MEKELLE UNIVERSITY

COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCES

DEPARTMENT INFORMATION TECHNOLOGY

APPROPRIATE TECHNOLOGY-BASED INFORMATION SYSTEM FOR DISTANCE EDUCATION IN MEKELLE

THESIS SUBMITTED TO DEPARTMENT OF INFORMATION TECHNOLOGY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A MASTER’S DEGREE IN INFORMATION TECHNOLOGY

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NAME AND SIGNATURE OF MEMBERS OF THE EXAMINING BOARD

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Abstract

The recent crises in the Tigray region, particularly in Mekelle, have deepened long-standing barriers to equitable education in region. Even before the conflict, traditional face-to-face learning was constrained by limited funding, challenging geography, and weak infrastructure. The war intensified these challenges through school closures, displacement, and damage to essential facilities. These conditions underscored the urgent need for educational models that are accessible, scalable, and resilient in times of crisis. Appropriate technology-based information system for distance education emerged as a viable alternative, with the potential to overcome time and distance barriers when adapted to the local context.

This study investigated the current state and challenges of distance education in Mekelle, focusing on students, educators, and marginalized groups such as rural residents, women, and internally displaced persons. A mixed-methods approach was employed, combining questionnaires from 115 students, interviews with 10 experts, focus group discussions, and document reviews. The findings identified the types of educational technologies in use, their level of functionality, and the socio-cultural and infrastructural barriers limiting effective adoption.

Drawing on these insights and lessons from both global and Ethiopian experiences, a Web-Based Distance Education Learning (WBDEL) system was designed and developed using the Design Science Research Methodology (DSRM). Web technology was selected for its scalability, low-resource accessibility, and support for both synchronous and asynchronous learning. The system was designed to be culturally relevant, user-friendly, and accessible to learners with varying digital skills. It supports multimedia learning materials, including text, images, videos, and hyperlinks, and incorporates offline access to address internet connectivity challenges.

The prototype underwent requirement analysis, iterative design, and pilot testing. Results showed that over 71% of respondents found the system easy to use, cost- and time-efficient, and effective in fostering interaction between learners and institutions. Timely feedback reduced learners’ sense of isolation, while training for teachers and students enhanced digital competency and reduced dropout risks.

This research delivered a practical and adaptable web-based distance education system tailored to the needs of Mekelle. The system improved educational access, enhanced learning quality, and strengthened community resilience. The findings demonstrate that, with thoughtful design and contextual adaptation, web-based distance education can provide equitable and continuous learning during crises and serve as a scalable model for post-conflict and resource-limited settings across Ethiopia and beyond.
Keywords: - *Distance Education;* Web-Based Distance Education*,*

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Acronyms

DL:Distance Learning

E-learning: Electroonic Learning

ETA(Education and Training Authority (ETA)(the former HERQA(Higher Education Relevance and Quality Agency)

LCMS: Learning Content Management Systems

M-Learning:Mobile Learningi

MLFDE: Mobile Learning for Distance Education

MLT: Mobile Learning Technique

MOODLE: -Modular ObjectOriented term Developmental Learning Environment

ODL: Open Distance Learning

PACMAD: People At Center of Mobile Application Development

PDAs: Personal Digital AssistanNTS

SMS: Short Message Service

TAM: Technology Acceptance Model

VPN: Virtual Private Network

WBDEL:Web Based Distance education Learning

WiFi: Wireless Fidelity

CHAPTER ONE

INTRODUCTION

1.1. Background

Ethiopia, as a developing nation, faces multiple obstacles in its efforts to provide equitable access to education. Financial, topographical, and infrastructural limitations remain widespread barriers to schooling, particularly in rural areas where communities are often isolated from educational facilities. Recent conflicts have further deepened these challenges, especially in the Tigray region and its capital, Mekelle, where large-scale displacement, the collapse of traditional educational structures, and the destruction of infrastructure have severely disrupted schooling. As a result, many students have been denied access to formal education, and families affected by the conflict can no longer afford traditional on-campus schooling. The urgency to find alternative and sustainable educational solutions has never been greater.

The need for more accessible educational opportunities highlights the importance of distance education as a potential strategy. Heinich, Molenda, Russell, and Smaldino (2002) define distance education as a form of education characterized by two-way communication, the use of technological media, structured instructional programs, and the physical separation of teacher and learner. Globally, distance education has proven to be an effective and flexible approach to overcoming financial, geographical, and scheduling barriers (Moore & Kearsley, 2011). While countries around the world have integrated distance learning into their education systems with varying levels of success, Ethiopia is still at the early stages of adoption, particularly in terms of infrastructure, pedagogical readiness, and technological adaptation.

Distance education is not a new phenomenon. Its roots can be traced back to the Industrial Revolution, when the demand for skilled labor led to the establishment of correspondence courses that allowed learners to study while physically separated from teachers (Garrison, 2000). These early forms of distance education relied heavily on printed materials and postal systems. However, with the advancement of communication technologies, distance learning has evolved significantly to include radio, television, and more recently, internet-based platforms (Keegan, 1996).

The growth of internet technologies has particularly revolutionized education by eliminating limitations of time and space. As Abdillah (2015) notes, “web-based distance education refers to a formal learning experience where students and instructors are geographically separated, and instruction is delivered primarily through internet technologies.” This mode of learning allows flexible access to educational resources, promotes collaboration, and enables instant feedback between learners and instructors. Similarly, Anderson and Dron (2011) emphasize that distance education has transitioned through different pedagogical models, from cognitive-behavioral approaches to constructivist and connectivist designs, reflecting the growing emphasis on interaction, collaboration, and learner-centered practices.

With the popularization of computing devices and wireless technologies, distance education has become increasingly embedded in global educational systems. Learners can now access instructional materials through mobile applications, web-based environments, and blended platforms. Tools such as computers, smartphones, tablets, and even PDAs have become central to supporting flexible learning opportunities (Ally, 2009). These digital devices allow education to extend beyond the classroom, creating learning environments that are accessible at any time and from any location.

Web-based distance education has particularly gained prominence due to its collaborative and interactive nature. According to Bates (2015), digital learning environments not only provide students with access to diverse resources but also foster collaborative communities where knowledge can be shared and constructed collectively. This aligns with constructivist learning theories that emphasize the role of learners as active participants in the educational process (Vygotsky, 1978). The flexibility of web-based learning has also been praised for promoting inclusivity, as it can reach learners in remote or conflict-affected regions who might otherwise be excluded from traditional educational systems.

The advantages of web-based distance education are numerous. It offers flexibility in terms of time and location, accessibility to diverse digital resources, and efficiency in knowledge delivery (Peters, 2003). Digital platforms allow for immediate sharing of instructional materials, instant communication between teachers and learners, and collaborative learning through forums, chats, and group activities (Anderson, 2008). Additionally, the portability of digital content, often stored in small devices such as USB drives or smartphones, has replaced traditional textbooks, making learning more convenient and engaging.

In the Ethiopian context, these features are particularly important, as many students in conflict-affected or rural areas have been deprived of structured educational opportunities. Distance education provides an alternative that could bridge gaps caused by displacement, poverty, and infrastructural destruction. Moreover, as UNESCO (2019) emphasizes, digital learning has the potential to play a transformative role in achieving inclusive and equitable quality education, especially in countries with significant educational disparities.

Despite its many opportunities, distance education also faces serious challenges, particularly in developing countries. Technical limitations include inadequate internet connectivity, limited access to reliable electricity, and the high cost of digital devices (Dhlamini, 2014). In Ethiopia, these challenges are magnified by underfunded educational systems and fragile infrastructure. Additionally, learners often face psychological and pedagogical challenges, such as distractions from social media, isolation from peers, and difficulties in adapting to new modes of learning (T. Elias, 2011). Poorly designed instructional materials also hinder the effectiveness of online learning, as they fail to align with pedagogical standards that foster deep engagement and understanding.

Furthermore, issues of privacy, security, and standardization complicate the delivery of web-based distance education. Non-compliant user interface designs, lack of teacher training, and resistance to adopting new teaching methods remain critical barriers (Guri-Rosenblit, 2009). In least developed countries like Ethiopia, these challenges are further exacerbated by cultural reliance on traditional face-to-face instruction and the scarcity of professional development programs for teachers.

In the context of post-conflict Ethiopia, particularly in Mekelle and the wider Tigray region, the importance of distance education cannot be overstated. Displacement, trauma, and financial hardship have left many students unable to attend conventional schools. Distance education, if properly designed and adapted to local realities, offers a pathway to re-establish learning opportunities. This aligns with Moore and Kearsley's (2011) argument that distance education must be contextualized to meet the unique needs of learners in different environments.

1.2. Statement of the Problem

Mekelle, the capital city of Tigray, has experienced profound disruptions in its educational system due to recent conflicts, leaving schools damaged and educational services fragmented. The region's post-conflict recovery has not only exposed the devastation caused by war but has also highlighted the long-standing inequalities in access to education, particularly among rural communities, displaced populations, and working professionals. Traditional on-campus education is no longer viable for many due to limited infrastructure, high costs, and ongoing safety concerns. As a result, distance education has emerged as a potential alternative, yet its implementation in Mekelle faces significant challenges.

Historically, distance education in Ethiopia, much like in other developing countries, began with print-based correspondence learning (Keegan, 1996). Printed learning materials were distributed to students at intervals, and learners were expected to study independently and return assignments. While this model offered some flexibility, it carried inherent disadvantages. As Holmberg (2005) and Garrison (2000) note, reliance on printed materials often led to superficial learning because such materials provide only second-hand experiences of reality, making it difficult for learners to grasp abstract concepts without prior knowledge or practical engagement. Furthermore, print-based correspondence courses in many contexts, including Ethiopia, were associated with high dropout rates due to limited interaction between teachers and students (Moore, 1993). The challenges were compounded by logistical barriers, such as delays in printing and delivering materials, increased costs of paper imports due to foreign currency shortages, and inflation of tuition fees. For example, the cost of distance education in Ethiopia has risen drastically, with fees per credit hour increasing nearly fifteen-fold between 2004 and 2024. These financial and logistical obstacles have made traditional print-based distance learning increasingly unsustainable.

In the case of Mekelle, these limitations are exacerbated by a fragile post-conflict infrastructure and unreliable postal systems. Delays or loss of correspondence materials disrupt the consistency of instruction, and learners are forced to repeatedly travel to branch offices to obtain study modules, which further increases costs and reduces efficiency. Moreover, such a system is incompatible with modern expectations of flexibility and accessibility. As Moore and Kearsley (2011) emphasize, effective distance education requires autonomy, where learners should be able to progress at their own pace and access resources when needed. However, the rigid distribution model of correspondence learning in Ethiopia has restricted such autonomy, leaving students dependent on institutional schedules rather than self-directed learning pathways.

The limitations of the print-based model underscore the urgent need to transition toward web-based distance education (WBDE). The development of internet technologies and mobile platforms has created opportunities to reimagine distance learning in ways that are interactive, flexible, and learner-centered. Anderson and Dron (2011) argue that digital distance education is best understood through the lens of interaction, where knowledge is co-constructed through continuous exchanges between learners, teachers, and digital systems. Unlike traditional correspondence study, web-based platforms provide immediate access to vast libraries of digital resources, enable real-time communication between students and instructors, and support collaborative learning environments that transcend geographic and temporal barriers (Bates, 2015).

Nevertheless, the transition to WBDE in Mekelle is not without challenges. Unreliable internet connectivity, limited access to digital devices, and insufficient training among educators and learners create significant barriers to adoption. Educators often lack familiarity with digital pedagogies, while students struggle to navigate new learning platforms without prior exposure. These issues are consistent with findings by Dhlamini et al. (2014), who highlight that poorly resourced educational systems in developing countries often lack the infrastructure and support mechanisms required for effective online learning. Furthermore, marginalized groups, particularly women and rural learners, face additional obstacles due to limited digital literacy and socio-economic constraints, further widening the educational divide (UNESCO, 2019).

Despite these challenges, the post-conflict reality of Mekelle provides a compelling case for investing in technology-driven educational solutions. As Peters (2003) asserts, the sustainability of distance education lies in its ability to leverage evolving technologies to enhance accessibility and learner engagement. For Mekelle, adopting web-based distance education tailored to local contexts—through culturally relevant curricula, affordable technologies, and teacher training—offers a pathway to address both the immediate crisis of disrupted schooling and the long-term goal of educational equity.

1.3. Objective of the study

1.3.1. *General Objective*

The objective of this research is to design and evaluate an appropriate technology-based information system aimed at enhancing distance education in Mekelle.

1.3.2. *Specific Objectives*

The specific objectives include:

1. To assess the current technological infrastructure available for distance education in Mekelle.

2. To identify the educational needs and challenges of distance learners and educators in the region.

3. To propose a technology-based information system model tailored to the local context.

4. To evaluate the feasibility and potential impact of the proposed system on educational access and quality.

1.4. Scope and Limitation of the Study

This study was confined to the design and evaluation of an appropriate technology-based information system aimed at supporting distance education in Mekelle, Tigray. The research concentrated on identifying the existing technological infrastructure, assessing the needs and challenges of both learners and educators, and proposing solutions that are responsive to the unique socio-economic and cultural context of the region. Given the post-conflict setting of Mekelle, the study particularly emphasized the appropriateness of the technology, prioritizing cost-effectiveness, scalability, and adaptability.

The scope of the study covered both primary and secondary stakeholders engaged in distance education. Primary stakeholders included students enrolled in distance education programs, educators responsible for delivering instruction, and school or university administrators who oversee the management of distance education. Secondary stakeholders included parents, community members, and local authorities who indirectly influence the success of educational interventions. By examining these groups, the research provided a holistic understanding of the opportunities and barriers in implementing a technology-based system for distance learning.

A major component of the scope was the investigation of the availability, functionality, and accessibility of technological resources in Mekelle. This included internet connectivity, the prevalence of mobile devices, and the use of digital platforms. Special attention was given to marginalized groups, such as women, rural residents, and internally displaced individuals, who face additional barriers in accessing education. Their inclusion in the study was critical to ensure equity and inclusiveness in the proposed system. Furthermore, the study examined the feasibility of implementing a blended system that combines online and offline resources. This was necessary in order to address infrastructural gaps, such as unstable electricity supply and inconsistent internet coverage, that often hinder fully online models of distance education.

The research also included the pilot implementation of the proposed information system in selected educational institutions in Mekelle. This evaluation focused on its practicality, usability, and adaptability to the local context. The pilot allowed for testing system functionalities, gathering feedback from users, and identifying the extent to which the system addressed the instructional and administrative needs of distance education.

Despite its contributions, the study was bounded by several limitations. First, the findings are context-specific to Mekelle and may not fully reflect the realities of other regions in Ethiopia, particularly those with different socio-economic or infrastructural conditions. The study was also limited by infrastructural constraints, including unreliable internet connectivity, limited access to digital devices, and inconsistent electricity supply. These factors affected the extent of adoption and testing of the system. In addition, financial and time constraints restricted the possibility of conducting a large-scale implementation across multiple institutions. The post-conflict environment in Tigray also imposed challenges, such as disrupted academic calendars and the psychological impacts of war on learners, which influenced data collection and implementation processes.

While these limitations restricted the generalizability of the study, they do not diminish its significance. On the contrary, they highlight the realities of working within resource-constrained and post-conflict environments. The insights drawn from this study provide valuable lessons for designing context-appropriate and sustainable distance education systems in Ethiopia and similar developing country settings. The findings contribute not only to the academic discourse on educational technology but also to practical policymaking and implementation strategies aimed at enhancing equitable access to education.

1.5. Significance of the Study

The significance of this study lies in its contribution to addressing the pressing educational challenges faced by Mekelle in the aftermath of conflict. Through the design and evaluation of an appropriate technology-based information system, the study has demonstrated how distance education can be strengthened and sustained within the local socio-economic and cultural context.

1. **Bridging Educational Gaps:** The study has enhanced opportunities for marginalized groups, including displaced individuals, rural populations, and working professionals, by providing a system that expands access to quality education. By doing so, it has addressed some of the disruptions caused by conflict and contributed to restoring learning opportunities for those most affected.
2. **Promoting Equity in Education:** By integrating localized, culturally relevant, and user-friendly technological solutions, the study has addressed the digital divide in Mekelle. The developed system has proven to be more inclusive and adaptable to learners with different backgrounds and resource levels, thereby promoting greater equity in education.
3. **Strengthening Educational Infrastructure:** The research has supported the development of a sustainable and resilient educational infrastructure capable of withstanding disruptions such as power shortages, connectivity issues, and displacement. Furthermore, the system's design has shown potential to be adapted and scaled to other regions in Ethiopia facing similar challenges.

4. **Empowering Educators and Learners:** The findings of this study have equipped educators with tools for effective instructional delivery and communication, while also empowering students to actively engage in distance learning. This has reduced barriers to participation, improved retention, and created pathways for better learning outcomes.
5. **Informing Policy and Practice:** The study has provided evidence-based recommendations that can inform educational policymakers and institutional stakeholders. By demonstrating how appropriate technology can be integrated into distance education programs, the research has contributed to the national and regional discourse on the role of ICT in education within developing and post-conflict settings.
6. **Catalyzing Regional Development:** Beyond the educational sector, this study has contributed to socio-economic recovery and development in Mekelle by helping to build a skilled and resilient workforce. By preparing learners with the necessary knowledge and skills for the demands of the 21st-century job market, the study has linked education to broader goals of regional development.

Research Questions

1. What are the current technological infrastructures available to support distance education in Mekelle?

2. What specific challenges do distance learners and educators face in accessing and utilizing educational technologies in Mekelle?

3. How can a technology-based information system be designed to address the educational needs of Mekelle's population effectively?

4. What are the expected impacts of implementing a technology-based information system on educational access and quality in Mekelle?

5. How can the proposed system be adapted to ensure sustainability and scalability in other regions of Ethiopia?

1.6. Limitation of the Study

The researcher may face some problems while conducting the paper. The main problems that will challenge the researcher are the current political condition of the region , shortage of data for some important variables and data may not be available at the right time and the right place.

This study encountered several limitations that must be acknowledged:

1. **Geographical Focus:** The research is limited to Mekelle, and the findings may not fully represent the challenges or opportunities in other regions of Ethiopia.

2. **Resource Constraints:** Limited access to funding and technological resources may affect the development and testing of the proposed information system.

3. **Participant Availability:** Due to ongoing recovery efforts, it may be challenging to secure consistent participation from educators, learners, and administrators in the region.

4. **Technological Infrastructure:** Variability in internet connectivity and access to digital devices may impact the generalizability of the proposed system.

5. **Data Availability:** Due to the conflict and ongoing restoration efforts in Mekelle, access to reliable and comprehensive data may be limited, which could affect the depth of analysis and recommendations.

6. **Time Constraints:** The researcher's commitments to other professional duties restricted the time available for conducting an in-depth study and pilot testing.

1.7. Organization of the study

This research organizes into seven chapters. The first chapter introduces the basics of the study topic. The second chapter gives a literature review on what has been done regarding appropriate technology-based information system for distance education in mekelle so far. The third chapter discusses the methodology followed in this research. Discussion and analysis data is presented in detail in chapter four. Chapter five shows functional requirements, non- functional requirements, and system models. Chapter six discusses the implementation of appropriate technology-based information system for distance education in mekelle and presents evaluations. Finally, the last chapter provides the conclusion of the research and the recommendation.

CHAPTER TWO

LITERATURE REVIEW

2.1. Overview of Distance education

Distance Distance education has experienced remarkable growth both nationally and internationally since the early 1980s. Before defining distance education, various scholars have used different terms to describe similar concepts. According to Akinwale et al. (2018), commonly used terms include correspondence education, home study, independent study, external studies, continuing education, distance teaching, self-instruction, adult education, technology-based or mediated education, learner-centered education, open learning, open access, flexible learning, and distributed learning. These terms are often used interchangeably, reflecting different perspectives and historical developments in the field.

In general, distance education refers to the provision of learning opportunities in which the teacher and learner are separated by time, place, or both, and one or more technologies are used to deliver instruction and support meaningful interaction (Moore & Kearsley, 2011; Heinich et al., (2002). The interaction between learners and instructors can be synchronous (real-time) or asynchronous (delayed), depending on the communication tools used. Kudryavtseva (2013) highlights that distance education often involves a variety of media, opportunities for occasional face-to-face meetings, and a specialized division of labor in the production and delivery of courses.

Another perspective focuses on open and distance learning (ODL). Here, "open" signifies ease of access, minimizing barriers to higher education, while "distance learning" refers to instructional methods that may include online learning, e-learning, flexible learning, or blended learning. Blended approaches often rely on information and communication technologies (ICT), but in regions with limited technological access, traditional methods such as correspondence, radio, or television may be used (Holmberg, 2005; Bates, 2015).

The rationale for distance education is strongly connected to equity and accessibility. It allows learners to access educational opportunities despite socio-economic, geographic, or infrastructural limitations. This is particularly relevant in post-conflict regions such as Mekelle, where schools have been disrupted, and learners face challenges accessing traditional on-campus education (UNESCO, 2019). Distance education therefore plays a critical role in bridging educational gaps and promoting lifelong learning.

2.1.1. *Theoretical Foundation*

The theoretical foundation of this study is anchored in three major theories that explain the acceptance, diffusion, and appropriateness of technology: the Technology Acceptance Model (TAM), the Diffusion of Innovation Theory, and the Appropriate Technology Theory. These theories collectively provide a robust framework for understanding how a technology-based information system can be effectively designed, adopted, and sustained to support distance education in the unique socio-economic and cultural context of Mekelle.

2.1.2. *Technology Acceptance Model (TAM)*

The Technology Acceptance Model (TAM), developed by Davis (1989), is one of the most widely used models to explain users' acceptance of information technology. TAM posits that two main factors influence the acceptance and use of technology: perceived usefulness (PU) and perceived ease of use (PEOU). Perceived usefulness refers to the degree to which a user believes that using a particular system will enhance their job or learning performance. Perceived ease of use reflects the degree to which a user believes that using the system will be free of effort.

