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Mobile Device: Centralized Local Area Network- Based Classroom Management System

Peranti Mudah Alih: Sistem Pengurusan Berpusat Bilik Darjah Berasas Rangkaian Kawasan Setempat

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ABSTRACT

With the advancement of technology nowadays, the emergence of mobile phones in a classroom set – up has been at a premium in delivering quality education. This study aimed to determine the current electronic learning platforms used by the faculty and develop a mobile and local Wi-Fi-based classroom management system for Samar State University that illustrates how a mobile phone can serve as an instrument in the advancement of classroom management. The incremental Model was used as a method in the development of the system. The result revealed that the developed system contains features that are not present in the existing system used by the faculty which bridged the gap between the online classroom and traditional classroom setting.

Keywords: online classroom, classroom management, attendance monitoring, learning management system

ABSTRAK

Dengan kemajuan teknologi pada masa kini, kemunculan telefon bimbit dalam penyediaan bilik darjah telah menjadi premium dalam menyampaikan pendidikan berkualiti. Kajian ini bertujuan menentukan platform pembelajaran elektronik semasa yang digunakan oleh fakulti dan membangunkan sistem pengurusan bilik darjah berasaskan Wi-Fi mudah alih dan tempatan untuk Samar State University yang menggambarkan bagaimana telefon bimbit boleh berfungsi sebagai instrumen dalam kemajuan pengurusan bilik darjah. Model incremental digunakan sebagai kaedah dalam pembangunan sistem. Hasilnya menunjukkan bahawa sistem yang dibangunkan mengandungi ciri-ciri yang tidak terdapat dalam sistem sedia ada yang digunakan oleh fakulti yang merapatkan jurang antara bilik darjah dalam talian dan persekitaran bilik darjah tradisional.

Kata kunci: Bilik darjah dalam talian, pengurusan bilik darjah, pengawasan kehadiran, sistem pengurusan pembelajaran

INTRODUCTION

Mobile devices are a technology widely used today and the population of the people using this technology is continuously growing because of its hi-tech features and capability. It is used not only for texting and for calling, but also to connect to the internet, play games, read books, make transactions, watch, and take videos and photos. Thus, cell phones have presented another age of instructive devices that bear the cost of imaginative use and moment access to abundance of assets. Indeed, the 21st century instructive set-up, PCs, cell phones and related innovations are increasing earth shattering in the lives of the youthful and turning into a piece of training in school. At the point when innovation is utilized successfully in the study hall, it empowers understudies to be inventive while growing new abilities and furnishes students with cutting edge data (Saxena 2013).

Further, the quality of instruction improves when technology is used in many ways. A key example is the use of Smart Classroom coined by Yau et al. (2013) where it structures a little gathering to take care of explicit issues or create a bunch of ventures through the utilization of circumstance mindful PDA which trigger correspondence action among the students and the teacher for gathering dialog. In fact, mobile technologies have already become a necessity in the lives of most teachers and students today (Laura et al. 2004). Thus, it now becomes the challenge for educators and designers to understand and explore how best these resources will support learning.

Mobile technology used in both private life and schools indicates a sea change in the way student's process information. It has been contended that, before the advanced insurgency, it was essential to have data in your mind; however, at this point it is imperative to know where the data is and how to rapidly get to it. In this context, it is therefore imperative to exploit the use of these technologies in instruction with the primary objective which is to improve the quality of education.

In a different context, mobile devices are being governed by Wireless Communication Systems. Its operations primarily depend on Cellular Communication and wireless technology such as WiFi, and Bluetooth maximizing the potential of Mobile devices in instruction purposes. Liu et al. (2003) developed a Wireless technology enhanced classroom (WiTEC) which integrates wireless LAN, wireless mobile learning devices, an electronic whiteboard, an interactive classroom server, and a resource for classroom management. On this note, the use of WiFi and LAN are also found to be feasible to be utilized as a Communication and network platform in the realization of the so-called off-line e-classroom which is one of the objectives of the study.

In the present, there are proprietary e-classroom softwares that are available. Google Classroom, Sakai, and Chamilo are some of the Learning Management System (LMS) that is available for free, while Edmodo, Moodle, and Schoology are some of the LMS that needs payment to unlock its full functionality. This LMS (free/for sale) existing today has its own uniqueness and generic functionality. The system developed in this research carries some of the functionalities that the above mentioned LMS have. However, this system was aligned to the standard and needs of the institution who will be using it. The system's flexibility is also a factor since the current system is developed locally and the necessary changes of its features will be easily incorporated. On the other hand, functionalities offered by other related systems are limited. This means that if any feature has been proposed, the same cannot be integrated since these LMS are proprietary and cannot be reprogrammed or changed.

According to Olandres (2017), the Philippines continue to lag behind all other Asia Pacific countries in terms of average internet speeds. In terms of broadband penetration, the Philippines has the lowest among Asia Pacific countries. The slow internet connection becomes a nightmare to almost all Filipinos especially to those who work online and study online. One of the most affected areas when slow internet connection strikes is the online classroom.

At present, traditional classrooms are still present up to this day. It is a learning space in which the teacher provides face-to-face instruction to students and communication between and among teacher and students is face to face. This setting does not need internet but requires a lot of manual tasks like, paper and pen quiz or examination and manual recording and computation of grades.

From the scenario mentioned above, the researchers aimed in determining the existing electronic learning system used by the faculty and developed a system that bridged the gap between the online classroom and traditional classroom setting. The researchers established an electronic classroom that could be used offline intended for non-distant learning students. Mobility of learning will be possible using the system since the students use their own mobile phones. The system has a standalone server and is accessible by just simply connecting the mobile phone to a local Wi-Fi. Once the students have already accessed the system, they would also have an access on the subject's downloadable instructional materials and with this, teacher's job on monitoring the student's performance would be easily done since the system has a function of recording computerized activity, quiz and examination.

RELATED WORK

E-Learning can be viewed as an innovative approach for delivering well-designed, learner centered, interactive and facilitated environments to anyone, any place, anytime by utilizing the attributes and resources of various digital technologies along with other forms of learning materials that are suited for open, flexible, and distributed learning environments. The role of learning management system (LMS) in pedagogical practices has expanded in recent years. Blended Learning which uses education technology tools is proving to be influential in helping both students and teachers to flip their classroom management from didactic approach towards blended learning through LMS that is more student-centered and constructivist (Brioso 2017).

In traditional, informal education, Mobile Learning is effectively to be developed. Even in the formal education field, there is an increasing interest in Mobile learning in the past years and it will only be successful if the teaching body would accept the essence of mobile technologies. (Sanchez-Prieto, Olmos-Miguelanez, & Penalvo 2016).

In the Mobile internet era, mobile phones have been widely used as a tool in communication. The ownership and the usage rate of mobile phones are ascending especially to the students in primary and secondary level. But the problems still exist in universities. At the present time, there are several types of counterpoint to these problems such as disallowing students from bringing their mobile phones and confiscation of mobile phones. Nevertheless, such problems only occur due to the poor implementation management of the campus (China Patent No. CN107529178 2017).

