University of Nairobi

SCHOOL OF COMPUTING AND INFORMATICS
MSC. INFORMATION TECHNOLOGY MANAGEMENT

ONLINE PLATFORM FOR INFORMAL VOCATIONAL LEARNING TO IMPROVE THE RATE OF KNOWLEDGE AND SKILL ACQUISITION AMONG WOMEN IN KENYA

BY
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Report submitted in partial fulfillment of the requirements of the Master of Science in Information Technology Management.

ABSTRACT

Early pregnancies and restrictive cultural practices constraint the time, mobility and flexibility required for women to access education. Consequently, the overall economic contribution and labour participation among women is exiguous. More research is necessary to investigate the application of technology in promoting women's access to Technical, Vocational and Entrepreneurship Training (TVET). Such skills provide prospects for career advancement as well as self-reliance in absence of employment. This is especially relevant to Kenya where more than 50% of women have not attained secondary school education level and above. This exploratory study aims at fostering informal vocational learning among women in Makueni County using publicly available content. The methodology adopted was a three-step process comprising of a prestudy to identify the requirements of the self-paced Learning Management System (LMS), development of a LMS as per the identified requirements, and finally, a post-study to evaluate its effectiveness in learning. Stratified purposive sampling was used to identify 30 women with limited prospects for tertiary education for the study. The evaluation for the LMS was done using phone interviews and involved giving the participants access to the LMS for two weeks. Findings of the study showed that 93% of the participants had effectively learned sufficient skills in at least one of the four learning areas provided in the LMS, and it concludes that offering publicly available content in self-paced LMSs can promote vocational learning among women.

ACKNOWLEDGEMENTS

I would like to express my utmost gratitude to my supervisor Prof. Oboko, Robert for his insightful guidance, invaluable suggestions and exceptional advice rendered in the course of this project. I would also like to thank all the panel members for their great contributions which in one way or another sustained my passion while undertaking this project.

Special thanks to my husband Simon Ndunda, my mother Anastasia K. and the rest of my family members for the amazing support and patience.

DECLARATION

The material presented in this research project is the original work of the candidate except as acknowledged in text. It has not been previously submitted, either in part or whole, for a degree at this or any other University.

Sign _____ Date_____

Gloria Mutunga

P54/6367/2017

This research has been submitted for examinations with my approval as a university supervisor.

Sign _____ Date_____

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1.0 INTRODUCTION

1.1 Background

Education plays a critical role in uplifting people from poverty by increasing access to employment opportunities and improving the chances to secure ones' economic resources (World Bank, 2014). However, social and cultural obstacles continue to limit women's access to education thus leading to gender inequalities in the labour market. Regardless of their background, women continue to bear most domestic and childcare obligations. These responsibilities strongly constraint the time, mobility, and flexibility necessary for their full participation in education and training (ILO, 2018).

In the last two decades, Kenya has made noteworthy gains towards the achievement of equitable access to education. Consequently, women's literacy rate has significantly improved leading to gender parity at the primary education level and near parity at the secondary education level. Despite the progress in education as a whole, 22% of women have literacy difficulties compared to 9% of men. The number of women with secondary school education level and above is less than 50% (UNESCO,2018).

For these women, who find formal education unreachable, there is a need to equip them with vocational and entrepreneurship training to empower them economically. Similarly, the unique challenges they face call for alternative strategies in delivering the training. One such approach is the use of self-paced online learning platforms to address the time, mobility, and flexibility issues (Brittany Gilbert, 2015). Research on the effectiveness of self-paced learning programs in promoting access to vocational training TVET institutions in Kenya has been promising, showing improved enrollment and completion rates. However, manpower capacity in developing and delivering the content remains a huge challenge (Chege & Kariuki, 2016).

The resource limitations on content development can be addressed by the use of publicly available content. Platforms like Youtube, blogs, and Open Education Resources already contain a lot of information that can be used to support vocational and entrepreneurship courses (Widiaty, Isma & Riza, 2018). The second issue of concern is digital literacy. Research by Global System for Mobile Communications (GSMA) found that women in low and middle-income brackets did not understand the potential of the internet and were unlikely to search for information online (GSMA, 2015). To address both of these challenges, this study proposes the integration of publicly available content from various sources and packaging them in a LMS, eliminating the strenuous process of searching for the relevant content from the internet.

1.2 Problem statement

Although vocational and entrepreneurship training is critical in economic empowerment (Ngugi & Muthima, 2017), uptake of these training has been relatively low among women in Kenya (the Republic of Kenya, 2016). Time pressures and constrained mobility imposed by domestic responsibilities interfere with school attendance, leading to poor enrollment and high dropout rates (KNBS, 2017). These challenges can be addressed by self-paced eLearning platforms. However, current institutions offering e-learning vocational courses face manpower capacity challenges on content preparation and implementation (Chege & Kariuki, 2016).

1.3 Research Objectives

The overall objective of this research is to develop an online learning platform that delivers vocational training using publicly available content and assess the effectiveness of the platform in learning. Specifically, the research aims:

- ❖ To assess the effectiveness of publicly available content in vocational training
- ❖ To provide just in time learning on vocational courses
- ❖ To improve accessibility to vocational training among women

1.4 Problem Justification

There is a wide gender disparity in economic contribution in Kenya with women constituting 64% of the unemployed and only a meager 25% of the formal sector employees (KNBS, 2016). Statistics indicate that there is a direct relationship between education and economic empowerment (Ngugi & Muthima, 2017). This research contributes to the body of knowledge on promoting access to education and training among women.

1.5 Definitions

- **Technical, Vocational and Entrepreneurship Training (TVET):** Training that emphasizes skills and knowledge required for a particular job function, for example, making carpets, hair and beauty, fashion and design, cooking, baking and so forth. In the context of this paper, TVET is used interchangeably with vocational training.
- **Economic Empowerment:** Having control over one's financial situation.
- **Educational Empowerment:** Giving learners relative control of the learning process.

2.0 LITERATURE REVIEW

The literature review section explores the importance of vocational training, gender inequalities in access to vocational training, the applicability of online digital learning programs in bridging the education gap, the current state of online digital learning programs in Kenya, and the use of publicly available content to promote vocational training.

2.1 Introduction

Although most governments concentrate on providing basic education, tertiary education is equally crucial in improving economic outcomes as it provides the basis for labour force skills and knowledge (Shanmugam, 2015).

In Kenya, higher education is divided into two: TVET and University education (the Republic of Kenya, 2019). On average the number of secondary school graduates who qualify to join university studies per year is less than 20%. For instance, the number of students who scored C+ and above in Kenya Certificate of Secondary School Education (K.C.S.E), the minimum grade required to join university, was 15% and 17% in 2018 and 2019 respectively (KNEC, 2019). On the other hand, TVET programmes target individuals, who for whatever reason do not enroll to/or drop from primary or secondary schools, as well as those who fail to attend university education.

International Center for Technical and Vocational Education and Training (UNEVOC) describes TVET as any training that contributes to acquisition of skills relevant to a particular work, and is characterized by either entrepreneurship, vocational or apprenticeship training (UNESCO, 2017).

TVET is core for sustainable development in developing countries. For school leavers, TVET plays a key role in providing training avenues and career progression prospects which are not only necessary for gaining employment but also lead to self-sustenance in absence of employment (Wahba M. M, 2011).

Kenya's vision 2030 acknowledges the importance of TVET training in economic growth. As a result, the TVET Act of 2013 was established to address the underlying challenges in access to TVET programmes. Topping the list is poor enrolment rate amongst females; insufficient TVET centers and inequitable distribution of the existing institutions. Others include inadequate localization of the learning materials and poor perception of TVET programmes (the Republic of Kenya, 2016).

In recent years, enrollment to TVET has gained significant traction. According to the Kenya National Bureau of Statistics (KNBS), TVET enrollment increased by 36.9%,

from 127,691 in 2012 to 202,556 in 2016. Female students' enrollment rose by 25% to 74,432 while male students' enrollment rose by 25% to 91,209 over the same period (KNBS, 2016).

Even with these gains, women enrollment and course completion rates on TVET programmes is particularly low. For instance, statistics from the Thika Technical Training Institute sex-disaggregated baseline survey showed that only 35% of the students in the institution were female (Chege & Kariuki, 2016).

2.2 Gender inequality

There is a growing understanding that promoting women's access to education is integral to lasting, inclusive and sustainable economic development. Women are now more educated and economically empowered than ever before, and there is greater appreciation that gender equality is fundamental to the success of poverty reduction and economic growth initiatives. Still, the journey in reaching gender parity in both education and economic contribution is far from over. Globally, the economic participation rate for women in the working age bracket is 63% in contrast to 94% for men (International Labour Organization, 2018).

In Kenya, whereas women constitute more than half the population (KNBS, 2019), their representation in formal employment is a mere 25%. Moreover, nearly two thirds of the unemployed people in Kenya are women (KNBS, 2016). The lack of vocational training in rural areas limits women to agricultural farming, even in non-productive regions. According to (World bank, 2014), women make up 80% of Kenya's farmers.

Early pregnancies are the leading contributor to the women education conundrum. The Kenya Demographic and Health Survey (KDHS) suggests that twenty percent of teenage girls have already began childbearing (KNBS, 2014). Another report by the United Nations Population Fund (UNFPA) reveal that approximately 378,400 teenage girls became expectant between July 2016 and June 2017 in Kenya (UNFPA, 2018). Adolescent pregnancies result in high school dropout rates amongst girls.

The second main inhibiting factor in women's access to education is social and cultural practices. Women, especially in rural areas, perform most of the household responsibilities limiting the time and flexibility needed to access education. Moreover, families with financial constraints are likely to educate a boy over a girl (International Labour Organization, 2018). A report by KNBS shows that women in rural areas spend substantial amount of time on household duties such as feeding their families and child rearing; obscuring the efforts to further their education and training (KNBS, 2017).

2.3 Digital skills among women

Internet penetration in Kenya has greatly progressed in recent years, owing to decreasing internet costs and falling smartphones' prices. As of 2017, 97.5% of Kenyans have access to mobile phones while 80% have access to the internet (Communications Authority of Kenya, 2018).