In this study, TAM helps to explore how distance learners and educators in Mekelle perceive the usefulness and ease of use of a technology-based information system for distance education. Understanding these perceptions is critical because they directly affect users' attitudes towards adopting and continuously using the system, which ultimately impacts the effectiveness of distance education delivery.

2.1.3. *Diffusion of Innovation Theory*

Rogers' Diffusion of Innovation Theory (2003) explains how, why, and at what rate new ideas and technologies spread within a social system. The theory identifies five key attributes that influence adoption rates: relative advantage, compatibility, complexity, trialability, and observability. Relative advantage refers to the degree to which the innovation is perceived as better than the idea it supersedes. Compatibility measures how consistent the innovation is with existing values, past experiences, and needs of potential adopters. Complexity relates to the perceived difficulty of understanding and using the innovation. Trialability is the extent to which an innovation can be experimented with on a limited basis. Observability refers to the visibility of the results of the innovation to others.

Applying this theory within the Mekelle context provides insight into factors that facilitate or hinder the adoption of distance education technologies. It emphasizes the importance of culturally and contextually appropriate technologies that align with local values and infrastructure capabilities, especially in post-conflict settings where adoption barriers may be higher.

2.1.4. *Appropriate Technology Theory*

The concept of Appropriate Technology, articulated by Schumacher (1973), argues for the use of technological solutions that are economically feasible, environmentally sustainable, culturally suitable, and accessible to the intended users. Appropriate Technology Theory stresses the importance of designing systems that fit the users' social, economic, and environmental conditions.

In Mekelle, where infrastructure is fragile and resources are limited following conflict, appropriate technology plays a critical role. This study uses the Appropriate Technology Theory to guide the design of a technology-based information system that leverages affordable, scalable, and user-friendly technologies such as mobile platforms and offline-accessible content, ensuring inclusivity and sustainability.

2.1.5. *Integration of Theories in Distance Education Context*

The integration of TAM, Diffusion of Innovation, and Appropriate Technology theories offers a comprehensive framework for this research. TAM provides a micro-level understanding of user acceptance behavior essential for system design and usability. Diffusion of Innovation offers a macro-level perspective on how the technology spreads and becomes embedded within the educational ecosystem. Appropriate Technology ensures the solutions are tailored to the unique socio-economic and cultural realities of Mekelle.

Together, these theories highlight the multidimensional considerations necessary for developing an effective technology-based system that enhances educational access, quality, and equity in distance learning. The synergy between perceived usability, innovation adoption challenges, and contextual appropriateness forms the foundation for designing and evaluating the proposed system for Mekelle.

2.2. Historical Development and Growth of Distance Education

Distance education began in the 19th century as correspondence courses, primarily using print-based materials sent through postal services (Keegan, 1996). These early systems allowed learners to study independently but had significant limitations, including delayed feedback, lack of interaction, and high operational costs. As Moore (1993) notes, print-based systems often led to learner dependency on external guidance and were associated with higher dropout rates, particularly for students with limited prior knowledge or low literacy skills.

With technological advancements in the 20th century, distance education incorporated radio, television, and early computer-assisted instruction. By the 1980s, and especially with the expansion of the internet in the 1990s, web-based learning became increasingly feasible, allowing learners to interact with instructors and peers in ways that were previously impossible (Holmberg, 2005; Bates, 2015). Web-based distance education offers flexibility, interactive learning opportunities, and the integration of multimedia resources, which enhance understanding and engagement (Sarrab, 2015; Abdillah, 2015).

2.2.1. *Web-Based Distance Education (WBDE)*

Web-based distance education uses internet technologies to deliver instructional content, facilitate communication, and support collaborative learning among geographically separated learners. This mode of learning has several advantages: it provides anytime-anywhere access, supports learner autonomy, enables interactive learning, and allows for multimedia integration (Moore, 1993; Anderson & Dron, 2011).

However, the adoption of WBDE in developing countries, including Ethiopia, faces significant challenges. These include limited internet connectivity, insufficient access to digital devices, low digital literacy among educators and learners, and the lack of culturally and contextually appropriate content (Dhlamini et al., 2014; Elias, 2011). Consequently, many students and educators experience difficulties fully participating in online education.

2.2.2. *Appropriate Technology in Distance Education*

The concept of appropriate technology emphasizes solutions that are affordable, sustainable, contextually suitable, and user-friendly (UNESCO, 2019). In the context of Mekelle, post-conflict disruptions have weakened infrastructure and limited access to reliable educational resources. Therefore, designing an appropriate technology-based information system is crucial for enabling effective distance education. Such systems can operate under low-bandwidth conditions, work on commonly available devices (smartphones, tablets), and combine both online and offline resources to ensure continuity of learning.

Studies in similar contexts demonstrate the importance of locally adapted, context-sensitive solutions. Mohamed Sarrab (2015) found that web-based systems tailored to students' technological capacities and socio-cultural needs improved engagement, access, and learning outcomes. Bates (2015) emphasizes that successful distance education in developing countries requires integrating technological, pedagogical, and contextual considerations to achieve effectiveness and sustainability.

In Mekelle, the implementation of an appropriate technology-based information system addresses several key gaps: limited access to learning resources, insufficient learner support, and the lack of scalable digital platforms. By integrating both online and offline modes and providing user-friendly interfaces, the proposed system contributes to improving access, engagement, and educational equity in post-conflict settings.

2.3. Challenges of Distance Education

Distance education, defined by Valentine (2002) as a mode of learning characterized by the separation of teacher and learner in time, place, or both, has experienced remarkable growth globally. It provides learners with flexible opportunities to access education despite geographical, temporal, or socio-economic constraints. However, despite its potential, distance education faces a number of persistent challenges that can hinder its effectiveness, especially in developing countries and post-conflict contexts like Mekelle, Tigray.

One major challenge in traditional distance education is the increasing cost of instruction. Correspondence-based programs often involve hidden costs for learners, including postal fees, travel expenses, and purchasing supplementary materials. Delays in the delivery of study materials may exacerbate these costs, as students must wait for modules to arrive or travel to regional centers to follow up, wasting both time and resources (Moore, 1993; Keegan, 1996). In Ethiopia, the most common form of distance education relies heavily on printed materials, which can be expensive to produce and distribute, especially given the country’s current economic constraints (Bates, 2015).

Quality of instruction is another significant concern. Many learners report insufficient support from instructors, delayed feedback, and difficulties accessing relevant resources. The lack of interaction between learners and instructors can reduce the effectiveness of learning and decrease motivation. Furthermore, individual-related challenges, such as limited study time due to work or family responsibilities, affect students’ ability to engage fully in distance learning (Valentine, 2002; Holmberg, 2005).

The **access and use of Information and Communication Technologies (ICTs)** also pose barriers. Limited access to computers, mobile devices, or the internet restricts learners’ ability to participate in more interactive or web-based distance education programs. Technical literacy, or the lack thereof, further limits students’ and educators’ ability to use available technologies effectively (Dhlamini et al., 2014; Elias, 2011). Financial constraints, lack of support from employers, and logistical challenges related to traveling for face-to-face sessions or examinations further complicate engagement in distance education, particularly for displaced populations, rural learners, and working professionals (UNESCO, 2019).

Misuse of technology and negative attitudes from instructors, students, and administrators can also affect the implementation of distance education. Some educators may resist integrating technology into teaching due to unfamiliarity or fear of change, while learners may lack motivation or confidence in using digital tools (Anderson & Dron, 2011; Bates, 2015). These issues highlight the need for contextually appropriate, user-friendly technology solutions that address the specific needs of learners and educators in Mekelle.

In light of these challenges, the adoption of a technology-based information system tailored for Mekelle could mitigate many of the difficulties faced in traditional distance education. Such a system would integrate both online and offline components to ensure continuous access to learning materials, provide interactive platforms for learner-instructor communication, and reduce delays and costs associated with printed materials. By doing so, it would enhance equity, improve learning outcomes, and make distance education more sustainable and efficient in post-conflict contexts.

2.4. Selection of Media for Distance Education

The selection of appropriate media is a critical component in designing effective distance education systems. Educators and instructional designers must carefully consider multiple factors when determining the most suitable modes of delivery. These factors include learner characteristics, learning objectives, availability of resources, equipment costs, instructional design, modes of delivery, and the desired level of interaction between teachers and students (Keegan, 1996; Bates, 2015). Furthermore, societal expectations regarding effective and efficient learning outcomes add additional pressure on distance educators and policymakers to select media that maximize accessibility and learning effectiveness (Moore, 1993).

Hashim and Hashim (2011) emphasize that media selection should be informed by user preferences and the availability of multiple media options. Their study highlights the importance of evaluating which media are currently used and preferred by learners, as this can significantly influence engagement, motivation, and the overall success of distance education programs. In other words, an effective distance learning system should guide learners toward the media most suitable for delivering content and supporting interaction.

Research has shown that mobile technologies are particularly effective in distance learning contexts, especially in resource-constrained environments. Mobile phones are widely accessible, relatively inexpensive, and flexible, making them a popular choice among distance learners of various age groups (Traxler, 2007; Ally, 2009). When integrated appropriately, mobile learning technologies can enhance communication between students and instructors, provide timely access to learning materials, and support collaborative learning activities. Training students and educators in the effective use of mobile technologies further improves learning outcomes and maximizes the benefits of distance education (Sharples et al., 2009).

In the context of Mekelle, where post-conflict disruptions have limited access to traditional learning resources and infrastructure, careful selection of media is essential. A well-designed technology-based information system can integrate mobile devices, offline-accessible digital content, and web-based platforms to ensure learners can access instructional materials anytime and anywhere. By aligning media choice with learners' needs and technological availability, such a system enhances educational equity, supports learner autonomy, and strengthens the overall effectiveness of distance education in the region.

2.5. Mobile Phone Technology

2.5.1. *Mobile Phone*

The evolution of mobile phone technology has significantly impacted communication and education. Initially developed in the 1940s, mobile telephony saw widespread adoption in the 1990s, transforming social interactions and information dissemination

(Ling, 2004). The production of mobile phones has led to new communication behaviors, such as texting and the use of short message service (SMS), which have become integral to daily life (Campbell & Kwak, 2011).

In Ethiopia, mobile phone usage has experienced substantial growth. As of early 2024, there were approximately 77.39 million cellular mobile connections in the country, equating to about 60.4% of the total population (GSMA Intelligence, 2024). This widespread adoption presents a significant opportunity to leverage mobile phones as a medium for delivering distance education, particularly in regions like Mekelle, where traditional educational infrastructures may be limited.

2.5.2. *Mobile Network Types in Ethiopia*

Ethiopia's mobile telecommunications landscape has evolved to support various network technologies:

- **2G (GSM)**: Initially the predominant network, offering basic voice and SMS services.
- **3G (UMTS/HSPA)**: Introduced to provide faster data speeds, enabling mobile internet access.
- **4G (LTE)**: Rolled out to enhance mobile broadband capabilities, supporting more data-intensive applications.
- **5G**: In 2024, Ethio Telecom launched 5G services in several cities, including Addis Ababa, Adama, Jigjiga, Dire Dawa, Harar, and Bahir Dar, marking a significant advancement in the country's digital infrastructure (Ethio Telecom, 2024).

Despite the availability of these advanced networks, a study revealed that 76% of Ethiopian mobile users do not have access to mobile internet, highlighting a significant digital divide (Borkena, 2024). This disparity underscores the need for tailored mobile learning solutions that consider varying levels of network access and device capabilities.

2.5.3. *Defining Mobile Learning*

Mobile learning (m-learning) refers to the use of mobile devices, such as smartphones and tablets, to access educational content anytime and anywhere. According to a systematic review of 97 studies published between 2014 and 2023, well-implemented mobile learning can enhance engagement, knowledge retention, and skill development across various educational levels (M-learning, 2023).

The flexibility and portability of mobile devices make them suitable for delivering educational content in diverse contexts, including formal, informal, and just-in-time learning scenarios (Docebo, 2022). In Ethiopia, where access to traditional educational resources may be constrained, mobile learning offers a viable solution to bridge educational gaps.

2.5.4. *Architecture of Mobile-Based Learning Systems*

The architecture of mobile-based learning systems typically comprises three layers:

1. ***Presentation Layer**: The user interface on the mobile device, facilitating interaction between the learner and the system.*
2. ***Application Layer**: The core processing unit that manages requests from the presentation layer, executes learning applications, and communicates with the data layer.*
3. ***Data Layer**: The backend database that stores educational content, learner data, and other resources (Ally, 2009).*

Recent advancements have led to the development of adaptive mobile learning systems that incorporate cloud computing and smart devices to provide personalized learning experiences (Ally, 2009; Kukulska-Hulme & Traxler, 2005). These systems can be particularly beneficial in regions like Mekelle, where infrastructure challenges necessitate flexible and scalable educational solutions.

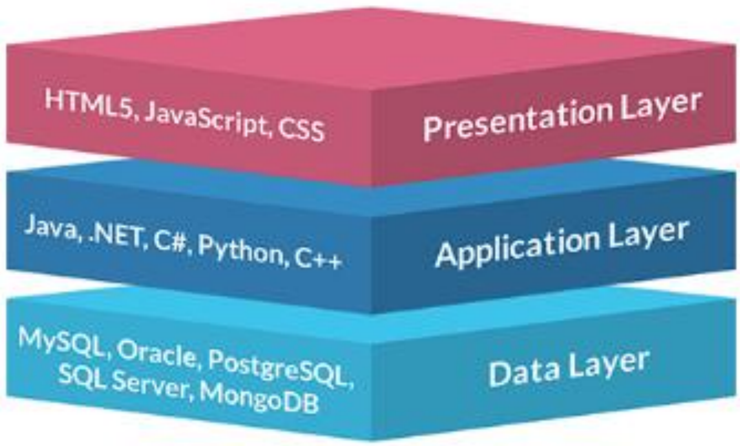

Figure 2.5-1Three-Tier Architecture

2.6. Open source Learning Content Management Systems

In the realm of distance education, Learning Content Management Systems (LCMS) play a pivotal role in delivering and managing educational content. These systems can be broadly categorized into open-source and proprietary platforms. Open-source LCMS platforms, such as Moodle, Sakai, and ATutor, offer the advantage of customization and cost-effectiveness, making them particularly suitable for institutions with limited resources.

2.6.1. ***Moodle****: A Versatile Open-Source LCMS*

Moodle, an acronym for Modular Object-Oriented Dynamic Learning Environment, is a widely adopted open-source LCMS that facilitates the creation of personalized learning environments. As of 2024, Moodle continues to be a leading choice for educational institutions worldwide due to its flexibility, scalability, and active community support. Moodle, an acronym for Modular Object-Oriented Dynamic Learning Environment, is a widely adopted open-source LCMS that facilitates the creation of personalized learning environments. As of 2024, Moodle continues to be a leading choice for educational institutions worldwide due to its flexibility, scalability, and active community support.

Key Features of Moodle:

- **Customizable Course Design:** Moodle's drag-and-drop interface allows educators to design and organize course content efficiently, accommodating various teaching styles and learning preferences.
- **Comprehensive Assessment Tools:** The platform offers a range of assessment options, including quizzes, assignments, and forums, enabling instructors to evaluate student performance effectively.
- **Mobile Accessibility:** Moodle's mobile-friendly design ensures that learners can access course materials and participate in activities on various devices, promoting learning anytime and anywhere.
- **Integration Capabilities:** Moodle supports integration with third-party tools and services, enhancing its functionality and adaptability to specific institutional needs.

Pros and Cons:

Pros:

- **Cost-Effectiveness:** Being open-source, Moodle eliminates licensing fees, making it an economical choice for institutions.
- **Customization:** The platform's modular architecture allows for extensive customization to meet specific educational requirements.
- **Community Support:** Moodle's large user community contributes to a wealth of resources, plugins, and shared experiences, facilitating continuous improvement and innovation.

Cons:

- **Technical Expertise Required:** Implementing and maintaining Moodle may require technical skills, which could be a barrier for some institutions.
- **User Interface Complexity:** While customizable, the user interface may appear complex to new users, necessitating training and support.

- **Performance Issues:** Some users report performance challenges, particularly when managing large numbers of users or courses.

Relevance to Ethiopian Context:

In Ethiopia, where access to quality education is a significant concern, Moodle presents an opportunity to bridge educational gaps. Its open-source nature aligns with the principle of appropriate technology, emphasizing solutions that are affordable, sustainable, and contextually suitable. By adopting Moodle, Ethiopian educational institutions can provide accessible and flexible learning opportunities to students, particularly in remote areas like Mekelle.

Comparison of WBDEL with Moodle and Google Classroom (Cost, Functionality, Local Adaptability)

WBDEL is positioned as an appropriate-technology adaptation rather than a replacement of established platforms. Compared to Moodle, WBDEL focuses on a narrower set of core distance education workflows identified in the Mekelle context—timely distribution of modules, assignment submission and feedback, low-bandwidth interaction, and practical payment activation—while emphasizing simpler navigation for first-time users and offline-first use cases. Moodle provides a broader and mature ecosystem of plugins and assessment tools, but it typically requires stronger technical administration, continuous server maintenance, and more sustained connectivity for optimal performance.

Compared to Google Classroom, WBDEL is designed for local hosting and operation even where cloud-service dependence and persistent connectivity are constraints. Google Classroom offers rapid deployment and integration with Google services, but its effectiveness depends on stable internet access and user accounts within the Google ecosystem. WBDEL emphasizes local language support, offline caching/synchronization, and integration with institution-specific constraints (branch-office workflows and local support structures), which improves contextual fit in post-conflict, low-infrastructure environments.

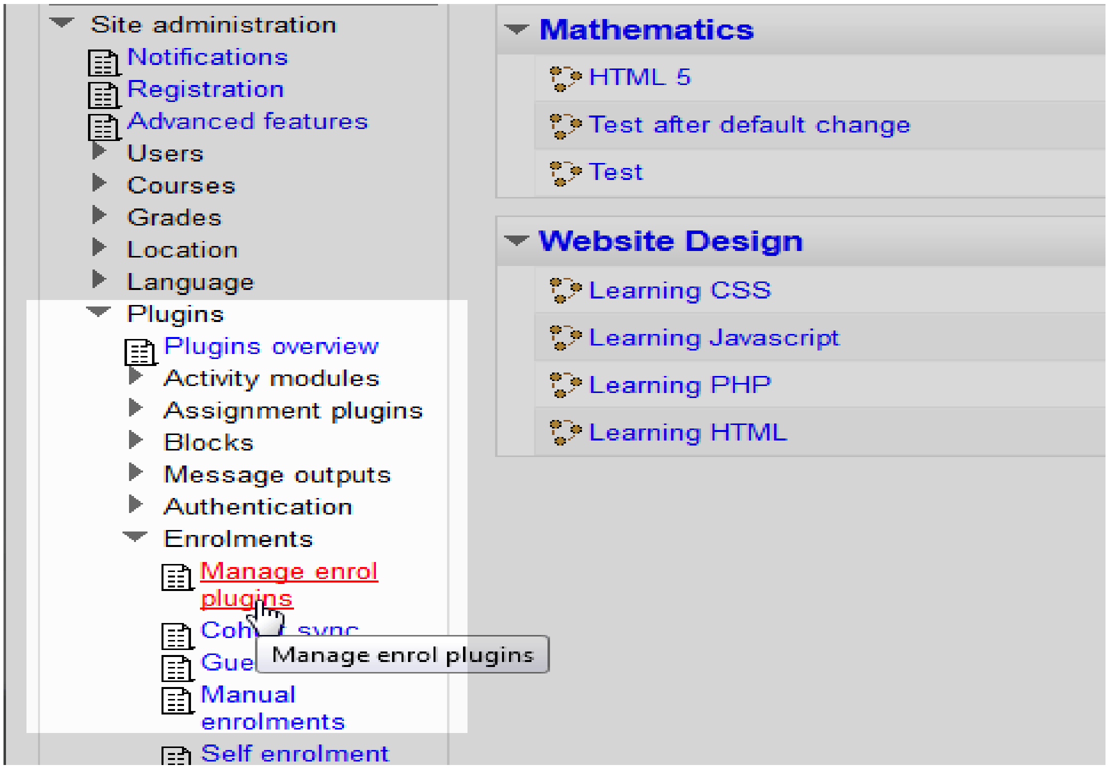

Figure 2.6-1-Managing plug-ins in Moodle

2.7. Related Works

2.7.1. *Foreign Works*

Different researches and developments have been carried out on Web-based distance education including requirements analysis, architecture design, proposed models, current and future trends. There are many Web-based distance educationapplications in the market today. The research tries to review some of the international works in this subsection.

Esam Idris K. Al Hassan (March 2015) ,attempt to detect services contained in Mobile learning technique (MLT) which could contribute to the development of Distance Learning courses (DLC) in Sudanese universities from the perspective of specialists of information and instructional technology. As well as to determine the obstacles, that could prevent the employment of MLT in the development of DLC in Sudanese universities. The methodology used to achieve the objectives and answer of the aim of the research, a questionnaire was designed to gather data. The approach is totally a quantitative method. The finding have shown that Mobile learning technique (MLT) through the provision of services can be contributing to the development of Distance Learning. The development of obtaining process and the contents of the courses at any time and place enable them to put their questions in collaborative learning framework and the consequent of storage for content even realized immediate feedback. It provides the renewable information base for each learner through interaction with information network and access to content, giving the learner a clear idea of what he needs from the information and how to access and view it. There are obstacles that would prevent the employment of Mobile learning technique (MLT) in the development of Distance Learning (DL) in Sudanese universities. The presence of obstacles in any of the Sudanese university environments that adopt Distance Learning (DL) may seem a matter of normal as long as it does not exist any environment does not suffer from technical or material or instructional difficulties that prevent the employment of MLT in the development of DLC,

Depend on the findings, it is recommended that initiate activation of MLT in the Sudanese universities and integrated into the DL systems according to a systematic and deliberate plan and the knowing of these obstacles will help to develop plans for the future and then access the optimized application for MLT in Distance Learning (DL) system.