The study entitled "User Interface for Classroom Management" of (United States of America Patent No. 20180213079 2018) expresses that teachers can manage students' devices during class hours to amplify the learning capability of the students. The set-up of this system is a

peer-to-peer management where a teacher can monitor the attendance based on the broadcast. The teacher's device can control the functionalities of the system to minimize and remove the capabilities of a user and can be resumed when a user is able to use the functionalities of the system.

This study has a similarity with the current study in the sense of managing the student's mobile devices in teacher and learning process. The current system has a capability to limit the topics being displayed on the student's mobile device depending on the teacher's discretion. However, the presents study is always accessible and ready to use even outside the class hours of the specific subject.

The study entitled "Centralized School Admission Application and Data Exchange System and Process" of (United States of America Patent No. 20170287091 2017) states that systems provide application management, data exchange, and controls for accredited users. A server or a cloud-based system offers a variety of functionalities to the users through the use of a network. The said system can register a teacher as the primary user which would be the controller of the system and the system can also enroll students to be the secondary users of this system. The system also enables access to different forms and data from the users. In this case, the system can save and retrieve information from the users.

The present study is similar to the above-mentioned study entitled "Centralized School Admission Application and Data Exchange System and Process". However, the current study is focused on how the students will utilize the mobile devices in teaching and learning. Also, the current study is a local area network-based system. Meaning, this does not need internet connectivity to work, only a network that can connect client's devices to the server.

Mobile devices are widely used by students as of now. This has transformed the kind of extraordinary education and started a new method of e-learning also known as m-learning. The purpose of this study is to calculate the penetration of mobile devices for educational purposes in higher education and to classify the key treatment patterns. To that end, the paper used two opposite procedures: web control mining and a questionnaire survey. Web control mining was accomplished to gain data from University's learning management system (LMS) to discover modern technology's usage development for the past four educational years and to recognize the key patterns of behavior. A questionnaire survey of 460 students was handled to reveal about the student-declared level of m-leaning penetration. The outcome is decisive: 25% of LMS entree was made from mobile devices and 75% of students used mobile devices for educational purposes. The result of this study has important implications not only for the proponents and lecturers, but also for the organization aiming to implement this kind of teaching process (Lopez & Silva 2014).

The researchers target those students with mobile devices to be respondents of the present study. The implementation of the current study is possible since most of the students today are already using smartphones, and the population of the students who uses this device continuously grows.

Another study by Young (2008) entitled "Using Technology in the Public School Classroom" desires to prove the importance of adding technology tools into a teacher's instruction method. According to Young (2008), when teachers add technology tools to proven instructional strategies in their curriculum, students could be more excited about learning, their attitude could be positive about technology, they could be more engaged in lessons, and their test scores

could improve. However, the fact classrooms contain computers with an abundance of software does not mean teacher technology use and student technology use will have an immediate and sustained positive effect on student grades and attendance. For these benefits to occur, instructors must undergo professional development in combining use of the technology tools with effective instructional strategies. Generally, the above-mentioned study pointed out that using mobile technology has a big impact in teaching and learning process.

Similar to Young's (2008) study, the present study aims to make students more excited about learning. It intends to capture students' interest by using the thing they said they cannot live without which is the mobile device. Further, for the present study to be effective the system must undergo a detailed and scrupulous development combining technology and effective instructional strategies.

In more particular aspect, Samar State University Student Information and Accounting System is one of the most relevant studies. SSU existing system stores all the information of the students. The system is controlled by the Information Technology Services under the Research and Extension office. The system serves as a repository of the students' information, such as but not limited to the students' financial statements, subjects, grades, and other relevant records. The system also allows the faculty members of all departments in SSU to enter the grade of the students into the system's database. Only the faculty members have access to the system. The system can be accessed through the university-shared local area network (Paculaba 2022). This existing process is limited to saving the students information such as subjects and grades. The system serves as a data warehouse of relevant student data.

On the other hand, the proposed system Wi-Fi Based Classroom Management System is a separate entity from that of the existing system of the university. The proposed system caters not only saving the grades of the students but also features such uploading instructional materials such as power point presentations and pdf files, uploading video tutorials, giving quizzes to the students, computing of grades, checking of attendance through QR technology. The system focus is on the classroom management of faculty members of all their subjects. Using the system, the faculty can manage the materials and methods of teaching the topics to the students.

METHODOLOGY

Research Design

This study used the Incremental Model as the software process model for the development of the system. Incremental Model, an agile approach in the development of the system, is best described by its continuous progress of the system by developing several versions until a suitable system has been developed (Sommerville 2011). Under this model, the developer of the system develops a version, exposes such version to the users for feedback and suggestions, and incorporates these recommendations in the development of the next version. Each increment or version of the system includes some of the functionality that is needed by the customer. Under this approach, system specification, system development, and system validation are concurrent activities so that these software engineering activities can be conducted simultaneously or in an interleaved order rather than a sequenced one.

The researchers used this model since the requirements of the proposed system can be dynamic and the end-user requirements would necessarily depend on the prospective users of the system. Consequently, the researchers released an initial version and intermediate versions to the users

for evaluation so that the users may propose changes to the systems or propose additional functionalities to be added on the next version. This process goes on a loop until an adequate system has been developed to address both the user requirements and system requirements. By using this model, system changes or recommendations given by the users during system validation cannot be incorporated easily as it is being developed.

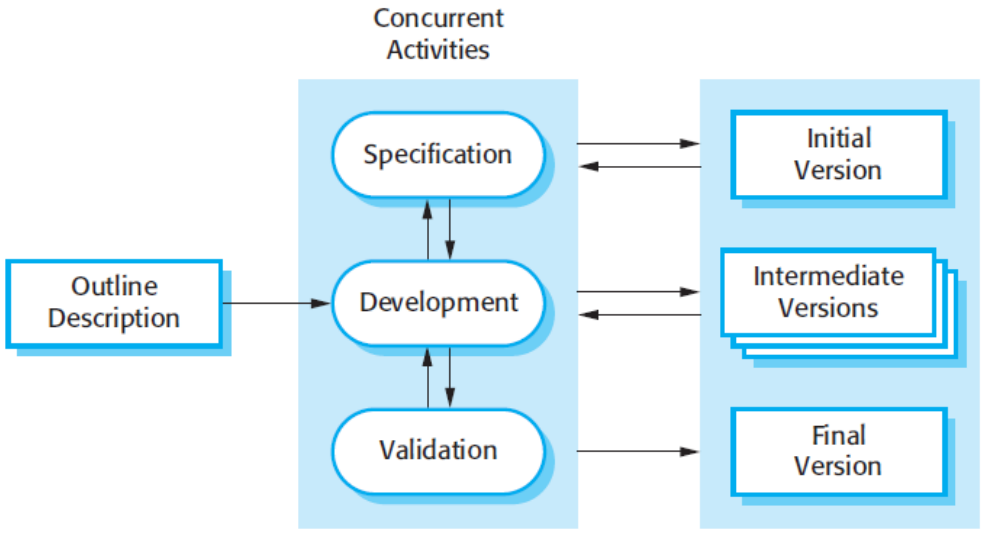

FIGURE 1. The incremental model

Outline Description

In conformity to the incremental design method used in this study, the outline description, which is the equivalent of requirement analysis, has been undertaken. In this phase, functional and non-functional requirements are identified and analyzed. A vast majority of the requirements for the development of an offline e-classroom accessible to any platform utilizing students' mobile device as a learning tool was captured by analyzing the existing technologies related to this study. Later, as defined in the process model, an initial version is to be developed, so as initial design would be communicated to the stakeholders and additional requirements would be suggested and incorporated. In particular, the following system requirements comprising both hardware and software are as follows:

Table 1 list the minimum required hardware and software for the system. The components and its corresponding specification refer to the minimum requirements of the systems in conformity to the projected system functions and operations. However, it is an advantage if higher-level specifications were utilized in order to attain maximum level of operations.

