A Requirements Modeling for E-Learning Management System (eLMS)

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Abstract: Nowadays, technology simplifies the learning process and assists in the communication between learners, lecturers, and administrators of universities and other educational organisations. At present, most of the universities in Somalia still use the face-to-face teaching approach and lecturers do not have an electronic repository for the learning materials. This demonstrates that an e-Learning model that is able to fulfil the users' requirements is lacking. This shortcoming is addressed in this study by developing a requirements model for an e-Learning Management System (eLMS) to improve the quality of the learning process. To achieve this objective, a design research methodology was adopted. During the modelling process, the Web Application Extension (WAE) for the Unified Modeling Language (UML) model was used to design the requirements model for the proposed eLMS. The significance of this model is that it facilitates the interaction between students, lecturers, and administrators, thus enhancing the learning process at the university. In addition, the proposed model will be a useful reference for other researchers working in a similar domain, or for developers who are interested in developing similar models. Additionally, the expected output of this research is the eLMS system that will enable students, lecturers, and administrators to communicate with each other.

Keywords: e-Learning Management System (eLMS); Requirement Engineering; Unified Modeling Language(UML); Web Application Extension(WAE); Learning Management System(LMS)

I. INTRODUCTION

The internet has provided the means for fast communication and access to information and services. Both synchronous and asynchronous interactions between learners and teachers can be used in designing distance learning [1]. The internet has become one of the most significant ways to deliver learning materials to students in order to contribute and gain information [2]. Todays' students are digital natives, as they have grown up utilising advanced technologies like laptops, mobiles, and the internet [3].

E-Learning is a relatively new learning mode that is fully dependent on the internet. It is an ICT that is based on applications for learning purposes. It assists in eliminating the distance between learners and universities. Saving time is another e-Learning objective, due to which it has become popular in the current education scenario [4].

According to [5], e-Learning is particularly useful for people who are already working and have the desire to continue learning, since they can use e-Learning to attend classes whenever they want from any location. E-Learning is a synonym for distance education. This term has been extensively used to describe distance education products and processes where learning relies on different technologies that allow communication between the teacher and the learner irrespective of their location [6].

At present, educational institutions in Somalia are still using the traditional ways of managing all learning activities. The current learning system is based on lecture-centred interactions between learners and lecturers, both inside and outside the classroom. Hence, technology still does not feature in the learning process, indicating the need for better alternatives that would improve the learning environment. The cost associated with face-to-face faculty education is higher than that incurred by e-Learning. Moreover, the financial benefits of e-Learning are higher than its costs [7]. Thus, the main goal of this research is to overcome the problems faced by Mogadishu University in order to improve its learning environment. This is achieved by proposing a requirements model of an e-Learning Management System (eLMS) for Mogadishu University that would improve the quality of the learning process, as well as facilitate communication among the university stakeholders.

II. RELATED WORKS

Requirement Model for e-Learning

Requirement identification is considered as an essential activity in any system development process. Software success or failure depends on how the requirements are collected and interpreted. Thus, requirements modelling has an essential role in the Requirement Engineering (RE) process [8]. It provides a structured explanation of the requirements that can be used throughout the requirement process and other system development processes. It is also the most important communication language among participants with dissimilar backgrounds [9]. Modelling notation delivers an abstract level of requirement description, which is achieved by using terminologies and structural rules for problem components. Modelling assists in analysing and classifying detailed requirements [10].

Requirements models are characterised as an information technology used to capture, interconnect, track, analyse, verify, validate, view, and manage hierarchical and interrelated system requirements [11].

Chumpia [12] proposed the development of a requirements model for social network learning sites, particularly forums and chat rooms, for Hatyia Technical College. The author used UML diagrams to represent the requirements model. However, [12] did not study the significant requirements for educational purposes. On the other hand, [13] proposed a requirements model used to store and retrieve IOS documents for the teaching and learning process. While he used UML diagrams to model the requirements, [13] focused on management requirements, rather than capturing other significant requirements and tools that can improve e-Learning performance. More recently, [14] proposed a generic requirements model for eLMS. During the requirement collection process, the story card technique was used. The collected requirements for this study were presented using UML diagrams, which were based on the use case and class diagrams. Moreover, [14] focused on communication channels, such as announcements and forums.

