Perception
5	Virtual e-learning platform records or enables instructors to time and manage students and provide excellent and fair grading.	6 (1.5)	12 (3.0)	82 (21.3)	200 (50.0)	97 (24.3)	3.93	0.840	High Perception
6	Virtual E-Learning system is important to facilitate interactive session such as Q&A forums and colaborative group activities?	6 (1.5)	66 (16.5)	177 (44.3)	96 (24.0)	55 (13.8)	3.32	0.956	Low Perception
7	Virtual e-learning platform records or enables instructors to time and manage students and provide excellent and fair grading.	12 (3.0)	92 (23.0)	181 (45.3)	85 (21.3)	30 (7.5)	3.07	0.927	Low Perception

8	Your experience with the current eLearning platforms user and accessibility friendly.	6 (1.5)	55 (13.8)	171 (42.8)	138 (34.5)	30 (7.5)	3.33	0.859	Low Perception
9	Managing Virtual eLearning resources by university administrators is feasible and can be done appropriately.	0 (0.0)	6 (1.5)	31 (7.8)	248 (62.0)	115 (28.8)	4.18	0.627	High Perception
10	Do you anticipate challenges while transitioning to new Virtual eLearning specifically related to its design and functionality?	6 (1.5)	6 (1.5)	67 (16.8)	242 (60.5)	79 (19.8)	3.96	0.748	High Perception
11	Students, lecturers and administrators can self-handle the access to virtual eLearning resources and learning.	18 (4.5)	67 (16.8)	129 (32.3)	144 (36.0)	36 (9.0)	3.24	1.072	Low Perception
12	Would you prefer e-learning over the conventional traditional delivery method throughout your academic studies?	6 (1.5)	12 (3.0)	85 (21.3)	200 (50.0)	97 (24.3)	3.93	0.840	High Perception

13	Instructors, students, and university administrators have good attitudes and will embrace using and implementing virtual eLearning.	6 (1.5)	66 (16.5)	177 (44.3)	96 (24.0)	55 (13.8)	3.32	0.956	Low Perception
14	Virtual e-learning can improve students' learning skills and performance effectively.	12 (3.0)	92 (23.0)	181 (45.3)	85 (21.3)	30 (7.5)	3.07	0.927	Low Perception
15	Lecture goals and objectives are clearly defined in eLearning resources.	6 (1.5)	55 (13.8)	171 (42.8)	138 (34.5)	30 (7.5)	3.33	0.859	Low Perception
16	Virtual eLearning provides a satisfying and positive learning experience.	0 (0.0)	6 (1.5)	31 (7.8)	248 (62.0)	115 (28.8)	4.18	0.627	High Perception
17	Financial (transportation, buying of textbooks) constraints can be avoided while using virtual eLearning for students and lectures.	6 (1.6)	6 (1.5)	67 (16.8)	242 (60.5)	79 (19.8)	3.96	0.748	High Perception
18	Pre-recorded and online lecturers or a combination of the two is preferable for content delivery.	18 (4.5)	67 (16.8)	129 (32.3)	150 (37.5)	36 (9.0)	3.24	1.072	Low Perception

Table 7: Total Frequency Count of Respondent, Percentage and Decision

Note: N=400 , SA= Strongly Agree , D=Disagree , N= Neutral , A=Agree, SA=

Strongly Agree. Decision -Weighted Average = $64.66/18 = 3.59$

In evaluating the outcomes of the research study, the perceptions of the respondents play a pivotal role. To gauge this, a weighted average value is computed. The sum of the mean values for all items is divided by the total number of items. The resulting decision is categorized into Low Perception and High Perception. When the mean of an item is lower than the weighted average, it suggests that respondents may find the particular question not applicable or visible. Conversely, if the mean is higher than the weighted average, it indicates that respondents perceive the item as applicable in reality.

Analyzing the data presented reveals that students are strongly inclined to embrace an e-learning system, as reflected by the average mean weighted value of 3.592. Most respondents expressed a positive attitude regarding their eagerness to engage with virtual e-learning, exhibiting a preference for an environment that is both user-friendly and interactive. Examining specific questions with high percentage values, such as questions 3, 5, 8, 7, and 11, further supports this trend, indicating that a majority of students strongly agree with these items.

Conversely, questions 12, 16, and 17 recorded some of the highest percentage responses. For instance, the question on preferring e-learning over the traditional method showed that students believe e-learning facilitates easier access to educational resources anytime and anywhere. Overall, respondents expressed a positive view of the usefulness of e-learning in their academic processes, particularly in tertiary institutions.

3.8.7 Likert Scale Frequency Table

Item Number	Valid	Frequency	Percent
1	Strongly Disagree	12	3.0
2	Disagree	18	4.5
3	Neutral	128	32.0
4	Agree	206	51.5
5	Strongly Agree	36	9.0
	Total	400	100.0

Table 8: Likert-scale frequency table

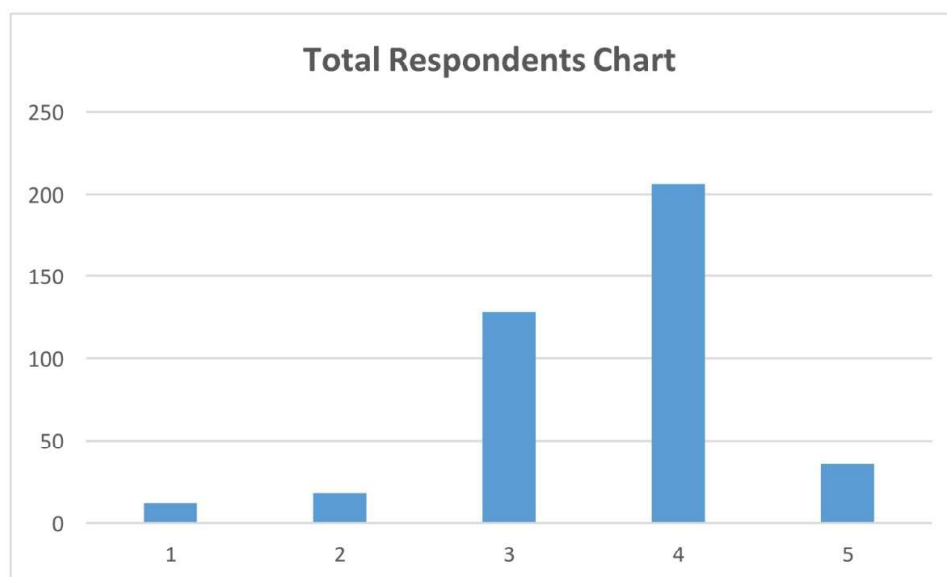


Figure 4: Bar-chart visualization of all respondent responses

The Likert scale responses from all respondents were categorized into 'strongly disagree' (SD), 'disagree' (D), 'agree' (A), and 'strongly agree' (SA). Figure 4 above illustrates the e-learning perspectives of the entire respondent pool, totaling approximately 400. Notably, most responses, specifically 206 (51.5%), fell under the 'agree' category, indicating a substantial agreement among nearly half of the total respondents. Interestingly, the 'neutral' option garnered responses equivalent to half of those in the 'agree' category, making it a noteworthy perspective among the respondents. Conversely, 'strongly disagree' received the fewest responses, comprising only 3.2% of the comments. This distribution suggests a prevailing consensus among students from public universities that implementing e-learning in Sierra Leone's educational institutions would be successful.

In summary, the data reflects a prominent and positive perception of e-learning, with students expressing a willingness to adopt the platform, particularly within the context of public higher education institutions in Sierra Leone.

3.8.8 Validity and Reliability Test of Instrument

The Pearson product-moment correlation test in SPSS was employed to determine the validity of the questionnaire. This test involved comparing the values of the r-test with the critical r-table values. The questionnaire item was considered valid if the r-test was greater than the r-table. Conversely, if the r-test was less than the r-table, the item was deemed invalid.

Additionally, reliability was evaluated using the Cronbach alpha test. According to Sujerweni's (2014) recommendation, a Cronbach alpha value higher than 0.60 indicated a credible questionnaire, demonstrating its reliability.

3.8.9 Reliability Test of Instrument

The Pearson product-moment correlation test in SPSS The questionnaire's validity was assessed using this method.. This test involved comparing the values of the r-test with the critical r-table values. The questionnaire item was considered valid if the r-test was more significant than the r-table. Conversely, if the r-test was less than the r-table, the item was deemed invalid.

Additionally, reliability was evaluated using the Cronbach alpha test. According to Sujerweni's (2014) recommendation, a Cronbach alpha value higher than 0.60 indicated a credible questionnaire, demonstrating its reliability.

A Cronbach's alpha close to 1.0 indicates high internal consistency among the items.

Scores greater than 0.8 are generally recommended for research purposes, while values above 0.7 are frequently accepted.

No	Variable	Items	Cronbach's Alpha	Criteria
1	eLearning effectiveness and Implementation	18	0.887	Reliable

Table 9: Item-Total Statistics and Cronbach's Reliability Test

NO	ITEMS	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
1	Can e-learning substitute traditional teaching and learning methods?	61.10	71.633	.576	.879
2	Would you recommend e-learning for tutoring at your university?	61.20	72.722	.533	.880
3	eLearning platform designed would provide relevant use and information for learners and instructors, which can be easily accessible via website address.	60.98	73.812	.442	.883
4	Virtual e-learning platform records or enables instructors to time and manage students and provide excellent and fair grading.	60.77	73.381	.442	.883
5	Virtual E-Learning system is important to facilitate interactive session such as Q&A forums and collaborative group activities?	61.37	70.716	.548	.880

6	Objectives of learning and assessment are aligned with virtual e-learning platform delivery.	61.62	67.544	.790	.870
7	Your experience with the current eLearning platform is user and accessibility friendly.	61.37	71.862	.539	.880
8	Your experience with the current eLearning platform is user and accessibility friendly.	60.51	73.709	.589	.880
9	Managing Virtual eLearning resources by university administrators is feasible and can be done appropriately.	60.74	74.388	.426	.884
10	Do you anticipate challenges while transitioning to new Virtual eLearning specifically related to its design and functionality?	61.46	72.299	.384	.887
11	Students, lecturers and administrators can self-handle the access to virtual eLearning resources and learning.	60.77	73.381	.442	.883
12	Would you prefer e-learning over the conventional traditional delivery method throughout your academic studies?	61.37	70.716	.548	.880
13	Instructors, students, and university administrators have good attitudes and will embrace using and implementing virtual eLearning.	61.62	67.544	.790	.870

14	Virtual e-learning can improve students' learning skills and performance effectively.	61.37	71.862	.539	.880
15	Lecture goals and objectives are clearly defined in eLearning resources.	60.51	73.709	.589	.880
16	Virtual eLearning provides a satisfying and positive experience learning experience.	60.74	74.388	.426	.884
17	Financial (transportation, buying of textbooks) constraints can be avoided while using virtual eLearning for students and lectures.	61.40	72.110	.433	.884
18	Pre-recorded and online lecturers or a combination of the two is preferable for content delivery.	60.89	74.402	.380	.885

Table 10: Validity Test result for each item

The reliability test results for the questionnaire survey are shown in table 9 above. The Cronbach Alpha coefficients for each variable are all in the range of 0.887, which indicates excellent questionnaire reliability. Each item had a Cronbach alpha coefficient of 0.60 or above, more than α .