TABLE 1. Minimum Required Hardware and Software

Component/ System Requirement	Specification/ Description
System Unit	Server type computer
Wi-Fi Access Point	Ubiquiti Nanostation M5 GHz
Mobile Device	Mobile phone, Tablet, Laptop
Sublime Text Editor	Software
XAMMP	Software

Conversely, a considerable software identification and selection process has been undertaken prior to development. While system performance and fairness continue to be an important consideration and in order to develop best system software, a parallel analysis has been undertaken along with the needed system hardware to ensure hardware – software compatibility.

Specification

In this phase, the researchers developed the first version of the system. The initial version has the basic features of an e-classroom, which includes saving the details of students, faculty members, and subjects to the database; assignment of the subjects to the faculty members and subject enrollment for the students; Automation of quizzes. And with the release of the first version, recommendations where given. The recommendations identified were the addition of a feature that determines where to set the semester and the school year, and the functionality to add the feature that the system be able to check the attendance of the system and have the attendance automatically recorded in the system. Another suggestion is for the system to have an automatic computation of score based on the date of the quizzes, exams, attendance, and other grade matrices found in the system. In its entirety, there were three intermediate versions that were released by the researchers.

Development

The development phase of the system included both the system design and programming. System design was based upon the existing patterns and tools of Classroom Management as indicated in the literature review of this study. It also adhered to program and database development standards. As defined in the system requirement, a sublime text editor and XAMPP would be used where a PhP programming language, MySQL database and Java Scripting are integrated.

An offline Wi-Fi based e-classroom Management System is to be designed in a manner that it can interact with the server – its database and business logic engines to customize a response in an offline manner. The system hardware architectural definition is being reflected as shown in Figure 2.

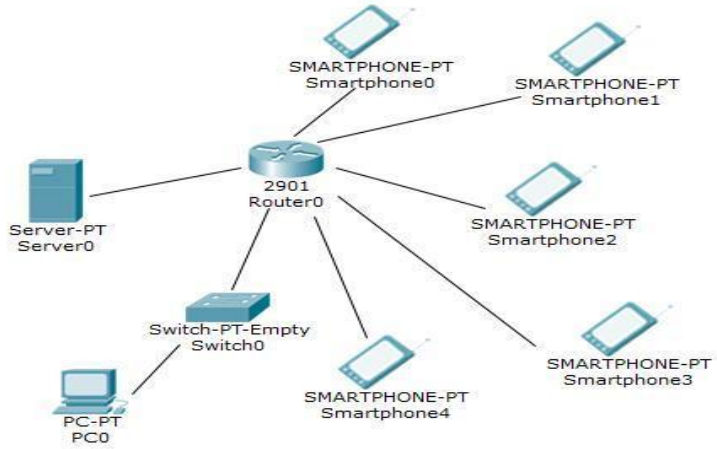

FIGURE 2. System's architecture

Data Flow Diagram

The complexity of the processes inside the proposed system necessitates the presentation of the data flow diagram. In this diagram, the flow of the data to and from the system is shown as well as the flow of the data from different modules inside the system.

Figure 3 represents the Level 0 Data Flow Diagram. This shows the system as on process and focuses on the data that go into and goes out of the system. Here, the data provided are mainly coming from the students while the data that goes out of the system is sent to the faculty members.

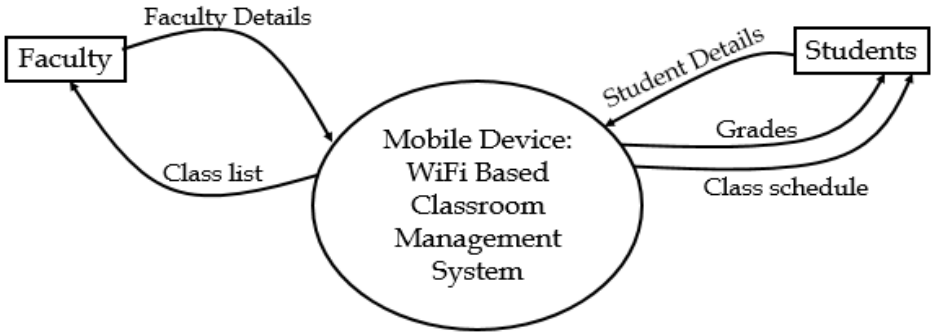

FIGURE 3. Level 0 data flow diagram

Figure 4 depicts Level 1 of the Data Flow Diagram; here the system is shown to be subdivided into modules. These modules represent the main features of the system and the flow of the data between these modules.