According to [15], The King Saud University's e-Learning Management System offers most functionalities needed by the university to provide courses. It manages them via the internet—including the management of admissions and registration—and provides virtual class tools. However, some important e-Learning management activities and aspects are not available. Furthermore, [15] stated that there is no material sharing activity on the existing system that would allow lecturers to share materials with students. Another weakness of the existing system is that there is no forum for students to discuss various topics of interest with each other.

A number of universities in African countries, especially in Rwanda, still lack IT support systems for teaching and learning activities. Moreover, the e-Learning systems that have been implemented several years ago in other higher education systems are not available to the students and faculty [16]. In addition, the systems that are available are not functional and have failed to meet users' expectations [16].

To overcome these barriers to learning, in this study, an eLMS that can overcome the challenges encountered in face-to-face learning is proposed, as recommended by Simad University [17]. However, the limitations of e-Learning environments are not the focus of this study. For instance, important functions, such as searching, sending messages to interact with lecturers and students, and posting announcement and notification functions are not addressed in this work. Furthermore, as the system administrator functions are not fully working, the prototype was designed using UML diagrams and the prototype evaluation was not based on stakeholders' acceptance.

While the studies reviewed in the preceding sections have revealed some significant requirements, their authors did not highlight the important functional requirements that are useful for educational processes, such as searching, sending message notifications and event calendars, and open source designing tools like Web Application Extension (WAE). According to [18], since the proposed prototype is a web application which is more complex compared to the traditional client/server application, an UML extension called Web Application Extensions (WAE) is used to provide the web-specific constructs for modelling the web information. Thus, in order to design the prototype, the StarUML software was used, which can be employed to draw the essential UML diagrams that help in developing system components. Additionally, it provides support in designing web applications, as it includes modules for the implementation of notation extensions, which allow diagram representation for WAE.

e-Learning

E-Learning enables the educational institutions to share information with the entire student body via electronic communication channels. It is also simple to use, as users can retrieve records and create reports without much effort [19]. E-Learning is a tool that helps students and lecturers interact while learning [20][21]. In general, it is a web-based system that offers access to the learning environment [22] and supports virtual learning [23].

The National Centre for e-Learning and Distance Learning (NCEL) has created its own learning management system in partnership with a meteor group of companies in Malaysia named Jusus LMS [24]. Jusur LMS was created according to universal standards and has the following 17 tools: the course description tool, survey manager tool, announcements tool, learning content management system tool, courseware controls tool, glossary tool, forum tool, file sharing tool, assignments tool, tests and assessment tool, virtual classroom tool, lecturer information tool, user administration tool, tracking forum participation tool, general chat tool, questions bank tool, and grad book tool [25].

The advantage of Jusus LMS, as highlighted by [26], is that it is easy to understand and use. It comprises of numerous instructional and administrative functions that assist students in completing their tasks speedily and allows them to download many types of documents. It also enables students to recover from mistakes easily by providing error messages that recommend how to solve the problem. In addition, it provides easy access to information and materials at any time and from any location, and lets users contact other students in the same course electronically. However, as noted by [24], Jusus LMS has some limitations and weaknesses. The users encounter problems when searching the functions and downloading materials. The Jusus LMS design, therefore, requires improvement so that it can be made more accessible to its users. Some of the problems, as noted by [27], include structures supporting only English and Arabic language content. In addition, individual students cannot be added to or removed from the system by their teachers using the support centre, because the forum does not provide a list of its online users at specific times. Therefore, only two browsing options are available, while large-sized files cannot be downloaded as compressed folders, since the system is not interconnected with others in the same university, especially the Registration or the Faculty Members academic portal.