3.9.1 Instrument Validity Test

Ensuring the reliability and validity of techniques employed to measure and collect study data is crucial for researchers. A validity test serves as a valuable tool in this process. In this study, the validity of the questionnaire was assessed by employing the Pearson product-moment coefficient of correlation between each questionnaire item's scores and the overall score of responses in the utilized SPSS version.

The results of the validity test, including the correlation coefficients for each question item, are presented in Table 10 below. Additionally, the significance level (5 per cent) for $N = 400$ is provided along with the validity test results.

Question	Coefficient of Correlation	Critical Value 5% (N=400)	
Q1	0.639		Valid
Q1	0.594		Valid
Q3	0.457		Valid
Q4	0.511	0.0981	Valid
Q5	0.515		Valid
Q6	0.620		Valid
Q7	0.827		Valid
Q8	0.605		Valid
Q9	0.633		Valid
Q10	0.493		Valid
Q11	0.483		Valid
Q12	0.515	0.0981	Valid
Q13	0.620		Valid
Q14	0.827		Valid
Q15	0.605		Valid
Q16	0.633		Valid
Q17	0.521		Valid
Q18	1.000		Valid

Table 11: Validity Test result

With a sample size of 400, the values in Table 10 above are based on the ratio of the two tails as determined by Pearson correlations. The degree of freedom (DF), which may be calculated as the sample size less the number of limitations, is an independent

piece of data used in statistical calculations.

Most studies consider the critical value's significance level significant at 5% ($\alpha = 0.05$). The degree of freedom for this study was ($df = N$ minus 2), with N being the total number of respondents. $Df = N-2$, $DF = (400-2)$.

This suggests that $DF = 398$; based on Pearson's correlation coefficient table numbers, 0.0981 is the critical value at 398. Question 1(Q1) obtained a value of 0.639, which is greater than the critical value of 0.0981 and is highly significant. Therefore, the question is valid. This also applies to all the corresponding questions(Q2 -Q18) whose values are higher than the critical value.

CHAPTER IV

System Analysis & Design

4.1 Overview

The phrases "synthesis" and "analysis," which mean "to put together" and "to take apart," respectively, come from the ancient Greek language. Many scientific fields, including economics, psychology, logic, mathematics, and economics, utilize these terminologies to characterize similar study approaches. "Analysis" indicates "the methodology used to break down a mental or substantial entity into its components." Moreover, according to Wikipedia writers (2023a), "synthesis" is "the process of combining disparate components or elements to create a cohesive whole." When examining dynamic systems, system analysts follow a procedure to get an overview. System analysis makes it simpler to become actively involved in a project rather than seeing it as a single module. This ensures accurate execution and appraisal of the project. After the project is completed, the architect offers the customer a trial. If problems do occur, they have to be fixed. System analysis concentrates on studying the system domain to properly comprehend the problem. It entails gathering and analyzing data, determining issues, and breaking down a system into its constituent parts. The process of examining a system or some of its components and determining its intended purpose is known as system analysis. It's a method of problem-solving that improves the system and ensures that each part functions properly to fulfil its designated tasks.

In this section, the approach and design utilized for this study's methodology and research are presented.

4.2 Existing System

Virtual e-Learning system has made an immense in the private and public sector. Many Universities in advanced countries have long made use of and implemented the services provided By online learning system. However, as mentioned earlier and also from the statistical. Analysis: most of the universities in the Sierra Leone context have yet to implore the fully

Effective use of e-learning. Further studies on three universities, MMCET, NU, and ETU, found that all three currently use the traditional means of tutoring students and that most academic and administrative activities are done manually.

This is because the university eLearning system has not been functional over the past years due to a lack of infrastructure and management of the existing learning system. Several issues, which include user-friendliness, reliability, performance, and network infrastructure resources, have led to users not being absorbed in using the existing system. Some of the universities only provide Online Application for intake of new students, which has been functional but however, has a very slow performance which engage by hundreds of online applicants for application process or admission

A preferable means of most of the universities e learning has been google meet or zoom, which has not been efficiently utilize or has help to administrate daily functions of the universities efficiently.

The figure below shows some of the design of the universities eLearning systems.

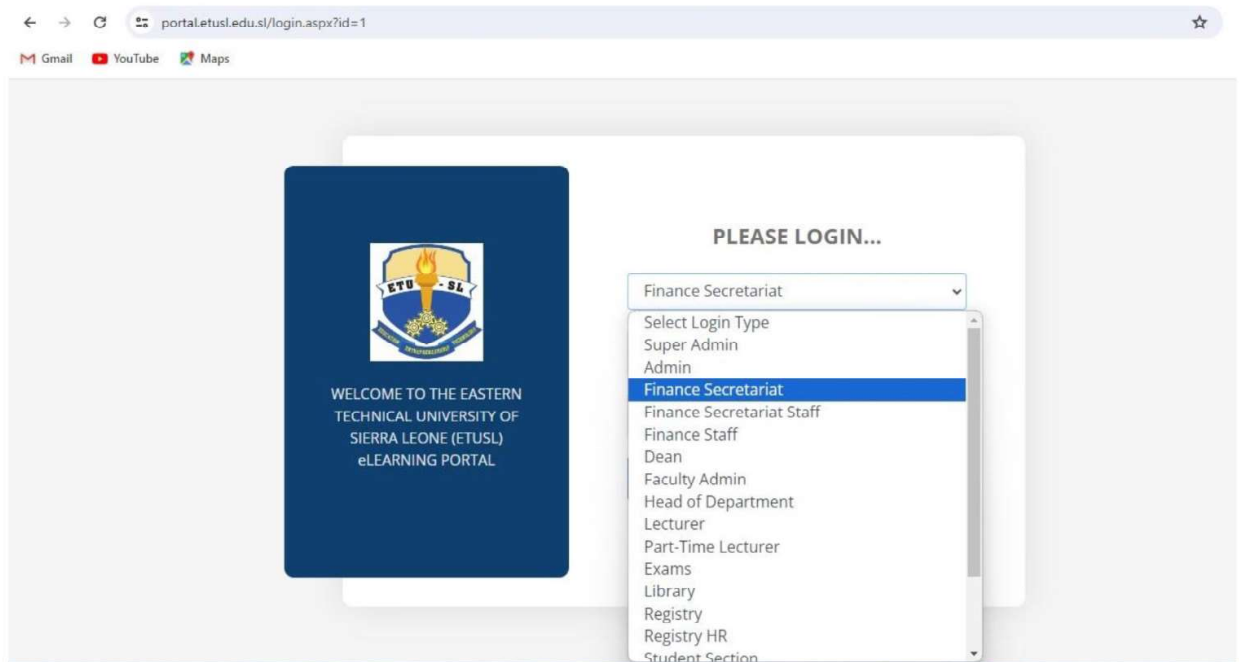


Figure 5: Eastern Technical University

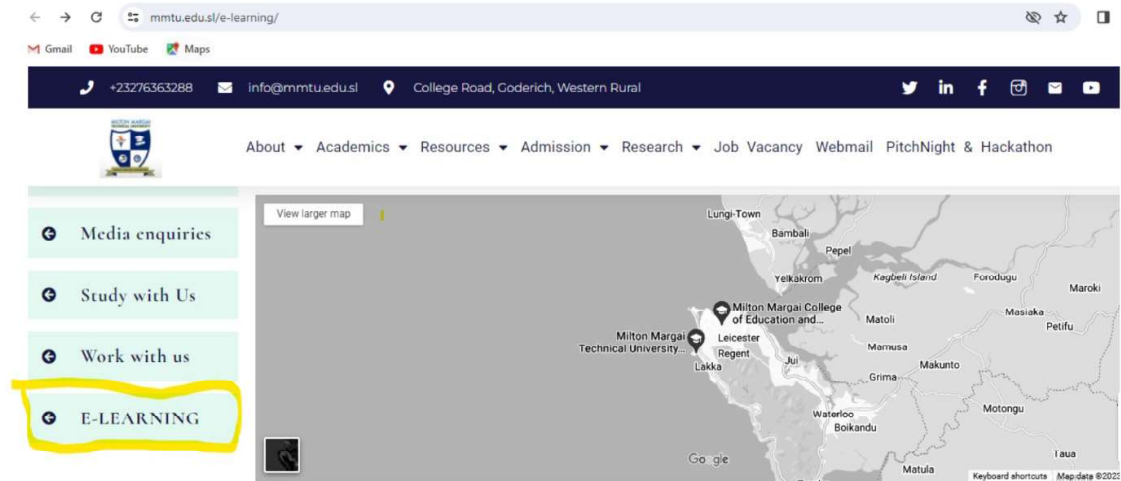


Figure 6 : MMCET e-Learning Page

4.3 System Development and Tools

In designing and developing uniPortal, the e-learning platform for this study, various programming languages were thoroughly assessed, considering crucial factors such as usability, user experience, and overall system effectiveness. The chosen micro-service architecture, a framework that divides the application into small, independently deployable services, was driven by its scalability, modularity, and reliability benefits.

Next.js, a JavaScript framework, was selected for front-end development due to its capacity for server-side rendering, enhancing performance and expediting page loads. This choice aligns with user experience (UX) principles, aiming to deliver a user-friendly interface, accessibility, and interactive features to engage learners effectively. The system prioritizes feedback mechanisms to continuously refine the user experience based on valuable insights from the education community.

On the other hand, the system's back-end utilizes Laravel PHP and MySQL, chosen for their reliability and security features. Laravel PHP's proficiency in ensuring system security aligns with the user acceptance goals defined by the Technology Acceptance Model (TAM). Emphasis is placed on creating a robust and secure system that meets the perceived usefulness and ease of use criteria, fostering a positive attitude toward the e-learning platform.

The micro-services approach enables the system to be scalable, modular, and reliable. By breaking down the software into independent micro-services, each platform facet can be developed, deployed, and scaled autonomously. This design aligns with the scalability requirements, ensuring the system can grow alongside an expanding user base and evolving educational demands.

In essence, uniPortal development reflects a holistic consideration of UX and TAM frameworks, with the micro-services architecture and selected technologies serving as the backbone for a robust, scalable, and user-centric virtual e-learning platform.

4.3.1 Proposed System Design

Software for virtual education requires a great deal of work to develop and manage. As a result, various factors need to be taken into account. It was discovered throughout this research and analysis that the need for more technology and human resources to administer had prevented the most university's in administering e-learning system from operating. This has resulted in several administrative tasks being completed manually that need to be completed electronically. For instance:

- enrollment of students
- Assigning students to courses
- Setting a Provisional Grade
- Information Accuracy

The virtual e-learning system design aims to create an all-encompassing, user-focused platform that uses cutting edge software designs and technology to improve the e-learning process. The design offers instructors and students a dynamic and participatory environment by bridging the gap between conventional and online learning. Three primary components make up the Virtual E-Learning System's basic architecture:

- Education Administration,
- Online Learning Environment,
- Tools for Engaging Students
-

The platform's core is the learning management system, which handles user accounts, assessments, and course material. It offers a central location where teachers may submit lesson plans, homework assignments, and evaluations, guaranteeing students easy access. Instructors and students can easily navigate the Virtual E-Learning Management because of its user-friendly layout.

In order to improve student involvement, the suggested system includes many tools, including:

- Direct communication to facilitate conversation,
- Tests and the grading of student assignments
- Assignments are uploaded.

Students are encouraged to share their knowledge, think critically, and collaborate using these technologies. Scalability and flexibility are prioritized in the system architecture, which can accommodate different learning models and change to meet changing educational demands.

