User-Centered Prototype to Enhance E-Learning Engagement (EDUSHARE)

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***Abstract*—Higher educational institutions' structure has changed partially because of the introduction of technological initiatives. As a result, many universities in Malaysia have moved from a conventional approach to education to a more flexible approach for both lecturers and students. Many technological initiatives have already been implemented in universities in Malaysia. Many of them can be divided into two big categories, namely Massive Online Open Course (MOOC) and Learning Management System (LMS). Both of these mechanisms generally act as an initiative to assist the sharing and acquiring of academic content to students. In MOOCs, the engagement of learners to the material provided has become a big issue where research has shown that the completion rates of MOOCs can be as low as 7%, as the participation of learners seems to start to fall even after the first week of course attendance. Many** attributes **these low completion rates to lack of interaction or to the fact that completion is not vital, as learners usually search for a specific piece of information they need. MOOCs do not tailor academic content to each student's unique needs, current understandings, and interests. Therefore, the aim of this project is to develop a hybrid application for the open access and management of online academic content. To achieve this aim, the methodology that is used for the development of this research project is the Waterfall model which includes phases of requirements, design, implementation, testing, and maintenance. As a proof of concept, the academic content related to the Information Technology (IT) domain area is selected. The system is developed mainly using Angular framework, Ionic, TypeScript, MySQL, HTML5, CSS3, and JavaScript. A study on the effectiveness of the system showed that the majority of the respondents agree that Edushare is a helpful supplementary for an education content sharing platform (83.33%) and helps tailor academic content according to the students' needs (80%). The results indicate that this system has the potential to be a good supplementary for education content sharing platform for content personalized with the user's needs.**

Keywords— User-Center education, E-Learning Engagement, LMS prototype.

I. INTRODUCTION

Higher educational institutions' structure has changed partially as a result of the introduction of technological initiatives. As a result, many universities in Malaysia have moved from a conventional approach to education to a more flexible approach for both lecturers and students (Shopova, 2011). Many technological initiatives have already been implemented in universities in Malaysia. Many of them can be divided into two big categories, namely Massive Online Open Course (MOOC) and Learning Management System (LMS). Both of these machines generally acts as an initiative to assist the sharing and acquiring of academic content to students (Shopova, 2011) Both Massive Online Open Course (MOOC) and Learning Management System (LMS) became an important mechanism in the higher education fields, which contributes to student-centered academical practice and flexible learning methods (Shopova, 2011). The distinction between MOOC and LearningManagement System (LMS) is that rather than creating better tools for Learning Management System (LMS) (Ahmad, 2011), the purpose of MOOC is to provide an educational opportunity for a mass audience, which turn into a sign of a larger modernization initiative for colleges and universities as it encourages scalability and the higher education's sustainability (Selwyn, 2014). One of the popular Massive Online Open Course (MOOC) applications in Malaysia is Openlearning, and one of the popularLearning Management Systems (LMS) that has been implemented in universities in Malaysia is Moodle. In MOOCs, the engagement of learners to the material provided has become a big issue (Haron, 2019). Research has shown that the completion rates of MOOCs can be as low as 7%, as the participation of learners seems

to start to fall even after the first week of course attendance (Parr, 2012).Many attribute these low completion rates to a lack of interaction (Kopp, 2014) or to the fact that completion is not vital, as learners usually search for a specific piece of information they need (Matthew, 2015). MOOCs do not tailor academic content to each student's unique needs, current understandings, and interests (Haron, 2019).The aim of this research is to develop A Hybrid Application for the Open Access and Management of Online Academic Content. Consequently, the objectives include: To study the requirements of Edushare by carrying out a case study on existing eLearningapplications in Malaysia.and , To carry out the design and development of a hybrid application for the open access andmanagement of online academic content. To assess the acceptance and correctness of Edushare by carrying out system testing and user acceptance testing after the development is completed. The user's scope comprises of two roles that are user and administrator. Edushare is a hybrid applicationthat is executed on web browsers and mobile devices. The application comprises nine modules; User and Registration, Rooms, Discussions, Documents, Bookmarks, Projects, User Administration, Document Administration, and Discussion Administration. The academic content related to the Information Technology (IT) domain area is selected.