Gender disparity continues to exhibit in internet consumption and possession of mobile phones. Research by Global System for Mobile Communications (GSMA) on digital literacy among women in Kenya, India and Indonesia showed that women face diverse barriers to internet access with cost and lack of digital skills ranking the highest in the list. Moreover, less literate women are inclined to access the internet only with familiar applications or websites, usually those that have been recommended to them by their social circles. They do not have sufficient cognizance of the capabilities of the online content complicating their ability to harness its full potential (Global System for Mobile Communications, 2015).

It is impossible to accurately estimate number of women in Kenya who face digital literacy barriers due to the lack of comprehensive statistics in this area. In 2016, it was estimated that only 51% of women were digitally literate compared to 63% of men (Institute of economic affairs, 2016). However, a study by GSMA showed a majority of unemployed women were interested in knowing how they could use the internet to further their education or start and promote businesses (Global System for Mobile Communications, 2015).

2.4 State of current digital learning platforms

Self-paced online learning platforms solve the time, mobility and flexibility complications by offering versatile learning opportunities that allow learners to participate in training at their convenient time, irrespective of the geographical location (Gilbert, 2015). The Ministry of Education recognizes the place of digital learning as key in bridging the gap in access to TVET training (the Republic of Kenya, 2016).

Thika Technical Training Institute (TTTI) is one of the tertiary institutions in Kenya that has already undertaken to offer digital learning. Upon introduction of the program, there was notable, although less than optimal, increase in women enrolment. A research by Chege and Kariuki on promoting women's access to TVET courses using the TTTI case study identified capacity challenges on developing digital content as the main hindrance to the success of the digital learning program. Their research showed that the need to showcase practical skills on vocational training requires a lot of time in content preparation, making it difficult to develop sufficient content for all vocational training needs. The researchers recommended partnering to address the capacity challenges when developing and delivering online content for vocational courses (Chege & Kariuki, 2016).

There are also private and non-governmental organizations that have also undertaken to offer online vocational and entrepreneurship training as self-paced online content. Among them is Arifu, which provides mobile-based education on agriculture and financial skills (Arifu, 2019). Most of these institutions offer limited content geared towards particular skills.

2.5 Public Online Content Platforms

Technology has changed the way people share information. Social media and blogs provide an enormous amount of content for entertainment and learning. A good example is Youtube. Youtube is a huge repository hosting massive video content with over two billion users and more than 800 million videos (Youtube, 2020). Its popularity, breadth of content and the fact that content is provided in Video format make it suitable for any training including those that require showcasing of skills.

Although the use of Youtube content for learning has shown great success in the past, care needs to be taken while choosing the learning content. Content in Youtube and other public online content platforms can be erroneous, bias or incorrect. The content is usually not curated. In this research, we reviewed three case studies of the application of Youtube content in learning.

In India, researchers explored the use of Youtube in learning batik among high school vocational students. The study used Youtube's Application Programming Interface (API) to build an application that provided the relevant content to the learners, and the conclusion was the application provided accurate content that could be used to learn batik (Widiaty, Isma & Riza, 2018). However, this research concentrated merely on developing the learning platform and verifying that the learning content was accurate. The effectiveness of the Youtube content in developing vocational skills was not studied.

In a study that evaluated the value of Youtube in academic writing, it was found that learners depicted positive characteristics such as innovation, playfulness and stimulation after using Youtube educational content on academic writing. The research was done on 40 high school graduates from South Africa to help improve their academic writing skills. The results showed an overwhelmingly positive outcome on academic performance an indication the publicly available content has huge potential for educational and training applications (Olasina,2017).

Another case study evaluated the effectiveness of Youtube content in teaching English as supplementary to classroom content and showed that Youtube content improved learners' understanding of concepts (Almurashi &Wael. 2016). Youtube videos were found to showcase the content in a lively and more comprehensively way than traditional teaching methods.

In the context of adult women in need of vocational training, the existing content on Youtube can be used to train them on vocational skills such as food and nutrition, beauty, fashion and design, among others. These skills create an opportunity to gain monetizable skills which could be applied in a variety of ways to improve economic outcomes

2.5.1   Open Educational Resources

Open Educational Resources (OERs) are publicly available materials for learning and research purposes. OER content is diverse, ranging from textbooks, lecture notes and presentations, multimedia, audio, illustrations, animations, quizzes and lab work. Most OERs use the Creative Commons license, which means they are generally free to use. However, several variations of the license that govern the redistribution of OERs exist. The most common ones are *No derivatives*, *Non-Commerical, Share a Like* and *attribution*. Although there are many OERs for high school and higher learning, very few OERS exist for TVET learning (UNESCO,2017).

2.6 Makueni County

The poverty rate in Makueni county currently stands at 64%, implying that nearly two thirds of the residents live under a dollar day. The adult literacy rate in the county is 77.6%, which is six points higher than the national average. Adult literacy rate is considered as the percentage of people who are 15 years or older capable of reading and writing brief sentences with comprehension. Notably, only 21% of Makueni residents have secondary school education and above, with Kibwezi East Constituency tailing this list at 17%. In the later, Masonga ward has the lowest number of people with secondary level of education at 14% while Kikumbulyu North ward has 21% of resident who do not have formal education, the highest number in the county (Republic of Kenya 2013).

According to (The Republic of Kenya, 2013), shortage of tertiary institutions to accommodate the high number of students from secondary schools has impacted the county's economic development negatively. At the moment the county has 12 tertiary institutions and 2 university satellite campuses. Although farming is the main economic activity in the county, it has been performing poorly due to the arid climate, limiting the segment's ability to contribute significantly to the economy (the Republic of Kenya 2013).

The high literacy levels and extensive mobile phone penetration in the county at 85% makes technology a feasible solution to offer technical, vocational and entrepreneurship training where formal classroom training is not tenable.

2.7 Theoretical Framework

The goal of this study was to assess the effectiveness of an online learning platform in promoting access to vocational training among women using publicly available content. Under this section, we reviewed frameworks that may shed light on assessing the effectiveness of an online learning platform. This contributed to the conceptual design.

2.7.1 2.1.1 Framework for Effective Online Learning

The theoretical framework for effective online learning, developed by Teo & Williams, states that effective learning occurs through opportunities for active construction of knowledge and social interactions and collaboration (Teo & Williams, 2005). The theory stipulates that effective learning is determined by seven key factors: the instructive environment (providing relevant learning content that meets specific learner's needs), the situating environment (engaging the learner in the learning process through activities similar to the real world), constructive environment(building on learners' knowledge and experiences to allow knowledge construction), the supportive environment (providing the cognitive support and supporting materials needed to execute learning activities), the communicative environment (establishing channels of communication between the learner and the instructor), the collaborative environment (promoting teamwork amongst learners), and the evaluative environment (providing mechanisms for learners to evaluate their learning progress). This framework provides a holistic perspective of the learning environment (Peter & Footring, 2008) and has widely been used in literature. It was adopted for the study because it fits well with both formal and informal learning.

2.7.2 2.7.2 Anderson's theory of online learning

Another theory considered for this research was Anderson's theory for online learning. The theory states that an effective learning environment is learner-centered, assessment centered, community-centered, and knowledge-centered. Learner-centered means learning content should be developed to meet specific learner needs while considering the learner's context; assessment centered requires putting in place evaluation mechanisms for learners to measure the acquired knowledge; knowledge-centered requires promoting utilization of the internet as a source of knowledge, and community-centered requires the learning platform to provide a social environment for interaction and collaboration among the learners. This framework was not adopted because most of the components were encompassed in the framework *for effective online learning*.

2.8 2.2 Empirical Study

Effective learning is considered as one that satisfies learners' learning needs, motivates learners to learn more, and achieves the desired learning outcomes (Teo & Williams, 2005). Although there are many factors attributed to effective online learning, most researchers agree that a learner-centric approach, provision of learning assessments(evaluations), engaging learners through learning activities, and social interactions are all determining factors.

The constructivist theory, which has widely been used in understanding learning, argues that learning is an active process where learners are constantly involved in the creation of knowledge-

based on their experiences and understanding of the world (Bada & Olusegun, 2015). Consequently, the use of learning activities is essential for learners to process and interpret knowledge (Suhendi, & Purwarno, 2018). Research done in TVET institutions in Uganda showed that learning activities in vocational training are of paramount importance as ultimately vocational learners should be able to put into practice the skills acquired in the context at which they are applied (Kyarizi, 2016).

Another factor attributed to effective learning is a learner-centered approach (Anderson, 2005). In a learner-centered approach, learning content is tailored to meet the specific learner's needs. Additionally, the delivery mechanism has to provide leeway for students to learn according to their styles, interests, and personal abilities. With this learning style, the teacher is just a guide, most of the learning is done by the student. In the study *learner-centered teaching: What makes it effective,* it was found that learner-centric approaches inspired learners to take charge of their learning and ultimately had better outcomes (Darsih, 2018).

Having an online community where learners can interact with peers and instructors is of paramount importance in online distance learning. Often, distance learners face isolation and loneliness. An online social community helps provide them with a sense of belonging (McInnerney & Roberts, 2004). Additionally, through social interactions, learners are able to learn from the experiences of their peers (Teo & Williams, 2005). A study in United Kingdom Universities offering online distance learning showed that students felt isolated and perceived the distance learning to be inadequate in cases where online social interactions were not established (Ingirige & J. Goulding, 2009).

The final factor, assessment in online learning, serves to provide crucial feedback that can be used to improve the learning and teaching process. Good assessments also serve to motivate learners (Hector & Francisco, 2005). To ensure that online learning assessments are effective, they have to be developed to test realistic learning scenarios and must be aligned to the learning objectives (Arend & Bridget,2019).

2.9 Conceptual Framework

> **Research question:** *How can we use publicly available content for effective online learning of vocational skills among women in Kenya?*

After reviewing several frameworks on effective online learning, the most relevant ones identified were: Anderson's theory of online learning, and the theoretical framework for effective online learning. The two frameworks, although using slightly different terms, had very similar underlying principles. Teo and William's theory was adopted as it was more wholistic and included all the components of Anderson's theory. Slight modifications were made to make it more relevant to the study.