The national ICT policy for Kenya, which lays the framework for e-Learning, is considered crucial to its development and utilization [28] [29]. Similarly, according to Kenya's Ministry of Education Policy Framework for Education and Training [30], ICT is identified as a major vehicle for teaching and learning. One of the strategies that can be adopted to achieve this aim is the establishment of an Open University of Kenya and expand ODL and e-Learning in the existing universities by leveraging on ICT in order to take advantage of the ICT infrastructure within the country. However, developing countries like Kenya still face many challenges, as implementing e-Learning requires an advanced level of technological infrastructure and heavy investment in resources, especially at the initial stages. According to [31], poverty is one of the most important barriers to technological innovation, due to which, ICT is relatively more expensive in Africa than in developed countries. Ssekakubo[32] pointed out that the majority of e-Learning initiatives implemented in Sub-Saharan Africa (SSA) tend to fail partially or completely due to various barriers to e-Learning.

III. METHODOLOGY

The present study was conducted in three main phases, namely (1) identification of eLMS requirements, (2) development of the eLMS requirements model based on the identified requirements, and (3) verification of the requirements model using horizontal prototype. The eLMS requirements were gathered through interviews. In this study, interviews were conducted with lecturers, administration, and learners of Mogadishu University to gather the appropriate information on the model functionalities and users' needs. The 20 participants (5 lectures, 10 students, and 5 admin) were interviewed using social media like Skype and Viber. The obtained list of requirements provided a better idea of the existing leaning process at the Mogadishu University.