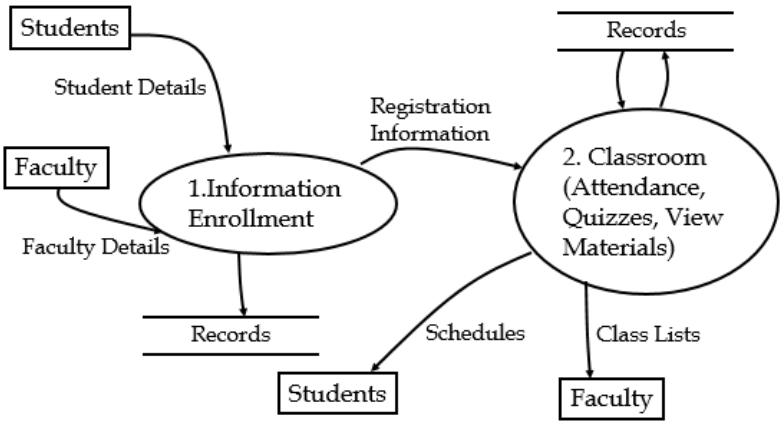

FIGURE 4. Level 1 data flow diagram

Software Design

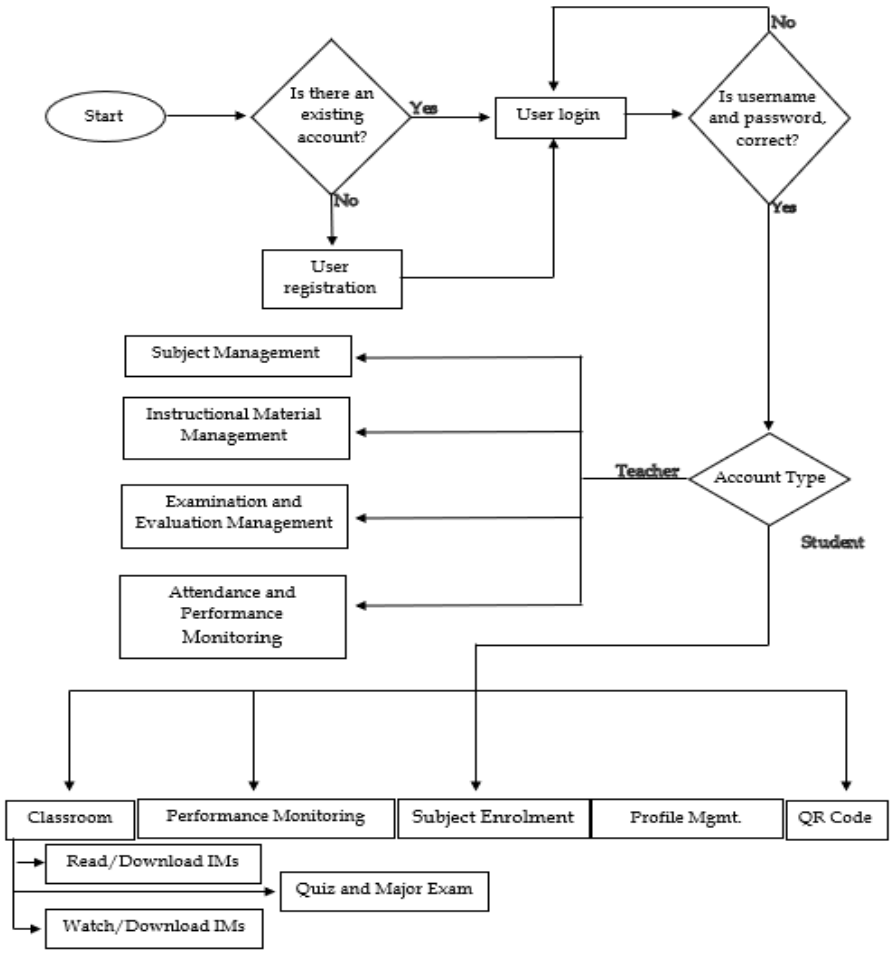

FIGURE 5. System flowchart

RESULTS AND DISCUSSION

The developed system's interface is shown in this section, the result of the existing classroom management software used by faculty, and the result of the development of the system.

The Current E - Learning Platforms used by Samar State University Faculty

There are three different e-learning platforms currently used by SSU – faculty. This result is based on the on responses of 30 faculty-respondents. Further, interview results also indicate that only 12 out of 133 faculty respondents made use of the e-learning platform. Table 2 indicates the different types of e-learning platform and the number of faculty users. The main objective of the interview process being conducted is only to determine the current e-learning platform used by the faculty.

TABLE 2. E-learning platforms used by faculty

E-learning platform type	No. of users
Schoology	2
Moodle	2
Google Classroom	8
Total	12

From the 12 currently utilized e-learning platforms, two (2) uses schoology, two (2) uses Moodle and eight (8) uses the google classroom. Moreover, it is clear that only a few faculties used an e-learning platform despite its popularity and advantages. Perhaps the reason for this is the fact that the said e-learning platforms are not designed or are not customized to the local curriculum process of the university.

Schoology is a social networking service and virtual learning environment for K-12 school and higher education institutions that allows users to create, manage, and share content. Learning Management System (LMS) or Course Management System (CMS) is a cloud-based platform that provides tools needed to manage an online classroom (Conte 2011).

Moodle is a free and open-source LMS written in PHP and distributed under the GNU General Public License. It is being developed on a pedagogical principle. In most cases, it is being used for blended learning, distance education, flipped classroom and other e-learning projects in schools, universities, workplace, and other sectors (Costello 2013).

Developed Wi-Fi Based Classroom Management System

A. Accessibility and Security

Accessibility and Security are considered important parameters to be considered in the design and development of a System. In this case, the developed system incorporates (1) a provision of accessibility via local area network; and (2) a customized user-security access and control of instructional materials for both the faculty and students.

In particular, system accessibility and security operation processes require the user to enter his/her authorized account. Figure 6 depicts the log-in page of the system where students and faculty as well as the system administrator needs to provide and enter their authorized log-in information. In other words, there are 3 accounting categories which define a different system accessibility provision as follows: (1) Administrator Account; (2) Teacher Account and (3) Student Account. Note that for each type of account there is a corresponding restriction and privileges. The said restriction and privileges form part of the security mechanism of the system.

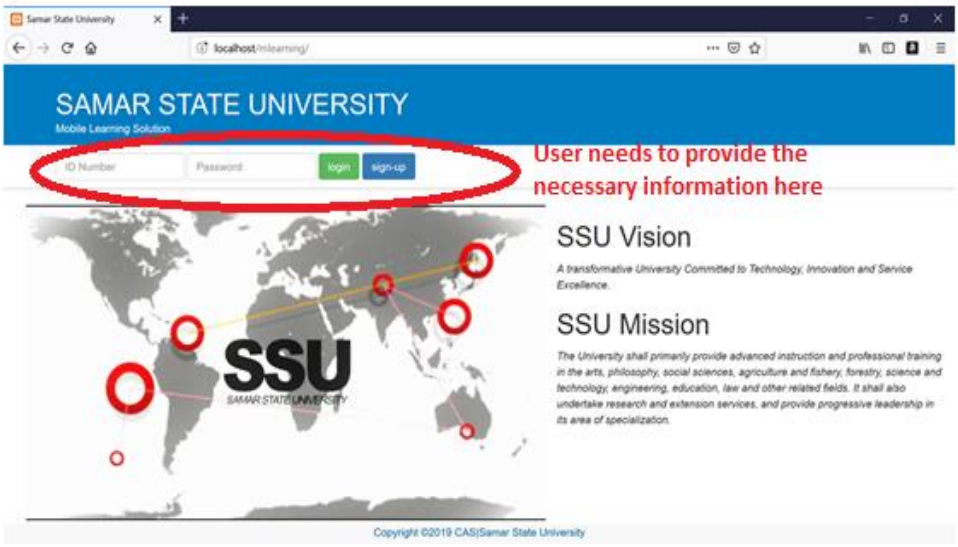

FIGURE 6. Login page for both students and teachers

B. Accessibility of the Instructional Materials

Accessibility and Control of Instructional Materials varies in accordance with the type of user accounts. For and on the case for teachers, processes and functionalities d includes but not limited to: (1) modifying, uploading and deleting instructional materials, (2) access to students' attendance records and other records; (3) printing of reports; etc. While system functions and processes associated with students' accounts include but are not limited to: (1) viewing their individual performance rating; (2) downloading of instructional materials; (3) signing for attendance via QR codes among others.

Figure 7 is the system design provision for control, management, and access of instructional materials. In connection to this, teachers and administrator accounts have full control for this particular system function. Student accounts can only utilize this feature by viewing and downloading all uploaded IMs by the teachers.