Borrowing from Anderson's theory, communicative environment, collaborative environment, constructive environment and supportive environment were combined to form Subject Community.
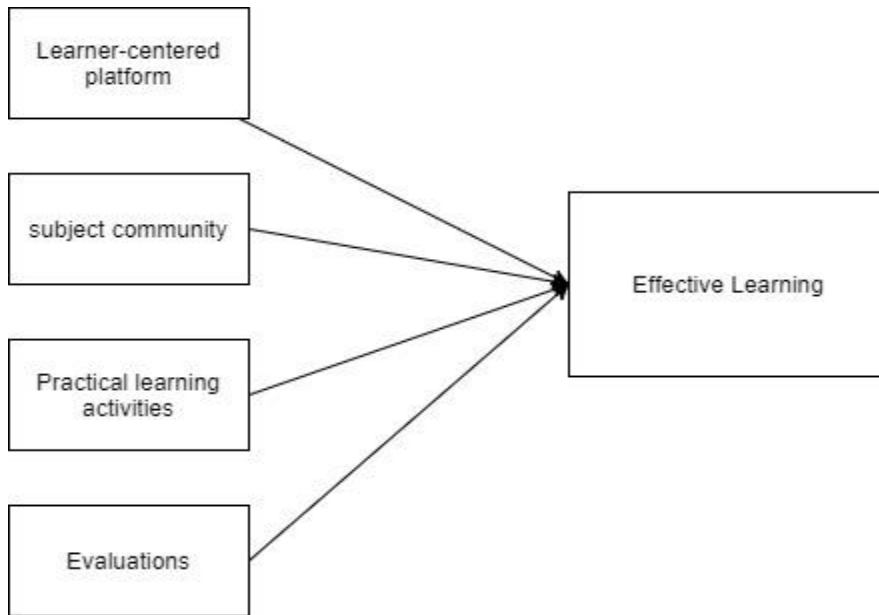
Figure 1:Conceptual Framework

2.9.1 Operationalization of Variables

Dependent variable

The dependent variable in this study is effective learning. Effective learning is defined as *providing a meaningful learning experience*, *learner satisfaction*, and *achieving the desired learning outcomes*.

The theoretical framework of effective learning	Anderson's online learning model	Conceptual framework
Instructive environment	Learner-centered	Learner-centered platform
Situational environment	-	Practical learning activities
Communication environment Collaboration environment Support environment Constructive environment	Community of inquiry	Subject community
Evaluative Environment	Assessment centered	Evaluations

Figure 2:Operization of Variables

Independent Variables

The table below shows how the independent variables map to the theoretical frameworks.

1. **Learner-centered platform**: Refers to providing relevant vocational training content suitable to learners' needs. This was measured by the *relevance* and *adequacy* of the content in each learning area, the *ease of use* of the learning platform, and the *satisfaction* of learners with the learning experience.
2. **Practical Learning Activities**: Refers to providing learners with a series of activities that help them relate the learning to a real-life environment. In this context, the learning content was provided in video format showcasing practical vocational skills and encouraging users to try putting the practical skills into use. This variable was assessed by the *ability of learners to practically apply the learning content*.
3. **Evaluation**: It was measured by the *ability of learners to evaluate their learning progress* using the evaluation tests provided in the platform
4. **Subject Community:** Refers to the facilitation of social interactions among learners. This variable is measured by the *ability of the learners to communicate and collaborate with peers; to get support from fellow learners* and *to learn* through interactions with fellow learners

3.0 METHODOLOGY

This was a qualitative, exploratory study designed to assess the effectiveness of using publicly available content in improving women's rate of skill uptake in informal learning. The methodology adopted comprised of a prestudy to get a deep understanding of the research area, development of eLearning Management System (LMS), and a post

study to evaluate its effectiveness. Stratified purposive sampling was used to identify the participants for the study. Interviews were used for data collection.

3.1 Pre-study

The pre-study was to carried understand the features of the LMS and the learning areas to be used for the study. The target respondents were 18 years and above, unemployed and with limited access to vocational training. The output of the pre-study was a list of features for the learning management system and the learning areas.

3.1.1 Study Design

This was exploratory research targeting unemployed women with low prospects for vocational training. Purposive sampling was used to identify the participants who met this criterion. Connelly (2008) suggests that a pre-study sample size ought to be at least ten percent of the projected sample size for the main study while Van Belle (2002) suggests a sample size of 12. Using this as a guideline, a total of 8 participants were selected for the prestudy and interviewed within a span of 2 weeks.

The instrument used for the research was researcher administered questionnaire, to cater for the needs of the participants especially those with literacy challenges. This approach also provided a deeper understanding of the study in terms of digital literacy of the participants, access to the necessary digital tools for online learning and the appropriate media for the learning content. The questions for the pre-study were informed by the literature review. Sample questionnaire that was followed during the interviews has been appended in Appendix 1.

3.1.2 Data Collection

Each interview process commenced with an introduction of the researcher and a statement on the overall goal of the study. This was then followed by interview questions from the questionnaire.

The questionnaire covered the following areas.

1. **General Information**: This was used to capture general information about the user such as education level and interest in online learning.
2. **Access to Digital Technology**: This covered user access to digital devices, such as mobile phones and computers, and internet
3. **Online Learning:** This was used to establish the features for the learning management system. It also captured the learning areas the respondents were interested in pursuing.

3.1.3 Results

3.1.3.1 Data analysis

Data analysis was carried out through open coding to identify the themes and patterns in the requirements for the learning management system. The analysis was mainly done through excel. Frequency distribution across the codes and percentages were used to summarize the results as shown below.

Learning areas of interest

All participants interviewed were found to be interested in furthering their studies. 62.5% had an interest in hair care and beauty, 37.5% in baking, 25% making soaps, 12.5% in business and 12.5% in information technology.
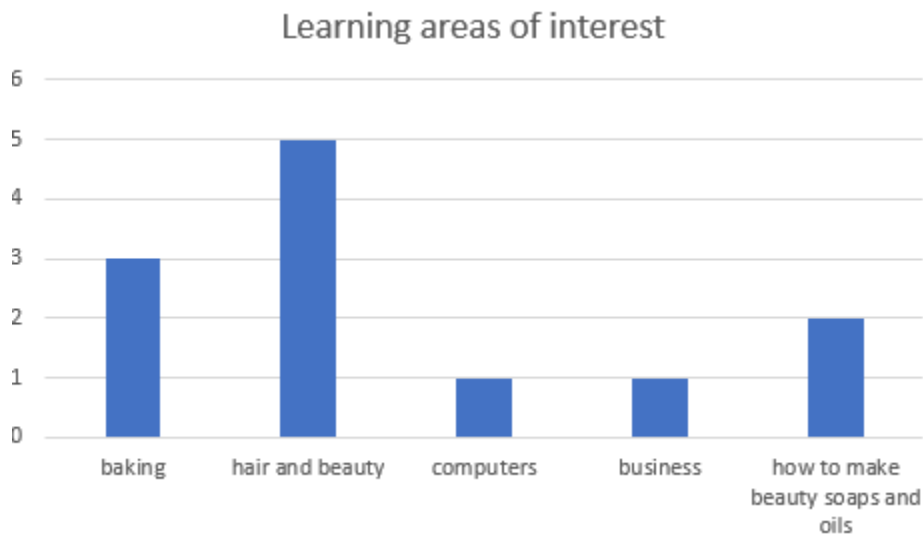
Content media

It was found that all the participants prefered learning content in video format. In addition, 37.5% also were interested in text content, 25% were interested in graphic content and only 12.5% were interested in audio content.

Media of content
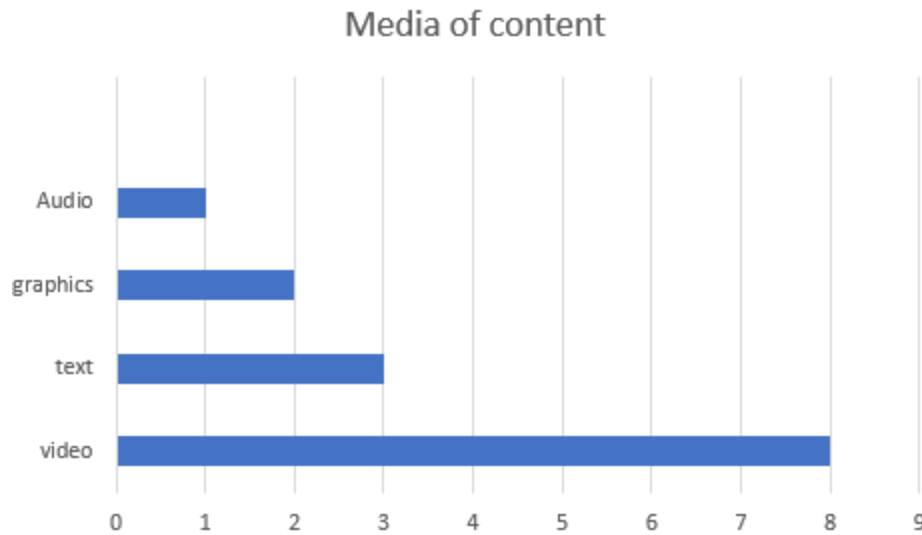
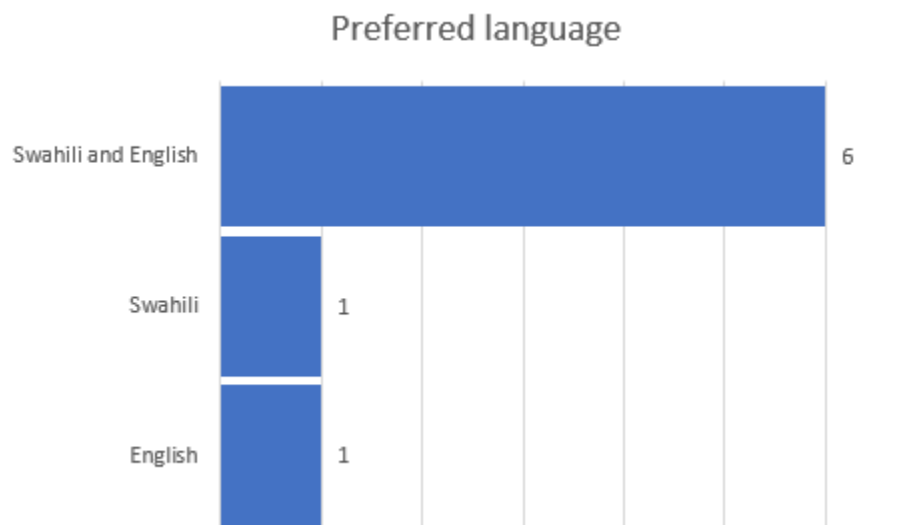**Content Language**

75% of the participants were found to prefer content in both English and Swahili. 12.5% of the participants preferred content in each English and Swahili.