These requirements were utilised when designing the requirements model for eLMS for Mogadishu University. First, the proposed model was developed to explain the feasibility of such eLMS. The designing process aimed to give more details about the design of the model to provide lecturers, admin, and students of Mogadishu University with the beneficial information, which depends on the requirement processes and the components of the software, such as the application platform and database. WAE-UML was used to create and build a case diagram, a storyboard sequence, and a navigational map. In order to verify the proposed requirements model, a horizontal prototype was constructed to ensure the interface and process flow are correctly mapped by the model.

IV. RESULTS AND DISCUSSION

The findings of this research pertain to the model elements, namely use case diagram, use case specification, activity diagram, sequence diagram, and navigational map. In this section, only use case diagram and navigational map are discussed because these diagrams demonstrate the top-level web application design. The diagrams indicate the proposed requirements model of eLMS for Mogadishu University. The use case diagram has three actors—Admin, Lecturer, and Student—and there are 17 use cases, namely login, register users, add class, add course, create department, create event calendar, upload material, send message, download material, view class calendar, download assignment, post announcement, post assignment, add student, view announcement, view student, and submit assignment. The use case diagram is shown in Figure 1.
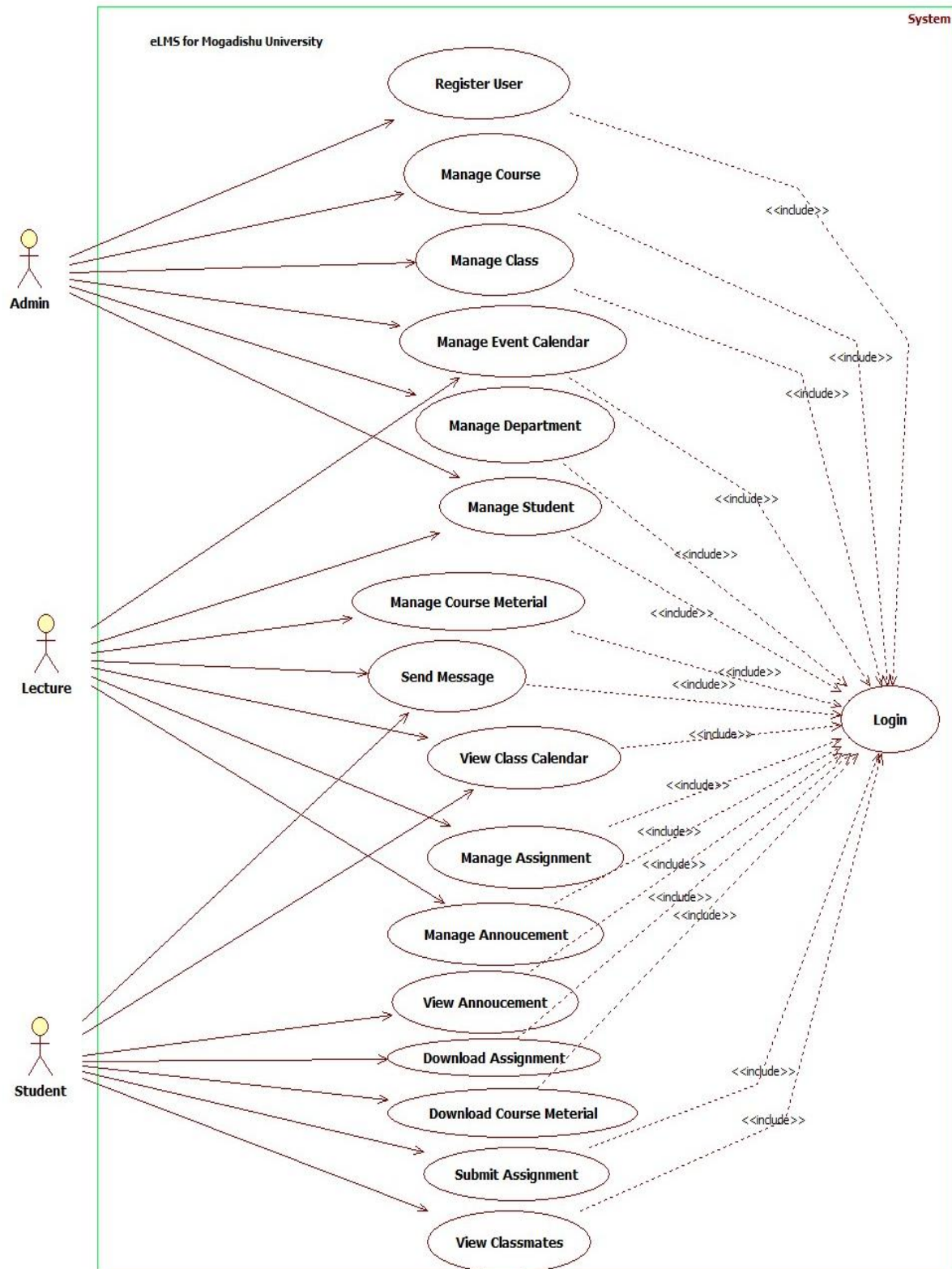
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Fig. 1 Use Case Diagram for eLMS