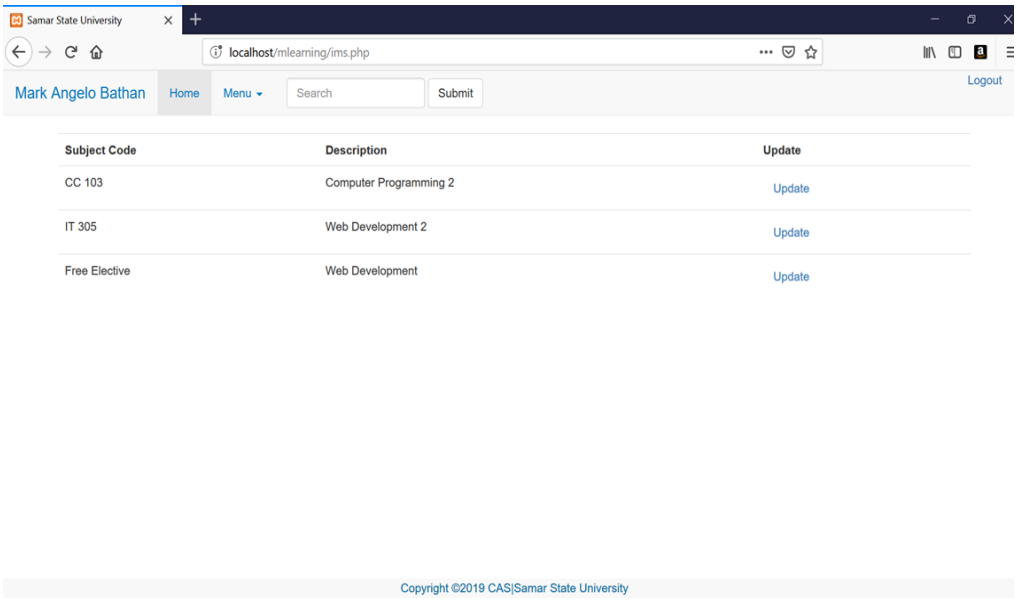

FIGURE 7. System design provision

C. Student Evaluation & Monitoring

Another key design parameter that has been considered in the development of the system is the student evaluation and Monitoring. Student evaluation and monitoring is a system functionalities and processes that refers to the auto-calculation of student performance and attendance monitoring.

The auto-calculation of student performance is shown and described in Figure 8. As indicated in the figure, the individual scores of students in a particular class activity are automatically generated. Other information is also included in this system functions such Subject description, subject Code, etc. Note that this feature is fully accessible and can be controlled by both the administrator account and teacher account. Student account has a limited control on this feature, i.e., students can only access and view their individual ratings.

On the other hand, attendance registration can be done via QR code. In other words, students only need to scan their QR code for them to be registered as present in a particular class. Figure 9 shows the QR codes attendance registration of the system – the sample QR codes and sample attendance records.

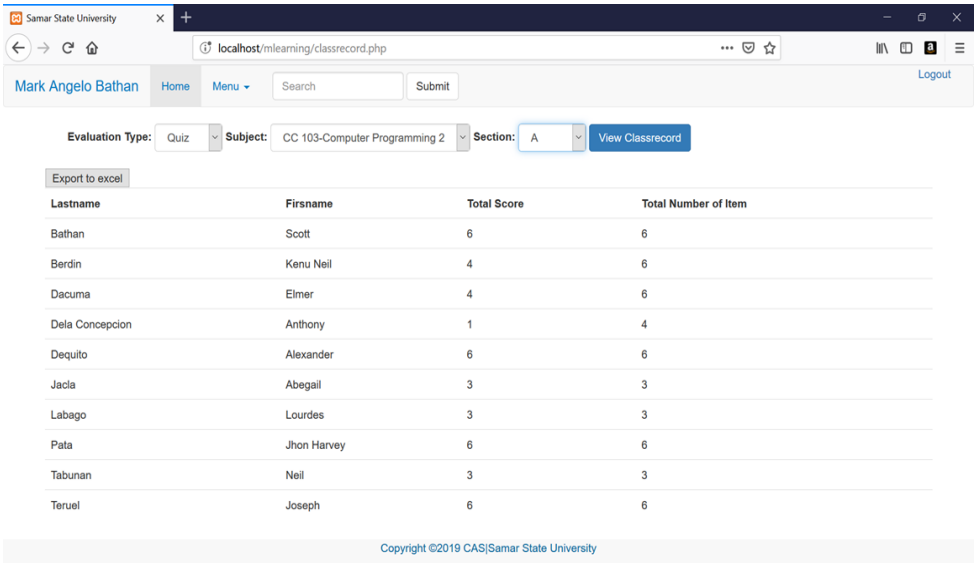

FIGURE 8. Student performance monitoring

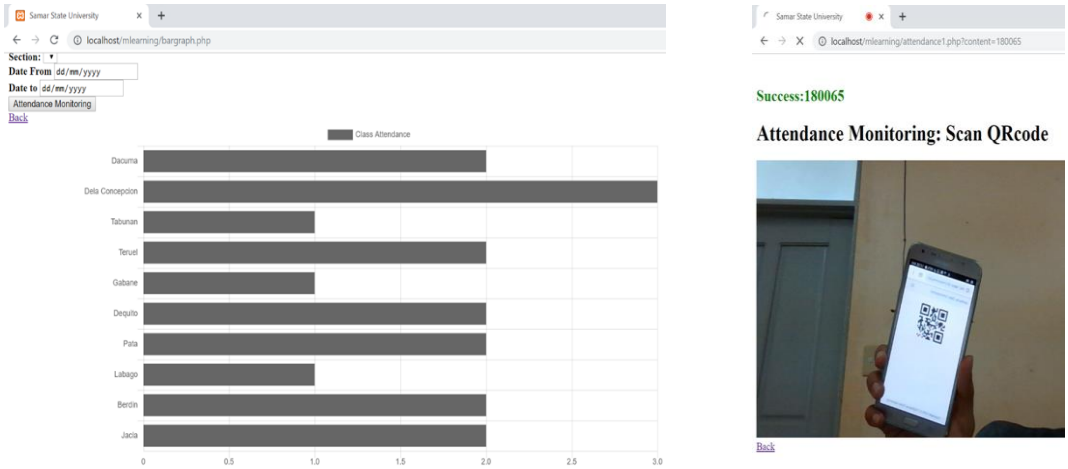

FIGURE 9. Attendance monitoring

Assessment of System Functionality and Acceptability

System Functionality and Acceptability has been assessed both by the experts and end-users as described in chapter 3. Hence two sets of evaluation questionnaires have been used. However, end-users are further categorized into two – (1) the faculty members and (2) the students. There was a total of 365 students who were selected as respondents in the beta testing conducted. With the use of Slovin's Formula, of the 365 students, 91 students were from College of Arts and Sciences, 95 from College of Education, 44 from the College of Engineering, 124 from College of Industrial Technology and 11 students from the College of Nursing and Health Sciences.

There were 133 faculty members who were selected as respondents. Out of 133, 36 were from College of Arts and Sciences, 27 from College of Education, 25 from College of Engineering, 33 from College of Industrial Technology, and 12 faculty members of College of Nursing and Health Sciences.