4.3.2 System Architecture

One important factor determining an e-learning system's functionality, scalability, and structure is its architecture. A robust and practical framework for online education is provided by a well-designed architecture, which guarantees smooth interaction between various aspects.

The system is essentially made up of several essential parts, each of which has a distinct function. The most crucial component is the interface students and instructors use to engage. This interface should be responsive and easy to use to meet various users with different technological ideas. The application layer, which controls the business logic and operation of the virtual e-learning system, is where the system is designed to authenticate all user requests that are made to the database. This is done using PHP and the JavaScript language. This covers user identification and authentication, content and data distribution, assessment tools, and course administration. This is the system's central component, coordinating the information flow and guaranteeing a seamless educational experience.

Since the system is internet-based, the MySQL database saves all the data for users to access anytime. This guarantees data confidentiality, integrity, and speedy retrieval, making it easy for teachers and students to access resources. The proposed virtual e-learning system has a strong networking layer that supports features like live chats, forums, and instructor-uploaded pre-recorded videos to enable real-time communication and collaboration. This creates an educational atmosphere among learners and promotes productive interactions between students and instructors.

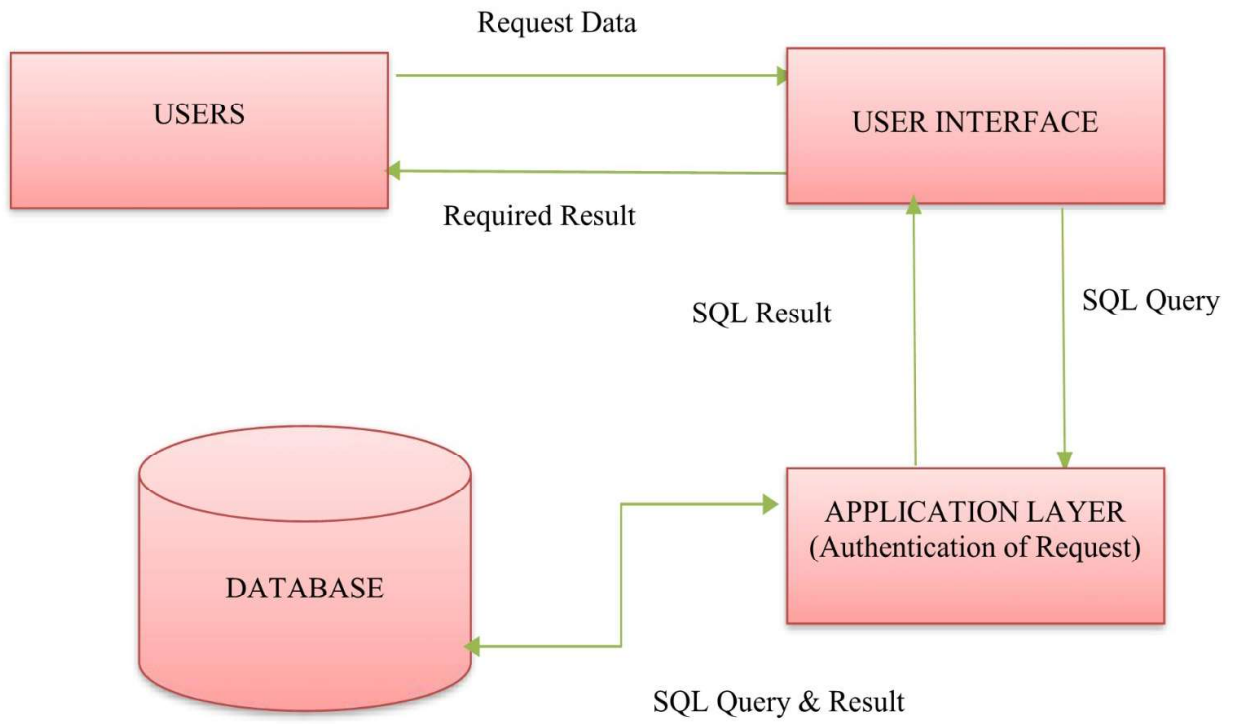


Figure 7. *Architecture Of the System*

CHAPTER V

System Testing and Implementation

5.1 Overview

In this section, the approach and design utilized for this study's methodology and research are presented. Validating user interfaces, functionality, and security are all part of testing of the virtual e-learning systems. Deploying modules enabling seamless learning experiences, guaranteeing scalability, and preserving data integrity will make of the testing and implementation.

5.2 System Requirements

To optimize the user experience and ensure efficient functioning of the uniPortal e-learning system, it is recommended to use the following hardware and software components. Adhering to these recommendations will contribute to a smoother, more responsive, and secure interaction with the online learning platform. Meeting these requirements can enhance the educational experience of the user.

5.2 Hardware Requirements

Component	Minimum	Recommended
Processor	Dual-core 2.0 GHz	Quad-core 2.5 GHz or higher
Ethernet	LAN	Broadband
Hard Drive	128 GB SSD or HDD	256 GB SSD or higher
Memory(RAM)	4 GB	8 GB or more
Key Board	122 keys	-
Graphics	Integrated graphics	Dedicated graphics with 2 GB VRAM

Table 12: Shows the hardware requirement of uniPortal e-learning system

5.3 Software Requirement

Operating System:

- Minimum Requirement: Windows 10, macOS 10.14, Ubuntu 18.04
- Recommended Requirement: Latest versions of Windows, macOS, or Ubuntu
- Web Browsers:
- Minimum Requirement: Google Chrome, Mozilla Firefox, Microsoft Edge
- Recommended Requirement: Latest versions of Chrome, Firefox, or Edge

5.4 System Use Specifications

UniPortal is a comprehensive, web-based platform offering users effortless access to diverse educational resources: resources and interactive features. The system has been tailored to fulfil the user's particular requirements in different user groups, including super admins, university admins, teaching staff, and students. The super admin has complete control over the entire system, managing user roles and system settings and ensuring its overall functionality. University admins have the authority to manage users within their respective universities. Teaching staff use the system to deliver lectures, manage course content, and interact with students. Finally, students can easily access course materials, participate in discussions, submit assignments, and track their academic progress. The system's architecture is designed to cater to each user group's unique needs and responsibilities, creating an efficient and collaborative virtual learning environment.

5.5 Functional Requirements

In requirements specification, functional requirements entail what the system must accomplish and the way it must function; in other words, they describe the system's features, which are focused on the needs of the user (Benslimane *et al.*, 2019).

The table below includes a comprehensive depiction of user level requirements and lays the foundation for developers, administrators, technical teams, and the users in the project. The functional requirements are also significant because they guide developers on what to implement in the system to make it easy for users to perform their tasks. Therefore, functional requirements also detail how the system behaves under certain conditions. For instance, for the uniportal e-Learning system, the following are the functional requirements:

User Level		Requirement Description	Related requirement
All users	R1	Users authentication: User Login, Password Reset	-
All users	R2	Manage settings: profile settings, notification settings, privacy settings	-
Super Admin	R3	Manage universities: add/create accounts, restrict access, update accounts, delete accounts	R1
Super Admin	R4	Manage academic year: add, delete	R1
Super Admin	R5	Resolve issues reported by university admin	R1
Super Admin	R6	Manage Inquires about the portal	R1
Super Admin	R7	Perform Database Backup	R1
Teaching Staff	R8	Course Management: add course details, add quizzes and assignment, add learning material(videos, documents etc), update course content, set attendance, conduct lecture online	R1, R9

Teaching Staff	R9	Enabled course registration for assigned courses	R1, R8
Teaching Staff	R10	Assessment: grade assessment	R1, R8, R10
Teaching Staff, Student	R11	Communication: course-related announcements, messaging, discussion forums	R1, R8, R9
Teaching Staff	R12	Reporting: assigned students, registered students to assigned courses	R1, R8, R9
Teaching Staff: HOD/ Dean	R13	Assign course to instructor	R1, R8, R9
Teaching Staff: HOD/ Dean	R14	Approve grades	R1, R10
Teaching Staff: HOD/ Dean	R15	Course Management: Add courses to department, update course details	R1, R8
Teaching Staff: HOD/ Dean	R16	Assign course advisors to student	R1, ..
Teaching Staff: HOD/ Dean, University Admin	R17	Add event or delete added event	R1
Student	R18	Course Management: register for courses, view approved courses, view course material, download course material, take test, submit assignment	R1, R9
Student	R19	View Grades and Transcript	R1, R18
Student	R20	Reports: view financial report, view reported issues	R1, R21
Student	R21	Log Issues for Support Staff	R1
Student	R22	View university events	R1
Student	R23	View books added in the university	R1

University Admin	R24	User management: Add/Create accounts for all teaching staffs and student, manage user access level	R1
University Admin	R25	Issue management: resolve internal issues, report issues to super admin	R1
University Admin	R26	Manage Calendar - Semester & Term	R1
University Admin	R27	Add Programs and Courses	R1, R30
University Admin	R28	Manage books: add, update and delete	R1
University Admin	R29	Backup university related data	R1
University Admin	R30	Department management: add, update, delete	R1
University Admin	R31	Manage reports: finance report, analytics report, reported issues, transcript report	R1, R24, R31
University Admin	R32	Manage student finance	R1

Table 13: Shows the functional requirement of uniPortal e-learning system

5.6 Non-Functional Requirements

The Non-functional requirement of uniPortal that describes the attribute of the service provided by the e-learning system is sub-grouped under the below categories:

5.7 Security Requirements

The uniPortal e-learning system prioritizes robust security measures to safeguard user information and system integrity. It enforces a stringent password policy, mandating a minimum of 8 characters, disallowing the reuse of previous passwords, and prohibiting easily guessable combinations such as '12345678' or users' names. Users are prompted to change their passwords at regular intervals for enhanced security. Notifications about any changes to passwords or personal data are promptly sent through in-app and other preferred communication channels. Access control is implemented through predefined roles, limiting specific operations; for example, only

the system admin can perform R3 - R7 as defined in Table 1 above. Authentication is required to access most pages, except for the landing page, and secure sessions prevent session hijacking and unauthorized access.

The system employs Laravel framework encryption to secure all sensitive data during transmission and storage, adding an extra layer of protection. Regular backups are facilitated, with university administrators responsible for university-related data and super administrators overseeing comprehensive portal data backups to mitigate potential data loss. Detailed audit trails are maintained, logging user activities and system events for robust security monitoring. The system diligently adheres to relevant data protection and privacy regulations, upholding legal and ethical standards in user data utilization.

5.8 Performance Requirements

The uniPortal e-learning system places a high premium on performance, striving to deliver users a seamless and efficient learning experience. Key to this objective is the system's responsiveness, maintaining an average response time of 2 seconds or less for standard operations. This ensures users can navigate the platform with minimal delays, contributing to an optimal user experience. Concurrency is another critical consideration, with the system engineered to support many simultaneous users. This capability ensures multiple users can engage with the platform concurrently without encountering performance bottlenecks. The system's availability is prioritized, aiming for a minimum uptime of 99.9% to minimize downtime and provide uninterrupted access to learning resources.