Preferred language

Challenges with Digital Learning:

It emerged that only 37.5% of the participants had pursued learning a skill online. Additionally, 100% of the participants who had engaged in online learning had encountered some difficulties. For instance, the high cost of the internet and challenges getting the learning materials were a huge hindrance.

Challenges with online learning
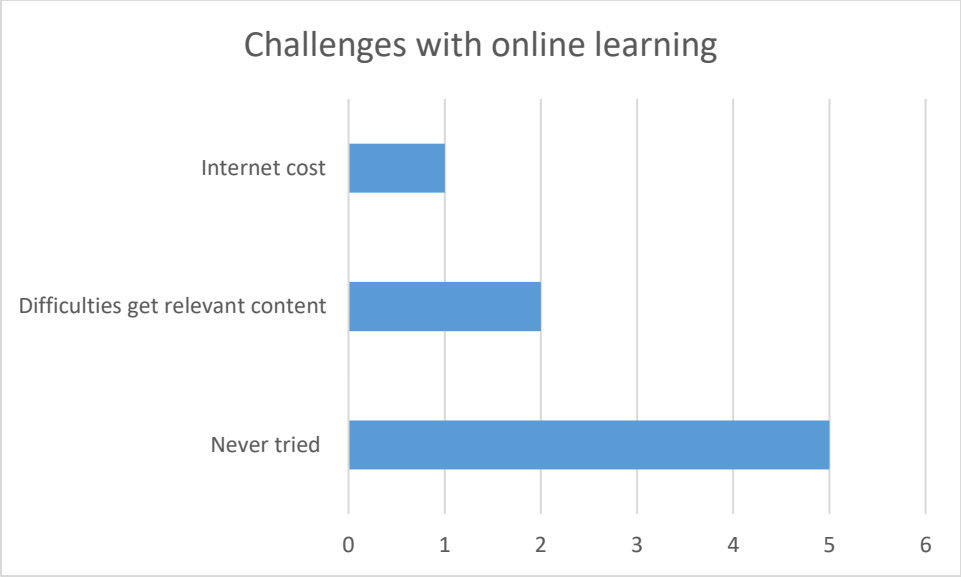
Access to Digital Devices and internet among the participants

All individuals interviewed were found to have access to a mobile device. This was expected given the high penetration rate of mobile phones in Kenya and the f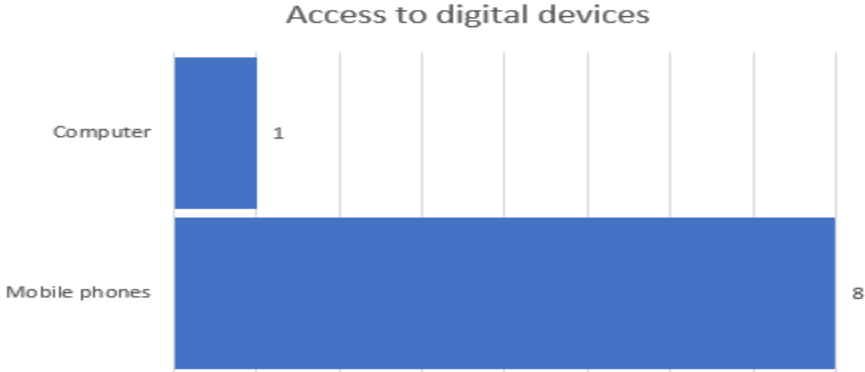act that all the individuals interviewed were in close proximity to the Mombasa-highway towns. The most common type of mobile device was a smartphone with only 12.5% of the participants having a feature phone and another 12.5% having access to a personal computer.

Most of the participants were found to have access to the internet. 75% had access the internet through mobile data bundles, 12.5% through wifi and another 12.5% did not have access to the internet at all. However, 85% of those using data bundles cited cost as a challenge.

Internet Access

Wifi ■ Data bundles ■ None
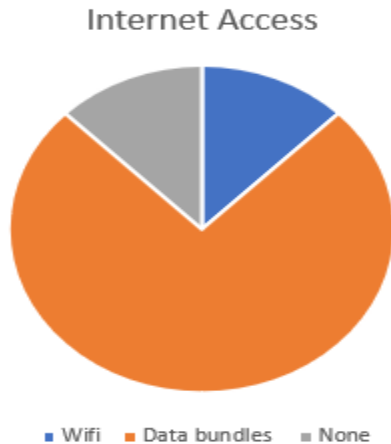
Functional Requirements

From the conceptual framework and the pre-study, the requirements for the LMS were identified as: a learning platform with support for multiple media content, support for evaluations, a discussion forum and provision for practical learning activities.

Non-Functional Requirements

The system characteristics that were identified as desirable to enable smooth operation of the LMS were: mobile accessible application, support for online access, user-friendly and easy to use the application, and support for self-paced learning.

Key observations:

One main observation that was made during the interview process, and was considered important in the design of the solution was digital literacy. Although the majority of the participants were willing to further their studies, digital literacy had hampered their ability to pursue skill acquisition online. The developed system had to be very easy to use to allow learners to access the content with minimal effort.

Secondly, most participants were interested in learning a skill that could easily be applied to start a business with minimal capital. Besides the three learning areas identified in the pre-study, content on entrepreneurship was also added to guide participants who may have an interest in starting a business

3.2 Application Development

3.2.1   Application Development Methodology

The rapid prototyping development approach was adopted for this research. Prototyping seeks to help respond to the unpredictability of end-user requirements through incremental iterations. In contrast to the traditional waterfall development approach, it facilitates faster product development

through brief regular iterations each providing a usable version of the product. By concentrating on reiteration of condensed product development cycles, new user requirements are identified from the users' interaction are then incorporated into the final product. Unlike waterfall, emerging user requirements can be incorporated to the already working system leading to shorter product development cycles.

3.2.2   System Design Process

The diagram below is an illustration of the design process that was adopted in the development of the learning management system.
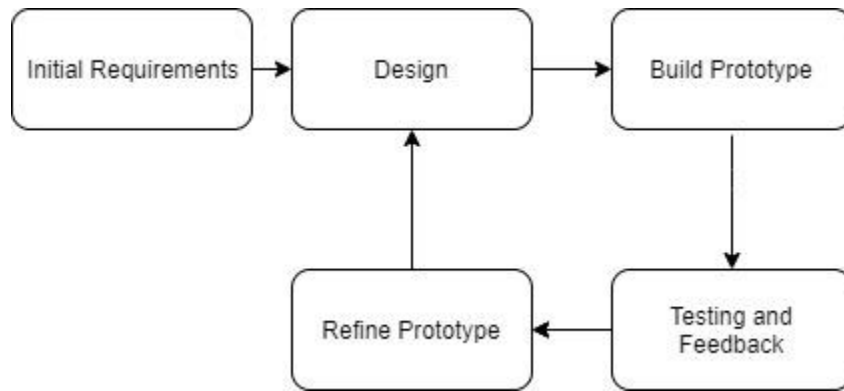
Figure 3:Prototyping

3.2.3 System Requirements

3.2.3.1 Requirements

Based on the pre-study, the functional requirements of the proposed learning management system are mobile and online access; ability to access learning content on various media formats; the ability for users to get content without intensive searching and a discussion forum to provide support to learners from the learning community.

3.2.3.2 Assumptions

In this research, it was assumed that the target participants for the study shall have access to the requisite devices to access the learning content, such as: computer/laptop/tablet/smartphone and the internet. It was also assumed that most participants understood English. From the pre-study, it was established that most participants had studied up to secondary school level, which informed the latter.

3.2.4   High-Level System Architecture

The high-level diagram for the developed Learning Management Platform (LMS) is as follows:
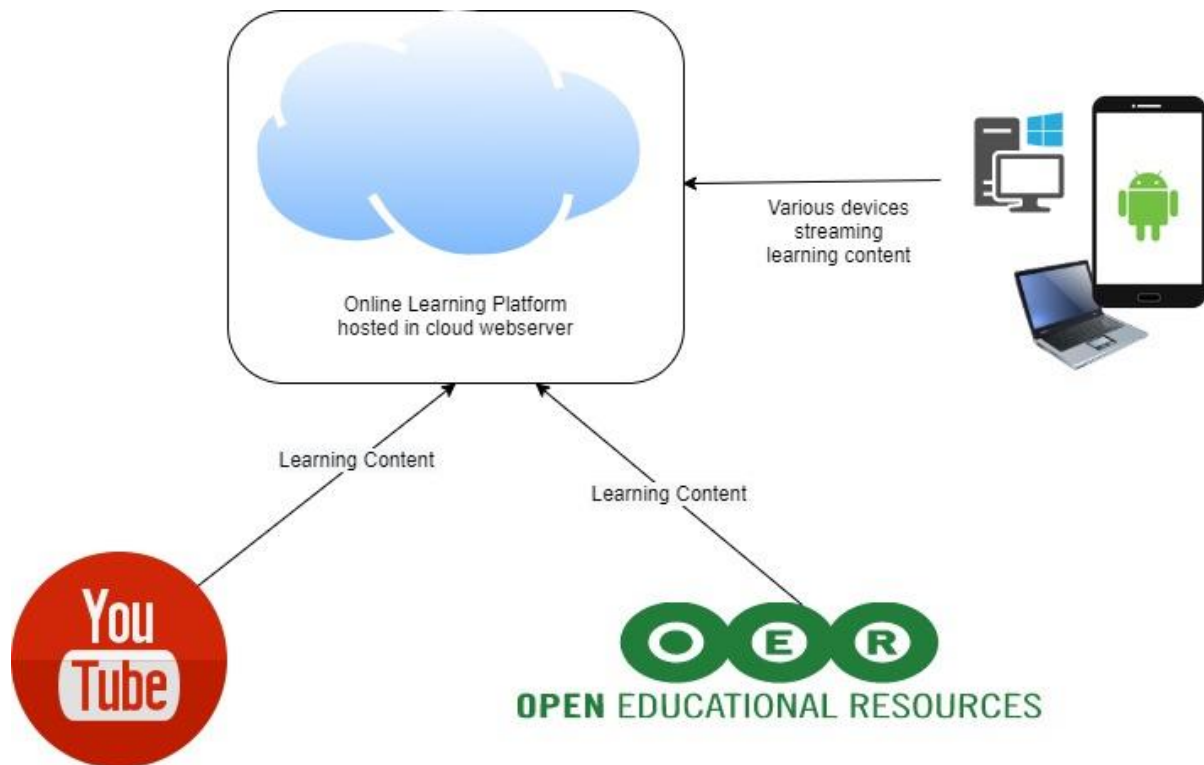
Figure 4:High Level Diagram

The main components of the system are as follows:

1. **Cloud Environment:** The system was hosted in the cloud to make it accessible from anywhere. It was also optimized to work with both mobile phones and computers.