Ten (10) technical experts were selected as respondents. They were to provide technical suggestions or recommendations on the technologies used in the system. This is so because, unlike an IT expert, an ordinary faculty member or student would not have knowledge and skills with respect to the technology used.

The beta testing was conducted for 2 weeks, from April 22 – May 6, 2019. A five-point hedonic scale as was used in the evaluation of the end-user responses as follows: (a) 5 – Highly Acceptable (HA); (b) 4 – Acceptable (A); (c) 3 – Moderately Acceptable (MA); (d) 2 – Slightly Acceptable (SL) and (c) 1 – Not Acceptable (NA). While a percentile-based evaluation was used in measuring the responses of the technical experts.

A. System Workability and Acceptability as Evaluated by End-users

System workability and acceptability has been measured based on the following criteria – (1) Interface, (2) input design, and (4) output design. This has been evaluated by a total of 498 end-user respondents. Out of 498 end-user respondents 365 were students while 133 were faculty members. Table 3, indicates the respondents' distribution.

TABLE 3. Distribution of end-users as respondents

End – User	CAS	COED	COENG	CIT	CONHS	TOTAL
Student	91	95	44	124	11	365
Faculty	36	27	25	33	12	133
TOTAL	127	122	69	157	24	498

CAS – College of Arts and Sciences
COED – College of Education
COENG – College of Engineering
CIT – College of Industrial Technology
CONHS – College of Nursing and Health Science

Based on the student assessment, system interface has been evaluated to be "Acceptable" with a computed mean of 4.50 as indicated in Table 4. From among the Interface design criteria, the provision on five interface design criterions received a rating of "highly acceptable" while the other five criterions have been rated as "acceptable". Further, form among the interface design criterion, the provision on "environment navigating system" received the highest with a computed mean of 4.81 which is highly acceptable.

TABLE 4. Student evaluation on system interface design

System Interface Design Criteria	SCALE 5	4	3	2	1	WEIGHTED MEAN	INTER-PRETATION
1. Interface provides users with an appropriate environment for navigating the system.	303	55	7	0	0	4.81	Highly Acceptable
2. The organization of the system is clear, logical and effective.	248	112	5	0	0	4.67	Highly Acceptable
3. The system is attractive and interesting; it motivates users to continue using the system.	176	175	14	0	0	4.40	Acceptable
4. Users can navigate through the system independently without difficulty.	199	142	21	3	0	4.50	Acceptable

5. The system introduces a user to an easy to follow and consistent navigation system.	141	186	34	4	0	4.30	Acceptable
6. The language in the program is clear to the intended audience.	225	116	22	2	0	4.55	Highly Acceptable
7. Graphics, audio, video, and/or animations add to the functionality of the system.	167	152	37	9	0	4.30	Acceptable
8. Help options are comprehensive and readily available.	184	144	21	16	0	4.40	Acceptable
9. Text is clear and printed in type suitable for target audience.	244	103	17	1	0	4.62	Highly Acceptable
10. Spelling, punctuation and grammar are correct.	253	89	23	0	0	4.63	Highly Acceptable
			Average Mean			4.50	Acceptable

4.51 – 5.00 Highly Acceptable
3.51 – 4.50 Acceptable
2.51 – 3.50 Moderately Acceptable
1.51 – 2.50 Slightly Acceptable
1.00 – 1.50 Not Acceptable

Table 5 shows the system functionality and acceptability based on System Input Design criteria as evaluated by the student. As reflected on the table, the general computed mean for System Input Design is 4.45 with a descriptive rating of "acceptable". Out of 10 input design criterions, 3 received a descriptive rating of "highly acceptable", while the rest had a descriptive rating of "acceptable".

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4. Users can navigate through the system independently without difficulty.	199	142	21	3	0	4.50	Acceptable
5. The system introduces a user to an easy to follow and consistent navigation system.	141	186	34	4	0	4.30	Acceptable
6. The language in the program is clear to the intended audience.	225	116	22	2	0	4.55	Highly Acceptable
7. Graphics, audio, video, and/or animations add to the functionality of the system.	167	152	37	9	0	4.30	Acceptable
8. Help options are comprehensive and readily available.	184	144	21	16	0	4.40	Acceptable

9. Text is clear and printed in type suitable for the target audience.	244	103	17	1	0	4.62	Highly Acceptable
10. Spelling, punctuation, and grammar are correct.	253	89	23	0	0	4.63	Highly Acceptable
					Average Mean	4.50	Acceptable

4.51 – 5.00 Highly Acceptable
3.51 – 4.50 Acceptable
2.51 – 3.50 Moderately Acceptable
1.51 – 2.50 Slightly Acceptable
1.00 – 1.50 Not Acceptable

Table 6 shows the results of the Output Design assessment of the system which has an overall descriptive rating of "Acceptable". In other words, the reports generated, and output graphical user interface is in conformity with that of the output expectation of the students.

TABLE 6. Student evaluation on system output

System Output Design Criteria	SCALE 5	4	3	2	1	WEIGHTED MEAN	INTER-PRETATION
1. The system keeps the display simple and consistent.	282	74	9	0	0	4.75	Highly Acceptable
2. The content is free from spelling and grammatical errors.	253	95	17	0	0	4.65	Highly Acceptable
3. The information is clear, concise and informative to the intended audience.	354	10	1	0	0	4.97	Highly Acceptable
4. The content is as extensive and original as possible.	195	149	20	1	0	4.50	Acceptable
5. The content is presented through the appropriate use of text, graphics and animation.	197	128	31	4	5	4.40	Acceptable
6. The content is displayed in digestive quantity.	146	165	33	21	0	4.20	Acceptable
7. Useful information like author, date created and updated and other factual data are clearly listed and available.	186	136	37	6	0	4.40	Acceptable
8. Use of valuable animation, graphics and sounds benefit the users.	129	142	73	21	0	4.00	Acceptable
9. The system can generate reports or printouts	131	117	81	36	0	3.9	Acceptable
10. Printouts are dated clearly and well organized.	134	95	85	44	7	3.8	Acceptable
					Average Mean	4.40	Acceptable

4.51 – 5.00 Highly Acceptable
3.51 – 4.50 Acceptable
2.51 – 3.50 Moderately Acceptable
1.51 – 2.50 Slightly Acceptable
1.00 – 1.50 Not Acceptable

In summary, students' evaluation indicates that the system has an over-all functionality and acceptability rating of "acceptable" as being defined by the general average mean of 4.40 as shown in Table 7. In fact, all systems functionality and acceptability indicators received a descriptive rating of "acceptable" with an average mean range from 4.40 – 4.50.

TABLE 7. General student evaluation result on system workability and acceptability

System Workability and Acceptability Indicators	Weighted Mean	Descriptive Rating
Interface	4.50	Acceptable
Input	4.45	Acceptable
Output Design	4.40	Acceptable
General Weighted Mean	4.40	Acceptable

4.51 – 5.00 Highly Acceptable
3.51 – 4.50 Acceptable
2.51 – 3.50 Moderately Acceptable
1.51 – 2.50 Slightly Acceptable
1.00 – 1.50 Not Acceptable

On the other hand, the system has been evaluated also by the faculty who are going to use it. Note that the total number of faculty-respondents as end users is 133 coming from the different Colleges of the University. Note the system is being evaluated with the same workability and acceptability criteria with that of student workability and acceptability criteria. On this however, both the faculty and students have different system user interface design, functions and processes.