The navigational map is a view of the e-Learning system, which displays how users will navigate the framework. It can be represented as a hierarchical tree diagram [33].Nor [18] stated that the navigational path map conveys the structure of a system's screens with their possible navigational pathways.

It expresses the full network of all legal and anticipated paths through the system. However, the navigational paths describe the anticipated paths only, not every probable path [18]. The navigational map is depicted in Figure 2.
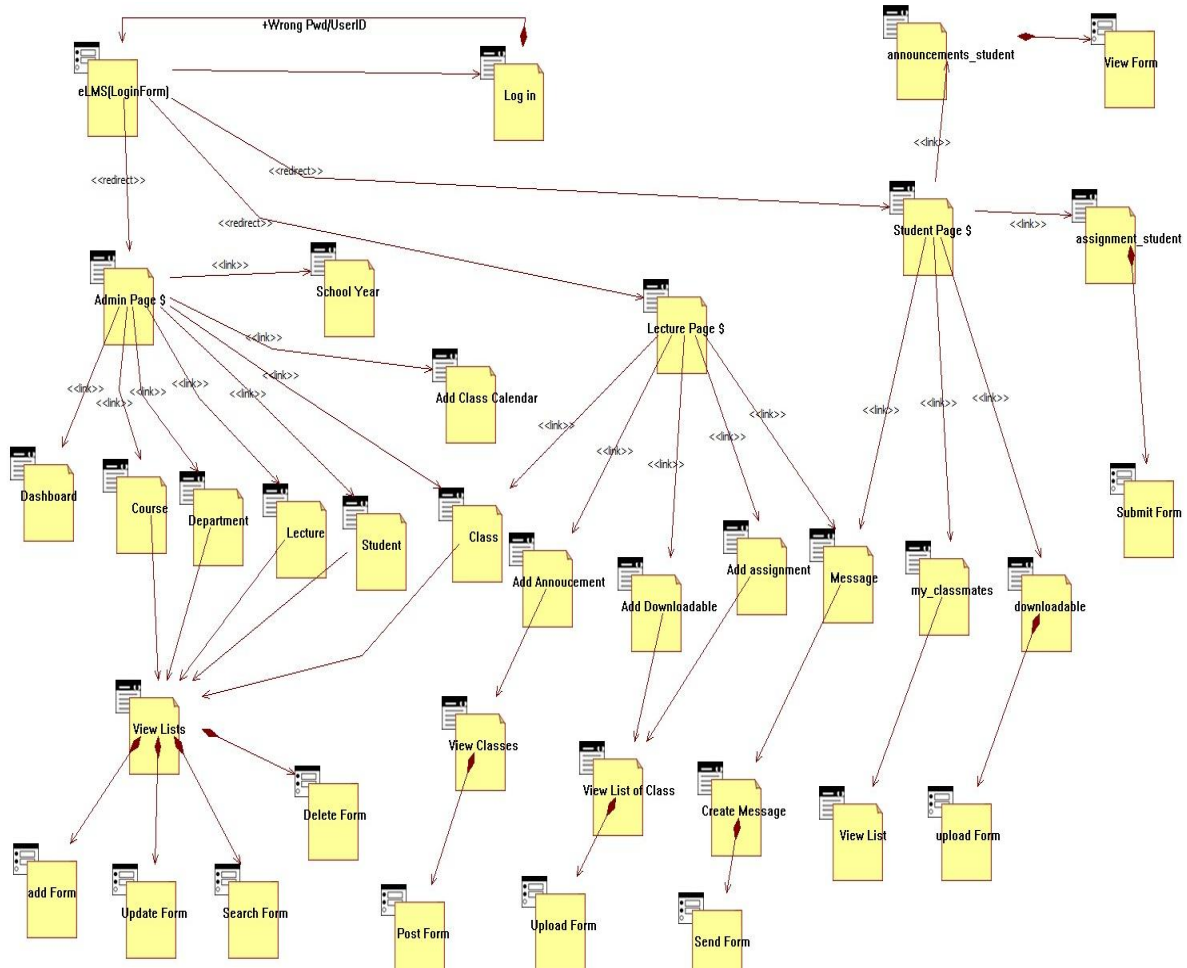
Fig. 2 Navigational Map

Figure 3−7 provide examples of the screenshots of the prototype system to verify the proposed requirement model.
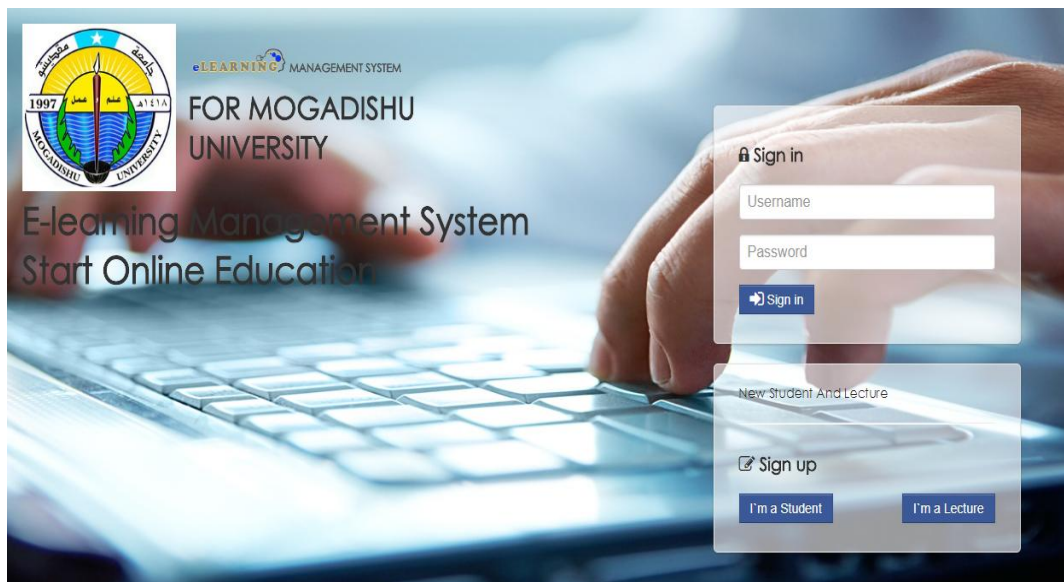

Fig. 3 Main Interface

Figure 3 illustrates the main home page of the eLMS for Mogadishu University. This is where the lecturers and students will have different options for operating the application, and will both login and sign up.