Reliability is a focal point, seeking to reduce errors, crashes, and system failures to maintain a stable and dependable learning environment. Utilizing a micro-service architecture enhances traceability and facilitates the quick resolution of crashes or errors. Optimization of data throughput is emphasized, ensuring swift and seamless data transfer, particularly during content delivery, file uploads, and downloads. The performance of database queries and transactions is finely tuned to enhance overall system efficiency. The use of Next.js as the primary front-end language contributes to performance by caching pages and frequently accessing data temporarily, reducing the necessity for repeated database queries and improving the system's overall responsiveness. Efficient content delivery is a focus, guaranteeing quick and smooth loading of multimedia elements.

Finally, the system prioritizes compatibility across various devices and web browsers, providing users a consistent and performant experience, irrespective of their chosen platform. This comprehensive approach to performance optimization enhances the overall usability of the e-learning system.

5.9 Reliability Requirements

The uniPortal e-learning system places a paramount emphasis on reliability, embodying a comprehensive set of robust requirements to guarantee a dependable and seamless user experience. Ensuring continuous access to learning resources is a core commitment, with the system maintaining a minimum uptime of 99.9%. This commitment extends to scenarios of failure, where the Probability of Failure on Demand (POFOD) is meticulously constrained to 0.0001 (1 out of 10,000). In the rare event of a failure, users are presented with informative error messages, complemented by detailed logging for subsequent analysis and resolution.

A seamless user login experience is a key focus, with the system setting a stringent standard for failure frequency during login attempts – less than one per million cases or users. Monthly system maintenance, encompassing updates, patches, and routine checks, stands as a pivotal pillar of reliability. To minimize disruption, updates are strategically scheduled during midnight hours, coinciding with the lowest user activity. Throughout this process, registered users receive prompt notifications via their preferred communication channels. The update period, lasting 2–3 hours, ensures a swift and efficient process while temporarily rendering the platform unavailable.

Version control, facilitated through Github and a private repository, is a critical element of reliability. This approach allows meticulous tracking of changes, version history, and the flexibility to revert to previous versions when necessary. The database update process contributes further to reliability by incorporating a rollback mechanism to address any failed updates that may occur during the process.

The super admin assumes a pivotal role in upholding reliability, possessing the capability to perform backups of system data at any given time. This includes the crucial ability to restore data in the event of unexpected failures or data loss, thereby safeguarding data integrity and reinforcing the overall reliability of the uniPortal e-learning system.

5.10 Legislative Requirements

The legislative requirement of the uniPortal e-learning system are listed and explained under the following categories:

5.11 Cookies Consent

The uniPortal e-learning system utilizes minimal cookies from users' browsers. A popup window will appear upon logging into the platform, providing users with concise information about using cookies. The window will include a link to the platform's privacy policy, allowing users to opt in, opt out, or customize their cookie preferences. This functionality enables the platform to track users' preferences and maintain their sign-in status for a specified duration. As a result, users can navigate the platform with ease and convenience.

5.12 Privacy Policy

A dedicated page featuring the privacy statement will be accessible on users' portals at all levels. This page outlines the procedures for collecting, processing and storing user data. Notably, the emphasis lies on assuring users that their data will not be shared with third parties. Rigorous security measures are implemented to safeguard against any potential breaches in users' data.

5.13 Terms Conditions

A user-friendly page outlining the terms and conditions for platform usage will be easily accessible on users' portals at all levels. This page comprehensively details platform usage rules, including guidelines, do's and don'ts, legal protocols for dispute resolution, and operational regulations. Consequently, users discovered violating these terms and conditions will face suspension, with a potential permanent removal if the violations persist.

5.14 Performance Testing

During the performance testing of the uniPortal e-learning system, real-world load scenarios were simulated to evaluate its responsiveness and speed under different conditions.

The system demonstrated high performance with a score of 86%, indicating its effectiveness in handling the simulated load. Figure 5 gives visual details of the overall performance. The Speed Index, which measured the completeness of page load visually, was impressive at 1.6 seconds. Key indicators such as First Contentful Paint and Largest Contentful Paint also performed well, registering at 1.6 seconds. These results highlight the system's ability to provide a seamless and efficient user experience even under high usage conditions, ensuring easy access to educational resources and uninterrupted learning activities.



Figure 8: Performance testing

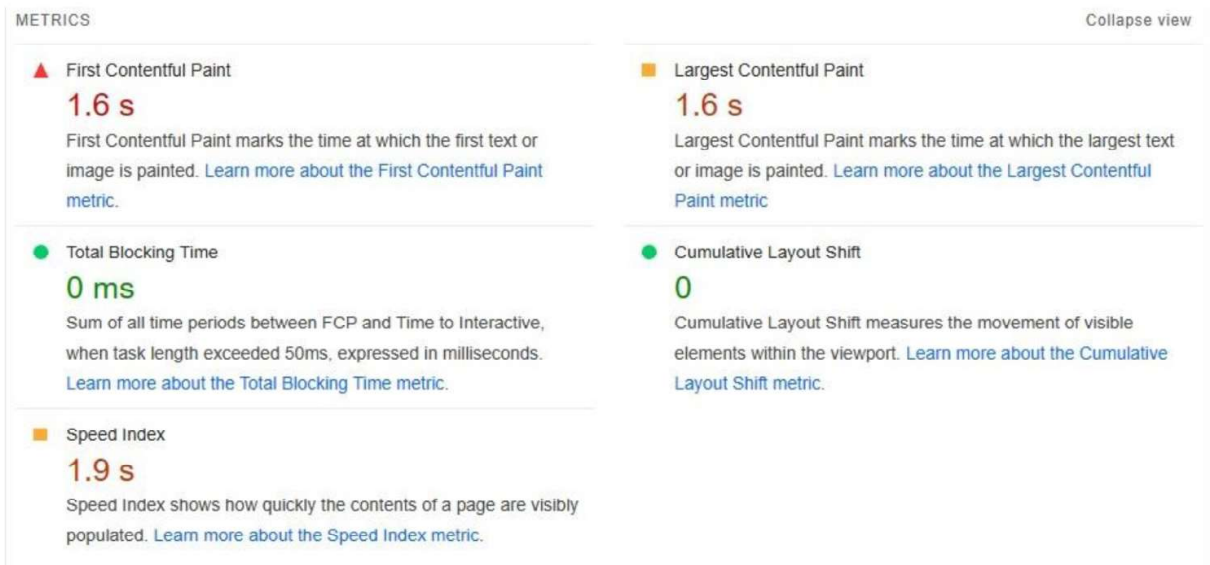


Figure 9: Performance metric

5.15 Security Testing

In conducting security tests for the uniPortal e-learning system, a multifaceted approach was adopted to fortify its defenses against potential threats. The SQL Injection Test evaluated the system's resistance to malicious SQL queries, ensuring robust input validation and protection against unauthorized database access. The File Upload Test scrutinized the platform's handling of file uploads, verifying its capability to detect and prevent potential security risks associated with uploaded files. Authentication controls underwent a rigorous examination in the Authentication Bypass Test, confirming that the system effectively prevented unauthorized access. The Error Handling Test assessed the system's response to errors, emphasizing secure and informative error messages. Additionally, the Session Timeout Test verified the implementation of appropriate session management, preventing unauthorized access during extended periods of user inactivity. These security tests collectively contribute to the uniPortal system's resilience against potential vulnerabilities, reinforcing its commitment to data security and user privacy.

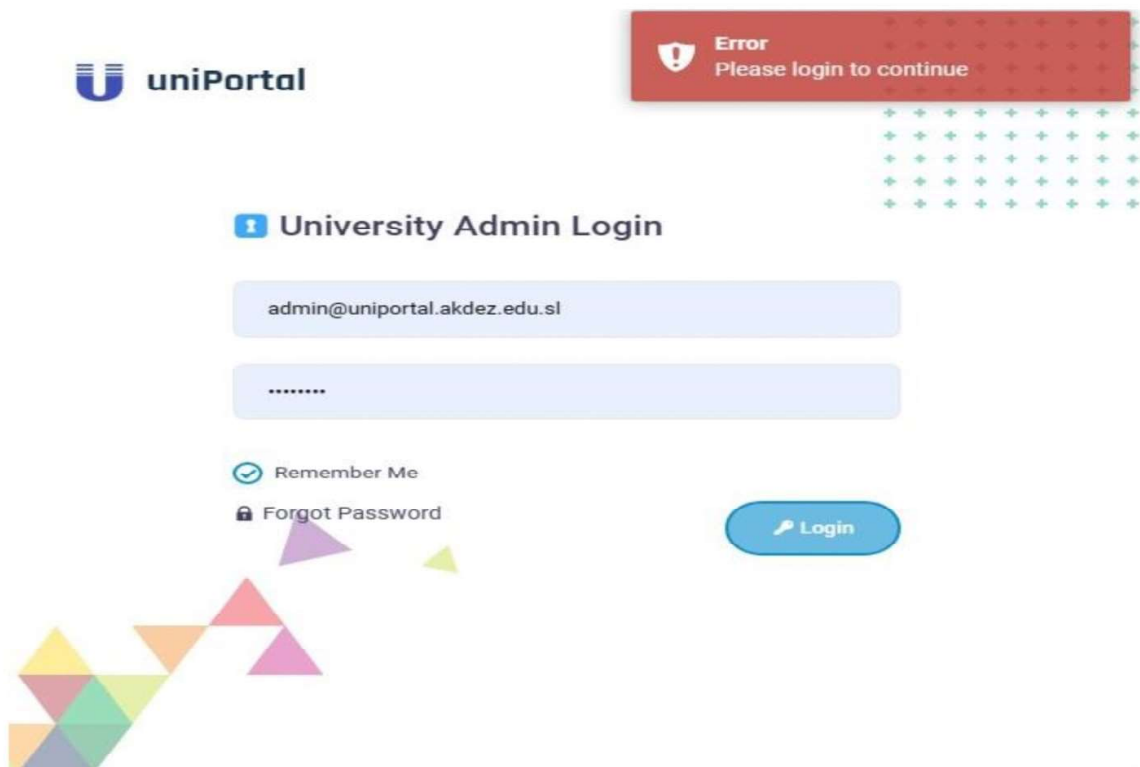


Figure 10: Security Testing

5.16 Responsive Testing

The responsiveness of the system to various screen sizes was assessed by simulating different devices using the developer's console in the browser. Screenshots for four distinct screen sizes are presented in Figures 8 to 11. Figure 8 represents the iPad Mini, Figure 9 illustrates the iPhone 14 Pro Max, Figure 10 showcases the Nest Hub Max, and Figure 11 displays the Samsung S8+.