II. LITERATURE REVIEW

The advancement in information and communication technologies (ICTs) and the Internet have transformed how higher education services are provided [1]. Furthermore, the ubiquitous use of learning management systems (LMS) requires a considerable technological advancement in higher education, and many educational institutions have been forced to transition to distance and online-only education because of the hard circumstances. Furthermore, the abrupt and unanticipated shift in teaching and learning techniques has prompted the adoption of information and communication technologies to aid learning. For example, the Moodle platform, a modular object-oriented dynamic learning environment (LMS) application, is rapidly being utilized to promote e-learning [2] [3]. In the last ten years, e-learning has risen to the top of the list of learning services aimed at strengthening educational quality [4]. E-learning has numerous advantages for both universities and students. The availability of e-learning at universities can minimize the cost of extra courses and encourage universities to embrace technology. This is critical in today's disruptive age because universities can make a greater contribution to science by sharing varied research and educational outcomes. In terms of students, e-learning can be a self-directed learning alternative [5]. E-learning is a long-term learning approach that opens up a world of possibilities for learning outside traditional boundaries. Increased reach to dozens of thousands of students, improved contact between students and educators, collaborative learning, and easier organization of the teaching process are only a few examples [6]. Despite the widespread use of such learning platforms, there are a number of factors that could have an impact on the outcomes and outcomes of e-learning. The two are (1) learner perceptions of e-learning and (2) the information technology used to enable e-learning (including quality, reliability, convenience of use, and usefulness)[6]. To this end, UX is frequently concerned with the product's value and how users perceive that value in order to achieve organizational objectives. Simultaneously, usability is frequently concerned with an interactive product's user interface and how it is designed so that tasks may be completed. Efficiency, efficacy, and satisfaction can all be used to assess this. As a result, when using UCD, both UX and usability are taken into account[7]. From a theoretical viewpoint, existing e-learning and LMS literature is primarily quantitative and focuses on technology adoption through the use of conventional conceptual approaches such as the Technology Acceptance Model [8]and usability testing (Nakamura et al., 2017b, p. 1015). Even though both allow for uncovering the experience-based component in human-computer interactions, providing deep insights into the factors affecting the adoption and the use of technology and how they have been related [9], technology adoption and UX models are rarely compared[7]. When it comes to effective e-Learning deployment, learner satisfaction has been discovered to be a factor that predicts the actual use of an e-learning system.[10] According to the DeLone and McLean Model of Information Systems Success, one of the criteria that define the system quality is usability[11]. Learnability, efficiency, memorability, error avoidance ability, and the ability to give pleasant system interactions are all aspects of usability[12]. As a result, from the user's perspective, it describes the quality of user interfaces. As a result, the quality of the user interface (UI) is one of the most critical factors to consider while establishing an e-Learning system[13]. Many various strategies have been used by numerous research to design user interfaces with excellent usability. The most common method of designing user interfaces is user-centered design (UCD)[14].UCD aims to design user interfaces that fit with users' expectations and goals by incorporating them into the process. It might be considered as a different take on genius design, in which the designers depend only on their own assumptions and knowledge[13]. Cota et al. [15]conducted a comprehensive literature review to evaluate and interpret all relevant papers on mobile usability and m-learning (mobile learning), with a focus on mobile devices such as smartphones and tablets. These papers were grouped into four categories by the authors: I mobile learning apps, (ii) guidelines and frameworks, (iii) specialized features of mobile learning, and (iv) learning analysis and trends. The authors found that there were no criteria, frameworks, or techniques for evaluating educational characteristics and usability in m-learning applications based on this categorization. As a result, they provided an initial model for

developing and evaluating m-learning applications that takes into account both learning and the student experience.The study undertaken by Navarro et al. [16]was an update of the earlier systematic mapping study. Only two frameworks for evaluating mobile devices for m-learning were discovered. The authors improved the proposed framework by describing its elements and subdivisions in depth. There are two types of usability in the framework: educational usability and user interface usability. The pedagogical usability is separated into five subcategories: I content, (ii) multimedia, (iii) tasks or activities, (iv) social interaction, and (v) personalization, and it is concerned with characteristics that make and assist teaching and learning activities. The user interface usability refers to how easy it is for people to learn, identify, and remember the interface. This area is further broken down into five subcategories: design, navigation, customization, feedback, and motivation. The authors choose to create a web tool to evaluate the m-learning application using a questionnaire, with the goal of scoring, comparing, and identifying possible improvements. This part comprises of the research domain areas; the overview of learning platforms in Malaysia and the review on the existing eLearning platorms in Malaysia. There are several types of learning platformfor students to learn and consume academic content under the IT domain area. These platforms are Massive