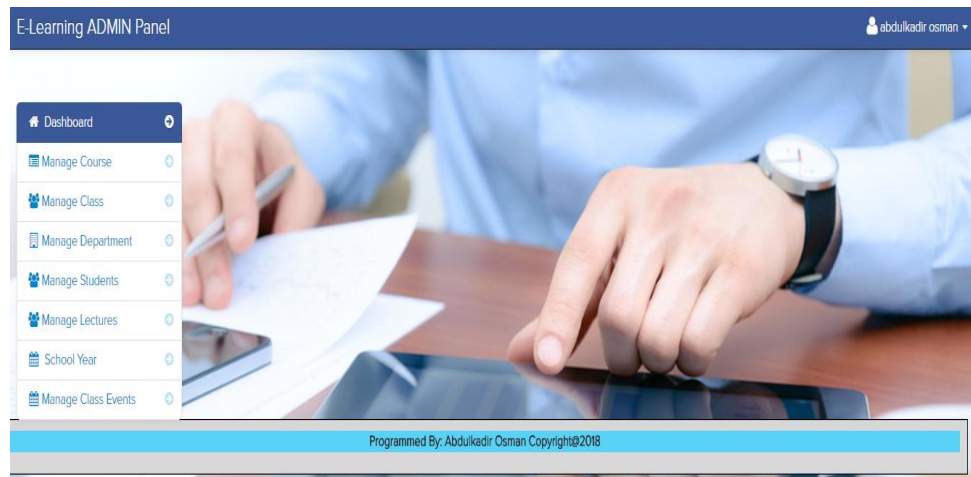# A Requirements Modeling for E-Learning Management System (eLMS)

Fig. 4 Admin Main Page

Figure 4 illustrates the main administrator page after a successful login. The page gives the user an access link to courses, classes, admin users, departments, students, lectures, school year and calendar of events, as well as the link to sign out after the admin finished the tasks.
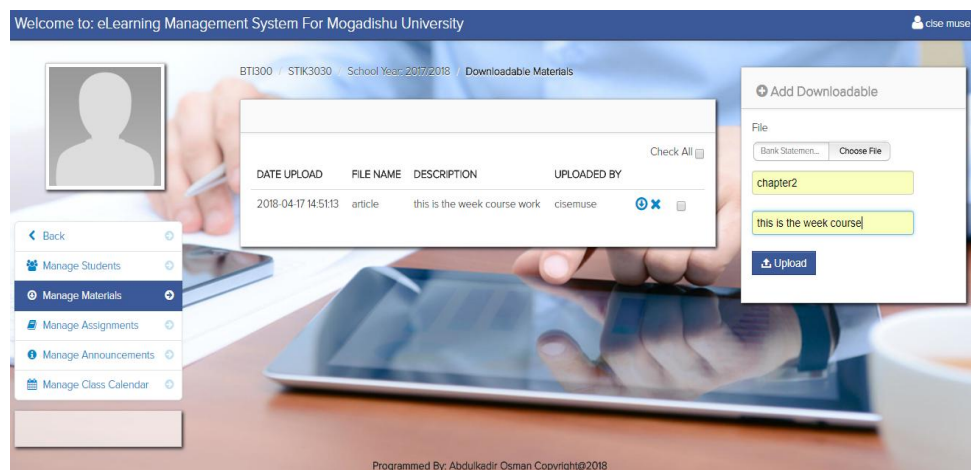
Fig. 5 Manage Course Material