2. **Database:** Most of the data on the system was stored in a database hosted in the cloud environment.

3. Learning Platform server: This is the application server that handled all logic of accepting user requests and delivering the requested content, keeping track of user progress and providing evaluations feedback.

4. Admin web-based interface: This is an interface for back system administration such as creating content categories, uploading content metadata, and linking the content metadata with the appropriate category

5. Youtube integration: Integration to Youtube using Youtube's API was used to fetch the learning content from Youtube, and render it in the learning platform.

6. Open Education Resources (OERs): Content from Open Education Resources was downloaded and uploaded to the platform.

3.2.5 Use case diagram

The diagram below shows the user interacted with the LMS.
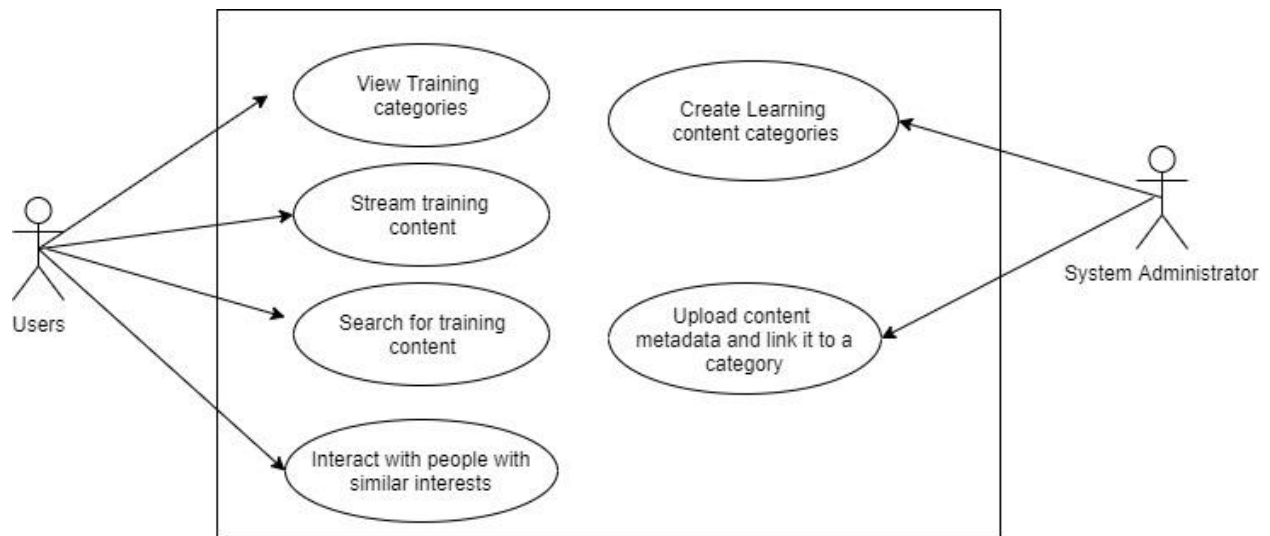
Figure 5:Use case Diagram

Below is a description of each actor:
- User: woman seeking to further her skills through online learning.
- Administrator: Person responsible for finding appropriate content and uploading it on the learning platform.

3.2.6 Deployment Diagram

The deployment diagram of the LMS is as folows.
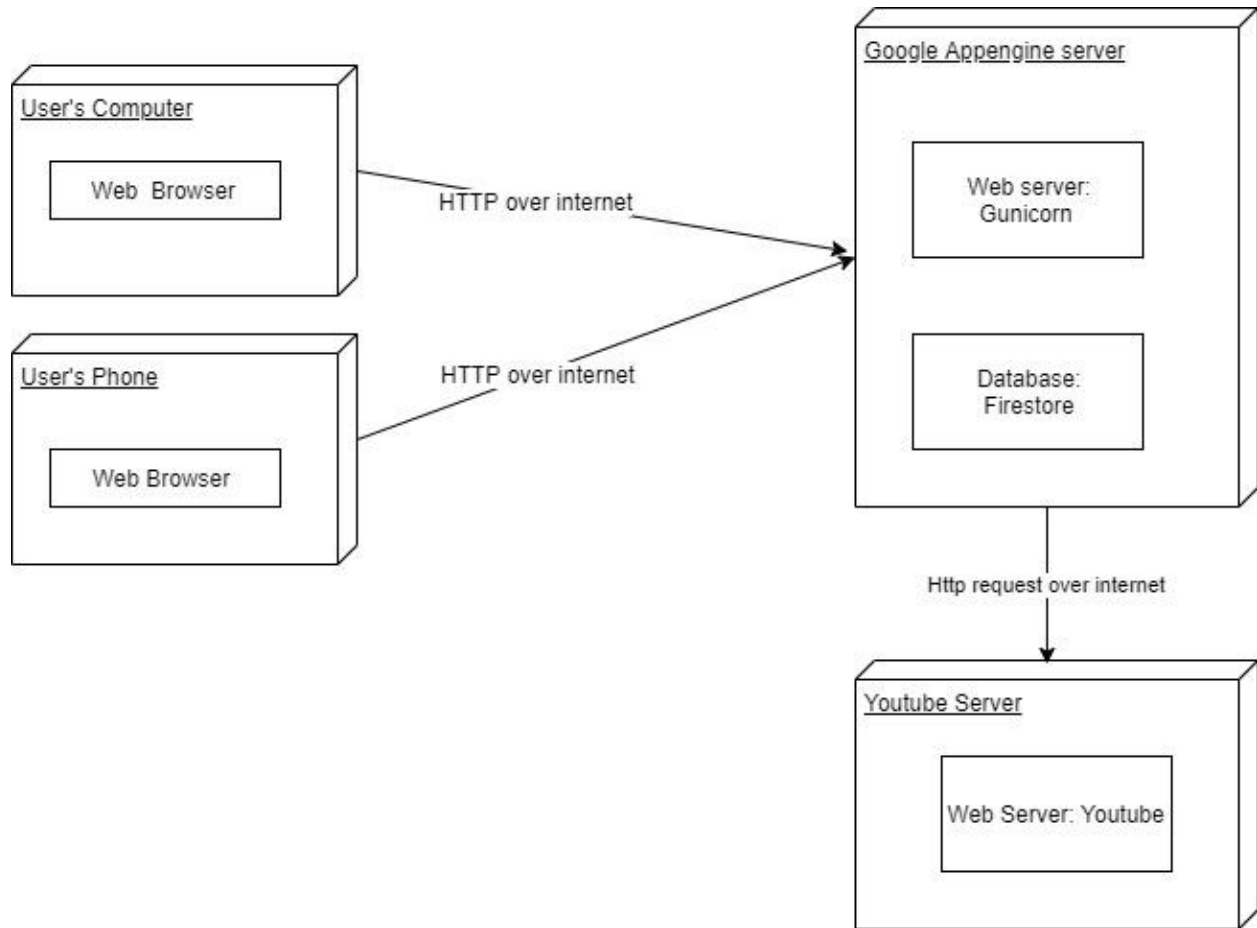
Figure 6:Deployment Diagram

3.2.7   Entity Relationship Diagram

The diagram below illustrates the database design for the learning management system.

UserAnswers

PK	id	int
	UserID	int
	UserAnswer	int
	UserQuestiom	int

ForumPost

PK	id	int
	Topic	varchar
	Author	int
	DatePosted	date

PostComment

PK	id	int
	ForumPostID	int
	UserID	int
	DatePosted	Date
	Comment	varchar
	QuotedComment	varchar

CourseQuestions

PK	id	int
	CourseId	int
	question	varchar

User

PK	id	int
	PhoneNumber	int
	FirstName	Varchar
	LastName	Varchar
	DateCreated	Date
	Password	Varchar

Post

|		
PK	id	int
	Title	Varchar
	content	Varchar
	DatePosted	Date
	Author	int
	AnswerType	varchar
	CourseId	int
	ContentType	Varchar
	Next	int