Dr. Muhammad Imran Yousuf (October 2007.), conducted a study to better understand and measure students attitudes and perceptions towards the importance of mobile learning in distance education. The objectives of the study were as follows: To explore the perception of distance learners about the importance of mobile learning, to draw the students' preferences for mobile learning in distance education. To examine what extent the distance learners are used to mobile learning. The research method was surveyed in nature; therefore, questionnaire was used for data collection. Researcher-developed the questionnaire and the data is statistically analyzed. The finding this survey clearly indicate that facilitating mobile learning can improve the entire distance education by enhancing ways of communication among distance learners, tutors and supporting staff. The biggest advantage of this technology is that it can be used anywhere, anytime and its usage is easy to access to a large number of distance learners. This study draws the preferences and the extent to which distance learners in Pakistan are used to mobile learning. The researcher concluded mobile technologies are perceived by the participants in this study to be an effective tool in improving communication and learning. Mobile technologies such as mobile phones, however, do hold the tremendous potential of the flexible mode of communication, which can be strategically used to support and improve student retention. Mobile technologies do appear to have a great future in developing countries.

The study conducted by Sara Sze Yan Ng and Dickson K. W (2015), aims to provide a current overview of mobile apps usage in distance education. Besides exploring the actual use of apps, the technology acceptance model was applied to examine (1) Undergraduate students' perceptions, which involve perceived usefulness and perceived ease of use, towards adopting mobile apps for educational purposes, and (2) Their overall attitude toward such adoption. The researcher used mixed methods research to triangulate the research questions and hypotheses that The researcher would like to address. For the quantitative method used online questionnaire was designed to explore general perspectives on adopting mobile apps for learning from undergraduates from three faculties in a university, i.e. (1) the Faculty of Business and Economics (Business major), (2) the Faculty of Education (Education major), and (3) the Faculty of Engineering (Engineering major). The survey instrument was a 40 question survey, which was adapted from various prior studies, and required about 15 minutes to complete. It was divided into three parts for the purpose of collecting (1) demographic information, (2) students' general behaviors on using mobile apps, and (3) their intention of adopting and usage of apps for academic learning. To collect data on students' general behaviors on using mobile apps, they asked questions about their general usage patterns (such as the number of apps used and downloaded), as well as their usage behavior on education apps. The researchers used the appropriate types of statistical tests ($\chi 2$-test and ANOVA) to conduct the data analysis.

The results show undergraduate students use mobile apps frequently to engage in learning activities related to their academic studies, with a particular focus on communication and collaborative working, accessing academic resources, and checking a dictionary.

The researchers concluded in this study examined undergraduates' behaviors in utilizing mobile apps for academic learning. It confirmed that young people nowadays have a positive attitude towards using mobile apps in daily life as well as for learning. Furthermore, their investigation into students' preferences on using apps showed a consistent pattern of using apps for communication and interaction purposes, searching and checking for learning and reference materials, and information sharing. In addition, a divergence in mobile apps adoption related to different majors was not identified although minor discrepancies still exist among faculties according to different subject needs.

In the researchers tried investigated the developments of multimedia technology and internet networks have contributed to immense improvements in the standard of learning as well as distance learning in developed world, the developing. World is still not in a position to take advantage of these improvements because of the limited spread of these technologies, lack of proper management and infrastructure problems. Unless they succeed in solving these problems to enable people of developing countries to take advantages of these technologies for distance learning the vast majority of the world population will be lagging behind.

The method uses experimental evidence by reviewing different literature. The researchers suggested mobile technology offers a very hopeful way to reach the vast population of the developing countries as it does not require bandwidth connections. The researchers have to develop distance learning using multimedia through mobile technology. This seems to be the most viable way to reach billions living in the rural areas of the developing countries. Hence, considerable research efforts must be dedicated to this line. The author plans to work on how to use mobile technology to provide distance learning in both developed and developing countries in an efficient way using advanced multimedia tools.

In this paper, they take stock of the current situation and suggest some future directions in the resolution on these problems. More research needs to be carried out to tap the vast opportunity of reaching billions in developing countries through mobile technology and gearing up multimedia technology to be easily transported to those locations. They recommend the use of mobile and multimedia technology to reach this vast population of under-developed countries to impart quality learning in an effective way.

Recent studies done by Alib et al. (2018), reveal problems with online information evaluation skills and a lack of ability in using evaluation criteria, including currency, relevance, authority, accuracy, and purpose. The primary purpose of this study is to develop a framework for cooperative and interactive mobile learning to improve students' online information evaluation skills. A mobile learning application subsequently developed based on the proposed framework. To assess the effectiveness of the developed application, an experiment conducted on diploma students in a university. A usability questionnaire conducted on an experimental group to identify students' perceptions regarding the usability of the developed mobile application. Usability is important in the success of mobile applications. Usability or ease of use can make products and systems easier to use, and allow them to accommodate learners' requirements

Findings of this research have shown that interactive and cooperative settings in learning environments can enhance students' motivation and foster greater student communication. The proposed framework in this study was shown to be an effective guide in implementing mobile learning to improve students’ online information evaluation skills via enhanced cooperation and interaction between students and instructors in real-time. Furthermore, the inclusion of timeliness in usability evaluation has enhanced acceptance of the mobile learning application since usability testing is an important feature in software application development. Finally, in any instructional design environment, effective and extensive cooperation and interaction must occur between students and the teacher. Insights gained from this study will be useful for instructors, librarians, instructional designers, and researchers interested in promoting information literacy skills. The experimental results indicate that the application is significantly more effective with an effect size of improving students' online information evaluation skills than traditional learning. The results contribute to the extant literature in the context of mobile learning by identifying usability evaluation features and providing a framework for developing cooperative and interactive mobile learning. The implications of the present findings for research and instructional practice are discussed.

The article written by Elsherifa et al.(2016), baims at exploring students and educators' attitudes towards the use of Web-based distance educationin distance educational universities within Oman and UAE. The aim of the paper study is to explore the attitudes of learners and educators towards the use of Web-based distance educationin the distance education institutions in order to predict their intention of using Web-based distance educationtechnology in the educational context.

To serve this purpose, two survey questionnaires were conducted: one for students and another for educators. This exploratory study focuses on the distance education students and educators from the perspective of perceiving the usefulness of mobile devices in the context of the educational environment. In terms of usage of smartphones in general life activities, the Arab Gulf region countries are vibrant.

Findings revealed significant differences among the students' attitudes towards Web-based distance educationwith regard to their smartphone ownership. Furthermore, results indicated that Web-based distance educationcan be one of the promising pedagogical technologies to be employed in the distance educational environments within the Arab Gulf countries. Results revealed that almost all of the educators have positive attitudes with regard to their academic ranks, academic experience, and smartphone ownership towards Web-based distance educationwith non-significant differences in these factors indicating that Web-based distance educationcan be adopted by all educators regardless to their academic ranks, academic experience, and smartphone ownership. Overall, these factors may not been taken into consideration by the decision makers of these institutions for designing the Web-based distance educationsystems.

The researchers conclude the emergence of revolutionary Web-based distance educationtechnologies had a significant impact on educational technology. In this paper, they have highlighted the state of the art in Mobile learning regarding students' and faculty members' attitudes towards the use of Web-based distance educationin the distance educational universities. The main contribution of this study is to explore the students and educators' attitudes. Which in turn will support the decision makers of the Arab Gulf region institutions in designing the required Web-based distance educationinfrastructure? Many factors took into concern while examining those attitudes. Gender, country, academic rank, academic experience, and smartphone ownership are the factors that are taken into concern while examining educators' attitudes.

Sarrab (2015) attempted to evaluate students' knowledge and awareness about M-learning. This empirical study includes 56 university students from computer engineering and science departments at the University of Sultan Qaboos. This study consists of two parts. The first part involved the study overview presentation and students' discussion about M-learning. The second part included a survey study that consists of three phases: General information, Web-based distance educationknowledge, and Web-based distance educationperception. Based on the study survey questions regarding the knowledge, acceptance, and use of M-learning, the students' responses are analyzed and evaluated.

The study initial findings indicated good Web-based distance educationawareness and acceptance level and show students a positive attitude that reflect students interesting in the use of mobile devices as learning tools. Most of the Web-based distance educationmechanisms are concentrating on students of different distance education providers. The article reports an empirical research study about student's' Web-based distance educationknowledge that conducted with the purpose of defining the meaning of Web-based distance educationand evaluates the student's acceptance of Web-based distance educationwithin university undergraduate students. This research study conducted on undergraduate students in departments of computer engineering and computer science at Sultan Qaboos University, Oman.

The researcher concludes From this 6 months research study it can be concluded that Web-based distance educationcan be used to solve the traditional learning (T-learning) issues and difficulties and both learners or students and instructors or staff members require a proper Web-based distance educationsystem to facilitate and improve their learning process. The Web-based distance educationdifferent mechanisms are not designed to replace T- learning different approaches but Web-based distance educationmechanisms can be used to overcome the limitations in the learning process of different learning providers. For future research, more empirical in-depth research study needs to be conducted in all aspects of Web-based distance educationin Oman. The initial results of this Web-based distance educationresearch study encourage the researchers for the more comprehensive study about the acceptance and adoption of Web-based distance educationincluding students from different departments, colleges, and universities.

B. et al (2013) present a semester-long study on using smartphone devices in computing engineering education. They developed Sortko, an Android-based smartphone application for learning sorting algorithms, an important undergraduate computer science topic. The application consists of four main components the module for interactive sorting, the platform module, the motivational module, graphical user interface module, each with a distinct helping students in learning sorting algorithms.

The methodology included data collection with administered two surveys, collected questionnaires querying students' perception of usage and usefulness of the Sortko application and the approach, in general, is the quantitative method.

This article described a case study exploring the benefits of using mobile devices in supporting teaching and learning of sorting algorithms, an important computer science topic. The researcher proposed an approach in which an Android mobile application was designed and made available to students to be used in and out of classrooms. As a contrast to the conventional mode of teaching and learning, this application allowed students to engage in learning sorting algorithms in a location-independent way—both in and out of classrooms. By leveraging the existing body of knowledge dealing with the use of animation in teaching and learning, The reseracher designed an interactive application which scaffolds students in trying out sorting on their own.

Generally, international works show that Web learning is very useful for learning application from their research works. It is flexibility, mobility, ubiquitous, cheap, availability and motivates the leaner in their education are best. Most of the researchers used the methodology is the qualitative or quantitative or mixed method.

2.7.2. *Gaps in international Works*

Generally, the fields of Learning Content Management Systems (LCMS) are full of open source and commercial and non-commercial products. These systems are tutor-oriented, not designed to facilitate personalized learning support for an individual learner. Professors and students, frustrated with current learning management systems, need a new, innovative, user-friendly alternative to encourage and empower students to take control of their education, and teachers to explore new styles of teaching, depending on their students' needs. Most of the students in the developing world, especially in the Ethiopia, suffer from limited English proficiency, in addition to limited computer skills. These obstacles compose a barrier to and impose limitations on the design and implementation of Web-based distance educationsystems. This paper introduces a prototype for a simple, dedicated, learner-oriented Web-based distance educationsystem to facilitate the learning process. The proposed system enables the student (even with moderate English level and General IT knowledge) to wander through the system, and register for a specific course to make use of the scientific material available therein. In addition, the design of a distance education course conforming standards are introduced. The proposed prototype is made available for students to examine and evaluate. Feedbacks will be analyzed and enhancements will be proposed.

2.7.3. *Local Works*

2.7.3.1. Mobile Based Tutoring System in Distance Learning:

Wedaj, M.A (2018) Mobile Based Tutoring System In Distance Learning: The Case Of St.Mary’s University," St. Mary's Universty attempted to develop mobile based training system in distance learning. It is implemented using WAMP (Windows, Apache, MySQL, and PHP) integrated development environment for the editor, Android SDK for compiling, and running java codes and the Android development tool as a plug into the SDK to run java codes which can run on only Android operating systems. The entire content is located on the mobile phone.

He concluded that mobile-based tutoring system that can address the existing challenges and provide effective tutorial services to distance learners by taking Institutions of Distance education as a case. It was also found that largest proportion of respondents have smartphone which implies that learners have mobile phones with advanced features and can use them for accessing and exchanging any multimedia content.

The results of his studies provide contributions to the design of a prototype mobile based tutoring system for distance learning. This system introduced a new approach for providing feedback to students. This study implemented a mobile tutoring system that facilitates interaction between distance learners and tutors using video as well as SMS text exchanges. The system is validated by users and they proved that the system has contribution in enhancing the provision of tutorial services and feedback to students. It can also address the challenges of getting well qualified and experienced tutor and missing tutorial sessions by students due to various problems.

2.7.3.2. Web-based distance education for Distance Education

Tilahun, E. (2010).M-Learning for Distance Eduvation developed a mobile-based system that makes use of the available mobile phones. The system is designed to facilitate student registration. The Mobile Learning for Distance Education (MLFDE) was developed by using Microsoft visual studio Edition (Visual C#) and runs on window applications of mobile phones. The system tested in Windows Mobile Professionals 6 mobile and the mobile web application can run on any mobile device, which has an internet browser. In addition, since the application is web-based, it needs an internet connection that is provided by local ISP. The use of such systems are questionable because of poor internet connection and also working window application mobile , but it is known that most mobiles are android application.

2.7.4. *Research Gaps of Local Works*

Web based tech are becoming important keys to success (or failure) in distance learning. Previous studies attempt to design web based and mobile-based learning in Ethiopia, but they are mainly focused on the student side or front side of the system to simplify the registration process rather than the learning-teaching activity. They did not study student need as a result most of them uses computer platform and are not practical mobile learning. Therefore, this study aims to conduct more in-depth and thoughtful research on this topic in order to fill the gap in research related to use of mobile apps in distance learning. One of the purpose this study is to develop a framework for cooperative and interactive mobile learning to improve students' online learning skills. A Web-based learning application subsequently developed based on the proposed framework.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1. Overview

The research presented in this study focuses on designing and evaluating an appropriate technology-based information system tailored to support distance education in Mekelle. This system aims to incorporate various technological artifacts, including hardware, software, and digital resources, to address the educational needs of learners remotely. In this context, the information system (IS) integrates both technological and social elements to create an efficient platform accessible and relevant to the users' needs.

One key challenge for researchers working with information systems is selecting the most suitable research methodology. This chapter discusses the overall research design adopted in the study. The successful implementation of the IS depends on developing effective artifacts that meet the specific requirements of the distance education system. To achieve this, the research employs a mixed-methods approach that combines qualitative and quantitative data to comprehensively understand and address the challenges faced by distance learners and educators in Mekelle. This approach is appropriate given the complex socio-technical nature of the system and the post-conflict context of the study area.

While Data Science Research (DSR) methods are recognized in the IS community for artifact creation, this study prioritizes a mixed-methods research design to gather in-depth insights and measurable outcomes. The mixed-methods approach allows for the iterative design, development, and evaluation of a technology-based information system that is both user-centered and contextually adapted to Mekelle's unique educational challenges.

3.2. Research Method

This research adopts a mixed methods research design to develop and evaluate a web-based distance education information system tailored for the Ethiopian context, specifically focusing on Mekelle. The study aims to address the practical challenges faced by distance learners and educators by designing a scalable and culturally appropriate web-based platform to enhance access and quality in distance education. The mixed methods approach integrates qualitative insights through interviews and focus groups with quantitative data from surveys to provide a comprehensive understanding of how web-based learning can be effectively implemented.
existing knowledge base on the related research area, in this study, the scientific inputs relate mainly to good practices and design principles that are crafted based on researchers' experience of designing, developing, and evaluating the WBDEL application.. The iteration steps taken in the mixed methods research are summarized in figure 3.2-1

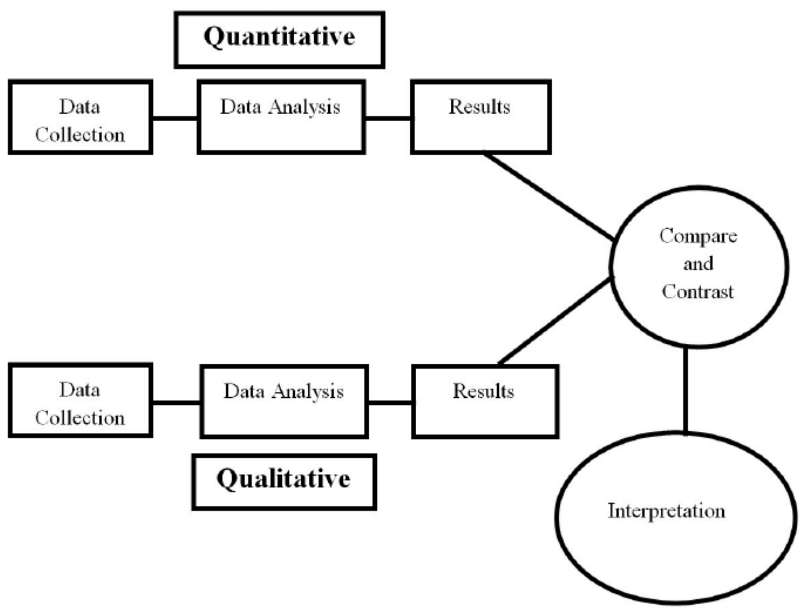

Figure 3.2-1- Mixed method research design approach (Adopted from Creswell 2012)

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The choice of Mixed method as a research method in this work was justified by the logical assumption that the method provides freedom to choose your own design and development. Each chosen design is evaluated based on its impact on IS artifacts iteratively. The method was priority used by other researchers' to examine a similar system, Web-based learning.

In order to solve a specific problem, mixed-methods research—which is centered on practical improvement—integrates qualitative and quantitative data. The study starts with a qualitative investigation (e.g., interviews, focus groups, or observations) to uncover mechanisms, user demands, and contextual limitations and to develop a preliminary solution concept, guided by abductive reasoning from previous theory and real-world observations. The creation of an artifact or intervention and the creation of quantitative measurements (experiments, surveys, and usage analytics) to evaluate the artifact's effectiveness are informed by the insights gained from this phase. Then, utilizing quantitative studies (effect sizes, reliability, performance indicators) and follow-up qualitative inquiries (usability, fit, unintended effects), the artifact is put into use and assessed against pre-established functional requirements. In order to assess overall efficacy, provide an explanation for the outcomes, and direct iterative solution development, findings are finally integrated at the interpretation stage (e.g., joint displays, meta-inferences).

Development, Evaluation, and further Suggestion were frequently iteratively performed in the course of the research effort. The conclusion indicates the end of a research cycle or the termination of a specific design science research project. Knowledge contribution resulting from new knowledge production is indicated in Figure 3.2-1 by the arrows labeled: Circumscription and Design Science Knowledge. The Circumscription process is especially important to understanding design science research process because it generates understanding that could only be gained from the specific act of construction..

The mixed method is used to get a complete picture of the problem as was recommended by Creswell, J.W., & Plano Clark,V.L.(2017). The researcher found the mixed method as an appropriate approach to answer research question i.e. how the use of web-based learning can effectively been integrated into distance education learning?

3.3. Problem Awareness

To increase access to education throughout the nation, Ethiopian educational institutions have been using distance learning more and more in recent years. Nonetheless, the majority of educational materials are still print-based and mostly use modules, which restricts interactive participation and presents difficulties for students in a variety of contexts. For areas like Mekelle, where persistent sociopolitical and infrastructure issues worsen educational disparities, this conventional method may be especially ineffectual.

In order to investigate the current conditions of distanc education delivery, this study focuses on a few chosen institutions, such as Sandaero and Oxfo centers. The problem awareness phase uses a mixed methodologies approach, integrating qualitative and quantitative research techniques to fully depict the reality and difficulties faced by educators and distant learners. This highlights the necessity for technology-governed, locally relevant, and user-centric distant learning solutions and clarifies the shortcomings of print-based methods.

Furthermore, the need for durable, accessible, and culturally appropriate alternative educational delivery models is made even more urgent by Mekelle's post-conflict environment. Poor educational outcomes and high dropout rates are caused by inadequate user training, a lack of supportive resources, and a limited technological infrastructure.

The educational gap widens as marginalized groups—such as women, people living in rural areas, and displaced people—are disproportionately impacted. In order to create and assess a customized, technology-based information system, this study aims to methodically examine these issues. The suggested system intends to revolutionize remote education in Mekelle by utilizing web- and mobile-based platforms in conjunction with offline resources, providing scalable solutions that support equity, usability, and long-term educational progress.

3.3.1. *Data Collection*

The data's sources were carefully chosen to provide accurate and trustworthy information. Students and educators in online learning serve as the main sources of data. Documents pertaining to the learning modules and assignments at the Sandaero and Oxfo centers are considered secondary sources. These consist of modules, rules, and institutional records, among other things. Due to the time-consuming and expensive nature of traveling to several places, a purposive sampling technique was employed for the study. In order to gather data for this study, questionnaires, interviews, and the examination of pertinent documents were used. Since primary sources are educated, questionnaires were essential for gathering data from them.

The prepared questions for distance learners are consistent with the evaluated linked publications. Appendices C and D contain the English and Tigringa versions of these questionnaires.

The total number of populations was 2500 of first year students; from these the sample selected was 115 questionnaires, which is around 5% of the population. The questionnaire was distributed to the students of Institutions of Distance education in Mekelle and around . From these, 90% of the questionnaires was properly filled and returned; 10% of the questionnaires were not returned from the student.

Sampling Strategy and Participant Selection Criteria (Purposive Sampling)

Purposive sampling was applied to ensure that participants had direct experience with the conventional (paper-based) distance education process and could meaningfully evaluate the proposed WBDEL solution. Student participants were selected using the following inclusion criteria: (i) registered distance education learners in Mekelle learning centers during the study period, (ii) first-year learners who had already used printed modules and the existing branch-office support services, (iii) willingness to participate and provide informed consent, and (iv) access to a mobile phone/tablet or computer used for learning (even if primarily for social use). For the qualitative component, academic staff involved in distance education delivery (instructors/tutors and administrators/coordinators) were selected based on their roles in module preparation, learner support, and assessment administration.