Online Open Course (MOOC) and Learning Management System (LMS). A massive open online course (MOOC) is an online course aimed at boundless engagement and open access through the Web. In addition to traditional course materials, such as face-to-face lectures and textbook readings, many MOOCs provide interactive courses with user discussions to support interactions among students and lecturers (Masson, 2014). A learning management system (LMS) is a system for the administration, documentation, reporting, tracking and educational courses delivery, training programs, or learning and development programs. The learning management system concept originated directly from e-Learning. Learning Management Systems make up the biggest portion of the learning system market (Davis, 2009). Comparison of the existing learning platform applications by platform, bookmarking, document sharing, project management, searching, filtering and sorting of content, smallest searchable content and interconnectivity of content are as shown in Table 1.

TABLE 1 COMPARISON OF EXISTING LEARNING PLATFORM APPLICATIONS

Feature	**Moodl eLMS**	**MOOC**	**Edushare**
Platform	Web and mobile	Web and mobile	Web and mobile
Bookmarking	No	No	Yes
Document sharing	Yes	No	Yes
Tasklist	No	No	Yes
Searching, filtering, and sorting of content	Searchin gonly	Searching only	Searching, filtering and sorting
Smallest searchable content	Individua lcourse	Individual course	Individual academic content
Interconne ctivity of content	No	No	Based on specific categories, uploaders and rooms

III. RESEARCH METHODOLOGY

The first stage of the research project is conducting background and domain studies. The purpose of these is to ensure that the researcher has a good understanding of the domain area (Brugger, 2010). The background and domain studies are carried out by conducting an interview with a Universiti KualaLumpur lecturer on the problems faces regarding academic content management. The purpose of the interview session is to allow the researcher to understand the academic content management process implemented in universities. Besides, information on the use of technology for developing solutions to the problem is obtained from academic journal articles. As support, case studies on existing applications on the Internet with a similar theme to the proposed solution are carried out and reviewed. Reading and conducting case studies give ideas to the researcher on the suitable technology to be used in developing the application. The SDLC model that

is chosen to be applied throughout the research project Is the Waterfall model. The waterfall model is a linearly sequential software development process that was first introduced by Dr. Winston W. Royce (Powell-Morse, 2016).

IV. REQUIREMENTS

In the requirements phase, the activities are divided into two processes which are requirements gathering and requirements analysis (Eid, 2015). Both of these processes are carried out to build a comprehensive understanding of problems faced by university lecturers on the current academic content management system. This phase is also important to determine the content of the system, its scope, and requirementsby conducting a case study on existing academic content management systems in the market.

V. DESIGN

In the design phase, all requirements identified in the requirements phase are transformed into detailed specification designs to give a clear expected user interface and processing logic (Phase 5: Design Phase, 2018). The design activities involved during this phase are divided into two main parts: designing the academic content structures and designing the software structures. For architectural design, Angular is consists of three main things which are Modules, Components, and Routing. Modules are compilation contexts for a set of components that can associate its components with related code to form functional units. Components comprise Template, Services,and Dependency Injection, and Data Binding. For architectural design, Angular is consists of three main things which are Modules, Components, and Routing. Modules are compilation contexts for a setof components that can associate its components with related code to form functional units. Components comprise template, Services, and Dependency Injection, and Data Binding. A RESTfulAPI is an architectural style for an application program interface (API) that uses HTTP requests to access and use data. That data can be used to GET, PUT, POST and DELETE data types, which refers to the reading, updating, creating, and deleting of operations concerning resources. For Edushare, data stored in the database are retrieved and manipulated via RESTful API, in which the data is returned in the form of JSON. Edushare's Templates and Components communicate with each other via event bindingand property binding to display the data to the end-user. Once the architectural design activities have been completed, it proceeds with database design activities. Database design includes determining the data to be stored in the database and the relationship between these groups of data (Watt, 2018). To avoid data redundancy and ensure referential integrity, the database design is normalized until the third normal form (3NF). Then, the database design of the system is depicted in Entity-Relationship Diagram (ERD) to graphically represent the logical structureof "the databases. Finally, it proceeds with the component design where components of the system are divided into several modules and designed on how to operate. The modulation of the components is described in a site map, while the operations of the components are depicted using Unified Modelling Language (UML) diagrams which are use case diagrams, sequence diagrams, and class diagrams.