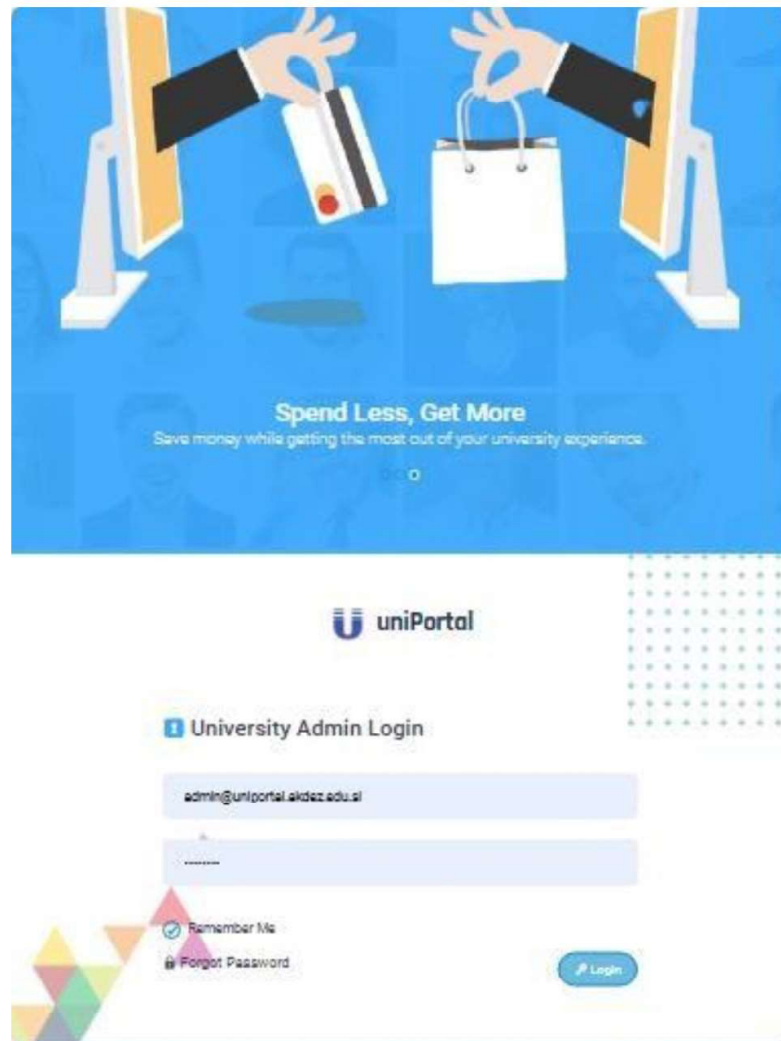


Figure 11: iPad Mini Responsive Testing



Figure 12: Desktop Responsive Testing

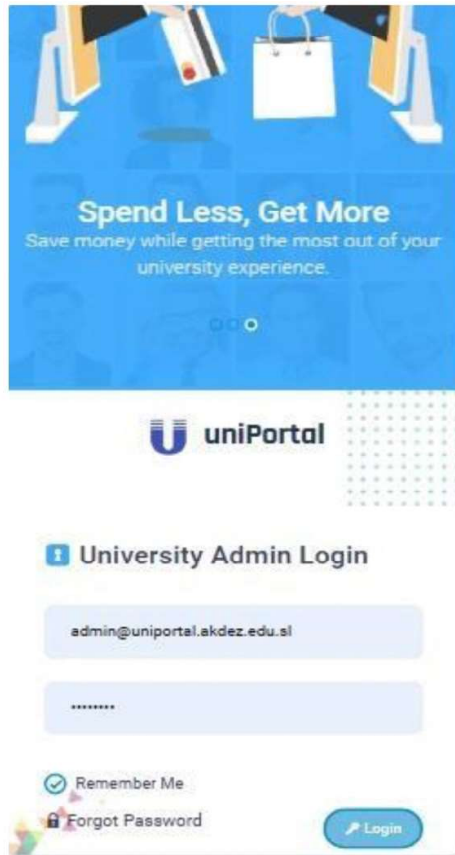
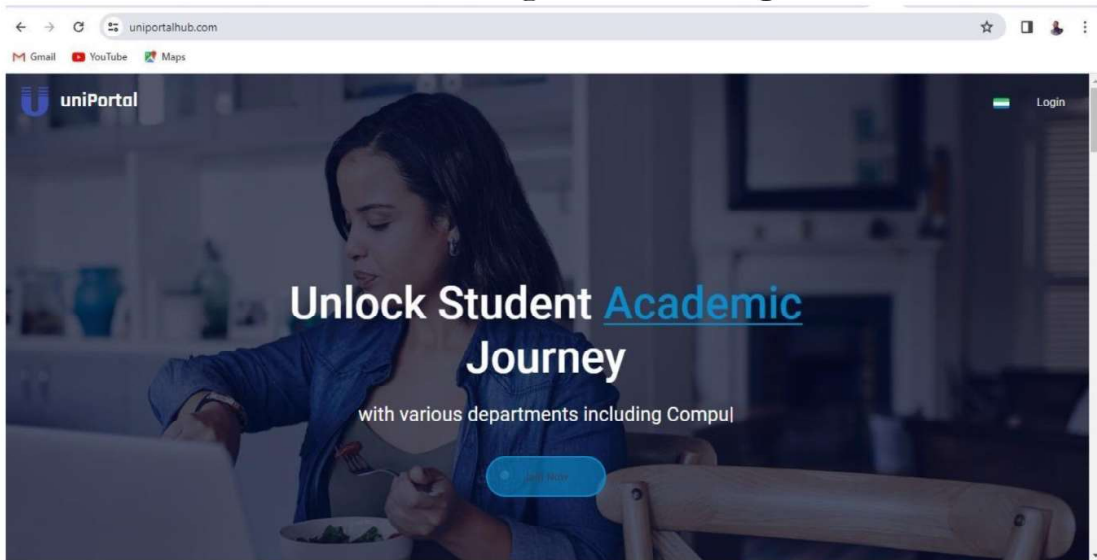


Figure 13: Samsung S8 Responsive Testing

5.17 Screenshots of the System

The index page of the system is accessible via the URL Address: uniportalhub.com

Figure 14: Index Page



5.18.1 Registrations of Clients

For users to be part of the uniportalhub, a university administration of the interested member must send an email to the super admin of the system by filling in the modal box as shown below; once a user clicks on the join button on the index page, a modal dialogue box will open for the user to fill in the required information.

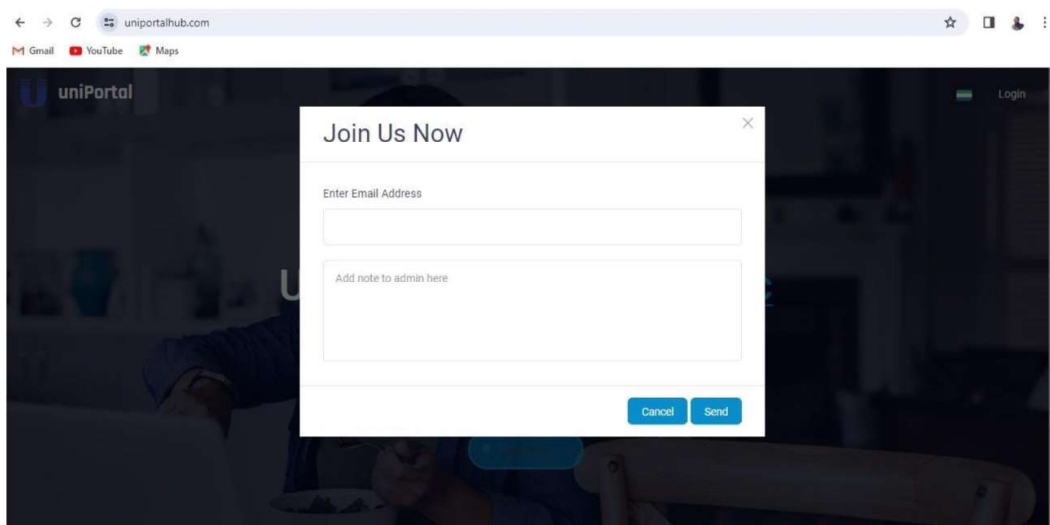


Figure 15: Join Modal Box

5.18.2 Super Admin Login Page

The login page of the general clients and users is differ from that of the super admin, this is to ensure security and appropriate user access level of the system. For the super admin to login he or she has to key in a user name and password in the text boxes provided , once the correct details is provided access will be grated to the admindash board of the super admin.

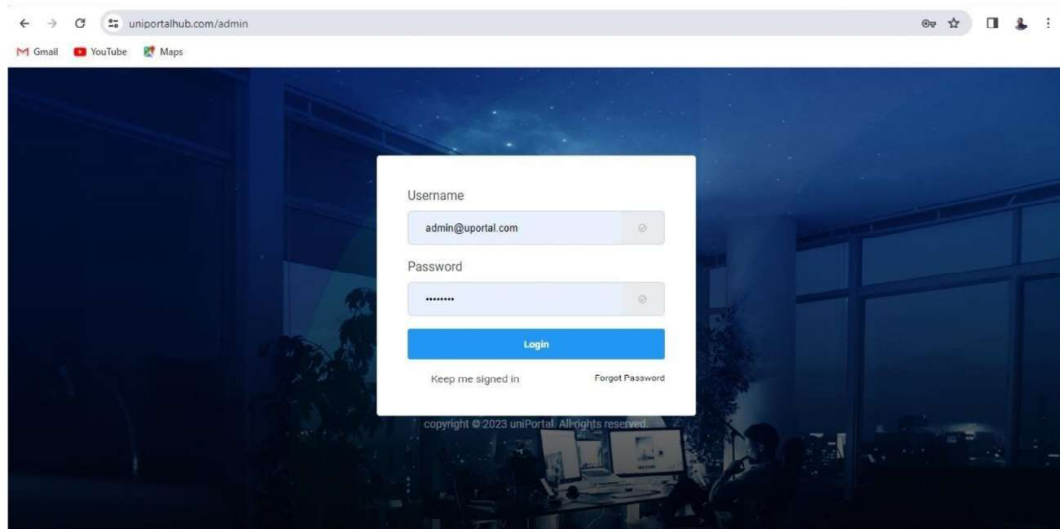


Figure 16: Super Admin Login Page

5.18.3 Super Admin Dash Board Page

All functions relating to super admin are highlighted in table 12.