Representation considerations were addressed by recruiting learners from multiple departments and by intentionally including participants who travel different distances to the branch office, including learners living in rural areas and those affected by displacement. Residence and access constraints were captured through the demographic and challenge items (e.g., distance to the branch office, cost, device ownership), which helped ensure that the sample reflected the major learner contexts in Mekelle post-conflict. Although the sample was purposive (not probability-based), these criteria improved coverage of marginalized learner groups relevant to the study objectives.

Clarification on sample size: 115 questionnaires were distributed to distance education learners, and 112 were properly completed and used for analysis (97.4% valid response rate). The previously reported “90%” return rate relates to the usability pilot evaluation (27 valid returns out of 30 distributed), not the main survey.

Ethical considerations: prior to data collection, institutional permission was obtained through the standard graduate research approval process (advisor and department endorsement) and permission letters were secured from the participating distance education center(s). Participation was voluntary, informed consent was obtained (Appendices C and D), and respondents’ identities were kept confidential by using anonymous codes during data entry and analysis. Data were stored with restricted access and used only for academic research purposes.

The opinion and beliefs of the respondents is useful to sharpen the problem statement of the research. Interviews were conducted to the experts after carefully developing a guideline (see Appendix E).

The last data collection method that was used in this work was review of existing documents in Sandaero. These documents cover the entire document in the institutes that are related to the actual learning or the process. The quality printed modules, the production and distribution method of the modules were the main documents that were reviewed. The list of the documents analyzed is annexed on Appendix A and Appendix B.

The challenges in the existing paper based method that the learners and intuitions face was effectively captured in the data collection processes. Afterwards, this data was fed as an input for the design of Web-based learning system.

3.3.2. *Data Analysis*

Microsoft Excel 2010 was used to code the data obtained from the questionnaires. The software groups the individual response based on their frequency and calculates the percentage of each question. A quantitative result was obtained from the software.The data obtained from the interviews was arranged based on the theme of their response. The themes were then analyzed to get a qualitative result from the interviews.

3.4. Suggestion

After The research moved on to the proposal phase after gaining a good understanding of the issue in the first stage of the Mixed-method framework. Based on the issues found in the first stage, requirements and expectations are established at this point, and artifacts are described. This phase is essential for developing a preliminary design for a new artifact and WBDE setup. At this point, initial fixes for the issues found are developed. This is accomplished by converting the expectations and requirements into the functional requirements of the suggested solution.

In order to support the learning process, the research created a learner-oriented, user-friendly, and basic prototype system based on the data collected (see Figure 3.4-1). This system consists of a Web-based learning platform that allows users to freely traverse the program. Students should enroll if they are required to study a certain course. After that, the student can sign up to take a particular course. The learner will be directed to a payment site automatically by the application. Students who have paid for the course can upload their assignments and obtain the course materials.

Figure 3.4-1-Proposed Tentative Design

3.5. Development

The third activity in Mixed-method design flow is the design and development of the artifact. The goal of this activity is to develop a concrete solution that addresses the identified requirements. The design of an artifact includes determining the functionality of the solution as well as its construction. The searcher choses agile design and participatory approaches to design the development. WBDEL developed using a database the researcher use MySQL database and also need web server the researcher also going to use apache server. That run as local host need have server-side scripting computer here the researcher also going to use PHP uses as a server-side scripting langue for establishing connection to the database. Insert information into a database and for testing purposes the researcher need WampServer, this Wamp server defines a Windows web development environment. It allows creating a web application with Apache2, PHP and a MySQL database alongside, PhpMyAdmin allows managing easily database. Finally, the researcher needs to create this android application that communicates the MySQL database.

3.6. Evaluation

The developed prototype in the above step was evaluated based on the requirements identified elier. The evaluation was done by distributing questionnaires to 27 students from Sandaero and Oxfo centers after giving a brief introduction about the application. The results from the questionnaires were analyzed based on their frequencies. The percentage of the responses to a specific question is analyzed quantitatively to gather feedback about the application.. In regard to the printing system, the application was found to solve the challenge that Sandaero and Oxfo centers face due to delayed material delivery and poor printing quality. The application also helps the learners to interact with their instructors that they could not do in a print-based learning materials.

3.7. Conclusion

This stage may mark the conclusion of a particular research endeavor or just the completion of a research cycle. Usually, the outcome of a research endeavor is the satisfaction of a student's desire. not only the outcomes of the endeavor, but also the facts learned. Acquired knowledge has been acquired and can be utilized repeatedly. the standards on the type and extent of knowledge contribution outputs.The conclusion phase demonstrates how well the "solution" that was put into place met the user's needs and the circumstances that need improvement. Results from the conclusion phase demonstrate how well the developed "solution" meets the needs of the intended consumers. the circumstance that needs to be improved.

Each step's material is presented in accordance with the research questions that were addressed during the full investigation. acquired abilities and knowledge.a better knowledge of how students enrolled in distant education feel about the use of mobile devices in classroom instruction. a better knowledge of how to create Web applications that include informal learning environments and the primary obstacles involved in creating such a tool.

CHAPTER FOUR

DATA ANALYSIS AND DISCUSSION

4.1. Overview

As it stated in the preceding chapters, the general objective of this research is to design and evaluate an appropriate technology-based information system aimed at enhancing distance education in Mekelle, that addresses the existing challenges in distance learning services faced by distance learners. The result is presented as follows: the quantitative data was collected through questionnaires, which were tabulated, with frequency counts and percentage.

It was divided into six parts for the purpose of collecting:- (1)Demographics of the Respondents. (2)Problem of Distance Education in Traditional System. (3)Students' Challenges in Location of Branch office . (4)Computer Owners, type and Duration Usage. (5) Intention of student to Use Web Based Learning. (6) Their Intention of Adopting and Usage of Apps for Academic Learning.

10 interviewees from the instructors and academic staff of Institutions of Distance education in head office has been taken as data source. From these, 70% of interviews were properly conducted.

4.2. Demographics of the Respondents

In order to provide a clear image of the respondents involved in the study, some major characteristics of respondents was presented in Table 1.

Variable	Representative	Frequency(112)	Percentage(%)
Sex	Male	86	76.8%
	Female	26	23.2%
Age	Less than 25	6	5.4%
	26-36	85	75.9%
	37-46	17	15.2%
	46 and Above	4	3.6%
Department	Accounting	15	13.4%
	Agri-Economics	5	4.5%
	Economics	6	5.4%
	EDPM	44	39.3%
	Management	24	21.4%
	Sociology	18	16.1%

Table 1-Response on Demographic Data

As it is indicated in Table1, the dominant proportion of respondents were 76.8% male compare to the 23.2% of female and furthermore the largest age group of respondents that amounts to 75% of the total is 26 – 36 about 85%.

Addressing Gender Disparity and Gender-Based Barriers in WBDEL Adoption

The demographic imbalance (higher male participation) is acknowledged as a contextual limitation and is common in settings where women face additional barriers to technology access, time availability, and mobility. To address potential gender-based barriers, WBDEL is designed to reduce travel requirements to the branch office and to support flexible access to materials and feedback, which can particularly benefit learners with household and caregiving responsibilities.

In implementation, targeted support strategies are recommended to improve female participation and retention: (i) orientation sessions scheduled at accessible times, (ii) peer support groups and mentoring, (iii) device-sharing or lending arrangements where feasible, and (iv) community access points (e.g., branch-office Wi-Fi windows) to reduce cost barriers. These measures align the system's inclusive design intent with practical steps for equitable adoption.

4.3. Problem of Distance Education in Traditional System

Problem in distance education are analyzed from the point of learning material, getting modules on time, easily access of instructor for student, getting assignment feedback after submission. Summary of respondents reply presented in Table 2 below.

Variables of Distance Education	Frequency (112)	Percentage (%)
The difficult part and print quality of learning material		
Understanding the module content	73	65.2%
Assignment	6	5.4%
Self-Check Exercises in the Module	6	5.4%
Other(paper and print quality is poor)	17	24.1%
Getting Modules on Time		
Yes	32	28.6%
No	80	71.4%
Easily Access of Instructor for Student		
Yes	2	1.8%
No	110	98.2%
Getting Assignment feedback after Submission		
Yes	2	1.8%
No	110	98.2%

Table 2:-Response on Distance Education Problems

From the 112 participants who completed the questionnaire in the study, 65.2% noted that understanding the module is difficult and 24.1% responded very poor paper and print quality. Out of 112 respondents, 71.4% did not get the module on time, however, 28.6% get the module on time because of the leftover module from the previous term.

One of the greatest challenges of students is unable to get the instructor and feedback of the assignment after submission. Almost 98.2% of the respondents, there is no mechanism to get an instructor and students cannot get the corrected assignment.

4.4. Students' Challenges in Location of Branch office

The challenges of students in distance education is investigated based on Distance From Branch Office (KM), Average Price from Branch office(Birr), Frequency of coming to the university to get learning material. Accordingly, Table 3 presents summary of respondents' reply.

Variables of distance learners with related distance institutions	Frequency (112)	Percentage (%)
Distance From Branch Office(Km)		
1-20	54	48.2%
21-40	5	4.5%
41-60	17	15.2%
61-80	12	10.7%
<200	24	21.4%
Average Price from Branch office(Birr)		
< 8	54	48.2%
<15	5	4.5%
< 30	17	15.2%
< 39	12	10.7%
50-85	24	21.4%
Frequency of coming to the university to get learning material		
Every week	34	30.4%

Twice a week	29	25.9%
Every month	25	22.3%
Twice a month	12	10.7%
Three times a month	4	3.6%
Every 4 month	8	7.1%

Table 3-Students' Challenges in Relation to Distance Education

From respondents suggestions the researcher observes that, 48% has been traveling a distance of 1-20km to come to the branch office. The average distance from the branch office found to be 80km. Similarly, 48% of students were spending around 8 Birr for travelling to education center, where the average price for transportation was found to be 43Birr. Therefore; the student should travel from branch office an average distance of 80km and cost them 43Birr. Out of 112 respondents who had traveled to the branches office to take the learning material of every week ,twice a week, every month 30.4%, 25.9%,22.3% respectively.

4.5. Computing device Owners, Type and Duration Usage

An investigation was also made about owning Computer, type of computer, duration of having computer and use of them for distance learning, respondents suggestion is summarized as follows in Table 4.

Variables of distant Learners	Frequency(n=112)	Percentage (%)
Have personal Computer		
Yes	109	97.3%
No	3	2.7%
Type of computer		
Tablets or mobile	99	88.4%
Standard pc(Desktop)	10	8.9%
No	3	2.7%
Duration of Having computer devices		
No	3	2.7%
One Year	3	2.7%

Two Years	16	14.3%
Three Years	15	13.4%
Four Years	70	62.5%
>Five Years	5	4.5%
Do use your nComputer for distance learning		
Yes	3	2.7%
No	109	97.3%

Table 4-Computer type and Duration Usage

Out of the total 112 participants who completed the questionnaire in the study, 62.5% have their own computer. From these 88.4% had tablets android version, 90.2% had used their phones for 2-4 years. 97.3% of distance learner's use their computer did not support their learning activity in distances education.

4.6. Intention of student to Use Web Based Learning

An other issues raised for respondents concerned with, intention of students' to use Web- based learning. Table 5 below presents response provided by participants in the survey.

Variables	Frequency(112)	Percentage (%)
Replacing the hard copy learning material into the web-based		
Good	80	71.0%
Not good	15	13.3%
I don't know	17	15.2%
Willingness to use web-based instead of the hard copy		
Yes	97	86.6%
I don't know	1	0.9%
Maybe	14	12.5%

Table 5-Intention to Use Web Based Distance Education Learning

More than half respondents 71% agreed replacing the hard copy to the Web-based system. As it indicated in Table 5, 86% of the respondents are willing to use the web-based learning system when it introduced.

4.7. Their Intention of Adopting and Usage of Apps for Academic Learning

The attitude of distance learners to use Web application is also investigated . Here under in Table 6 below the researcher present the response given by respondents.

NO	**Questions:-** **How important do you think is the use for Web base in distance education?**	**Yes**		**No**		**I Don't Know**	
		n=112	(%)	n=112	(%)	n=112	(%)
1	Time saving	102	91%	2	2%	8	8%
2	Increase your learning peace	99	88%	9	8%	4	4%
3	maximize interaction between the student and the instructor	93	83%	12	11%	7	6%
4	Minimize transportation and other related costs	107	96%	2	2%	3	3%

Table 6:-Distance Learners' Attitude towards the Use of Web App

Among 112 distance learner 96% of respondents said it minimize transportation and other related costs and it is cost-effective, 91%, to time-saving,88.4%, to increase the learning pace and 83%, to maximize interaction student and instructor.

Structured TAM Analysis (Perceived Usefulness and Perceived Ease of Use)

To operationalize the Technology Acceptance Model (TAM), the questionnaire items and findings were organized into the two key constructs—Perceived Usefulness (PU) and Perceived Ease of Use (PEOU)—and linked to learners' Intention to Use (IU). PU was reflected by items such as cost reduction (transport and printing), time saving, faster access to learning materials, improved interaction with instructors, and timely feedback on assignments. PEOU was reflected by learners' reported ability to navigate the application, understand menus and icons, and complete common tasks (registration, accessing content, submitting assignments) with minimal assistance.

The results are presented primarily using descriptive statistics (frequencies and percentages), which is appropriate for the exploratory and design-oriented nature of the study and the mixed-method approach adopted. The high levels of agreement on usefulness-related items (e.g., cost, time, accessibility, and interaction) and the reported willingness to replace hard-copy processes provide converging evidence that PU and PEOU positively influence IU in this context.

To further strengthen TAM validation in future work, a follow-up study can compute composite PU and PEOU scores and apply inferential analysis (e.g., correlation/regression) to test the relationships PU→IU and PEOU→PU/IU across a larger and more diverse sample. This would complement the current descriptive findings and provide stronger statistical support for adoption conclusions.

4.8. Interviews on Expertise Perception and Support on the Implementation of Web- Learning

As it stated in the methodology, interview method employed to collect qualitative data. The researcher selected academic staffs who are involved in distance education. The interview was developed in such a way that the questions can address the research objectives. The result analyzed according their theme or core idea

4.8.1. *Summary of results from the interview*

The results of the interview were summarized using the following Table 8

Themes	Explanation
Challenges	The major challenges identified by respondents include: ✓ the problem infrastructure and skilled man power ✓ lack of expertise of the module preparation ✓ Upgrade Infrastructure and Skilled Employee Required ✓ Upgrade Infrastructure country level ✓ Training for student ICT knowledge we in distance education

	✓ Difficulty replacing paper based to electronically
Advantages of the instructor and student	✓ Motivation for learner ✓ Decrease the complain of student ✓ More simple the learning activity ✓ Good Weblearning ✓ Increase quality of education and Minimize the tuition fee ✓ Increase quality of education and everywhere and anytime can address learning ✓ Minimize responsibility of the cost university ✓ It decrease the load of Instructor ✓ Decrease the complaint learner with related the material

Table 7:-Summary of results from the interview

4.9. Discussion

The results indicate that understanding the paper based system the paper and printing quality very poor is annexed in Appendix B in document analysis , this results made module is difficult. Consequently, they fail in doing the self- check exercise, assignment, and final exam. This conclusion supports by the data from the interview and literature. This finding confirmed by expertise interviews: "Of course, many distance learners complained about the incomplete course materials every day. That is true, there are problems related to course material distribution, such as the distribution of course materials without assignment, lost course materials, distribution of course materials arbitrarily. Due to these problems, students do not succeed in the final exam." According to the findings, instructors had not been accessed when learners need them. Learners did not get feedback from assignments after submission. Students isolated from the instructor and no responses to their work and tasks.

This survey result shows learning materials are not accessible on time due to delay of material from head quarter. Students should come to the centers many times from different distance and places cost them money and time, even if the materials is not available in the center in regular fixed time. Because of the inconvenience of the transportation system and cost, Students are disappointing to attend teaching learning practice In addition, the increase the learning cost per credit hour this increase the dropout rate. Scholars thought that theoretically distance education institutions have high dropout rate. One of the obstacles of distance education, is using the traditional method of teaching learning processes is unsuccessful.

The largest proportions of respondents have a smartphone and used for social activity used minimum of four years but they are not using to support their distance learning. More than 70% of respondents agreed the hard copies replace learning material into Web . Students revealed that Computer devices were the most accessible technological tools compared to other technological tools that are mostly available in the student hand.

These results fit on existing evidence of literature technology-supported teaching and learning has helped in covering the physical distances between teachers and students, to enable the flexible delivery of teaching-learning material at a distance, anywhere and anytime.

The 80% of respondents in this study confirmed the importance of Computer devices for its flexible availability, improving the communication between students and instructor, gaining feedback on any courses. They use assignment submission, getting learning material, schedule of tutorial meetings, exam date, and feedback. In line with the recent literature study majority of the distance, learners preferred the effective use of web technology in distance education teaching learning.

The analysis confirmed that more than 90% of respondents agreed that usability of the Web-based teaching, learning is easy to use, saves time and money, create interactivity, less cost in delivering most of learning material, services, improves or motivates distance learners to attend or follow up learning. Learner get feedback for any request through the system, they do not feel isolated from the institution.

The aim this research totally changing the traditional system to modern use of technology more than automation. Most institution have ICT department they have no more than knowledge using the common office program but there is high potential to upgrade the traditional method distance education to modernized using mobile and computer. The finding of this research gives some insights to simplify teaching and learning activity and solve the challenges of the learner.

CHAPTER FIVE

PROPOSED SYSTEM

This chapter's goal is to create requirements that will help define and identify model user scenarios. After these needs have been analyzed, the consequences for the system model will be determined. The examination of student data, expert data, and secondary data from Sandaero and Oxfo distance education institutions served as the foundation for the work that was presented here. This chapter's content, which contributes to the overall system design, is the outcome of that process.

Additionally, it offers a collaborative learning approach; sharing is nearly instantaneous among users of the same content, resulting in immediate feedback and advice. Additionally, WBDEL offers great portability by substituting small RAMs with customized learning materials for books and notes. This type of learning is also entertaining and interesting. As a result, using Web learning for a more engaging and successful experience is easy.

5.1. Modeling the Current Learning System

We attempt to model the current system using use case, for example, take the OXFO COLLAGE has learning system as shown below Figure 5.1.1 use case and most distance education in Ethiopia uses this type of model.

The existing system is not any interaction between the instructor and student. The student is isolated from the teaching-learning experience. All actions, which the support system the distance education takes, place once a term like registration and payment. However, the student and teacher are isolated. The student cannot get any help from the teacher because there is no mechanism to create interaction in the current system. One branch office needs many employees to run the traditional distance education system. HERQA(Higher Education Relevance and Quality Agency) compels to have many employees to get accreditation.

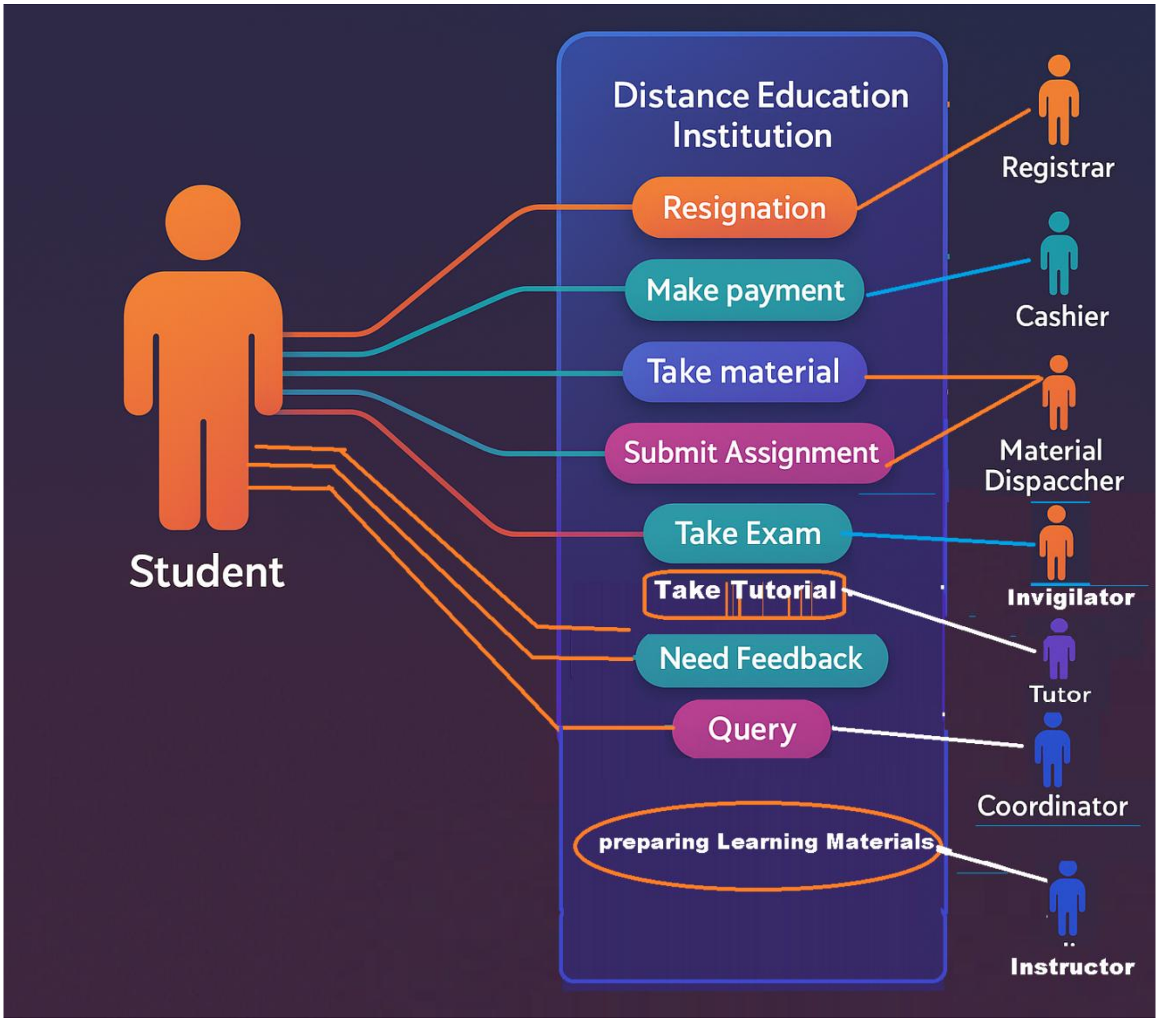

Figure 5.1-1:-Existing Learning System of actors participate in it use case diagram modeling

5.1.1. *Existing system of Production the Printed Material*

The process of production for one course in the existing system is shown below in figure 5.1-2. The production of print materials like the module, assignment, and exams take several times in ever steps through this process delay of availability of material the student should come many times to the branch office if it is arrived. Even if the material is arrived in centers; some materials may be lost and damaged due to the transportation system.