QuestionAnsweres

PK	id	int
	QuestionId	int
	question	varchar
	CorrectAnswer	Boolean

UserProgress

	UserID	int
PK	id	int
	CourseId	int
	CompletedPostID	int
	DatePosted	Date

Course

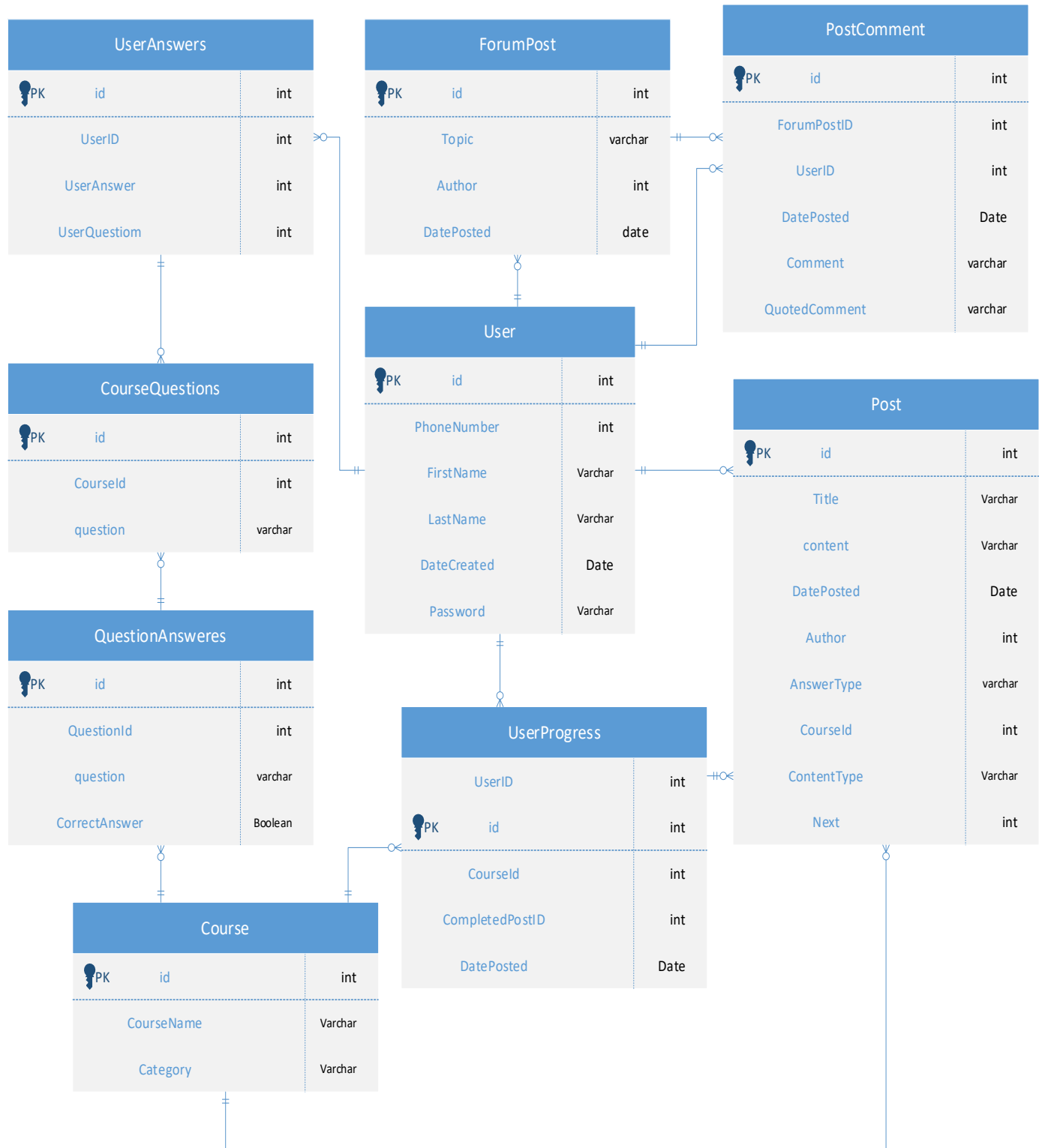|		
PK	id	int
	CourseName	Varchar
	Category	Varchar

Figure 7:ERD

3.3 Post -Study

Following the development of the Learning Management System (LMS), a post-study was done to evaluate its effectiveness in learning on four subject areas identified from the pre-study, namely: baking, hair and beauty, soap making, and entrepreneurship. The content on the four learning areas was sourced from Open Education Resources and Youtube.

3.3.1 Study Design

The overall goal for the study was to examine the effectiveness of the platform in vocational and entrepreneurship training. Stratified purposive sampling was used to identify participants fitting this criterion. According to Crewswell, research saturation in qualitative study is achieved with a sample size of between 20 and 30 interviews (Creswell, 1998). Using this as guideline, a sample size of 30 was identified for the study. All the participants where from Makueni County, with 10 from Kikumbulyu North ward, 10 from Masonga ward and 10 from Emali ward. The choice of Kikumbulyu North ward and Masonga were informed by literature review which showed that they had the highest number of residents lacking formal education, and the lowest number of people who have not gone beyond secondary school in the county respectively. Emali ward was chosen due to access to a women empowerment group that fit the criteria of the target group. The instrument used for the research was phone interviews, which helped get a deeper understanding on the research area.

3.3.2 Data Collection

The questions for the post-study were informed by the conceptual framework and sought to shed light on how the independent variables contributed to effective learning. The participants were given access to the learning platform for a duration of 7-14 days. Thereafter, a phone interview was conducted to assess the effectiveness of the platform in learning. A sample questionnaire that was used to guide the phone interview has been provided in Appendix 2.

Each interview process commenced with an introduction of the researcher and a statement on the overall goal of the study. This was then followed with interview questions from the questionnaire.

The questionnaire covered the following areas.

1. **General Information**: This was used to capture the participants' name and the learning areas studied.
2. **Learner centered**: This was used to capture the participants' experience and challenges encountered. The section aimed to establish whether the learning

platform was learner centered and how that affected the overall goal of effective learning.

3. **Practical learning activities and evaluations:** This section combined the questions on evaluations and practical learning activities, and sought to explore the impact of the two components in effective learning.

4. **Effective learning:** In this section, the research sought to understand whether the learning platform contributed to skills acquisition on any of the learning areas, and participants comments/recommendations.

3.3.3   Data analysis

Data analysis was carried out through open coding to identify themes and patterns. Mean was used to summarize the central tendency of the Likert items. Frequency distribution across the codes and percentages were used to summarize user comments. The results of the analysis have been visualized below.

Summary of learning areas

An analysis of the post-study data found that 30% of the participants undertook the baking courses, 30% entrepreneurship, 26.67% soap making and 23.3% hair and beauty. Further drill-down on this data showed that on average, the participants took 1.3 courses with 93.3% studying only one learning area and 6.7% at least 2 learning areas.

A course, in this case, was a series of videos showcasing particular skill from beginner to a somewhat professional level. Each learning area had multiple courses from diverse content providers.

Summary by learning areas

Learning area	Value
Enteprenuership	9
Soap making	8
Baking	9
Hair and beauty	7
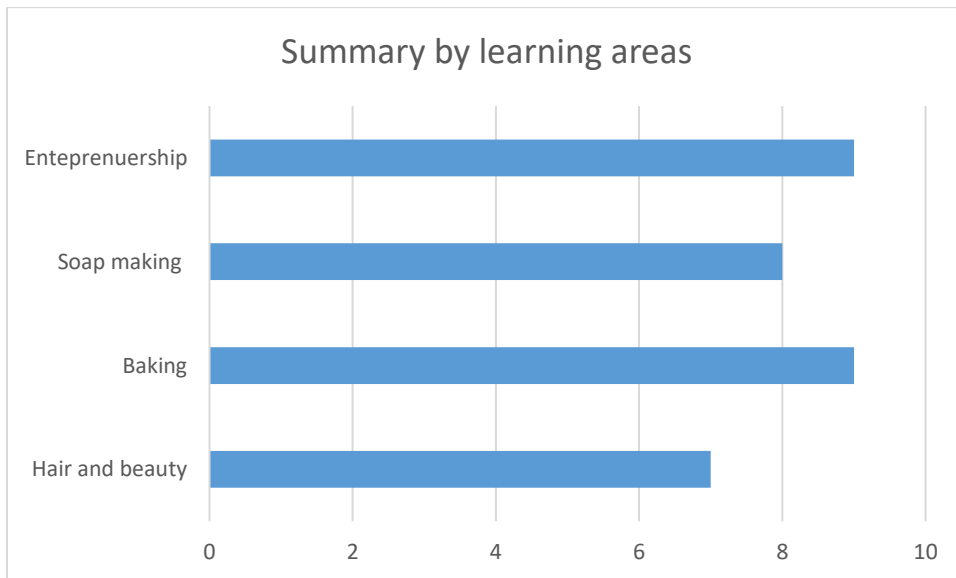
On average the participants undertook at least 1.8 courses

1. **Learner-centered**

In assessing the learner-centered parameter as defined in the conceptual framework, the research considered: the adequacy and relevance of the content in providing sufficient training in a particular learning area, the ease of use and user-friendliness of the LMS, and the respondents' satisfaction with the learning experience. The platform scored an average of 80% in all aspects signaling that self-paced learning using publicly available content could be used for effective learning of vocational, technical and entrepreneurship training.