Table 8 shows the evaluation result on System Interface as evaluated by the Faculty. It can be gleaned from the table that the computed average mean for System interface design is 4.50 with a descriptive rating of "acceptable". This result indicates that the system interface design adheres to the interface design requirements as suggested by the faculty.

TABLE 8. Faculty evaluation result on system interface design

System Interface Design Criteria	SCALE 5	4	3	2	1	WEIGHTED MEAN	INTER-PRETATION
1. Interface provides user with an appropriate environment for navigating the system.	107	24	2			4.79	Highly Acceptable
2. The organization of the system is clear, logical and effective.	81	50	2			4.59	Highly Acceptable
3. The system is attractive and interesting; it motivates users to continue using the system.	69	54	10			4.40	Acceptable
4. Users can navigate through the system independently without difficulty.	63	63	7			4.40	Acceptable
5. The system introduces a user to an easy to follow and consistent navigation system.	37	78	17	1		4.10	Acceptable
6. The language in the program is clear to the intended audience.	85	41	6	1		4.58	Highly Acceptable

7.	Graphics, audio, video, and/or animations add to the functionality of the system.	65	56	9	3	4.40	Acceptable
8.	Help options are comprehensive and readily available.	62	57	6	8	4.30	Acceptable
9.	Text is clear and printed in type suitable for target audience.	90	36	7		4.62	Highly Acceptable
10.	Spelling, punctuation and grammar are correct.	85	41	7		4.59	Highly Acceptable
				Average Mean		4.50	Acceptable

4.51 – 5.00 Highly Acceptable
3.51 – 4.50 Acceptable
2.51 – 3.50 Moderately Acceptable
1.51 – 2.50 Slightly Acceptable
1.00 – 1.50 Not Acceptable

Table 9 shows that the majority of the faculty-respondents rated the input design criteria of the system as "Acceptable" with a computed mean of 4.42. Again, the result indicates that the actual input design of the system conforms to that of the faculty expectation.

TABLE 9. Faculty evaluation result on system input design

System Input Design Criteria	SCALE 5	4	3	2	1	WEIGHTED MEAN	DESCRIPTION
1. Input screens are designed for user convenience.	75	52	6	0	0	4.50	Acceptable
2. There are efficient input and data entry methods.	64	60	7	2	0	4.40	Acceptable
3. There is a logical sequence of data entry.	69	55	7	2	0	4.40	Acceptable
4. There are common expressions used to identify fields.	61	64	8	0	0	4.40	Acceptable
5. There are provisions for input verification and control.	68	60	5	0	0	4.47	Acceptable
6. There is clarity of error and feedback messages.	59	64	9	1	0	4.40	Acceptable
7. Simple labels are used to simplify data entry.	83	40	9	1	0	4.54	Highly Acceptable
8. Emails and contact details are visible for making contact	47	73	8	3	2	4.20	Acceptable
9. Help options are comprehensive and readily available.	59	64	9	3	0	4.30	Acceptable
10. Language used in the text of the system is clear and concise.	88	35	10	0	0	4.59	Highly Acceptable
			Average Mean			4.42	Acceptable

4.51 – 5.00 Highly Acceptable
3.51 – 4.50 Acceptable
2.51 – 3.50 Moderately Acceptable
1.51 – 2.50 Slightly Acceptable
1.00 – 1.50 Not Acceptable

Table 10 shows the results of the Output Design evaluation. Results indicate that the computed mean is 4.40 with a descriptive rating of “acceptable”.

TABLE 10. Faculty evaluation results on system output design

System Output Design Criteria	SCALE 5	4	3	2	1	WEIGHTED MEAN	DESCRIPTION
1. The system keeps the display simple and consistent.	96	33	4	0	0	4.69	Highly Acceptable
2. The content is free from spelling and grammatical errors.	102	26	5	0	0	4.73	Highly Acceptable
3. The information is clear, concise and informative to the intended audience.	120	133	0	0	0	4.90	Highly Acceptable
4. The content is as extensive and original as possible.	84	42	6	1	0	4.60	Highly Acceptable
5. The content is presented through the appropriate use of text, graphics and animation.	71	49	10	2	1	4.40	Acceptable
6. The content is displayed in digestive quantity.	55	56	15	7	0	4.20	Acceptable
7. Useful information like author, date created and updated and other factual data are clearly listed and available.	58	65	10	0	0	4.40	Acceptable
8. Use of valuable animation, graphics and sounds benefit the users.	54	54	20	5	0	4.20	Acceptable
9. The system can generate reports or printouts	59	38	20	8	0	4.10	Acceptable
10. Printouts are dated clearly and well organized.	49	39	30	13	2	3.90	Acceptable
					Average Mean	4.40	Acceptable

4.51 – 5.00 Highly Acceptable
3.51 – 4.50 Acceptable
2.51 – 3.50 Moderately Acceptable
1.51 – 2.50 Slightly Acceptable
1.00 – 1.50 Not Acceptable

In general, Table 11 shows the overall system evaluation results based on the perception of Faculty-respondents. As indicated in the table, the general computed mean is 4.43 with a descriptive rating of "acceptable". Hence, it can deduce that the develop system conforms to the overall standard based on the perception of the faculty-respondents as one of the end-users of the system.

TABLE 11. General faculty evaluation result on system workability and acceptability

System Workability and Acceptability Indicators	Weighted Mean	DESCRIPTION
Interface	4.50	Acceptable
Input	4.42	Acceptable
Output Design	4.40	Acceptable
General Average Mean	4.43	Acceptable

4.51 – 5.00 Highly Acceptable
3.51 – 4.50 Acceptable
2.51 – 3.50 Moderately Acceptable
1.51 – 2.50 Slightly Acceptable
1.00 – 1.50 Not Acceptable

In summary, the designed and developed system has an overall functionality and acceptability level of "acceptable" with a computed general average mean of 4.44. The results indicate that the system graphical user interfaces and the associated functionalities/processes as defined by the Interface, Input and Output Design indicators generally passed the standard requirements of the end-users – both the students and the faculty. Also, results indicate that the system has an acceptable processing performance level. The said results are indicated in Table 12.

TABLE 12. Over-all end-users' evaluation results of the system

System Workability and Acceptability Indicators	Student Evaluation	Faculty Evaluation	Average Mean	Description
Interface	4.50	4.50	4.50	Acceptable
Input	4.45	4.42	4.44	Acceptable
Output Design	4.40	4.40	4.40	Acceptable
	General Average Mean		4.44	Acceptable

B. System Functionality and Acceptability as Evaluated by Technical Experts

To further ensure the functionality and acceptability level of the system, this has been subjected for further assessment of technical experts. Note that the concern of technical experts is on the technical details of the system design. And in order to eliminate technical and end-user biases, the same functionality and acceptability criteria has been used. However, in technical evaluation a YES/NO checklist method instead of a five-point hedonistic level was used. This is because technical experts do not concern themselves with the extent of the system workability and acceptability level but rather look only into the presence and absence of the technical requirements as defined on each indicator.