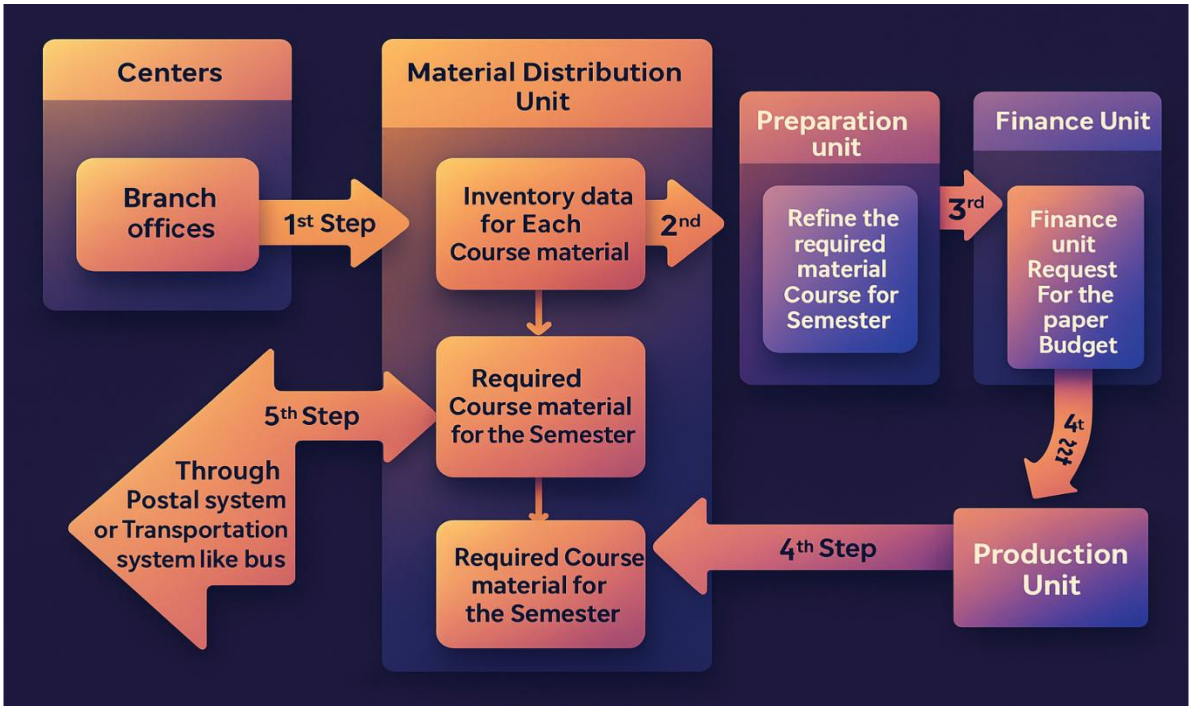

Figure 5.1-2:-The Existing Production System

5.2. Modeling the New System

The WBDEL consists of a mobile or web server broadcasting sub-system to share data and resources among all computer devices connected to the server as well as a classroom management and administration sub-system where all activities for blended learning, collaboration, social networking, and learning assessment are carried out.

The proposed system is Web-based learning system that provides an efficient and easy learning system that students can interact with teaching and learning practice. A simple user interface used that facilitates the interaction with the system. Administrative tools provide capabilities for implementing online courses.

An efficient student management system presents all the functions required by the student , fully implement the concept of distance learning system.

5.2.1. *Functional Requirements*

An empirical study was conducted to investigate the current practices and challenges of learning system as well as to identify the needs of distance learners towards web-based services. The findings of the empirical study provided as inputs and the required conceptual support to the design and development of the Web-based teaching system. The findings also served to prioritize areas of intervention based on the existing critical gap and learner's functional requirements. The following key findings were summarized from chapter four that can be used as a basis for the design and development of Web-based teaching system distance learners.

The new system is Web app utilization for learning system. The largest proportions of respondents have a smartphone, tablets and computers which imply that learners have devices with advanced features and can use them for accessing and exchange any multimedia content. More than 70% of respondents agree the hard copies replace learning material into web learning, students' willingness to use technology instead of the hard copy.

Therefore, web-based learning proposed in order to address the above-stated challenges, gaps, solving these challenges used an input for functional requirements for the new system.

5.2.2. *Support from Literature*

Support in designing and developing a Web-based learning system from chapter two as well in order to investigate its practices and challenges. The findings of the literature review provided input in the form of existing practices and challenges that served as the basis for designing and developing a Web-based learning system. These findings also provided the required conceptual support to the design and development of the learning-teaching system. There many open sources to solve the traditional learning system. Computer devices like mobile, tablets, and other are appear to be a more convenient tool for learning than any other technological tools in terms of portability, accessibility, affordability, operability, flexibility, and applicability

Generally, the functional requirements WBDEL of the system consists of the learning center, the clients (users), system administration panel, and the server.. It is comprised of many activities to achieve the requirements outlined for WBDEL. The activities described in chapter 6 in the implementation part. The main three actors are students, instructors, and administrator.

Students: who join the system?

Instructor: who will teach the student the required courses?

Administrator: who will control the overall system?

5.2.3. *Nonfunctional Requirement*

As many types of mobile learning requirements are described some of the dimensions, four dimensions: pedagogical, economic and technical. This framework developed based on personal experience in developing and evaluating Web-based distance educationapplications, input from colleagues, the ISO 9126 software quality standard and the literature on evaluation of human-computer interaction, e-learning, e-commerce and web-based distance educationApplications(MLAs)

Non-Functional requirement explains and describes the user visible aspects of the system. The following lists states the nonfunctional requirements.

- The system does not allow unauthorized users.

Security and Privacy Measures for Student Data, Payments, and Assessments

WBDEL enforces secure authentication and authorization by requiring unique user accounts and role-based access control (student, instructor, administrator). Passwords are stored using salted one-way hashing on the server, and session management is implemented to prevent unauthorized access. Administrative functions (course assignment, payment activation, grade entry) are restricted to authorized roles only.

To protect data confidentiality in transit, deployment should use HTTPS/TLS for all client-server communication. Server-side input validation and parameterized database queries are used to reduce risks of SQL injection and related attacks. Sensitive records (student profiles, grades, payment status) are protected through access logging, least-privilege database accounts, and regular backups to prevent data loss.

For payments and coupon activation, the system uses single-use coupon codes that are validated against the server database and marked as “used” once redeemed, reducing the risk of re-use or theft. When offline storage is used on the learner device, only the minimum required cached data are stored locally, and the device’s built-in storage encryption and application sandboxing are relied upon to reduce privacy risks. These measures collectively address confidentiality, integrity, and availability requirements for operating in a post-conflict, low-infrastructure context.

- The system should be platform independent.

- The system should be extendable.

5.3. System Design

The design goals are derived from the functional and non-functional requirements of the system, which were stated in the previous section of this document. They describe the qualities of the system.

Information should be thoroughly analyzed to get a clear understanding of them to categorize the users who use this system into the system.

5.3.1. *Use Case Model*

It is a detail description of the use-case view of the software architecture of WBDEL. It describes the set of scenarios and/or use cases that represent some significant, central functionality in the system. The WBDEL use cases are the student, the admin, and the instructor initiate these use cases. The actors generalized as the payment system controlled by the administrator, the invigilator, the tutor, the material dispatcher activated done by instructor.

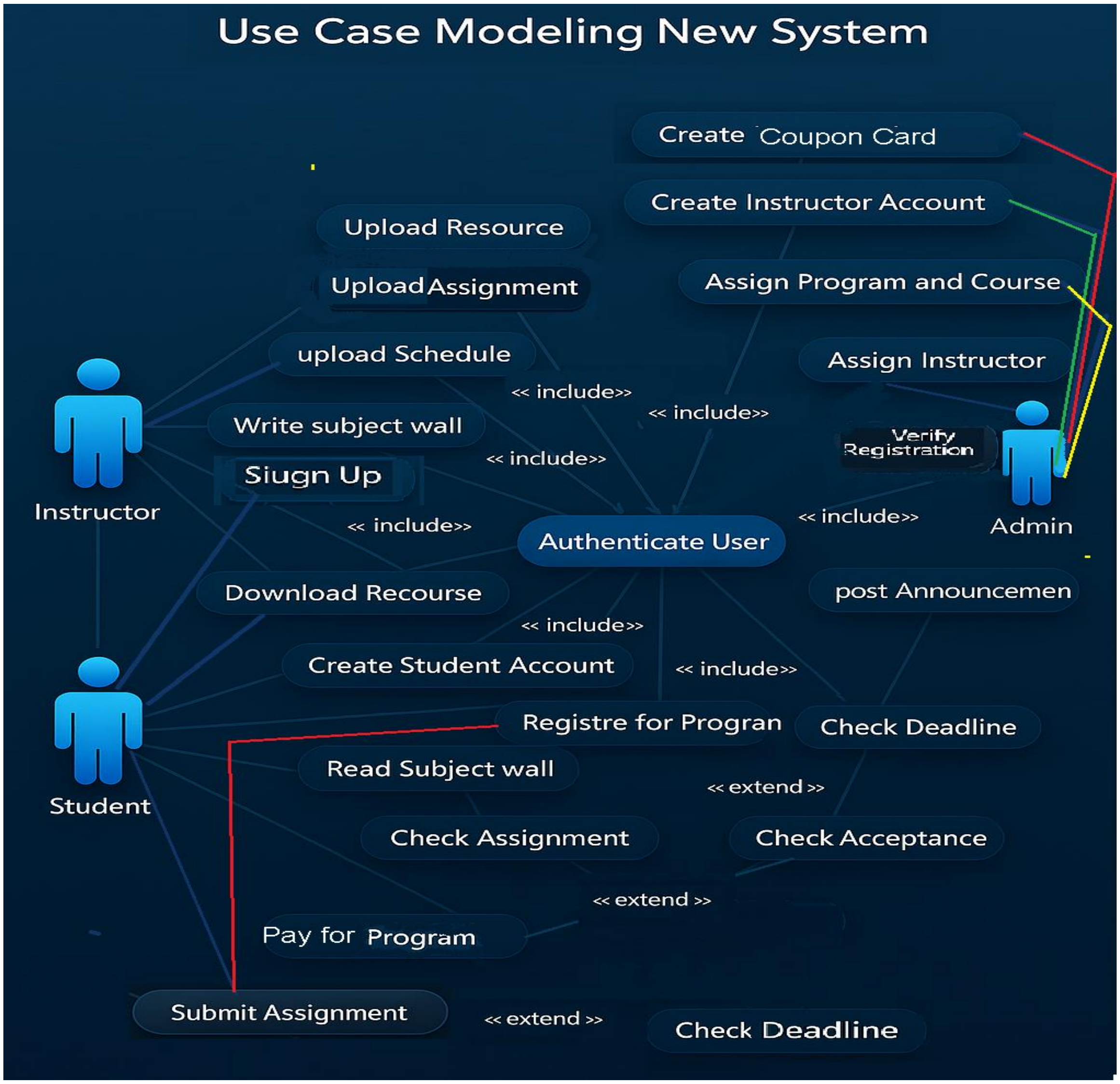

Figure 5.3-1-Use Case Diagram New System Modeling

5.3.2. *Class Diagram*

It describes the structure of the WBDEL system using classes and objects of the system. The classes are used to represent the object of the system in an abstract form. The diagram shown below depicts the class diagram of the WBDEL.

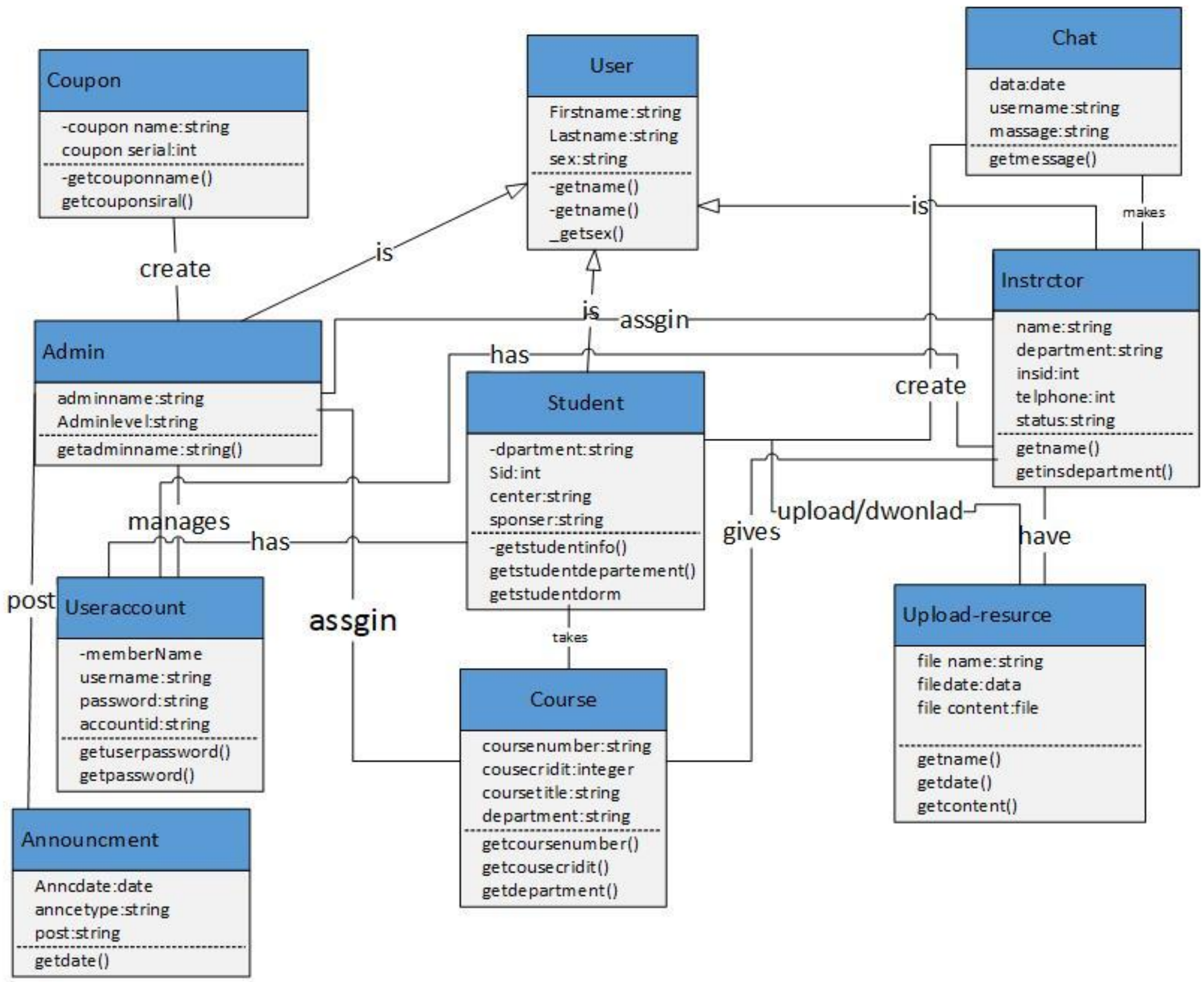

Figure 5.3-2-Class Diagram WBDEL System

5.4. Architecture

The architecture determines the type of interactions that the components are going to have. The architecture that this work uses is client-server architecture. In this type of architecture, the server is responsible to receive a request from the client and respond to the request, whereas the client is responsible to interact with that of the users of the system.

The server parts of this work are of two types. The first type is a web server, which is responsible to receive browsers' request through the Web app protocol and responds accordingly. Whereas the second type of server is a database server, which is responsible to provide the requested database services to the web server. The database server is generally responsible for the modification and insertion of data to the database. It can only communicate with the web server.

The client side is a Web App which receives requests from the user of the system and responds to the request by communicating with the web server. If the user has a request for data, the browser passes the request to the web server then the web server passes the request to the database server. As shown below the architecture of the system.the admin and instructor receive and send a data through VPN(Virtual Private Network)

Offline Functionality and Synchronization Mechanism (Online/Offline Modes)

Offline access in WBDEL is achieved by using a local storage layer on the learner device (mobile/tablet/computer) combined with a lightweight synchronization service on the server. Core learning resources (course outlines, announcements, downloadable modules, and previously accessed pages) are cached locally after the first successful connection. When the network is unavailable, the client switches to offline mode and continues to display cached content and allows the learner to complete offline tasks such as drafting assignments, preparing messages, and viewing saved materials.

Synchronization is performed when connectivity is restored. The client maintains a queue of “pending actions” (e.g., assignment uploads, discussion posts, profile updates) with timestamps. Upon reconnection, the client authenticates, uploads queued actions through an API endpoint, and then pulls updates from the server (new materials, instructor feedback, grades, and announcements). To avoid conflicts, each record carries a last-updated timestamp; if a conflict is detected (e.g., the same item edited both offline and online), the server retains the latest version and logs a conflict for manual review by the user or administrator.

The syncing mechanism is designed for low-bandwidth environments by prioritizing small payloads (metadata first, then files), supporting resumable uploads for large files, and limiting background synchronization to reduce data costs. This approach enables “graceful degradation”: learners can continue studying with cached materials during outages and synchronize progress when a connection becomes available at the branch office or through intermittent mobile data.