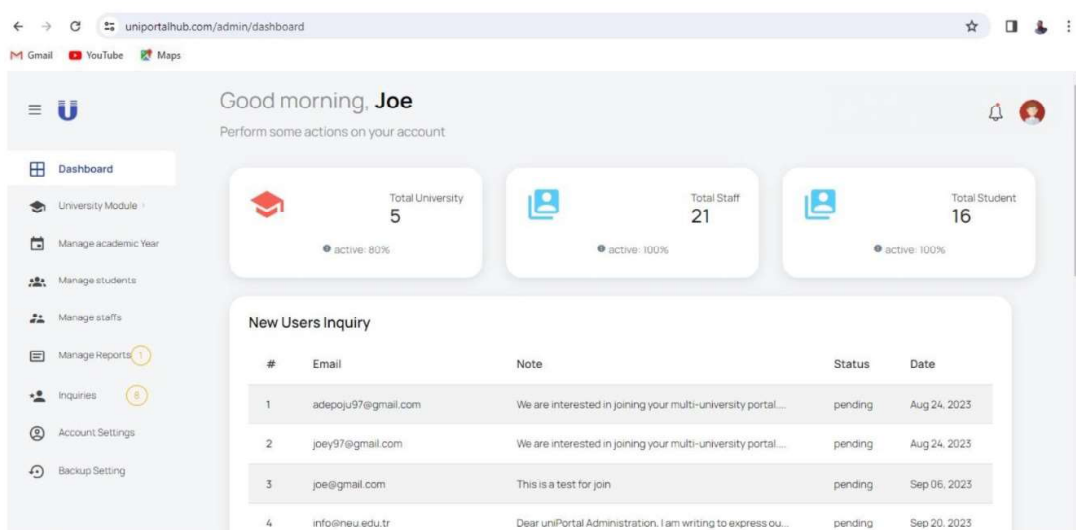


Figure 17: Super Admin Dash Board

5.18.4 University Admin Dash Board Page

Table 12 captures all function of University Admin Staff

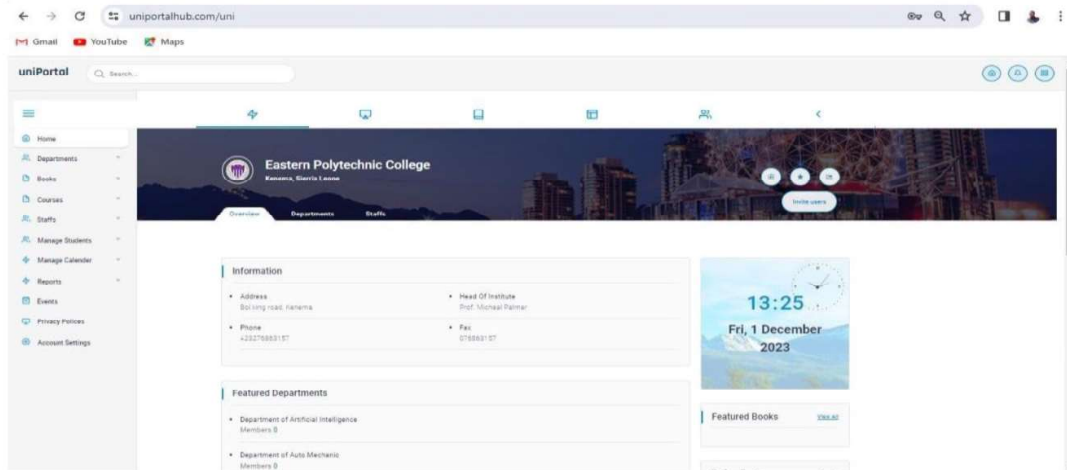


Figure 18: University Admin Dash Board

5.18.5 Student Admin Dash Board Page

The university admin and teaching staff shares similar admin dash bord , the major difference lies in the functionality of the user, the university admin is responsible to add teaching staffs, manage issues that are reported by the teaching staff. He can also delete students and teaching staff or make them inactive in the syst

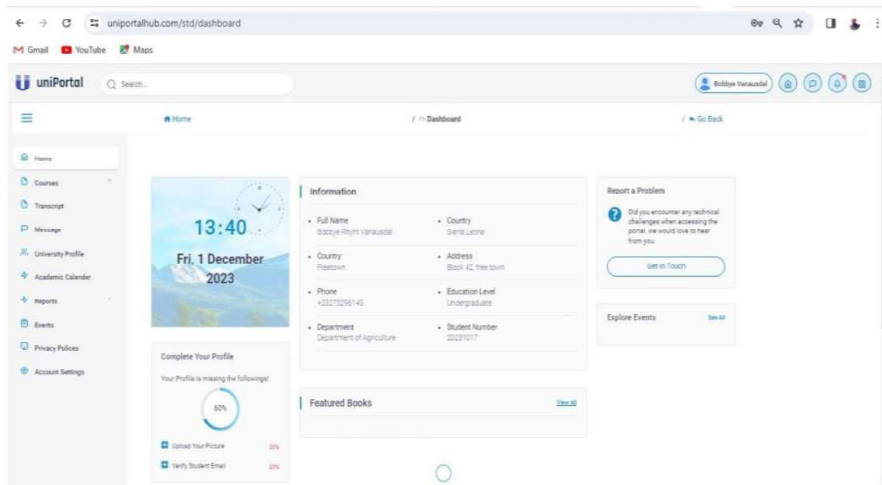


Figure 19: Student Admin Dash Board em

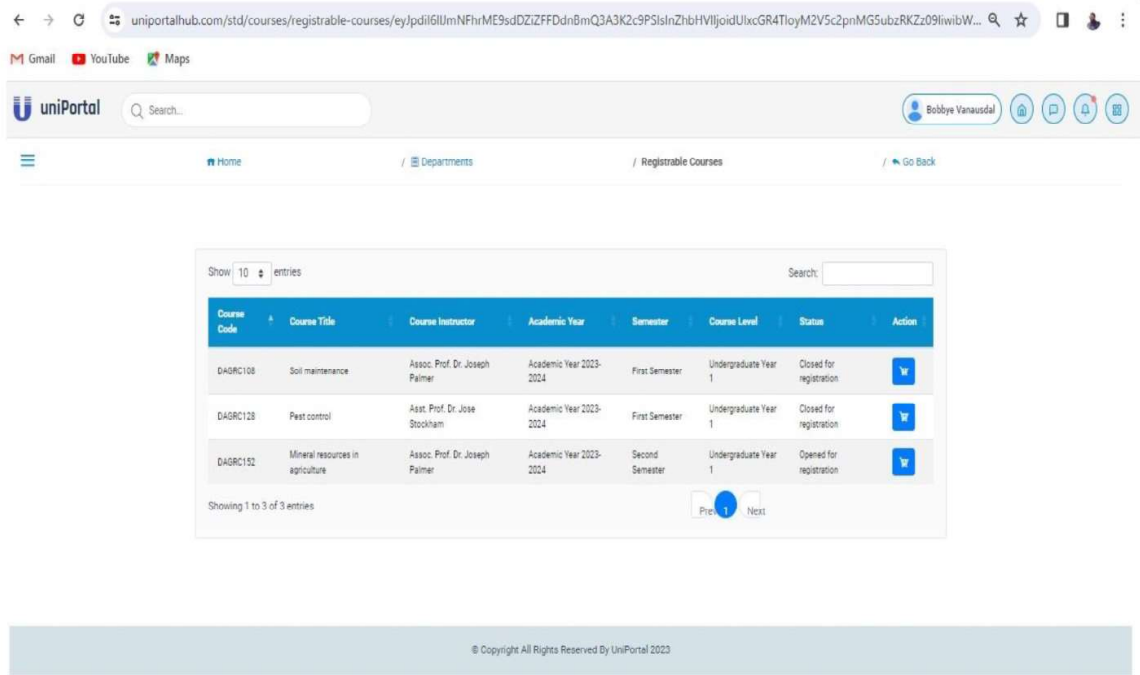


Figure 20: Student Course Registration Page

CHAPTER VI

RESULT

6.1 Result

The research findings shed light on the present state of virtual learning in Sierra Leone's institutions of higher education, aligning with Ali *et al.*'s (2018) conclusions that e-learning provides an affordable and satisfying higher education experience. Virtual e-learning, facilitated through web-based applications, has proven popular and effective in tertiary education, as evidenced by empirical research. This mode of learning not only reduces costs related to transportation, printing, and other academic expenses but also offers the flexibility for students to study from the comfort of their homes. While traditional instructional methods persist, the global trend favours the implementation of virtual e-learning to augment educational classes. This approach saves students time and enables them to access learning resources without the need for extensive travel.

The findings also provide substantial insights into the addressed research questions. Firstly, regarding the attitudes of instructors and students toward virtual online learning, the survey reveals a notable preference for e-learning over traditional methods, particularly evident in responses to questions 12 and 16. Despite some respondents having initially modest expectations regarding the efficacy of virtual learning, a significant percentage of learners strongly agree that this mode of instruction is preferable. Regarding the supposed importance of virtual e-learning in the learning and teaching processes, the survey underscores the significance of accessibility. Questions 3, 4, and 5 indicate a strong consensus among respondents that availability on the virtual e-learning platform at any time is crucial. This suggests that virtual e-learning is essential to the educational landscape, providing learners with flexibility and convenience.

Furthermore, addressing the challenges faced by virtual online learning, the research identifies various aspects, including students' preferences for an interactive and user-friendly e-learning environment (Q7 and Q8). These insights contribute to understanding the strategies that instructors and students can employ to manage challenges effectively. Finally, the sustainable framework technologies for successfully implementing a virtual learning environment are implied in the discussions about the modelling and development of the uniPortal virtual learning system. Integrating user-friendly features, security measures, and performance optimization aligns with pursuing sustainable and effective technological solutions for virtual education.

The uniPortal system achieves its objectives, aligning with the overarching goals of enhancing accessibility, efficiency, and sustainability in virtual e-learning. The system ensures continuous access to educational resources and opportunities, promoting flexibility in university learning schedules. Furthermore, the system facilitates distance learning by allowing students to register for courses and engage remotely in academic activities. The intuitive design of the platform streamlines processes such as course enrollment, result checking, and downloading course materials, contributing to a seamless and user-friendly experience for students. Moreover, the uniPortal system significantly reduces the administrative burden on lecturers by offering online assessment tools for mid-term and final assessments. This accelerates the grading process and allows for instant grade submission, fostering efficiency in the academic workflow. In essence, the uniPortal system emerges as a comprehensive solution that not only achieves its specific objectives but also contributes to the broader goals of advancing accessibility, efficiency, and health-conscious education in the virtual e-learning landscape.

Finally, this research contributes valuable insights to the discourse on virtual e-learning, presenting a nuanced understanding of user perceptions and a tangible solution in the form of the uniPortal system. The combination of research findings and system development creates a synergy that holds promise for advancing education through technology in Sierra Leone's public universities and beyond.

CHAPTER VII

Conclusion & Recommendations

7.1 Conclusion

In conclusion, this research embarked on an in-depth exploration of virtual learning in the context of Sierra Leone's public universities. The journey began with a meticulous methodology, including data collection through a structured questionnaire and developing the uniPortal virtual learning platform based on the identified needs and preferences. The research delved into the intricacies of user experiences, attitudes, and perceptions, revealing a positive inclination toward virtual e-learning. Through data analysis and discussions on system requirements, functionalities, and security measures, the uniPortal system emerged as a robust and user-centric platform designed to address the specific challenges and opportunities within the Sierra Leonean higher education landscape. A thorough examination of the performance, security, and reliability requirements ensured that the virtual e-learning environment system meets and exceeds expectations. The system's readiness for deployment was confirmed through rigorous testing. Real-world loads were simulated during performance testing, as illustrated in Figure 5, revealing an impressive system performance score of 86%. Noteworthy metrics, such as a speed index of 1.6s, first contentful paint, and largest contentful paint, all achieved within 1.6s, further highlight the system's robustness and efficiency.

According to the research findings, the current landscape of virtual learning has some tremendous potential in providing a pleasant and fulfilling learning experience at an affordable cost. The uniPortal system, as a manifestation of these findings, not only addresses the research questions but also contributes to the broader goals of accessibility, efficiency, and health-conscious education. In essence, this research journey has not only broadened the knowledge and understanding of challenges and opportunities in virtual e-learning but has also provided a tangible and innovative solution in the form of the uniPortal system. The insights from the research findings can provide a valuable guide for further advancements in the dynamic field of virtual education

7.2 Recommendation

Although the research and the corresponding solution provided in this fills a major gap in eLearning research and virtual learning system development, a few recommendations can be provided to present clear, specific, and realistic suggestions for future research and the uniPortal improvements. For instance, it is highly recommended to incorporate artificial intelligence (AI). This would enable personalized learning paths by analyzing user behavior using AI algorithms, allowing for tailored content delivery. Intelligent tutoring systems could offer real-time assistance, while predictive analytics would identify students who may be at risk, enabling timely intervention. Automated grading, natural language processing for communication, and continuous system improvement through AI contribute to a more adaptive and secure virtual learning environment. In short, AI integration promises to improve the capabilities of the uniPortal system, ensuring that it remains at the forefront of both practical and creative e-learning platforms in Sierra Leone's public universities.