Figure 5 shows to lecture page used to upload materials relevant to a particular class. After the lecturer provides the file information (file name and description), the page gives the lecturer an access link to manage course materials, assignments, announcements, and the class calendar, along with the link for signing out after finishing the tasks.
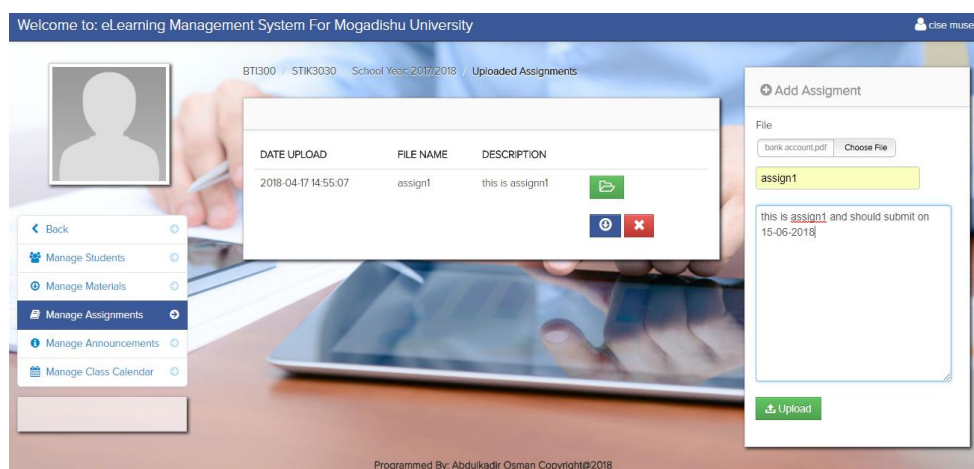
Fig. 6 Manage Assignment

Figure 6 illustrates to lecture page used to post assignments for a particular class. The lecturer first chooses the relevant class and then writes the file name and the description. As soon as this is finished, he/she can click the "Upload" button. In addition, the lecturer can download, remove, and view students who submitted the assignment.
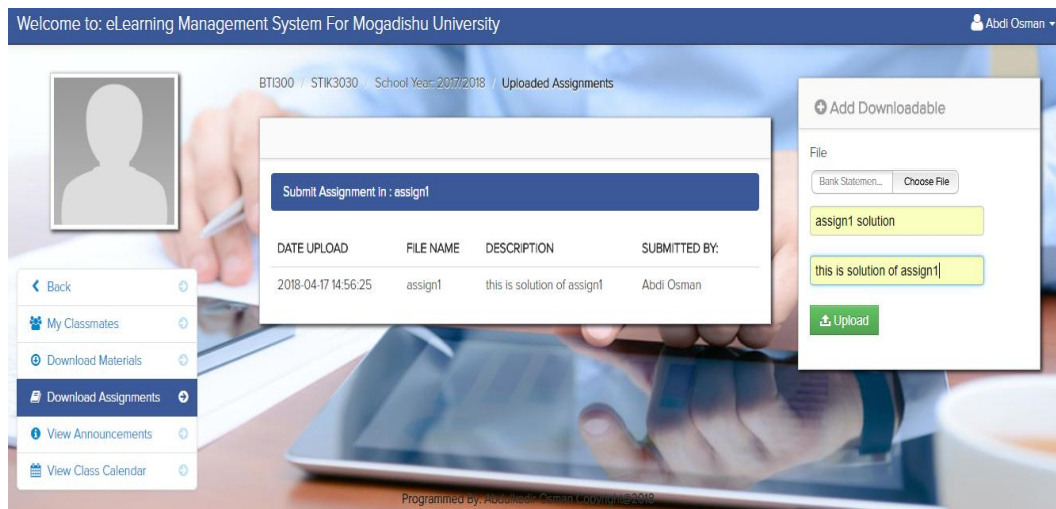

Fig. 7 Submit Assignment

Figure 7 illustrates the student page used to download and submit assignments. The student fills the file name and description, and chooses the assignment file to be upload. The student can also view the list of files he/she has uploaded to the system.

V. CONCLUSION

In this study, a requirements model for eLMS was proposed, primarily focusing on interactions and communication between admin, lecturers, and students. Although the requirements model for eLMS has been successfully implemented, there is still room for improvements. At present, the prototype does not have fully functional requirements for enhancing the learning environment, like a quiz function, and notes repository that allows the students and lecturers to upload any document types, such as video and audio files. In addition, the model can also be improved by having a "manage exam" function. The model also needs to be fully tested by the stakeholders to ensure that their requirements are met. It is hoped that this eLMS requirements model can guide the development of a comprehensive eLMS for a university.

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