Figure 5.4-1:-Client-Server Architecture

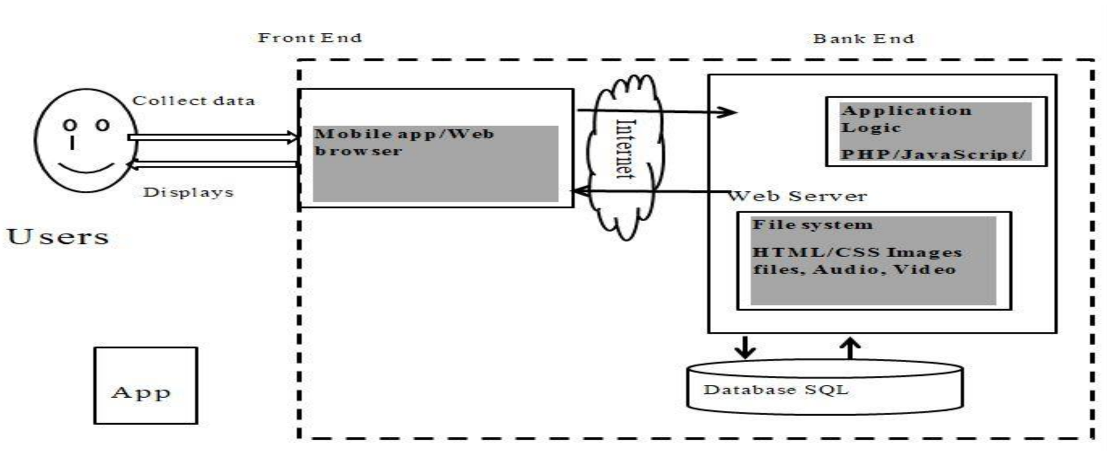

Figure 5.4-2: Architecture Front End and Back End

5.4.1. *Framework for cooperative and interactive Web-based learning*

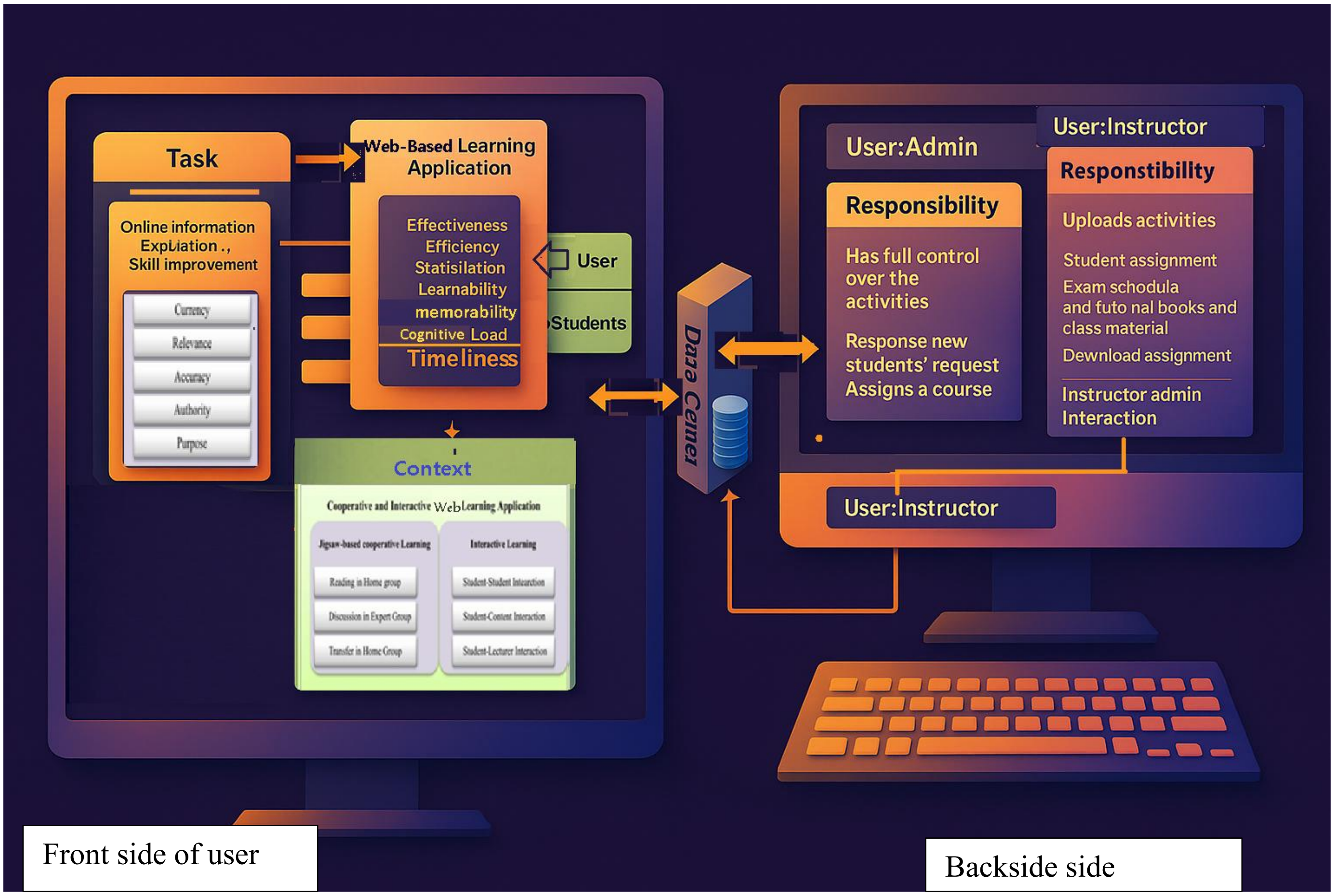

Figure 5.4-4:-Framework for cooperative and interactive web-based learning

5.4.1.1. Framework for cooperative and interactive Web learning

Figure5.4. indicates a framework for cooperative and interactive Web learning. Harrison et al was adopted with some modification to develop the cooperative and interactive web learning framework for this study. The developed framework for this study was designed based on previous research, the cooperative learning model, and interactive learning theory. This framework is an adoption of the Jigsaw-based cooperative learning model form and interaction theory form. The framework was used to develop a web learning application to demonstrate how cooperative and interactive learning approaches helps to improve online information evaluation skills of students. User, task, and context are three factors that affect the usability of mobile learning applications. In this framework, *task* is identified as the online information evaluation skills of students that should be improved after students have used the mobile application. The five online information evaluation criteria were adopted from Association. *User* describes the students that used the web application in an experiment study and participated in pre and post-test. *Context* describes that the developed mobile application was based on the Jigsaw-based cooperative learning model adopted from Aronson and the three types of interaction theory adopted from Moore. This study adopted the seven usability are according to from L. Harrison et a *Effectiveness* is the ability of a user to complete a task in a specified context. *Efficiency* is the ability of the user to complete their task with speed and accuracy. *Satisfaction* is the perceived level of comfort and pleasantness afforded to the user through the use of the software. *Learnability* is the ease with which a user can gain proficiency with an application. It typically reflects how long it takes a person to be able to use the application effectively. *Memorability* is the ability of a user to retain how to use an application effectively. *Errors* The PACMAD usability model extends the description of Errors. *Cognitive load* refers to the amount of cognitive processing required by the user to use the application attributes of mobile applications including from PACMAD model in this study. The researcher also identified timeliness or interactive response time as an important usability attribute required in evaluating usability of cooperative and interactive mobile learning applications reveals the implication of usability attributes in the mobile learning context. *Timelines*:-To provide usability model that can be used to assess the usability of

mobile applications in education context, usability model was improved in this study by adding timeliness as another attribute of usability, Timeliness or response time means “the degree to which user thinks a received message is time-sensitive or has immediate feedback.

5.4.2. *Deployment Diagram*

The deployment diagram describes the relationship of components with that of hardware nodes. It gives a high-level view of each component. The proposed system will permanently reside on the server i.e. the Web Server that will host the pages. Whenever a client (in our case the student, admin, and instructor) browses the site; some part of the system will be transported to the client machine. Therefore, what is needed on the client machine is only the Mobile App.The following are the machines that will be involved in the WBDEL system operation:

Web Server: It is the server where the institution's official web site resides. Since the system is part of the institution's official , it will also reside on the Web Server for better performance.

Client Machine: The client machine is the mobile phone or digital computer from which the student access the WBDEL system. This client machine can be anywhere in the world where Internet access and mobile connection are available.

Backup Web Server: This server that will contain all the recent copies of the Web Server.

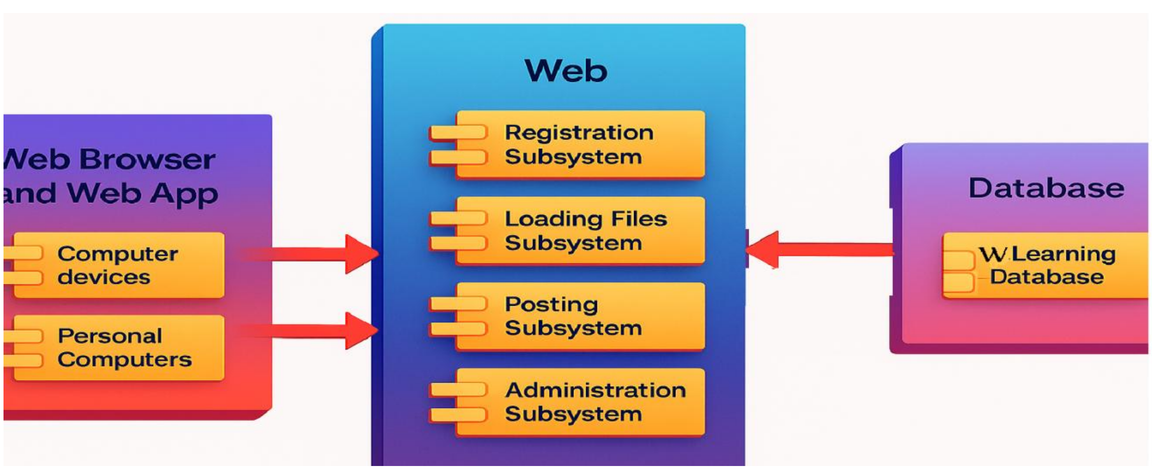

Figure 5.4-5:-Deployment Diagram for WBDEL System

5.4.3. *The System Development Tool*

WBDEL developed using a database the researcher use MySQL database and also need web server the researcher also going to use apache server. That run as local host need have server-side scripting computer here the researcher also going to use PHP uses as a server-side scripting language for establishing connection to the database. Insert information into a database and for testing purposes the researcher need WampServer, this Wamp server defines a Windows web development environment. It allows creating a web application with Apache2, PHP and a MySQL database alongside, PhpMyAdmin allows managing easily database. Finally, the researcher needs to create this android application that communicates the MySQL database.

5.5. Android SDK

For developing the application using the Android SDK as it provides the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language. It includes a mobile device emulator a virtual that runs on a computer. The emulator lets you develop and test Android applications without using a physical device.

CHAPTER SIX

IMPLEMENTATION

This chapter is concerned with the implementation of WBDEL. This system is tested based on functionality and performance in the environment of distance learning services in any distance education learning system.

This research is aimed at designing and developing Web based teaching system. The functional requirements of the proposed system were aligned with the specifications derived from the empirical study and review of literature. The literature provided input and conceptual support to the design and development of the computer and mobile based teaching system. Therefore, the detailed specification and description of each component is discussed below. The users that interact with the system application, specifically the teaching content is categorized as follows based on their relevant roles.

6.1. Web-based Development

The application was architected with a dual-layer structure comprising the client-side (front-end) and server-side (back-end) components. The front-end interface was implemented as a web application, with mobile accessibility facilitated through Android Studio version 2.2.3. For desktop users, the front-end was developed using standard web technologies, including HTML, JavaScript, and CSS. The server-side functionality was programmed using PHP, enabling dynamic content delivery and data management.

Within the context of this study, the system allows users to access distance education resources—such as instructional materials and virtual classroom content—via both mobile and computer platforms. This ensures flexible and inclusive access to learning materials regardless of device type. The overall system architecture and operational workflow are presented in a series of step-by-step diagrams provided below.

6.2. Administrators

The administrator holds comprehensive access privileges within the system, initiating their session through a secure login using a designated username and password. One of the administrator's primary responsibilities involves generating and managing coupon cards, which include details such as the coupon name, serial number, and associated price. These coupons are then distributed to designated educational centers.

Subsequently, the administrator processes incoming student applications, evaluating each based on predefined eligibility criteria. Applicants are either accepted or rejected accordingly. Upon acceptance, the system prompts students to complete their semester fee payment. The administrator then proceeds to allocate courses and assign appropriate instructors or tutors to each course.

The system supports multiple administrative functions via a web-based interface. These include managing applicant requests, confirming or declining applications, verifying student payments, and assigning academic programs. The administrator is also responsible for entering key academic data such as program name, center location, year level, semester, and academic year based on student enrollment. Furthermore, the administrator may engage in direct communication with students through integrated messaging or chat features.

6.3. Instructors

Instructors and tutors are granted secure access to the system through individual login credentials comprising a username and password. Upon authentication, they are assigned specific courses and student groups by the system administrator. Their primary responsibilities include uploading instructional content and managing academic activities such as student assignments, tutorial schedules, examination timetables, textbooks, and other course-related materials. Additionally, they are tasked with recording and submitting student performance data, including marks and final grades.

Communication between instructors and students is facilitated through integrated messaging and chat functionalities, allowing for the exchange of feedback and the retrieval of submitted assignments. All instructional and administrative tasks are conducted via a web-based interface on a computer platform.

Key instructional functions available to instructors include:

- **Subject Wall**: Posting general course information, including credit hours and course descriptions
- **Student Assignment**: Uploading assignment materials for student access
- **Tutorial Schedule**: Publishing tutorial session timetables
- **Exam Schedule**: Uploading examination schedules
- **Book/Class Materials**: Sharing textbooks and supplementary learning resources
- **Student Mark and Grade**: Recording and uploading student assessment results

All educational resources and grading documents—whether in PDF, Word, or Excel format—can be uploaded directly through the system using the designated upload feature.

6.4. Students

Distance learners: have the privilege to access selected files. He should be registered or sign up in the registration form by purchasing, coupon card from the centers after registration .He log in his user name and password, then fill the application form. He waits his acceptance from the university. If he is qualified for the specific program; he gets the acceptance otherwise rejected. After acceptance the mobile app asks term payment by purchasing the coupon card from centers then, user pays term payment. After completion of term, payment for course the page automatically activates and the student starts the class. Finally, the student knows the course and the instructor assigned. He can make downloading the necessary material for learning.

1st step:- The student open Mobile App the following figure open as shown

Figure 6.4-1:-Welcome Page from the App

Figure 6.4-2:-Web based App Home Page

2nd Step: - The student sign up from home page and fill registration as shown following

Figure 6.4-4:-Registration Page

Figure 6.4-3:-Registration Page

After the student sign up, he gets and log in user name and password when fill the application page shown

Figure 6.4-7:-Application form

Figure 6.4-6:-waiting page accepted or rejected

Figure 6.4-5:-Semester payment

After filling the necessary field application from the student gets message successfully registered. Then close and log in he get the message “Please wait until the university accepted your applicant” after the Admin University accepted student. The page asks to pay semester payment by purchasing Coupon card then he pays semester payment.

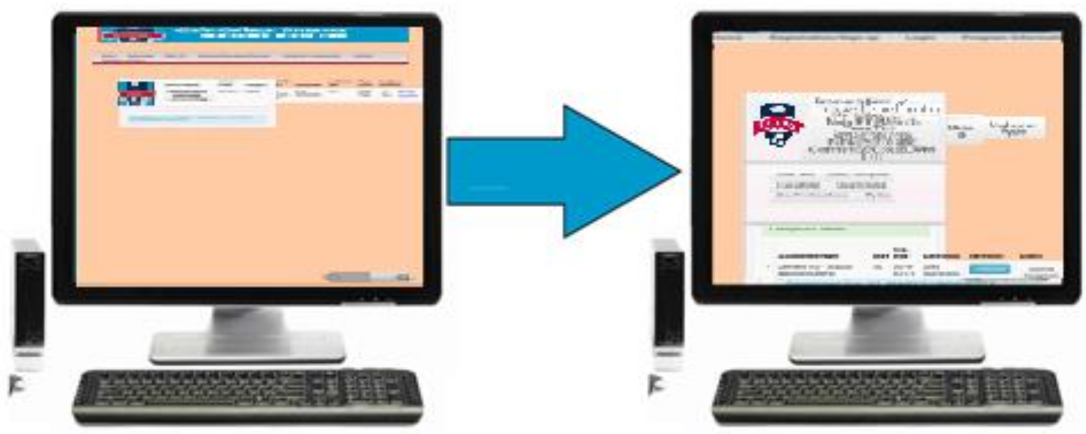

Figure 6.4-9:-Web app see the prepared course and assign instructor

Figure 6.4-8:- Material down load page

The app gives this message “Semester Payment Successfully Paid Now Your Account Is Active Thank You!” Then, the student is active and attends the class and download the learning material.

The course and instructor is prepared the student get in his web page. The student click the button for example the Course(for example Introduction Principle Accounting) When click the Subject Wall in formation about the subject, Student Assignment, Exam schedule, Book Class Materials and Student Mark and Grade button displayed.

6.5. Evaluation of WBDEL

To evaluate the feasibility, effectiveness, and suitability of WBDEL in computing education, conducted quantitative in Oxfo collage at Mekelle. The aim of this experiment was to assess the usability of the artifact-WBDEL. In the case of quantitative approach, a questionnaire administered to obtain narrowing the gap between student and teacher, removing the student isolation, student pace on leaning, getting feedback and learning material on time analyzed descriptive statistics.

The International Organization for Standardization (ISO) was founded in 1946 in order to facilitate international trade, international coordination and unification of industrial standards by providing a single set of standards that would be recognized and respected (E. L. Psomas, 2009). ISO 9126 was originally developed in 1991 to provide a framework for evaluating software quality and then refined over a further ten year period (A.Abran, 2003). Many studies criticize ISO 9126 for not prescribing specific quality requirements, but instead defining a general framework for the evaluation of software quality (S. Valenti, 2002). The researcher believes that this is in fact one of its strengths as it is more adaptable and can be used across many systems, including Web-based distance educationsystems. The original model defined six product characteristics (Figure 6.5-1).These six characteristics are further subdivided into a number of sub-characteristics (see Table 9).

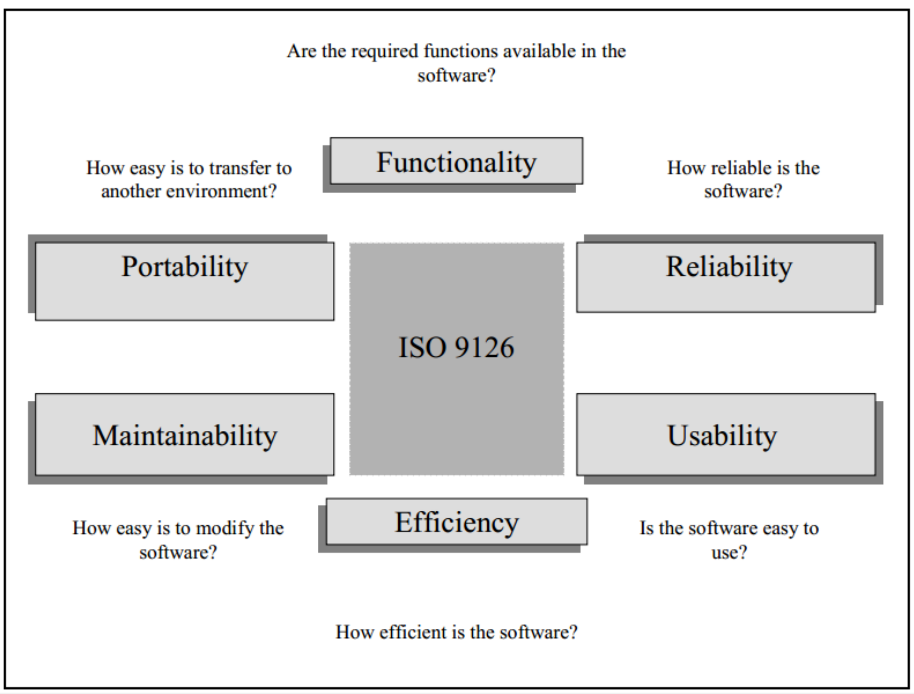

Figure 6.5-1:-ISO 912669

The study gathered responses to the questionnaire addressing the existing practices and challenges of conventional distance education comparing utilization mobile apps evaluation. This provided closer feedback and allowed to ask additional specific questions when the answers were vague and with brief introduction.

6.5.1. *Characteristic and sub-characteristics*

Characteristic	Sub-characteristic	Explanation
Functionality	Suitability	Can software perform the tasks required?
	Accurateness	Is the result as expected?
	Interoperability	Can the system interact with another system?
	Security	Does the software prevent unauthorised access?
Reliability	Maturity	Have most of the faults in the software been eliminated over time?
	Fault tolerance	Is the software capable of handling errors?
	Recoverability	Can the software resume working and restore lost data after failure?
Usability	Understandability	Does the user comprehend how to use the system easily?
	Learnability	Can the user learn to use the system easily?
	Operability	Can the user use the system without much effort?
	Attractiveness	Does the interface look good?
Efficiency	Time Behaviour	How quickly does the system respond?
	Resource Utilisation	Does the system utilise resources efficiently?
Maintainability	Analysability	Can faults be easily diagnosed?
	Changeability	Can the software be easily modified?
	Stability	Can the software continue functioning if changes are made?
	Testability	Can the software be tested easily?
Portability	Adaptability	Can the software be moved to other environments?
	Installability	Can the software be installed easily?
	Conformance	Does the software comply with portability standards?
	Replaceability	Can the software easily replace other software?
All characteristics	Compliance	Does the software comply with laws or regulations?

Table 8:-ISO 9126 Characteristic and sub-characteristics

6.5.2. *Results*

The results were summarized using an issue-based ISO 9126 mapping that relates each quality sub-characteristic to the main tools offered by the WBDEL system (see Table 9). In the table, an empty cell indicates that no usability issue was observed for that tool under the given sub-characteristic during the pilot, or that the item was not applicable/not evaluated in that session. Where a deficiency was identified, a numbered code is shown in the corresponding cell, and the meaning of each code is explained in the legend that follows.

6.5.3. *Quality Characteristics*

No	Characteristics	No	Sub-characteristics	Students' and Teachers' Tools						Admin &Teacher's tools			
				Schedule Tutorial & Exam	Teaching materials	Assignments	Group discussion board	Class chat room	Group file exchange	Manage groups	Coupon card	Assign Course and Instructors	Grade Report
1	Functionality	1.1	**Suitability:-**Can software perform the tasks required?	✓	✓	✓	✓	✓	✓	12		✓	12
		1.2	**Accurateness:-** Is the result as expected?	✓	✓	✓	✓	✓	✓	✓		✓	✓
		1.3	**Interoperability:-** Can the system interact with another system?	✓	✓	✓	✓	✓	✓	✓		✓	14
		1.4	**Security**:- Does the software prevent unauthorized access?	✓	✓	✓	✓	✓	✓	✓	9	✓	✓
		1.5	**Compliance:-** Does the software comply with laws or regulations?	✓	✓	✓	✓	✓	✓	✓		✓	✓
2	Reliability	2.1	**Maturity:-** Have most of the faults in the software been eliminated over	✓	✓	✓	✓	✓	✓	✓		✓	✓
		2.3	**Fault tolerance:-** Is the software capable of handling errors?	✓	1,4	✓	✓	✓	✓	13		✓	✓
		2.5	**Recoverability:-** Can the software resume working and restore lost data after	✓	2	✓	✓	✓	✓	13		✓	✓
3	Usability	3.1	**Understandability:-** Does the user comprehend how to use the system easily?	✓	2	✓	5	7	✓	12		✓	10
		3.2	**Learnability**: - Can the user learn to use the system easily?	✓	2	✓	5	7	✓	12		✓	10
		3.3	**Attractiveness:-**Does the interface look good?	✓	3	3	✓	✓	3	3		✓	3
		3.4	**Operability:-**Can the user use the system without much effort?	✓	✓	✓	5	3	✓	14		✓	✓
4	Efficiency	4.1	**Time Behavior :-** How quickly does the system respond?	✓	✓	✓	6	8	6	14		✓	✓
		4.2	**Resource Utilizations**: - Does the system utilize resources efficiently?	✓	✓	✓	✓	✓	✓	✓		✓	✓
5	Maintability	5.1	**Analyzability:-** Can faults be easily diagnosed?	✓	✓	✓	✓	✓	✓	✓		✓	✓
		5.2	**Changeability:-** Can the software be easily modified?	✓	✓	✓	✓	✓	✓	✓		✓	✓
		5.3	**Stability:-**Can the software continue functioning if changes are made?	✓	✓	✓	✓	✓	✓	✓		✓	✓
		5.4	**Testability:-**Can the software be tested easily?	✓	✓	✓	✓	✓	✓	✓		✓	✓
6	Portability	6.1	**Adaptability:-**Can the software be moved to other environments?	✓	✓	✓	✓	✓	✓	✓		✓	✓
		6.2	**Installability:-** Can the software be installed easily?	✓	✓	✓	✓	✓	✓	✓		✓	✓
		6.3	**Conformance:-** Does the software comply with portability standards?	✓	✓	✓	✓	✓	✓	✓		✓	✓
		6.4	**Replaceability:-** can software easily replace other software?	✓	✓	✓	✓	✓	✓	✓		✓	✓

Table 9:-Evaluation of WBDEL using ISO 9126

Legends for Table 10

1. Accepts null content when content is logically required.
2. Lack of labeling regarding the required field makes it more difficult to use.
3. Font size is too small. Huge inconsistencies in font from one page to another.
4. The system does not check for validity of dates when teaching materials will become available.
5. Poor navigation. A menu of navigation buttons is needed instead of the one button provided, and these need to be clearly named according to their function.
6. Loading group page was very slow when lots of users were online.
7. Problem with interpreting non-standard terminology.
8. Chat room is very slow in initializing.
9. May the coupon card stolen and used without paying
10. Poor functionality and hard to understand how to use it: unable to display a grade.
11. Cannot search on user's first name and cannot list all group members
12. When creating new groups, system is unable to cope with a too long group description.
13. Most of the buttons involved cannot be activated from the keyboard. This affects time behavior.