a) *Adequacy and relevance of the content*

This section sought to understand whether the content provided was relevant and sufficient. From the analysis of the data, 96.7% of the participants found the content relevant. On adequacy, the content scored an average of 4 on a scale of 1 to 5 where 1 is very inadequate and 5 very adequate.
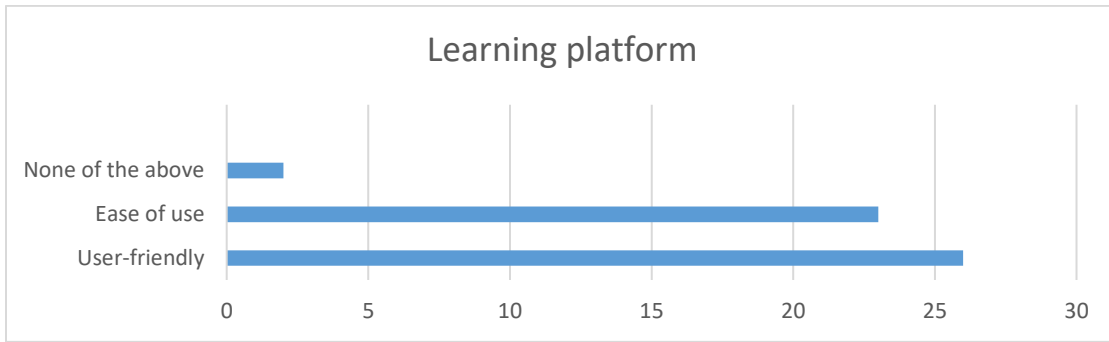
The major issues that were raised concerning the content were insufficient content in text format, the need to have a smartphone to access the content, lack of readily available tools and equipment to practice application of the content in real life, and lack of sufficient content to prepare one on the challenges they are likely to face in the industry.
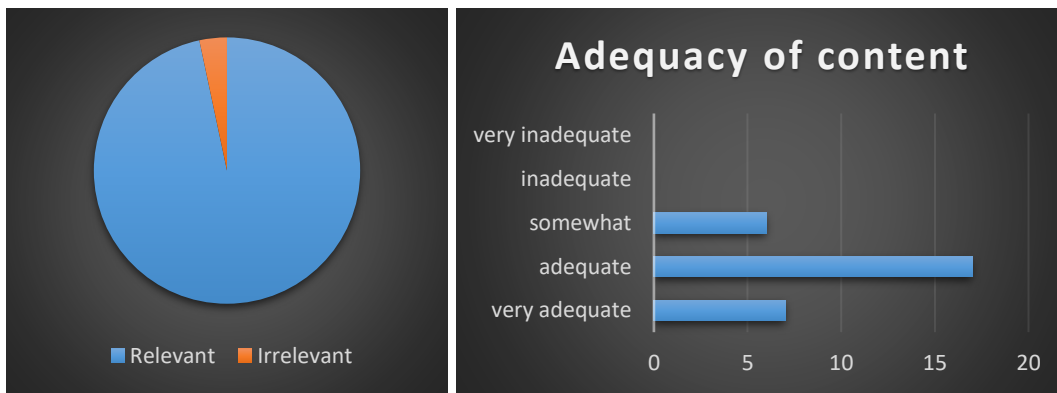
b) *Ease of use and user-friendliness of the learning platform*

Ease of use is defined as having a well-organized user interface for easy locating of different learning materials and system features. User-friendly, on the other hand, is being intuitive and requiring minimal explanation to learn and use.
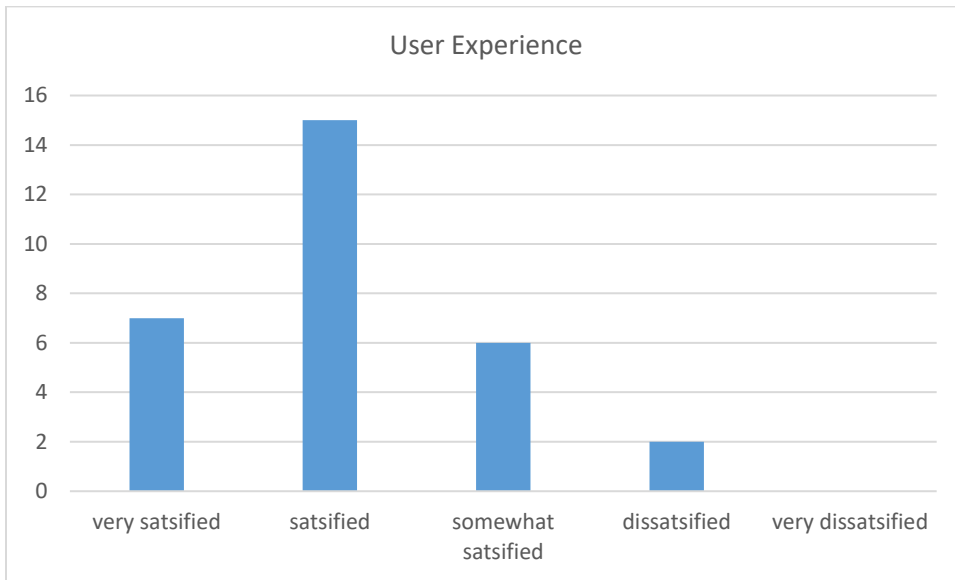
86.7% of the participants found the platform user-friendly while 76.3% of the participants found the platform easy to use. Overall, 6.3% of the participants found the platform as neither user-friendly nor easy to use. Users cited lack of a native mobile application and the to know the website URL as challenging.

Learning platform

Category	Value
None of the above	~2
Ease of use	~23
User-friendly	~26

(Chart: horizontal bar chart titled "Learning platform" with x-axis from 0 to 30)

c) *Learning experience*

In this section, the research sought to assess the participants' satisfaction with the learning experience. Satisfaction scored an average of 4 out of 5.

The cost of the internet was found to be a huge challenge for most users. Additionally, taking a course online was also identified as a stiff learning curve. However, the respondents were excited about the opportunity to study at their own pace and convenience. The participants identified the user progress tracking feature that allowed them to pick up from where they left as very beneficial in the learning process.

User Experience

(Chart: vertical bar chart titled "User Experience" with y-axis from 0 to 16)

| Category	Value
very satsified	7
satsified	15
somewhat satsified	6
dissatsified	2
very dissatsified	0

2. Evaluations

After each course, evaluations were provided to assist learners assess their learning progress. 96% of the respondents found the evaluations were sufficient in assessing their learning progress.

3. Practical Learning Activities

Here, the researcher aimed to understand if the participants found the learning materials applicable in the real world. 96% of the respondents said the content provided could be practiced in the real world. However, access to tools and materials used in some of the content was found to be a huge hindrance. Some respondents also cited the need to have some professional background in the field as requisite for practically applying the content in the real world.
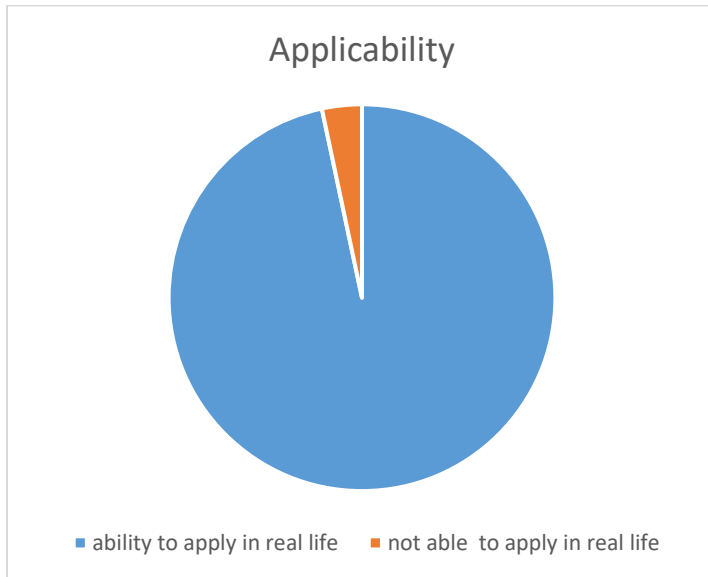
4. Effective Learning

Overall, 93% of the participants found the platform as having facilitated effective learning. On the upside, the respondents found the platform educative, user-friendly and comprehensive. On the other hand, it was noted that more content was needed to make the platform more appealing. There was also notable demand for content in text format owing to the high cost of the internet. Even though the learning curve seemed stiff for some participants, with a little demonstration of the platform, majority were able to undertake their training with minimal help.

4.0 DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

4.1 Discussions and conclusions

This research sought to assess the effectiveness of self-paced learning using publicly available content in making vocational and entrepreneurship training more accessible to women in Kenya. This was achieved through the development and evaluation with potential users of a fully-fledged learning platform integrating content from Open Education Resources (OERs) and Youtube. It was concluded that self-paced learning offering publicly available content can promote effective learning on technical, vocational and entrepreneurship training among women. This was achieved through the development and evaluation of a fully-fledged learning platform offering content from Open Education Resources (OERs) and Youtube with potential users. It was concluded that self-paced learning using publicly available content can promote effective learning on technical, vocational and entrepreneurship training among women.

4.2 Recommendations for further work

The high cost of internet was found to be a huge hindrance to the accessibility of the learning content. We therefore recommend further work to investigate the effectiveness of using light-weight content formats such as text, audio and graphics in vocational and entrepreneurship self-paced online courses.

This research did not evaluate the role of social interactions such as discussion forums. There is need for further work to assess how online social interactions can contribute to effective learning on self-paced courses by providing a platform for participants to get support and learn from their peers.

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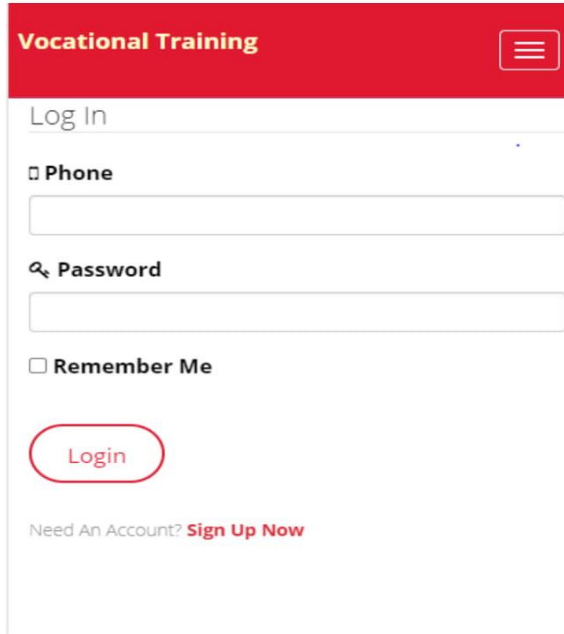# 6.0 APPENDICES

APPENDIX 1: WEB INTERFACE

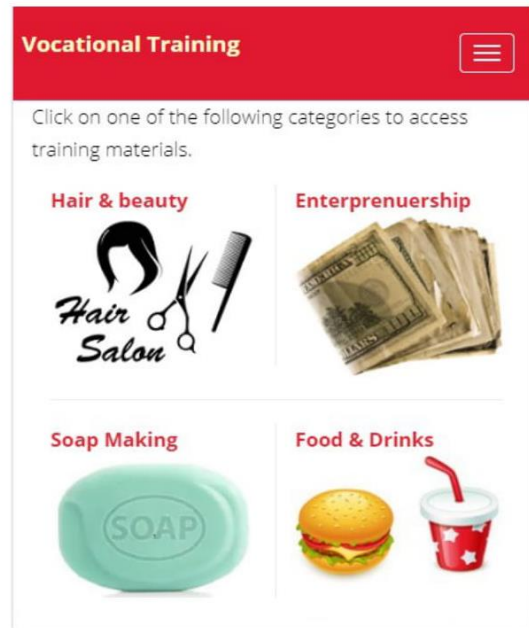*Figure 1: Login Page*

Figure 2: Learning Categories

Figure 3: Example course page

Figure 4: Example of content page

APPENDIX 2: PRE-STUDY INTERVIEW GUIDE

UNIVERSITY OF NAIROBI

SCHOOL OF COMPUTING AND INFORMATICS(SCI)

ONLINE PLATFORM FOR INFORMAL VOCATIONAL LEARNING TO
IMPROVE THE RATE OF KNOWLEDGE AND SKILL ACQUISITION AMONG
WOMEN IN KENYA

This survey is being undertaken at UoN, SCI, department to assist in development of a learning management system using publicly available content.