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APPENDIX A

Questionnaire & Response Data

Usability and Design of Virtual E-

Learning

System Design and Implementation

We want to thank you for partaking in this survey on Usability and Design of E- Learning System Design and Implementation, your genuine answers to this questionnaire will be appreciated. The information required from you are non-sensitive and kindly known that it will be kept confidential.

Demographic Data

Age: 18 - 25 26-35 36-45 Over 45

Gender: Male Female Other

Educational Level: Certificate Diploma Undergraduate Master's

Ph.D University Attending / Lecturing: Njala University Eastern Technical

University MMCET

Current Designation: Student Lecturer HOD DEAN University Administrator

How Long Have you Use E-Learning: 1-5yrs 6-10yrs Over 10yrs

How Regularly Do You Access Internet: Daily Weekly Monthly Rarely Never

Device Used to Access Internet/Web Services: Laptop Mobile iPad Desktop **Health**

Status: Normal Visually Impaired Hearing Problem Any Other

(Specify)-----

Form of eLearning Regularly Used: WhatsApp Google Class Room Zoom Skype

Kindly check one of the empty cell in the table below labelled as : a; Strongly Agree b; Disagree C; Neutral d; Agree e; Strongly Disagree

NO	ITEMS	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Can e-learning substitute traditional teaching and learning methods?					
2	Would you recommend e-learning for tutoring at your university?					
3	eLearning platform designed would provide relevant use and information for learners and instructors, which can be easily accessible via website address.					
4	Virtual e-learning platform records or enables instructors to time and manage students and provide excellent and fair grading.					
5	Virtual E-Learning system is important to facilitate interactive session such as Q&A forums and collaborative group activities?					
6	Objectives of learning and assessment are aligned with virtual e-learning platform delivery.					
7	Your experience with the current eLearning platform is user and accessibility friendly.					
8	Managing Virtual eLearning resources by university administrators is feasible and can be done appropriately.					

9	Do you anticipate challenges while transitioning to new Virtual eLearning specifically related to its design and functionality?.					
10	Students, lecturers and administrators can self-handle the access to virtual eLearning resources and learning.					
11	Would you prefer e-learning over the conventional traditional method of delivery throughout your academic studies?					
12	Instructors, Students and University admin have good attitudes and will embrace the use and implementation of virtual eLearning.					
13	Virtual e-learning can improve students' learning skills and performance effectively.					
14	Lecture goals and objectives are clearly defined in eLearning resources.					
15	Virtual eLearning provides a satisfying and positive experience learning experience.					
16	Financial (transportation, buying of textbooks) constraints can be avoided while using virtual eLearning for students and lectures.					
17	Pre-recorded and online lecturers or combination of two is more preferable for content delivery					
18	Can an e-learning platform provide the academic resources to learn accordingly?					

Response Data

The Responses of the Questionnaire (Q)

NO	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18
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387	5	5	1	5	3	5	5	5	4	4	5	5	5	4	5	4	5	1
388	3	5	2	1	2	5	5	5	4	4	5	5	5	4	5	5	5	5
389	5	5	5	5	5	5	5	5	4	4	5	5	5	5	5	5	5	5
390	5	5	2	1	5	5	5	5	4	4	5	2	5	5	4	5	5	5
391	5	5	5	5	5	5	5	5	4	4	5	1	5	5	4	3	4	5
392	5	5	1	5	5	5	5	5	4	4	5	4	5	5	4	5	5	5
393	5	5	5	5	5	5	5	5	4	4	5	4	5	5	4	5	5	1
394	5	5	3	5	5	5	5	5	4	4	5	5	5	5	4	5	5	5
395	5	5	5	5	5	5	5	5	4	4	5	1	5	5	4	2	5	5
396	5	5	5	5	5	2	5	5	4	4	5	1	5	5	4	5	5	5
397	5	5	5	5	5	4	5	5	4	4	5	1	5	5	4	5	5	5
398	5	5	2	3	5	4	5	5	4	4	5	1	5	5	4	1	5	5
399	4	5	5	5	5	5	5	5	4	4	5	1	5	5	4	5	5	5
400	4	5	5	5	5	5	5	5	4	4	5	1	5	5	4	5	5	5

APPENDIX B

Uniportal Index Page Code

```

<!DOCTYPE html>
<html lang="en">

<head>
  <meta http-equiv="Content-Type" content="text/html; charset=utf-8"
/>
  <meta name="viewport" content="width=device-width, initial-
scale=1.0">
  <meta name="description" content="" />
  <meta name="keywords" content="" />
  <meta name="csrf-token" content="{{ csrf_token() }}">
  <title>uniPortal</title>
  <link rel="icon" href="{{ asset('assets/images/favicon-48.png') }}"
type="image/png"
  sizes="16x16">

  <!-- common css -->
  {!! Html::style('css/main.min.css') !!}
  {!! Html::style('css/uikit.min.css') !!}
  {!! Html::style('css/style.css') !!}
  {!! Html::style('css/color.css') !!}
  {!! Html::style('css/responsive.css') !!}
  <link
href="//cdnjs.cloudflare.com/ajax/libs/toastr.js/latest/css/toastr.min.css"
rel="stylesheet" />
  <!-- end common css -->

```

```
</head>
```

```
<body>
```

```
<div class="page-loader" id="page-loader">
```

```
<div class="loader">
```

```
<span class="loader-item"></span>
```

```
<span class="loader-item"></span>
```

```
<span class="loader-item"></span>
```

```
<span class="loader-item"></span>
```

```
<span class="loader-item"></span>
```

```
<span class="loader-item"></span>
```

```
<span class="loader-item"></span>
```

```
<span class="loader-item"></span>
```

```
<span class="loader-item"></span>
```

```
</div>
```

```
<!-- add banner for cookies -->
```

```
<!-- <div id="cookie-consent-banner" class="cookie-banner">
```

```
<p>We use cookies to improve your experience on our website.  
By continuing to browse, you agree to our use of cookies.</p>
```

```
<button id="accept-cookies" class="btn btn-  
primary">Accept</button>
```

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

```
</div><!-- page loader -->
```

```
<div class="theme-layout">
```

```
<div class="responsive-header">
```

```
<div class="logo res">
```

```

```

```
<span>uniPortal</span>
```

```
</div>
```

```

<!-- <div class="user-avatar mobile">
    <a href="profile.html" title="View Profile"></a>
    <div class="name">
        <h4>Danial Cardos</h4>
        <span>Ontario, Canada</span>
    </div>
</div> -->
div class="right-compact">
    <div class="sidemenu">
        <i>
            <svg id="side-menu2"
xmlns="http://www.w3.org/2000/svg" width="26" height="26"
            viewBox="0 0 24 24" fill="none"
stroke="currentColor" stroke-width="2"
            stroke-linecap="round" stroke-linejoin="round"
class="feather feather-menu">
                <line x1="3" y1="12" x2="21" y2="12"></line>
                <line x1="3" y1="6" x2="21" y2="6"></line>
                <line x1="3" y1="18" x2="21" y2="18"></line>
            </svg></i>
        </div>
</div>
<!-- <div class="restop-search">
    <span class="hide-search"><i class="icofont-close-
circled"></i></span>
    <form method="post">
        <input type="text" placeholder="Search...">
    </form>
</div> -->
</div><!-- responsive header -->

```



```

<header class="transparent">
  <div class="topbar">
    <div class="logo">
      
      <span>uniPortal</span>
    </div>

    <ul>
      <!-- <li><a class="join-butn" href="feed.html"
title="">About uniPortal</a></li>
      <li><a href="#" title="">help</a></li> -->

</a></li>      
      </a>
</li>
      </li>
      <a
href="#"      <li><a uk-toggle="target: #loginModal" title="">Login
title="">
      </ul>
    </div>
  </header>

  <nav class="sidebar">
    <ul class="menu-slide">
      <li class="active menu-item">
        <a class="" href="/" title="">
          <i><svg id="icon-home" class="feather feather-home"
stroke-linejoin="round"
          stroke-linecap="round" stroke-width="2"
stroke="currentColor" fill="none"

```

```

        viewBox="0 0 24 24" height="14" width="14"
xmlns="http://www.w3.org/2000/svg">
        <path d="M3 9l9-7 9 7v11a2 2 0 0 1-2 2H5a2 2 0 0
1-2-2z" />
        <polyline points="9 22 9 12 15 12 15 22"
/></svg></i> Home
    </a>

</li>

<li class="menu-item-has-children">
    <a class="" href="#" title="">
        <i class="">
            <svg id="ab9" xmlns="http://www.w3.org/2000/svg"
width="14" height="14" viewBox="0 0 24 24"
            fill="none" stroke="currentColor" stroke-width="2"
stroke-linecap="round"
            stroke-linejoin="round" class="feather feather-
lock">
                <rect x="3" y="11" width="18" height="11" rx="2"

```

```

ry="2"></rect>
      <path d="M7 11V7a5 5 0 0 1 10 0v4"></path>
    </svg></i> Authentication
  </a>

  <ul class="submenu">
    <li><a uk-toggle="target: #loginModal" title="">Sign
In</a></li>
    <!-- <li><a href="signup.html" title="">Sign Up</a></li>
    <li><a href="forgot-password.html" title="">Forgot
Password</a></li> -->
  </ul>
</li>

</ul>
</nav><!-- nav sidebar -->

<section>
  <div class="gap overlap nogap mate-black low-opacity">
    <div class="bg-image" style="background-image: url({ {
asset('images/resources/slider3.jpg') } })"></div>
    <div class="feature-meta">
      <h1>Unlock Student <span>Academic </span>
Journey</h1>
      <h3>with various departments including
<span></span></h3>
      <a uk-toggle="target: #joinModal" title="" class="main-btn"
data-ripple="">Join Now</a>
    </div>
  </div>
</section>

```

```

<section>
  <div class="gap no-bottom grey-bg nogap">
    <div class="container">
      <div class="row">
        <div class="col-lg-4 col-md-6">
          <div class="info-sec">
            <i class="icofont-checked"></i>
            <div>
              <h6>Unlock Limitless Possibilities</h6>
              <p>Collaborate with your learners and educators,
get the support you need to
              advance your career.</p>
            </div>
          </div>
        </div>
      </div>
      <div class="col-lg-4 col-md-6">
        <div class="info-sec">
          <i class="icofont-play-alt-1"></i>
          <div>
            <h6>Join a Global Community of Scholars</h6>
            <p>Join a vibrant community of learners and
educators that use uniPortal.</p>
          </div>
        </div>
      </div>
      <div class="col-lg-4 col-md-6">
        <div class="info-sec">
          <i class="icofont-clock-time"></i>
          <div>
            <h6>Transform Your Academic Journey</h6>
            <p>Elevate your learning experience with cutting-
edge tools and technologies, empowering you to achieve academic
excellence.</p>
          </div>
        </div>
      </div>
    </div>
  </div>
</section>

```

```

        </div>
    </div>
</div>
</div>
</div>
</div>
</div>
</section>

<section>
    <div class="gap no-bottom">
        <div class="container">
            <div class="row">
                <div class="col-lg-12">
                    <div class="banner-full">
                        <div class="row">
                            <div class="col-lg-3 col-md-3 col-sm-6">
                                <div class="funfact-counter">
                                    <i class="icofont-air-ticket"></i>
                                    <span class="counter">{{ $staff }}</span>
                                    <em>Registered staff</em>
                                </div>
                            </div>
                            <div class="col-lg-3 col-md-3 col-sm-6">
                                <div class="funfact-counter">
                                    <i class="icofont-network"></i>
                                    <span
class="counter">{{ $std_count }}</span>
                                    <em>Registered student</em>
                                </div>
                            </div>
                        </div>
                    </div>
                </div>
            </div>
        </div>
    </div>
</section>