In particular, 100% of the technical experts believed that the technical details and/or components required for System Input Interface design were available and made functional in the system itself. The results indicate that technical experts believe that all interface indicators are available and functional.

TABLE 13. Technical experts input design interface evaluation

System Input design indicator	Frequency		Percent
	Yes	No	Indicator
1. Input screens are designed for user convenience.	10	0	100%
2. There is an efficient input and data entry methods.	10	0	100%
3. There is a logical sequence of data entry.	10	0	100%
4. There are common expressions used to identify fields.	10	0	100%
5. There are provisions for input verification and control.	10	0	100%
6. There is clarity of error and feedback messages.	10	0	100%
7. Simple labels are used to simplify data entry.			
8. Emails and contact details are visible for making contact	10	0	100%
9. Help options are comprehensive and readily available.	10	0	100%
10. Language used in the text of the system is clear and concise.	10	0	100%
Average	10	0	100%

Table 14, shows the technical experts' evaluation results on the output design of the system. From the table, it is indicated that 100% of the respondents agree with the availability of the functions and processes of the system output generation.

TABLE 14. Technical experts output design evaluation

System Input design indicator	Frequency		Percent
	Yes	No	Indicator
1. The system keeps the display simple and consistent.	10	0	100%
2. The content is free from spelling and grammatical errors	10	0	100%
3. The information is clear, concise and informative to the intended audience.	10	0	100%
4. The content is as extensive and original as possible.	10	0	100%
5. The content is presented through the appropriate use of text, graphics and animation.	10	0	100%
6. The content is displayed in digestive quantity.	10	0	100%
7. Useful information like author, date created and updated and other factual data are clearly listed and available.	10	0	100%
8. Use of valuable animation, graphics and sounds benefit the users.	10	0	100%
9. The system can generate reports or printouts	10	0	100%
10. Printouts are dated clearly and well organized.	10	0	100%
Average	10	0	100%

Further, Table 15 indicates the Database design of the system. Note that considering the technical complexity in understanding the details of the database structures and design, this parameter has not been included as part of the Workability and Acceptability criteria on the part of the end-users. On this, the table indicates that 100% of the respondents indicate an affirmative response in all indicators stipulated in Table 15. This result implies that the database design is within the acceptable standards.

TABLE 15. Technical expert's database design evaluation

System Input design indicator	Frequency		Percent
	Yes	No	Indicator
1. Each record contains a unique identifier as the primary key	10	0	100%
2. Fields represent distinct characteristics of the subject	10	0	100%
3. Records are easily stored and retrieved.	10	0	100%
4. There are provisions for database backup facility.	10	0	100%
5. There are provisions for database security.	10	0	100%
6. Database can accommodate the changing data needs within organization	10	0	100%
7. Database is ready and flexible for future plans like system upgrades.	10	0	100%
8. Necessary technical documentation is included	10	0	100%
9. Database structure to suit different types of user needs	10	0	100%
10. Database structure avoids duplicate entry in the system.	10	0	100%
Average	10	0	100%

In general, it can be observed that experts have a positive response in the workability and acceptability of the system in terms of technical aspects. In Table 16, 100% of the respondents agree on the workability and acceptability of the developed system.

TABLE 16. Technical experts' overall evaluation on the workability and acceptability of the system

System Workability and Acceptability Indicators	Percent indicator
Interface	100%
Input	100%
Database Design	100%
Average	100%

In summary, the workability and acceptability of the designed and developed system is found to be generally acceptable by both the end-users and technical experts. The workability and acceptability encompass the functionality of the system, technical merits and the associated processes.

Evaluation and Processing performance of the Developed System

System Design, its functionality and acceptability are deemed to be useless if its efficiency and effectiveness level is not good. Thus, the system has been further evaluated in terms of its processing performance particularly its (1) efficiency and (2) effectiveness level. Results of the evaluation are indicated in subsequent paragraphs.

A. Efficiency Level of the System

The efficiency level of the system has been evaluated using a rubric that defines the efficiency. Note however that, efficiency level performance of the system has been evaluated only by the technical experts considering that efficiency parameters are technical in nature. Table 17 shows the evaluation results of the efficiency level of the system.

TABLE 17. Efficiency level of the system

Efficiency Indicators/Parameters	Scale			Average	Description
	3	2	1		
1. The system operates at an acceptable speed.	30	0	0	3.0	Very efficient
2. There is accuracy of data processing.	30	0	0	3.0	Very efficient
3. System can handle predicted volumes of data in a timely and efficient manner.	30	0	0	3.0	Very efficient
4. The system uses an internal search facility to let users find what they want quickly and efficiently.	30	0	0	3.0	Very efficient
5. The system is compatible and efficient to most operating systems available.	30	0	0	3.0	Very efficient
	Average mean			3.0	Very efficient

2.6 – 3.0 Very efficient
1.6 -2.5 efficient
1.0 – 1.5 Not efficient

As indicated in Table 17, the system is found to be very efficient based on the evaluation results having an efficiency level indicator of 3.0 which has a descriptive rating of 'very efficient'. In particular, the level of efficiency has been evaluated by observing the performance of the system while it is on its actual operations and used. Observation has been made by technical experts following the rubrics that define the different efficiency parameters.

B. Effectiveness of the System

The effectiveness of the system has been evaluated in different system effectiveness indicators. The said effectiveness indicators are in accordance with the system general operations and functions. On this, it has been found out that the system is found to be 'very effective' as evaluated by technical experts and users. Table 18 shows the effectiveness evaluation results of the systems.

TABLE 18. Efficiency level of the system

Effectiveness Indicators/Parameters	Scale			Average	Description
	3	2	1		
1. The system is found to be effective in providing an automated e-learning services	30	0	0	3.0	Very effective
2. The system is found to be effective in terms of management, control and access of instructional materials	30	0	0	3.0	Very effective
3. The system is found to be effective in terms of auto-registration and monitoring of students attendance	30	0	0	3.0	Very effective
4. The system security and access features is found to be effective as it is being customized based on the type of user	30	0	0	3.0	Very effective
5. The system over-all graphic design, interface design and process is effective as it captures the needs of the users	30	0	0	3.0	Very effective

	Average mean	3.0	Very effective

2.6 – 3.0 Very effective
1.6 -2.5 Effective
1.0 – 1.5 Not Effective

C. Security

Based on the respondents, the system has a high security level. The personal information provided by the user is only accessible by the user alone. Every user goes through a login (providing username and password) process before using a personal account. The credentials of the students like quizzes, exams and any other academic related activities is very confidential. Students can only access their own credentials and are restricted to view others.

CONCLUSION

The developed mobile and local Wi - Fi – based system contains features of classroom management such as giving quizzes, uploading instructional materials, checking attendance through QR technology, and monitoring students' performance which are not present on the existing system which eliminated the boundaries between traditional classroom settings and online learning environments. The system satisfied both the functional and non-functional needs of both students and faculty members, as well as the objectives of the study. In general, having a mobile-based LMS increases accessibility, convenience, and engagement options for both students and faculty.

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