6.5.4. *Learners Evaluation with Related Challenges of the Existing System*

30 participants were selected from OXFO COLLAGE distance education learners in Mekelle office, in order to confirm the system acceptable or not 27(90%) were properly filled and returned.Finally, this evaluation fulfills to solve key challenges that OXFO COLLAGE distance learners faced increase cost, lack of feedback from instructor, delayed material, no interactive with the printing material, poor quality of papers and printing press. The opinions of students which were collected through multiple choice questionnaires, were examined and are presented in Table 11.

Pilot Testing Scale and Stakeholder Involvement

The pilot evaluation with 27 valid learner responses was conducted as a formative usability and feasibility test rather than a statistically representative impact study. Its purpose was to identify interface issues, workflow gaps (registration, payment activation, assignment submission, feedback), and offline/low-bandwidth constraints before wider rollout. Therefore, findings from the pilot are interpreted as indicative of usability strengths and weaknesses, not as definitive generalization to all distance learners.

To improve representativeness and triangulation, the study also incorporated stakeholder input beyond learners. Instructors/tutors and administrators/coordinators were engaged through expert interviews and walkthrough reviews during requirements analysis and prototype validation (see interview summary table), providing feedback on course management, assessment workflows, and administrative controls. A larger-scale pilot involving multiple centers and additional instructor/admin participants is proposed as a next step for full deployment.

Table 10:-Evaluation of Web app usability

No	Variable	Agree		Uncertain		Disagree	
		F(27)	%	F(27)	%	F(27)	%
1	The cost of downloading the web course materials is acceptable	24	88.9%	1	3.7%	2	7.4%
2	The cost of uploading response of assignment is acceptable	23	85.2%	0	0.0%	4	14.8%
3	The cost of Mobile/ computer is reasonable	25	92.6%	1	3.7%	1	3.7%
4	This Web app is easy to install.	23	85.2%	2	7%	2	7%
5	One can get the material any time	25	92.6%	1	3.7%	1	3.7%
6	Use of mobile/computer increases the learning pace	23	85.2%	3	11.1%	1	3.7%
7	Access to content learning menu is fast	21	77.8%	6	22%	0	0%
8	App menu icons are working properly.	8	29.6	4	14.8	15	55.5

Looking at Table 11 it is clear that most of the student, they expressed a high level of agreement on the cost aspect of a Web application. . When examining the opinions of students on “The cost of Mobile/comuting device is reasonable”, ” The cost of downloading the mobile course materials is acceptable” and “The cost of uploading response of assignment is acceptable ”it can be seen that “agree” answer has a considerably high rate 92.6% , 88.9% and 85.2% respectively. This shows that students generally accept the cost on a mobile educational application developed. It emerged during the observations that the students enjoyed the use of mobile application very much when compared to the traditional distance education system.

Table 11 shows a percentage the learner can install the app in branch office in offline state because they once for short introduction how the teaching leaning activity takes place. The get material get any time through the app, as result “increases the learning pace” 85.2%, agreed increase the learning speed. Because they can learn at any time and any place with their flexibility on bus station or any sort of certain queue. Majority of students expressed a high level of agreement .It shows that mobile application can exceed the barriers between in-class and out-of-class experiences with opportunities for anywhere anytime learning and the potential for students to participate in educational activities beyond the limitations of the traditional study.

Table 11 shows 77.8% felt that “Access to content learning menu is fast. In contrast, a high percentage 55.5% get difficulty menu icons are working properly. It appeared during the observations this difficulty arise due to the phone compatibility issue. Different devices may have similar or different accessibility features. Therefore, the instructor has to ensure every student will benefit from the devices at hand or else equal alternatives for those unable to exercise the technologies should be provided (Ziden, 2013). The problem related poor quality of papers and printing press totally solved using mobile phones or other mobile devices for viewing the learning materials.

6.5.5. *Discussion*

From our evaluation, we discovered many errors with the system. Some of these are critical to user satisfaction and some are minor. This depends on who the user is (Admin, teacher or student). The ISO 9126 model provides an indication to educators and educational administrators of the quality of a system they are considering buying into and provides a basis of comparison of different systems.

Though our results demonstrate the ISO 9126 model is useful in evaluating Web-based distance educationsystems, the researchers also have some recommendations on how it could be enhanced. Firstly, the researcher believes that it could be improved by having a global characteristic to summarize the overall user satisfaction. To determine the user satisfaction level, it is not possible to simply add up the number of problem sub- characteristics. Different users will have different priorities that will influence on which characteristics they will place more emphasis. Therefore, we need to consider incorporating a final characteristic for the user to state whether the particular tool being evaluated is acceptable overall or not.

Secondly, the sub-characteristic Appearance is too general and covers too many different factors and is therefore not very helpful. It is recommended that the sub-characteristics included under Usability be extended to include more specific appearance factors based on accepted HCI usability principles. For example, Usability should include the sub-characteristics consistency, simplicity, legibility (e.g font size) and use of color (Preeece, 2002).

CHAPTER SEVEN

CONCLUSION AND RECOMMENDATION

7.1. Conclusion

The objective of this study is to design and develop Web-based distance education learning system that can address the existing challenges and provide effective teaching learning to distance learners by taking Institutions of Distance education as a case. This study is an example of Mixed method, an inclusive framework that employs different, mutually constituting methods and techniques to address a research problem. Questionnaires, interviews, personal observations, and documentary analysis were the instruments employed to gather the required data. The major findings of this study can be summarized as follows:

A survey was conducted to identify the existing practices and challenges associated with distance learning system and serve as for student functional requirements. This empirical study provided input for the design and development of mobile based learning distance learning some of the major inputs were make learning is easy to use, saves time and money, create interactivity, less cost in delivering most of learning material, services, improves or motivates distance learners. The findings of these studies provide contributions to the design of prototype mobile-based distance learning. This system introduced a new approach for providing service for distance learners. User evaluated and validated the system a significant change in brings learning activity in to their home. WBDEL application developed with an emphasis on noticeable presentation and integrated distance education and learning materials.

Research findings indicate that Web applications like WBDEL have the potential to provide a different and exciting learning experience for users. The application of Computer technology for learning purposes is boundless, especially because mobile, tablet and PDA devices are now common amongst students. It was also found that largest proportion of respondents have smartphone which implies that learners have mobile phones with advanced features. Most of the previous studies showed a positive impact and encouraging results; Web-based education has vast potential implications and benefits especially in life learning.

This study has showed that in order to move beyond putting material online to making that material adapted to the various Computer technologies through which it is disseminated, there are a number of challenges. The study have discussed lightening challenges pertaining to training teachers and students on technology use web-based distance education benefits, strengthening policy, building robust infrastructures, integrating social media in learning platforms. It is deemed relevant for teachers and leaners, promoting sound practices for instructional and content design, providing constant technical support for teachers and students, and promoting the use of open source applications to minimize costs. There is no doubt that emerging web based distance education environments in a developing country would be implemented over a long time.

Having shown the contributions of this study, there are limitations. One of the limitations of this research is the limited scope and boundaries pertaining to the study having been conducted at Institutions of Distance education .

7.2. Recommendation

In this study an attempt is made to design a Web-based learning for distance education. For a better reliable and effective service, The research recommend to investigate an integration of WBDEL with web-based systems.

Since the present study was restricted only at Mekelle as a case in a distance education, research should be conducted for investigation in the practices and challenges of distance education at country level to enhance the features of the system and make it applicable. Future research can be conducted with a larger sample size to obtain an in-depth analysis of the usage of smart devices for information access and sharing activities.

In addition, further research should been conducted with the aim of improving the functionality of introducing additional features for Web-based on distance education and the payment system is integrated with in system.

HERQA (Higher Education Relevance and Quality Agency) gives accreditation for distance education institutes in Ethiopia. The HERQA should take modern use of technology one of criteria to get accreditation for the institutes. Policy maker uses this study standardize its policy. If any distance education institutes want to get accreditation from the they should have modern use of technology. They should apply small segment of Web-based learning to improve the quality of education in Ethiopia.

Sustainability, Scalability, and Maintenance Plan for WBDEL

To ensure scalability and sustainability after implementation, WBDEL should be maintained through a shared governance model involving (i) the hosting institution's ICT unit, (ii) the distance education center/branch office, and (iii) designated academic coordinators. The ICT unit would manage server administration, backups, user account provisioning, and security updates; the distance education center would provide first-line user support; and academic coordinators would oversee course setup and quality assurance.

A practical sustainability roadmap is proposed: (1) capacity building for local IT staff through short trainings on the selected open-source stack (PHP/MySQL/Moodle components where applicable), (2) budgeting for recurring costs (domain/hosting, modest server hardware or cloud fees, backup storage, and occasional maintenance visits), and (3) establishing a help-desk workflow for issue reporting, ticket tracking, and release cycles for incremental updates. Using open-source tools reduces licensing cost and supports long-term maintenance within local institutional capacity.

Barrier Prioritization and Phased Implementation Strategy

Based on the identified barriers, implementation should be phased by prioritizing: (i) connectivity/electricity instability, (ii) delayed materials and limited instructor feedback, (iii) digital literacy gaps, and (iv) device affordability and data costs. Phase 1 (Pilot, one center): deploy core functions—registration, announcements, module distribution, assignment submission, and feedback—together with offline caching and basic support. Phase 2 (Scale to multiple centers): add group discussion, chat, grade reporting, and strengthened analytics, with continuous training. Phase 3 (Integration and optimization): integrate with institutional systems (where available), refine payment workflows, add accessibility enhancements, and formalize policy alignment for accreditation.

Training and Support Mechanisms for Adoption

Effective adoption requires structured orientation and ongoing support. It is recommended to provide: (i) short onboarding sessions for students at the branch office (account setup, offline use, assignment submission), (ii) instructor training on course management and feedback workflows, and (iii) simple user guides in English and Tigrinya with screenshots for common tasks. Peer support groups and a designated focal person at each center can reduce support load and improve learner confidence.

Digital Equity, Accessibility, and Conflict Sensitivity

To bridge the digital divide, complementary measures such as device-lending schemes, community access points (campus/center Wi-Fi windows), and low-bandwidth content formats (compressed PDFs, audio summaries) are recommended. For learners with low digital literacy, the interface should prioritize clear labeling, consistent navigation, and minimal steps to complete key tasks.

Accessibility and inclusion should be strengthened by supporting readable font sizes, high-contrast options, keyboard navigation where possible, and alternative text for key images. In post-conflict settings, conflict sensitivity can be supported through flexible deadlines, asynchronous participation options, and referral information for academic and psychosocial support services for displaced or traumatized learners.

Longitudinal Evaluation and Learning-Outcome Assessment

Beyond immediate usability, a longitudinal evaluation plan is recommended to measure impact on learning outcomes and retention. This can include pre- and post-implementation surveys of perceived usefulness/ease of use, analysis of assignment completion and feedback turnaround time, and institutional indicators such as dropout rates, course completion, and graduation progression over at least one academic year. Comparative analysis between print-based cohorts and WBDEL-supported cohorts can provide stronger evidence for effectiveness.

Risk Mitigation and Multi-Platform Continuity

Given unstable electricity and internet, WBDEL should maintain continuity through offline-first design, scheduled synchronization opportunities at centers, and content packaging that can be shared locally (e.g., via local Wi-Fi hotspot or removable media). As an additional enhancement, a multi-platform approach can be explored where critical notifications (deadlines, announcements) are also delivered through SMS for learners without reliable smartphones or data connectivity, ensuring graceful degradation of service.

Engagement with Educational Authorities and Policy Alignment

For institutionalization, engagement with educational authorities and quality assurance bodies is recommended to align WBDEL with distance education standards and accreditation criteria. Stakeholder workshops with HERQA, regional education authorities, and institutional leadership can support adoption, resource allocation, and integration into broader distance education strategies.

References

1. Abdillah, M. R. (2015). Web-based distance education as a formal learning experience with geographic separation and internet delivery. International Journal of Distance Education, 12(3), 45-62.

2. Ally, M. (2009). Mobile learning: Transforming the delivery of education and training. Athabasca University Press.
3. Ally, M. (Ed.). (2009). Mobile learning: Transforming the delivery of education and training. Athabasca University Press.
4. Anderson, T. (Ed.). (2008). The theory and practice of online learning (2nd ed.). Athabasca University Press.
5. Anderson, T., & Dron, J. (2011). Three generations of distance education pedagogy. International Review of Research in Open and Distance Learning, 12(3), 80-97.
6. Anderson, T., & Dron, J. (2011). Three generations of distance education pedagogy. The International Review of Research in Open and Distributed Learning, 12(3), 80–97.
7. Bates, A. T. (2015). Deciding on modes of delivery in distance education. Open University Press.
8. Bates, A. W. (2015). Teaching in a digital age: Guidelines for designing teaching and learning. BCcampus.
9. Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13(3), 319–340.
10. Dhlamini, J. (2014). Technical limitations in distance education: Challenges of connectivity and device access in developing countries. Journal of Distance Learning, 8(2), 110-124.
11. Elias, T. (2011). Universal instructional design principles for mobile learning. International Review of Research in Open and Distance Learning, 12(2), 143-156.
12. Garrison, D. R. (2000). Theoretical challenges for distance education in the 21st century: A shift from structural to transactional issues. The International Review of Research in Open and Distributed Learning, 1(1), 1–17.
13. Guri-Rosenblit, S. (2009). Digital technologies in higher education: Sweeping expectations and actual effects. Nova Science Publishers.
14. Holmberg, B. (2005). The evolution, principles and practices of distance education. BIS-Verlag.

15. Holmberg, B. (2005). Theory and practice of distance education. Routledge.
16. Keegan, D. (1996). Foundations of distance education (3rd ed.). Routledge.
17. Moore, M. G. (1993). Theory of transactional distance. In D. Keegan (Ed.), *Foundations of distance education* (pp. 22-38). Routledge.
18. Moore, M. G., & Kearsley, G. (2011). Distance education: A systems view of online learning (3rd ed.). Wadsworth Cengage Learning.
19. Peters, O. (2003). Distance education in transition: Developments and issues (4th ed.). BIS-Verlag.
20. Rogers, E. M. (2003). Diffusion of innovations (5th ed.). Free Press.
21. Sarrab, M. A. (2015). Effects of web-based distance education tailored to students' socio-cultural contexts. Journal of Educational Technology Development and Exchange, 8(1), 20-33.
22. Sharples, M., Taylor, J., & Vavoula, G. (2009). A theory of learning for the mobile age. In *The Sage handbook of e-learning research* (pp. 221-247). Sage.
23. Traxler, J. (2007). Defining mobile learning. International Journal of Mobile and Blended Learning, 1(1), 13-24.
24. UNESCO. (2019). Digital learning and educational transformation: Achieving inclusive and equitable quality education. UNESCO Publishing.
25. UNESCO. (2019). Global Education Monitoring Report 2019: Migration, displacement and education—Building bridges, not walls. UNESCO Publishing.
26. Valentine, D. (2002). Distance learning promises, problems, and possibilities. Online Journal of Distance Learning Administration, 5(3).
27. Valentine, D. (2002). Distance learning: Promises, problems, and possibilities. The Online Journal of Distance Learning Administration, 5(3).
28. Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press.
29. Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press.

30. Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Appendix A፡- **Document Analysis Related to Price**

አክስፎ ኮሌጅ
አገንና ርቀት ትምህርት ኮሌጅ

Oxfo college
College of Open & Distance Learning

Re. No. አ/ኮ/ 314/2016

Date ሰኔ 29 ቀን 2016 ዓ.ም

ለሁሉም ሪጅናል ጽ/ቤቶች፣ ክላስተር ማዕከላት፣ ማዕከላትና ወኪል ጽ/ቤቶች

በያሉበት

ጉዳዩ:- በርቀት ትምህርት ተማሪዎች የትምህርት ክፍያ ላይ ማሻሻያ የተደረገ መሆኑን ስለመግለጽ

የዩኒቨርስቲው አገንና ርቀት ትምህርት ኮሌጅ በገበያ ዋጋ መናር፣ በኑሮ ውድነትና በዋጋ ግሽበት....ወዘተ ምክንያት የሚፈጠረውን ችግር ከግንዛቤ ውስጥ በማስገባት በርቀት ትምህርት ተማሪዎች የትምህርት ክፍያ ላይ በየጊዜው ማሻሻያ ሲያደርግ መቆየቱ ይታወሣል። ዘንድሮም ከብር የውጭ ምንዛሬ ለውጥ ጋር በተያያዙ እና በሌሎች ተጨማሪ ምክንያቶች ከፍተኛ የሆነ የገቢና የወጭ አለመጣጣም በመከሰቱ ከ2016 (3ኛ ተርም) ጀምሮ በትምህርት ክፍያ ላይ የሚከተለውን ማሻሻያ አድርጓል።

ተ.ቁ	የክፍያ ማሻሻያው የሚመለከታቸው የርቀት ትምህርት ተማሪዎች (በቅበላ ዓመት)	እስከ 2010B (2ኛ ተርም) ድረስ የነበረ የክፍያ መጠን በ1 ክሬዲት አወር (1cr-hr)	ከ2010C (3ኛ ተርም) ጀምሮ የተሻሻለና ለ1 ክሬዲት አወር (1cr-hr) የሚከፈል የክፍያ መጠን
1	ከ2007C ጀምሮ ወደኋላ በነበሩት ተርሞች (2007C, 2007B, 2007A, 2006C, 2006B, 2006A, 2005C, 2005B, 2005A, 2004ABC እና ወደኋላ) በነበሩት ተርሞች ተመዝግበው በመማር ላይ ያሉና እስካሁን ያልተመረቁ ተማሪዎች	በ1 ክሬዲት አወር (1cr-hr) ብር 80.00 (የተርም መመዝገቢያ ክፍያን አይጨምርም)	በ1 ክሬዲት አወር (1cr-hr) ብር 90.00 (ዘጠና ብር) (የተርም መመዝገቢያ ክፍያን አይጨምርም)
2	ከ2008A ጀምሮ የተመዘገቡና አሁንም በመማር ላይ የሚገኙ ተማሪዎች (2008A, 2008B, 2008C, 2009ABC, 2010A እና B	በ1 ክሬዲት አወር (1cr-hr) ብር 85.00 (ሰማንያ አምስት ብር) የተርም መመዝገቢያ ክፍያን አይጨምርም	በ1 ክሬዲት አወር (1cr-hr) ብር 90.00 (ዘጠና ብር) (የተርም መመዝገቢያ ክፍያን አይጨምርም
3	ከ2010C (3ኛ ተርም) ጀምሮ የተመዘገቡና የሚመዘገቡ አዲስና ነባር ተማሪዎች 3.1- ከሰኔ 01/2016 ዓ.ም ጀምሮ የተመዘገቡና የሚመዘገቡ አዲስ ተማሪዎች 3.2 ከሐምሌ 30/2016 ዓ.ም ጀምሮ ለቀጣይ ተርማቸው የሚመዘገቡ ነባር ተማሪዎች	በ1 ክሬዲት አወር (1cr-hr) 85.00 (ሰማንያ አምስት ብር) (የተርም መመዝገቢያ ክፍያን አይጨምርም)	በ1 ክሬዲት አወር (1cr-hr) ብር 90.00 (ዘጠና ብር) (የተርም መመዝገቢያ ክፍያን አይጨምርም)

የተደረገው የትምህርት ክፍያ ማሻሻያ ስራ ላይ በሚውልበት ወቅት በቅድሚያ የሚከተሉትን ጥንቃቄዎች ማድረግ ያስፈልጋል።

. ገንዘብ አሰባሰብ በተመለከተ

1.1. ተማሪዎች ክፍያ ከመፈፀማቸው በፊት የተመዘገቡበትን /Entry/ በመለየት ሬጅስትራር ክፍል የመዘገበውን ኮርስና ክሬዲት ሃወር በየተርሙ በመያዝ መመዝገባቸውን ማረጋገጥ ያስፈልጋል።

1.2. ተማሪዎች በተመዘገቡበት /Registration Slip/ መሰረት የኮርሱን የክፍያ መጠን፡-

- ለዲግሪ ተማሪዎች
  - በክሬዲት ሃወር - 40 ብር
  - የመመዝገቢያ -60 ብር
- የ1996 ዓ.ም. እና የ1997 ዓ.ም. /የTVET ተመዝጋቢ/ ተመዝጋቢ ተማሪዎች /Weight average/ አሠራር
  - በክሬዲት ሃወር - 40 ብር
  - የመመዝገቢያ 60 ብር
- ከ1998 ዓ.ም. ጀምሮ የተመዘገቡ የ/TVET/ ተማሪዎች
  - በኮርስ ብር 125.00 ብር
  - የመመዝገቢያ 60.00 ብር
- ከላይ በተጠቀሰው የክፍያ መጠን መሠረት የተርሙ / ሴሚስተሩ/ ሂሳብ ተሰልቶ በገቢ ደረሰኝ ገንዘቡን መቀበል ይኖርብናል።
- የገቢ ደረሰኝ አዘገጃጀትና አጠቃቀምን በተመለከተ ከዋናው መሥሪያ ቤት ታትመው በተረቡ የገቢ ደረሰኞች በማዘጋጀት ገንዘቡን መረከብ ይጠበቅብናል።
- የገቢ ደረሰኝ በ3 ኮፒ የታተመ ሲሆን፡-
  - ዋናው / ኦርጂናል/ - ለከፋይ /ለተማሪ/ ይሰጠዋል።
  - የአንደኛው ኮፒ - ለሂሣብ ክፍል ይሳካል።
  - ሁለተኛው ኮፒ - ከፓድ ላይ ይቀራል/ ማስተባበሪያ ማዕከሉ ጋር ይቀመጣል/ ።
- የገቢ ደረሰኝ በሚዘጋጅበት ወቅት ኮፒው በካርቦን መስራት ይኖርበታል።

1.3. <u>የተበላሹ ደረሰኞች አሰራርን በተመለከተ / VOID/</u>

- የገቢ ደረሰኞች ሲዘጋጅ በተለያዩ ምክንያቶች ቢበላሹ ተቀደው አይጣሉም።
- የተበላሹ ደረሰኞች 3ቱም ኮፒዎች /VOID/ ብሎ በመሰረዝ /ዋናውንና የመጀመሪያውን ኮፒ/ አያይዞ ለሂሣብ ክፍል ከሚላከው ጋር ማስቀመጥ ይኖርብናል።
  ይኸም የሆነበት የደረሰኙን ቁጥር ተከታታይነት መኖሩን ለማረጋገጥ ሲባል ነው።

1

Appendix B:- Document Analysis Related to Sample Module Print Quality and Paper Quality

? Do you have any idea about measurement problems related to the above items?