Section1 : Basic Information

1. What is your highest education level?
    - o Primary education
    - o Secondary education
    - o University/Tertiary

2. Would you be interested in taking online vocational training?
    - o Yes
    - o No

If yes, what would you like to study? _____

_____

Section 2 : Access to digital technology

3. Which of the following do you have easy access to?
    - ☐ Smart phone
    - ☐ Laptop/computer
    - ☐ Cyber

4. Do you have access to the internet?
    - o Yes
    - o No

If yes, how do you currently access the internet?
    - ☐ Using mobile phone data bundles
    - ☐ Using wifi
    - ☐ Other

Specify _____

Section 3: Online learning platform

5. If you were to choose the language for the learning materials, which ones would you choose?
    - ☐ English
    - ☐ Kiswahili
    - ☐ Other

Specify _____

6. If you were to study a course online, please select the preferred format for the content.
    1. Audio
    2. Graphics
    3. Video
    4. Written

7. Have you tried looking for content on your learning area of interest online?
   - o Yes
   - o No

   Please explain your experience:

   _____

8. Please state below the features you would like to see in an online learning platform.
   1.
   2.
   3.
   4.
   5.

   Thank you for your participation!

APPENDIX 3: POST-STUDY INTERVIEW GUIDE

UNIVERSITY OF NAIROBI

SCHOOL OF COMPUTING AND INFORMATICS(SCI)

ONLINE PLATFORM FOR INFORMAL VOCATIONAL LEARNING TO
IMPROVE THE RATE OF KNOWLEDGE AND SKILL ACQUISITION AMONG
WOMEN IN KENYA

*This survey is being undertaken at UoN, SCI, department to assist in assessing the
effectiveness of online learning management system developed using publicly available
content.*

SECTION 1: GENERAL QUESTIONS
1. Your Name: _____

2. Which learning areas did you study?

   Check all that apply.
   ☐ Hair and Beauty
   ☐ Culinary (Baking)
   ☐ Soap Making
   ☐ Entrepreneurship

SECTION 2: LEARNER CENTERED
3. How would you describe your learning experience in a scale of 1 to 5?
   ☐ Very satisfied
   ☐ Satisfied
   ☐ OK
   ☐ Dissatisfied
   ☐ Very dissatisfied

   Please   explain

   _____

   _____

   _____

   _____

   _____

4. Do you feel the course content was relevant to the learning are?
   ○ Yes
   ○ No

5. How would you rate the adequacy of the course content on a scale of 1 to 5?
   Adequacy is the content's ability to provide sufficient training in a particular area
   ☐ Very adequate
   ☐ Adequate
   ☐ Somewhat adequate

☐ Inadequate
☐ Very inadequate

Please explain

_____

_____

_____

_____

_____

6. Which of the below best describes the learning management platform?
   Easy to use: User interface is well-organized, making it easy to locate different learning materials and system features
   Comprehensive: the content provided can teach sufficient skills in the learning area
   User friendly: The application is intuitive and requires minimal explanation to learn and use

   ☐ User friendly
   ☐ Easy to use
   ☐ Comprehensive
   ☐ None of the above

7. What challenges did you encounter while using the learning platform, if any?
   _____

SECTION 3: PRACTICAL LEARNING ACTIVITIES AND EVALUATIONs
8. Do you feel the content was presented in a way that you could practically apply in real world?
   ☐ Strongly agree
   ☐ Agree
   ☐ Not Sure
   ☐ Disagree
   ☐ Strongly disagree

Remarks

9. The course evaluations (quizzes) helped you assess your learning progress.
☐ Strongly agree
☐ Agree
☐ Not Sure
☐ Disagree
☐ Strongly disagree
Remarks
_____

_____
_____
_____
_____
_____

SECTION 4: EFFECTIVE LEARNING
10.   Do you feel like you learned sufficient skills on the learning areas studied using the platform?
☐ Strongly agree
☐ Agree
☐ Not Sure
☐ Disagree
☐ Strongly disagree

11.   What are your comments or recommendations on the learning platform?

_____
_____
_____
_____
_____

APPENDIX 4: SAMPLE SOURCE CODE

```python
from flask import Blueprint, render_template, request, url_for, flash, redirect
from flask_login import login_user, current_user, login_required
from masters.users.forms import (LoginForm)
from masters.main.forms import (PostForm, CourseForm,AnswerForm,QuestionForm)
from masters import bcrypt, db
from masters.models import User, Post, Course,
UserProgress,CourseQuestion,QuestionAnswers,UserAnswers

main = Blueprint('main', __name__)
@main.route("/", methods=['GET', 'POST'])
@main.route("/home", methods=['GET', 'POST'])
def home():
page = request.args.get('page', 1, type=int)
if current_user.is_authenticated:
return render_template('index.html', page=page)

else:
form = LoginForm()
if form.validate_on_submit():
user = User.query.filter_by(username=form.username.data).first()
# use below when models are sorted
if user and bcrypt.check_password_hash(user.password, form.password.data):

login_user(user, remember=form.remember.data)
next_page = request.args.get('next')
if current_user.accountType == "admin":
return redirect(url_for('main.new_course'))
else:
return redirect(next_page) if next_page else redirect(url_for('main.home'))

else:
flash('Login Unsuccessful. Please ensure the phone number and password are correct',
'danger')
return render_template('index.html', page=page, form=form)
@main.route("/posts/all", methods=['GET', 'POST'])
@login_required
def all_posts():
page = request.args.get('page', 1, type=int)
```

```
posts = Post.query.paginate(page=page, per_page=20)
return render_template('admin_course_posts.html', posts=posts, all_posts="all_posts")


@main.route("/user/view_post", methods=['GET', 'POST'])
@login_required
def view_training():
id = request.args.get('id')
course_id = request.args.get('course_id')
if id:
print("******************** Next one ****************")
post = Post.query.filter_by(id=int(id)).first()
else:
print("******************** The very first one ****************")
course = Course.query.get(int(course_id))
post = course.get_next_post()
print(post)
return render_template('user_view_post.html', post=post)


@main.route("/training/<int:post_id>/completed", methods=['POST'])
@login_required
def training_post_completed(post_id):
UserProgress.create_user_progress(current_user.id, post_id)
return '{"success": 1}'


# training posts belonging to particular course
@main.route("/course/<int:course_id>/posts", methods=['GET', 'POST'])
@login_required
def course_posts(course_id):
form = PostForm(course_id)
if form.validate_on_submit():
Post.create_post(form, course_id)
flash('Your post has been created!', 'success')
return redirect(url_for('main.course_posts', course_id=course_id))
else:
print("errors", form.errors)

course = Course.query.get(course_id)
```

```python
form = QuestionForm()
if request.method == 'POST':
question = CourseQuestion(question=form.question.data, course_id=course_id,
answer_type=form.answer_type.data)
db.session.add(question)
db.session.commit()
flash('Your Questions has been saved!', 'success')
questions = CourseQuestion.query.filter_by(course_id=course_id).paginate(page=page,
per_page=20)
course = Course.query.get(course_id)
return render_template('course_questions.html', questions=questions, course=course,
form=form)


@main.route("/question/<int:question_id>/answers", methods=['GET', 'POST'])
@login_required
def question_answers(question_id):
page = request.args.get('page', 1, type=int)
form = AnswerForm()
if form.validate_on_submit():
answer = QuestionAnswers(answer=form.answer.data,
question_id=question_id,correct_answer=form.status.data)
db.session.add(answer)
db.session.commit()
flash('Your Questions has been saved!', 'success')
answers =
QuestionAnswers.query.filter_by(question_id=question_id).paginate(page=page,
per_page=20)
question = CourseQuestion.query.get(question_id)
return render_template('answers.html', answers=answers, question=question,
form=form)


# display questions
@main.route("/user/course/<int:course_id>/evaluation", methods=['GET', 'POST'])
@login_required
def user_course_evalution(course_id):
questions = CourseQuestion.query.filter_by(course_id=course_id).all()
answers={}
user_answers = {}
for question in questions:
answer=QuestionAnswers.query.filter_by(question_id=question.id).all()
```

```python
page = request.args.get('page', 1, type=int)
posts = Post.query.filter_by(course_id=course_id).paginate(page=page, per_page=20)

return render_template('admin_course_posts.html', posts=posts, course=course,
form=form)


@main.route("/courses/category", methods=['GET', 'POST'])
@login_required
def filtered_courses():
category = request.args.get('category')
page = request.args.get('page', 1, type=int)
courses =
Course.query.filter_by(category=category).order_by(Course.course_name.asc()).pagin
ate(page=page,
per_page=20)

return render_template('user_courses.html', courses=courses)


@main.route("/course/new", methods=['GET', 'POST'])
@login_required
def new_course():
page = request.args.get('page', 1, type=int)
form = CourseForm()
if form.validate_on_submit():
course = Course(category=form.category.data, course_name=form.course_name.data)
db.session.add(course)
db.session.commit()
flash('Your Course has been created!', 'success')
courses =
Course.query.order_by(Course.category.asc()).paginate(page=page,per_page=8)
return render_template('admin_courses.html', form=form, courses=courses)


# evaluation routes
@main.route("/course/<int:course_id>/evalution", methods=['GET', 'POST'])
@login_required
def course_questions(course_id):
page = request.args.get('page', 1, type=int)
```