VI. IMPLEMENTATION

In general, Microsoft Visual Studio Code is primarily used to develop the overall application. From the database designs modeled in the previous phase, they are realized using phpMyAdmin. The logic and presentation of the application are then developed using Ionic Angular Framework which includes Typescript programming language. The coding activities are carried out modularly, where the phase begins with basic modules such as user registration, authentication, and authorization. While more critical modules such as academic content management are done towards the end of the implementation phase.

VII. TESTING

There are two types of testing being carried out which are system testing and verification of the application, and user acceptance testing (UAT) for the validation part of the application.The purpose of verification of the application is to verify if the system performs and behaves as expected and based on the documentation in the requirements phase (Ghahrai, 2017). System testing isconducted by examining each documented requirement and then conducting a functional test for the requirement. This is also to ensure the correctness of the application. Once the test cases have been verified, the application is ready to proceed to be tested by real users.The validation of the application is to validate if the system meets the

user's needs and fulfills its intended use. UAT is conducted to gather user feedback on the application and ensure that the product is ready to be deployed and made available in the market (Setter, 2018). Therefore, the application is demonstrated to a Universiti Kuala Lumpur lecturer and a group of Universiti Kuala Lumpur students,then sets of the questionnaire are distributed. The questions are made to gather information on the usability and effectiveness of the application along with their feedback. After considering the feedback from the respondents, it is ready to proceed with the deployment and maintenance phase.

VIII. MAINTENANCE

When the application has been fully developed and tested, the application is then deployed to a web server, iOS, and Android device. Then, it proceeds with the maintenance phase once the application is madeavailable to the users. Changes or enhancements to the current application such as adding a new feature of content management, are determined in the maintenance phase. Besides, any defects or errors that are found after the application is deployed are also handled in this phase.

IX. OUTCOME

Edushare is a fully functional, web and mobile-based application primarily based on Angular framework. The framework allows the development of the system across all platforms as in web and mobile with maximum speed achieved via Web Workers and server-side rendering. It is written in TypeScriptand the main building blocks are modules, components, templates, metadata, data binding, directives services, and dependency injection. For Edushare, the Angular framework is integrated with Ionic, anopen-source SDK for hybrid mobile application development where it provides easy access to native device features by only importing JavaScript libraries to the project. Edushare is a system consisting ofacademic content that is generated by registered users. Therefore, the changes of the system in the future does not affect the contents as it is always stored in the database. Edushare, a hybrid application for the open access and management of online academic content incorporates the feature of the management of rooms, discussions, documents, tasks, and bookmarks.Edushare also incorporates the feature of system administration consisting of user account administration and discussion administration. User Evaluation Result

Edushare's evaluation was conducted with 30 UniKL MIIT students enrolling in IT Bachelor programs. The evaluation is conducted and recorded via a research instrument, a questionnaire. The statements provided on the helpfulness of Edushare as a supplementary platform for academic content sharing are measured using the Likert scale level of agreement as shown below. The data collected for each statementare calculated in its Likert scale frequency percentage. The result is later tabulated and presented in a table as shown in Table 2.

TABLE II RESULT OF EDUSHARE'S USER EVALUATION

Statement	**1**	**2**	**3**	**4**	**5**
Edushare is a helpful supplementary for an education content sharing platform	0%	3.33%	13.33%	23.33%	60%
Edushare helps me navigate between academic content better	3.33%	6.67%	10%	13.33%	66.67%
Edushare helps me in tailoring academic contents according to my needs	0%	6.67%	13.33%	30%	50%
Edushare helps me get open access to various topics of IT subjects	0%	0%	10%	10%	80%
Edushare is user friendly	0%	0%	6.67%	23.33%	70%
Edushare is highly engaging	0%	6.67%	3.33%	33.33%	56.67%

Based on the result, it is shown that the majority of the students agree that Edushare is a helpful supplementary for an education content sharing platform (83.33%), helps navigate between academic content better (80%), helps tailor academic content according to the students' needs (80%), helps provide open access to various topics of IT subjects (90%), user friendly (93.33%) and highly engaging(90%). The results indicate that this system has the potential to be a good supplementary for education contentsharing platform for content personalized with the user's needs.

X. CONCLUSION

The research project has successfully achieved the aim as stated. As a result, the project's outcome is aweb

and mobile-based learning application for the open access and management of online academic content, namely Edushare. Based on the conducted user evaluation, Edushare is proven as a helpful supplementary for an education content sharing platform, helps the student navigate between academic content better, and helps students in tailoring academic content according to their needs.

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