2.3.1 Problem in Measuring Depreciation

Economists view depreciation as capital consumption. For them, there are two distinct ways of charging for depreciation: (i) the depreciation of an equipment must equal its *opportunity cost,* or alternatively, *(ii)* the replacement cost that will produce comparable earning.

Opportunity cost of equipment is the most profitable alternative use of it that is foregone by putting it to its present use. The problem is then of measuring the opportunity cost. One method of estimating opportunity cost is to measure the fall in value during a year. Here the method assumes selling of the equipment as an alternative use. This method, however, cannot be applied when capital equipment has no alternative use, like a hydropower project. In such cases, replacement cost is the appropriate measure of depreciation.

To accountants, depreciation is an allocation of capital expenditure over time. Such allocation of historical cost of capital over time, *i.e.,* charging depreciation, is made under unrealistic assumptions of *(a)* stable prices, and *(b)* a given rate of obsolescence. What is more important in this regard is that of the methods of charging depreciation over the lifetime of equipment are various. The use of different methods of charging depreciation results in different levels of profit reported by the accountants.

? How do you compare and contrast the economists' and accountants' measurement of depreciation?

2.3.2 Treatment of Capital Gains and Losses

Capital gains and losses are regarded as '**windfalls**'. Fluctuation in the stock market prices is one of the most common sources of 'windfalls'. In a progressive

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Do you have any idea about measurement problems related to the above items?

2.3.1 Problem in Measuring Depreciation

Economists view depreciation as capital consumption. For them, there are two distinct ways of charging for depreciation: (i) the depreciation of an equipment must equal its *opportunity cost*, or alternatively, *(ii)* the replacement cost that will produce comparable earning.

Opportunity cost of equipment is the most profitable alternative use of it that is foregone by putting it to its present use. The problem is then of measuring the opportunity cost. One method of estimating opportunity cost is to measure the fall in value during a year. Here the method assumes selling of the equipment as an alternative use. This method, however, cannot be applied when capital equipment has no alternative use, like a hydropower project. In such cases, replacement cost is the appropriate measure of depreciation.

To accountants, depreciation is an allocation of capital expenditure over time. Such allocation of historical cost of capital over time, *i.e.*, charging depreciation, is made under unrealistic assumptions of *(a)* stable prices, and *(b)* a given rate of obsolescence. What is more important in this regard is that of the methods of charging depreciation over the lifetime of equipment are various. The use of different methods of charging depreciation results in different levels of profit reported by the accountants.

How do you compare and contrast the economists' and accountants' measurement of depreciation?

2.3.2 Treatment of Capital Gains and Losses

Capital gains and losses are regarded as '**windfalls**'. Fluctuation in the stock market prices is one of the most common sources of 'windfalls'. In a progressive

Appendix C:- Questioner English Version

English version of written consent form for Students

Greetings. My name is Kidane Teklay. I would like to inform you that we will have a brief discussion related to this research study. Before proceeding, I kindly ask you to carefully listen as I explain the purpose and general conditions of the study. After this explanation, you may indicate whether you agree or decline to participate.

Consent Form

The objective of this study is to evaluate the implementation of computing device technology for Web-based language learning within the distance education program at OXFO College. The findings may assist program administrators in designing and deploying suitable communication technologies, thereby improving interaction between students and distance education providers.

Your participation will require approximately 20 to 30 minutes of your time. All information you provide will be treated with strict confidentiality. Your personal identifiers such as name and address will not be recorded during the interview to ensure your privacy is protected. You have the right to skip any questions that you find uncomfortable or do not wish to answer. Nonetheless, your responses are vital to the assessment and enhancement of the program. Please be assured that all data collected will be used exclusively for research purposes.

Do you consent to participate in this study?

☐ Yes, I agree

☐ No, I do not agree

Date: ___________

Thank you for your time and cooperation.

No	Questions	Coding Categories
1.1	Sex of respondent	Male Female
1.2	How old are you?	☐below25 ☐26-36 ☐37-46 ☐Above
1.3	Department	
1.4	Admission year	
1.5	Current year	☐1st ☐2nd ☐3rd ☐4th

Section II: Response on Distance Education Problems and Good Practice

No	Questions	Coding Categories
2.1	Of your distance-learning, what has been more difficult to complete and with the relation printing and paper quality? (Please check all that apply.)	1.understanding the module content 2.solving problems or answering self –check exercise in the module 3.Assignments 4. If others specify____________________
2.2	Do you get module as you need?	1.Yes 2. No
2.3	Do you get instructor as you want?	1.Yes 2.No
2.4	Do you get the assignment feedback after submission?	1.Yes 2.No

Section III: Student Challenges with Related to Distance Education Institutions

No	Questions	Coding Categories
3.1	How far is your home from the university center in km?	1-20 21-40 41-60 61-80 <200 If others specify___________

3.2	What is the cost of transportation from your home to university?	<8 <15 <30 <39 50-85 If others specify__________
3.4	Your answer is no, how many times come to the university to get the learning material the module and assignment?	Every week Twice weeks Every month Every two months Every three months If others specify____________

Section IV: Computing Device access (owners) and use patterns use of Students

No	Questions	Coding Categories
4.1	Do you have mobile,tablate or desktop?	Yes No
4.2	what type mobile,tablate or desktop do you have?	1.Standard Cellular 2.Smartphone android version 3.I have no
4.3	If yes, for above question For how long do you have it?	1.One Year 2.Two years 3.Three Years 4. Other_____
4.4	Do you use your mobile, for learning purpose in distance	1.Yes 2.NO

Section V: Intention to Use Web Based Distance Education Learning

No.	Questions	Coding Categories
5.1	It is good university to use mobile instead of hard copy?	1.Yes 2. No

5.2	If Institutions of Distance education (OXFO COLLAGE) introduces tutoring service using mobile,tablate or desktop , would you use it?	1.Yes 2.No 3.May be

Section VI: Students' attitude towards the use of mobile,tablate or desktop in distance education

Please Rate the Extent to Which You Agree With the Following Statements (Please Check Only One Option).

1. Yes (1) 2: No(2) 3: I don't know (3)

NO	Questions How important do you think is the use for mobile base in distance education?	Yes (1)	No (2)	I Don't Know(3)
6.1	In time saving			
6.2	Increase your learning peace			
6.3	To maximize interaction between the student and the learning			
6.4	Minimize transportation and other related costs			

Appendix D :- **Questioner Tigrinya Version**

መቐለ ዩኒቨርስቲ

ቤትትምህርትድህረ ምረቃ

ዲፓርትመንት ኢንፎርሜሽን ቴክኖሎጂ

ብሓበሬታ ዝተሰነየ ፍቓድ ቅጥዒ

ክቡር ተማሃራይ፡

መእተዊ

ሰላም ኪዳነ ተኽላይ ይበሃል። ኣብ መቐለ ዩኒቨርስቲ ኣብ ናይ ክረምታዊት/ቲ ናይ ኢንፎርሜሽን ቴክኖሎጂ ት/ቲ ዊብ ቤዝ ርሕቐት ትምህርቲ ብዝብል ኣርእስቲ መፅናዕቲ የካይድ ኣለኹ። ዕላማ እቲ መፅናዕቲ ኣብ መቐለ ርሕቐት ትምህርቲ ወይ ግሊጋሎት ርሕቐት ትምህርቲ ዝህባ ናይ ውልቀ ኣብያተ ትምህርቲ(ኮሌጃት) መስርሕ ብኢንተርነት ዊብ ቤዝ ትምህርቲ ንምግምጋም እዩ። እዚ ድማ መዳርግቲ ኣካላት ንሞባይል፣ ዴስክቶፕን ታብሌታትን ሓዊሱ ኣብ ዝህልዎም ቴክኖሎጂካዊ መሳርሒታትን ነቲ መስርሕ ከዕብይዎ ወይ ክድርትዎ ዝኽእሉ ረቛሒታትን ብዝበለፀ ንምርዳእ ክሕግዞም እዩ። ካብዚ ብተወሳኺ ውፅኢት እቲ መፅናዕቲ ኣብዚ ሕዚ እዋን ዘሎ ናይ ርሕቐት ትምህርቲ ሃዋህው ንምምሕያሽ ዝሕግዝ እዩ።

በዚ መሰረት ኣብ ኮሌጃት አክስፎን ሳን-ዳዕሮን ዝርከቡ ቴክኖሎጂካዊ ትካላት ከም ሞባይል፣ ዴስክቶፕን ታብሌትን ንምልላይን ብዛዕባ መስርሕ ምልውዋጥ ሓበሬታ ንምፍላጥን ኣገዳስነት ርሕቀት ትምህርቲ ኣብ ግምት ከተእትውዎ ክሓትት እፈቱ። ይኹን እምበር፡ ዝኾነ ትህብዎ ሓበሬታ ምስጢር ከም ዝሕሎ ኣቐዲመ ከረጋግጸልኩም እፈቱ።

ኣብዚ ቤት ትምህርቲ ይኹን ኣብቲ መጽናዕቲ ዘሎ ሰብ ነቲ እትህቦ ሓበሬታ ዝፈልጦ የለን። በዚ ምኽንያት እዚ፡ ብዛዕባኻ ወይ ብዛዕባ ስምካ ዝኾነ ሓበሬታ ኣብቲ መጽናዕቲ ኣይካተትን እዩ። ዝኾነ ትህቡኒ ርእይቶ ዋጋ ኣለዎ። ሰፊሕ ኣረኣእያ ምህላውና ነቲ ጉዳይ ብዝበለጸ ንምርዳእ ክሕግዘና እዩ።

ኣብ ቃለ መሕትት ክትሳተፍ ፍቓደኛ ዲኻ?

○እወ ○ኣይሰማማዕን እየ ቀን_________________________

የቕንየለይ!

ቀዳማይ ክፋል፡ ብዛዕባ ሓፈሻዊ ማሕበራዊ ኩነታት ተማሃራይ ምሕታት

ተ.ቁ	ሕቶ	መማርፅታት
1.1	ፆታ	1.ተባ 2.ኣን
1.2	ክንደይ ዓመትካ እዩ?	☐ካብ 25 በታች☐26-36 ☐37-46 ☐ከ47ንላዕሊ
1.3	ዘፈር/ክፍሊ ትምህርቲ	________
1.4	ማእከል ትምህርቲ	
1.5	ናይ ምዝገባ ግዜ(Year of Admission)	
1.6	መበለ ክንደይ ዓመትካ እዩ?	☐1ይ☐2ይ ☐3ይ ☐4ይ

ካልኣይ ክፋል፡ - መሕትትት ፅቡቕ ኣሰራርሓን ብድሆታትን ኣብ ርሕቀት ትምህርቲ

ተ.ቁ	ሕቶ	መማርፅታት
2.1	ኣብ ክፍሊ ርሑቕ ትምህርቲ፡ ጽሬት ወረቐትን ሕትመትን ካብዞም ዝስዕቡ ኣየናይ እዩ ዝያዳ ዝኸበደካ?	1. ትሕዝቶ መጽሓፍ ትምህርቲ 2. ክፍሊ ሕቶ ውልቃዊ መርመራ(ዕዮታት) 3. ሕቶታት ዕዮ ገዛ 4. ካልእ እንተሃልዩ ግለጽ______________
2.2	ኣብ ዝደለኻዮ ግዜ ሞጁል ትረክብ ዲኻ?	1. እወ 2.አይፋል
2.3	ነቲ መምህር ኣብ ዝደለኻዮ ግዜ ክትረኽቦ ትኽእል ኢኻ?	1. እወ 2.አይፋል
2.4	እቶም ኣሳይመንት ወይ ሕቶታት ዕዮ ገዛ ተኣሪሞም ይምለሱ ድዮም?	1. እወ 2.አይፋል

ሳልሳይ ክፋል፡ - ብዛዕባ እቶም ተምሃሮ ብመንጽር ርሕቀት ትምህርቲ ዘጋጥሞም ጸገማት ምሕታት

ተ.ቁ	ሕቶ	መማርፅታት
3.1	ካብ ገዛኻ ናብ ትካል ትምህርትኻ ዘሎ ርሕቀት (ኪ.ሜ) ክንደይ ይኸውን?	1. 1-20 2. 21-40 3. 41-60 4. 61-80 5. <200 6. ካሊእ ተሃሊዩ ይግለፁ____________
3.2	ናብ ኮለጅ ክትመጽእ ከለኻ ናይ መጓዓዝያ ወጻኢ.ታትካ ክንደይ ይኸውን? (ብብር)	1. <8 2. <15 3. <30 4. <39 5. 50-85 6. ካሊእ ተሃሊዩ ይግለፁ____________
3.3	ሓደ ሞዱል ንኽወስዱ ክንደይ ግዜ ይወስዱ?	1. ሰሙናዊ 2. ኣብ ሰሙን ክልተ ግዜ 3. ወርሓዊ 4. ኣብ ወርሒ ክልተ ግዜ 5. 5ኣብ ወርሒ ሰለስተ ግዜ 6. ካሊእ ተሃሊዩ ይግለፁ____________

ራብዓይ ክፋል፡ ብዛዕባ ዓይነት ሞባይል ዘለዎም፡ ከምኡ'ውን ክንደይ ግዜ ከም ዝጥቀሙ ምሕታት

ተ.ቁ	ሕቶ	መማርፅታት
4.1	ሞባይል፣ታብሌት ወይ ዴስክቶፕ ኣለካ ድዩ?	1. እወ 2.አይፋል
4.2	መልስኻ እወ እንተኾይኑ እንታይ ዓይነት?	1. ስታንዳርድ ሞባይል 2. ስማርት ፎን ኣንድሮይድ ታብሌት ዴስክቶፕ(ዊነዶውስ) 3. ዝኾነ ይኹን 4. ካልእ እንተሃልዩ ግለጽ_______
4.3	መዓዝ ምጥቃም ጀሚሮመ?	1 ሓድ ዓመት 2 ክልተ ዓመት 3 ሰለስተ ዓመት 4 ካሊእ ተሃሊዩ ይግለፁ___________
4.5	ሞባይል፣ታብሌት ወይ ዴስክቶፕ ንት/ት ብርቀት ምምሃር ምሰትምሃር መሰረት ዝገበረ ይጠቀሙሉዶ?	1. እወ 2.አይፋል

ሓምሻይ ክፋል ፡- በሞባይል፣ታብሌት ወይ ዴስክቶፕ ንምመሃር ዝለዎም ድልውነት ምሕታት

ተ.ቁ	ሕቶ	መማርፅታት
5.1	እቲ ኮሌጅ ካብ ሞጁል ምጥቃም ሞባይል፣ታብሌት ወይ ዴስክቶፕ እንተዝጥቀምከ?	1.ፅቡቕ እዩ 2. ፅቡቕ ኣይኮነን 3.ኣፍልጦ የብለይን
5.2	እቲ ናይ ርሕቐት ኮሌጅ ትምህርቲ ብ ዌብ-ቤዝ(ኦን-ላይን) ምሃብ እንተ ዝጅምር ይጥቀሙሉዶ?	1.እወ 2.ኣይጥቀመሉን 3.ርግፀኛ ኣይኮንኩን

ሻድሻይ ክፋል ፡- እቲ ተማሃራይ ኣብ ርክብ ሞባይል፣ታብሌት ወይ ዴስክቶፕ ዘለዎ ኣረኣእያ ብዝምልከት ካብዞም ዝስዕቡ መግለጺታት ሓደ ምረጹ፡ (1) እወ (2) ኣይፋልን (3) ኣይፈልጥን

ተ.ቁ	ኣብ ሞባይል፣ታብሌት ወይ ዴስክቶፕ ብርሑቕ ምጽናዕ ኣገዳሲ ይመስለካ?	(1) እወ	(2) ኣይፋልን	(3) ኣይፈልጥን
6.1	ግዚ የድሕን(ይቑጥብ)?			

6.2	ቅልጣፈ ትምህርቲ ይውስኽ?			
6.3	ኣብ መንጎ ተማሃራይን ቤት ትምህርትን ዘሎ ርክብ ይውስኽ?			
6.4	ተማሃሮ ብዛዕባ ቤት ትምህርቲ ዝሓስብሉ ኣገባብ ይቕይሮ?			
6.5	ናይ መልኣኪ (መጓዓዚያን) ወጻኢታትን ተዛመድቲ ወጻኢታትን ይቕንስ?			

Appendix E: - Interview for Experts

Guide for in-depth interview for qualitative

I. Introduction

Greeting. Introduce yourself and Objective of the study.

We are going to talk about computing device technologies Support of Effective mobileWeb-base learning distance education in Institutions of Distance education Mekelle. The purpose of this discussion is for you to share your ideas, perceptions and experiences about distance education of hard copy system knowledge, attitude, utilization leave, and factors that affect using mobile phone assisted g in your University with me so that we can explore and identify the effective of distance education using technology accordingly.

Please give me some time?

- Please write your valuable suggestion

II. In-depth interview guide for distance education expertise(focal person) and student service supporter For distance education expertise (focal person)

1. What do you think about Web based apps implementation for students replacing module?

.____

____

____

____

____

____

2. What do you think are the major challenges or problems in designing and implementation mobile,tablate or desktop for students replacing module in your university?

____

____

____

____

____

3. How does mobile,tablate or desktop support distance education?

____

____

____

____

____

Any additional comment____

____

____

Additional information use the Back Side

Thank you for sharing your thoughts, perceptions, and experiences

Thank you very much for you cooperation in case of related to the questionnaire or the overall study related issues you can use the contact information as: Email: sadukidu1@gmail.com/ 0963727190

Appendix F: - Evaluation of WBDEL

English version of written consent form for Students

I am asking you for a little of your time, about 20 - 30 minutes only to help us in this study. The information you give me will be kept confidential and your name and address is not recorded in the interview to protect your confidentiality. You have also the rights to answer or not for the questions which might be inconvenient for you .However, your information is very important to evaluate and improve the program .Again we would like to confirm to you that all your answers are confidential and used for research purpose only .

Are you willing to participate in this study?

Yes, I agree ☐

No ,I disagree☐

I. Evolution of Web-based usability

No	Characteristics	No	Sub-characteristics	Students' and Teachers' Tools						Admin &Teacher's tools			
				Schedule Tutorial & Exam	Teaching materials	Assignments	Group discussion board	Class chat room	Group file exchange	Manage groups	Coupon card	Assign Course and Instructors	Grade Report
1	Functionality	1.1	**Suitability:-**Can software perform the tasks required?										
		1.2	**Accurateness:-** Is the result as expected?										
		1.3	**Interoperability:-** Can the system interact with another system?										
		1.4	**Security:-** Does the software prevent unauthorized access?										
		1.5	**Compliance:-** Does the software comply with laws or regulations?										
2	Reliability	2.1	**Maturity:-** Have most of the faults in the software been eliminated over										
		2.3	**Fault tolerance:-** Is the software capable of handling errors?										
		2.5	**Recoverability:-** Can the software resume working and restore lost data after										
3	Usability	3.1	**Understandability:-** Does the user comprehend how to use the system easily?										
		3.2	**Learnability :-** Can the user learn to use the system easily?										
		3.3	**Attractiveness :-**Does the interface look good?										

		3.4	**Operability** Can the user use the system without much effort?										
4	**Efficiency**	4.1	**Time Behaviour :-** How quickly does the system respond?										
		4.2	**Resource Utilizations :-** Does the system utilize resources efficiently?										
5	**Maintability**	5.1	**Analysability:-** Can faults be easily diagnosed?										
		5.2	**Changeability:-** Can the software be easily modified?										
		5.3	**Stability :-**Can the software continue functioning if changes are made?										
		5.4	**Testability :-**Can the software be tested easily?										
6	**Portability**	6.1	**Adaptability :-**Can the software be moved to other environments?										
		6.2	**Installability:-** Can the software be installed easily?										
		6.3	**Conformance:-** Does the software comply with portability standards?										
		6.4	**ReplaceabilityC:-** software easily replace other software?										

II. Evaluation users

No	Variable	Agree	Uncertain	Disagree
1	The cost of downloading the Web course materials is acceptable			
2	The cost of uploading response of assignment is acceptable			
3	The cost of mobile,tablate or desktop is reasonable			
4	This Web-based is easy to install.(crom.safari)			
5	One can get the material any time			
6	Use of mobile,tablate or desktop increases the learning pace			
7	Access to content learning menu is fast			
8	App menu icons are working properly.			