```


Stay Informed: Monitor University Metrics

```

    </p>
  </div>
</div>
</div>
<div class="col-lg-5 col-md-5">
  <figure class="side-image">
    
  </figure>
</div>
</div>
</div>
</div>
</div>
</section>

```

```

<section>
  <div class="gap">
    <div class="container">
      <div class="row">
        <div class="col-lg-5 col-md-5">
          <figure class="side-image">
            
          </figure>
        </div>
        <div class="col-lg-7 col-md-7">
          <div class="verticle-center">
            <div class="measure right">
              <i class="icofont-connection"></i>
              <h2>Connect, Explore, and Unleash Your
Potential with Diverse Departments</h2>

```



```

    <div class="welcome-parallax">
        <i></i>
        <h2>Unleash Your Institution's Potential</h2>
        <span>Elevate your institution's success.</span>
        <a uk-toggle="target: #joinModal" title=""
class="main-btn" data-ripple="">Join us Now</a>
    </div>
</div>
</div>
</div>
</div>
</section><!-- parallax section -->

<section>
    <div class="gap">
        <div class="container">
            <div class="row remove-ext30">
                <div class="col-lg-12">
                    <div class="title">
                        <h1>Featured University</h1>
                        <!-- <p>Our Recent News about the events.</p> -->
                    </div>
                </div>
            </div>
            @foreach($universities as $uni)
            <div class="col-lg-4 col-md-6 col-sm-6">
                <div class="blog-grid" >
                    <figure></figure>
                    <div class="blog-meta">
                        <div class="blog-head">
                            <ul class="postby">
                                <li>

```

```

                <figure></figure>
                <span>VC: {{Suni->VC}}</span>
            </li>
            <!-- <li><i class="icofont-
heart"></i><span>1.3k</span></li> -->
        </ul>
        <a href="#" title="" class="date">{{Suni-
>created_at->format('d M')}}</a>
        <h4 class="blog-title"><a href="#"
title="">{{Suni->name}}</a>
        </h4>
    </div>
</div>
</div>
</div>
</div>
@endforeach

</div>
</div>
</div>
</section><!-- events -->

<section>
    <div class="gap no-top">
        <div class="container">
            <div class="row">
                <div class="col-lg-12">
                    <div class="newsletter-sec">
                        <figure></figure>
                        <i
ripple=""><i

```

```

        </div>
<div class="leter-
meta">
  <span>our
newsletter</spa
n>
  <h3>subscribe
now</h3>
  <form method="post">
    <input type="text" placeholder="Email @">
    <button type="submit" class="main-btn" data-
      class="icofont-paper-plane"></i></button>
  </form>
</div>
</div>

</div>
</div>
</div>
</section>

<section>
  <div class="gap no-top">
    <div class="container">
      <div class="row">
        <div class="col-lg-12">
          <div class="title">
            <h1>Student Testimonial!</h1>
            <p>Recent testimonies from students</p>
          </div>
        </div>
        <div class="col-lg-12">
          <div class="student-review">
            @foreach($students as $std)
            <div class="review-item">
<figure></figure>
        <h6>{{ $std->first_name }} {{ $std-
>last_name }}</h6>
        <span>{{ $std->department->name }}</span>
        <p>
            {{ $std->testimonial }}
        </p>
    </div>
    @endforeach

    </div>
</div>
</div>
</div>
</div>
</div>
</section>

<!-- login Modal start -->
<div id="loginModal" uk-modal>
    <div class="uk-modal-dialog">

        <button class="uk-modal-close-default" type="button" uk-
close></button>

        <div class="uk-modal-header">
            <h2 class="uk-modal-title">Choose Login Type</h2>
        </div>
        <div class="uk-modal-body" uk-overflow-auto>

            <p>Click on the login type below:</p>

```

```

        <button class="btn btn-primary btn-block"
onclick="redirectToLogin('university')">University Admin</button>
        <button class="btn btn-primary btn-block"
onclick="redirectToLogin('staff')">Staff</button>
        <button class="btn btn-primary btn-block"
onclick="redirectToLogin('student')">Student</button>
    </div>
</div>
</div>
<!-- login login end -->

<!-- join Modal start -->
<div id="joinModal" uk-modal>
    <div class="uk-modal-dialog">

        <button class="uk-modal-close-default" type="button" uk-
close></button>

        <div class="uk-modal-header">
            <h2 class="uk-modal-title">Join Us Now</h2>
        </div>
        <form id="joinForm">
            <div class="uk-modal-body" uk-overflow-auto>

                <input type="hidden" id="id" name="id" />

                <div class="uk-margin">
                    <label for="name"> Enter Email Address </label>
                    <input class="uk-input" required type="email"
maxlength="50" name="email" id="email">
                </div>
                <div class="uk-margin">

```



```

</div>
<p>Subscribe to our newsletter and get notifications
and alerts about our new product / services</p>
<div class="contact-little">
  <span><i class="icofont-phone-circle"></i> +1-
235-099-34</span>
  <span><i class="icofont-email"></i> <a
href="http://wpkixx.com/cdn-cgi/l/email-
protection" class="__cf_email__"
data-
cfemail="157c7b737a55747e7071787c763b767a78">[email&#160;prote
cted]</a></span>
</div>
</div>
</div>
</div>
<div class="col-lg-2 col-md-3 col-sm-6">
  <div class="widget">
    <div class="widget-title">
      <h4>uniPortal</h4>
    </div>
    <ul class="quick-links">
      <li><a href="#" title="">About Us</a></li>
      <li><a href="#" title="">Career</a></li>
      <li><a href="#" title="">Privacy</a></li>
      <li><a href="#" title="">Terms</a></li>
      <li><a href="#" title="">FAQ</a></li>
      <li><a href="#" title="">Contact</a></li>
    </ul>
  </div>
</div>
</div>
<!-- <div class="col-lg-2 col-md-3 col-sm-6">
  <div class="widget">

```

```

<div class="widget-title">
  <h4>Quick Links</h4>
</div>
<ul class="quick-links">
  <li><a href="#" title="">Product</a></li>
  <li><a href="#" title="">Market</a></li>
  <li><a href="#" title="">Courses</a></li>
  <li><a href="#" title="">Services</a></li>
  <li><a href="#" title="">Enterprise</a></li>
  <li><a href="#" title="">Sitemap</a></li>
</ul>
</div>
</div -->
<div class="col-lg-2 col-md-4 col-sm-6">
  <div class="widget">
    <div class="widget-title">
      <h4>Follow Us</h4>
    </div>
    <ul class="quick-links">
      <li><a href="#" title=""><i class="icofont-
facebook"></i>facebook</a></li>
      <li><a href="#" title=""><i class="icofont-
twitter"></i>twitter</a></li>
      <li><a href="#" title=""><i class="icofont-
instagram"></i>instagram</a></li>
      <li><a href="#" title=""><i class="icofont-
google-plus"></i>google +</a></li>
      <li><a href="#" title=""><i class="icofont-
whatsapp"></i>whatsapp</a></li>
      <li><a href="#" title=""><i class="icofont-

```



```

<div class="bottombar">
  <div class="container">
    <div class="row">
      <div class="col-lg-12">
        <span class="">&copy; copyright All rights reserved by
uniPortal <script> document.write(new Date().getFullYear());
</script></span>
      </div>
    </div>
  </div>
</div><!-- bottombar -->

```

```
</div>
```

```
<script data-cfasync="false" src="../../cdn-
cgi/scripts/5c5dd728/cloudflare-static/email-decode.min.js"></script>
```

```
{!! Html::script('js/main.min.js') !!}
```

```
{!! Html::script('js/uikit.min.js') !!}
```

```
{!! Html::script('js/script.js') !!}
```

```
{!! Html::script('js/typed.js') !!}
```

```
{!! Html::script('js/counterup.min.js') !!}
```

```
{!! Html::script('js/counterup-t-waypoint.js') !!}
```

```
<script
src="https://cdnjs.cloudflare.com/ajax/libs/toastr.js/latest/js/toastr.min.js"
></script>
```

```
<script>
function redirectToLogin(userType) {
```

```

let loginUrl;
  switch (userType) {
    case 'university':
      loginUrl = '{{ route("university.login") }}';
      break;
    case 'staff':
      loginUrl = '{{ route("staff.login") }}';
      break;
    case 'student':
      loginUrl = '{{ route("student.login") }}';
      break;
    default:
      loginUrl = '{{ route("/") }}';
  }

  window.location.href = loginUrl;
}

//Event handler for form submission
$('#joinForm').submit(function(e)
{
  e.preventDefault();

  var formData = new FormData(this); // Pass the form element
here

  // Perform AJAX request to update university data
$.ajax({

```

```

url: '{{route("uni-join")}}',
type: 'POST',
headers: {
    'X-CSRF-TOKEN': $('meta[name="csrf-
token"]').attr('content')
},
data: formData,
contentType: false,
cache: false,
processData: false,
success: function(response) {
    // Handle success response
    if (response.status === 'success')
    {
        toastr.success(response.data);
    }
    else
    {
        toastr.error(response.data);
    }

    // Close the delete modal
    $('.uk-modal-close').trigger('click');

},
error: function(xhr, status, error) {
    toastr.error(error);
}

```

```

        // Close the delete modal
        $('.uk-modal-close').trigger('click');
    });
});
</script>
<script>

    Cookies" button
    var acceptCookiesButton = document.getElementById('accept-

// Add click
event listener acceptCookiesButton.addEventListener('click', function () {
to "Accept // Set a sessionStorage flag to remember the user's choice for
the session
    sessionStorage.setItem('cookie_consent', 'accepted');

    // Remove the overlay to re-enable interactions
    overlay.remove();

    // Hide the cookie consent banner
    document.getElementById('cookie-consent-
banner').style.display = 'none';
    });
}
function logout() {
    // Remove the 'cookie_consent' item from sessionStorage

    sessionStorage.removeItem('cookie_consent');
}
</script>
</body>

















</html>

```

APPENDIX C

Similarity Report

SIMILARITY REPORT

Submit						
	AUTHOR	TITLE	SIMILARITY	FILE	PAPER ID	DATE
<input type="checkbox"/>	Joseph Palmer	Abstract	0% 		2283301372	01-Feb-2024
<input type="checkbox"/>	Joseph Palmer	Conclusion	0% 		2283301446	01-Feb-2024
<input type="checkbox"/>	Joseph Palmer	Results	0% 		2283302296	01-Feb-2024
<input type="checkbox"/>	Joseph Palmer	Chapter Four	1% 		2283306400	01-Feb-2024
<input type="checkbox"/>	Joseph Palmer	Chapter Two	2% 		2283304695	01-Feb-2024
<input type="checkbox"/>	Joseph Palmer	Chapter One	3% 		2283303953	01-Feb-2024
<input type="checkbox"/>	Joseph Palmer	Chapter Three	9% 		2283305425	01-Feb-2024
<input type="checkbox"/>	Joseph Palmer	Complete Thesis	15% 		2283307539	01-Feb-2024

Supervisor: Assist. Prof. Dr. John Bush Idoko

Date: 06/02/2024

Sign 