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Curriculum Management Systems for Blended Learning Support

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Abstract— The ongoing COVID-19 has left some serious impacts on education, bringing academic activities to a halt, and restrictions have been in place to hamper the proliferation of the virus. The utilization of technology these days plays a vital role in assisting students in attending education online or blended learning and keeping academic activities running. However, limited learning management systems present a new problem in online learning, especially in higher education. Thus, a new information system is required to resolve this issue. This study aims to develop the Bauran information system to assist lecturers in higher education with curriculum design, semester lesson plans, and to evaluate the effectiveness of Bauran's implementation using the ISO 25010 model. The material used during the research process included the Bauran application, Guidelines for Developing Higher Education Curriculum, and some data from relevant users to test the application. Meanwhile, during the development stage of the research, the prototype method was used to allow for adjustment of the development to the feedback given by stakeholders. This application received positive feedback from relevant users regarding the curriculum development flow in line with the Guidelines of Curriculum Drafting for Higher Education. The results of user evaluations, using the ISO 25010 model during the testing process, demonstrated its effectiveness with an average score of 4.84 out of 5. Future research is expected to evaluate the long-term effectiveness of Bauran using a larger sample size and a different software evaluation model.

Keywords— **Blended Learning; Learning Management System; E-Learning; Curriculum; Higher Education.**

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I. INTRODUCTION

The COVID-19 pandemic has left huge impacts and transformed how education is delivered. The number of human resources in higher education was reduced to help hamper the proliferation of the virus [1][2]. In 2020, United Nations reported that the halt of education activities affected 94% of scholars worldwide and 99% of scholars in low-income countries with a middle-low economy [3]. Since the outbreak, faculties and staff in universities and colleges have been burdened with countless responsibilities but restricted to limited time to seek solutions for efficient learning for students [4].

Maintaining learning activities amidst the pandemic has forced almost all learning systems to change. The entire transformation has demanded universities and schools to quickly adapt to the existing circumstances to ensure that student's learning needs are met.

One of the solutions that can be applied to handle this issue is by utilizing blended learning (locally referred to as *Pembelajaran Bauran*) that involves information technology [5][6]. This approach could give students and lecturers access to the teaching and learning process by amalgamating offline and online learning [7][8]. This hybrid-based online learning can be synchronized within one class session at different times [9]. Moreover, this method can also reduce the risk of COVID-19 infection, as reported in previous research [10] asserting that since 30 May 2020, almost all educational institutions in India have implemented online learning to hamper the spread of Covid-19.

Despite the shift from face-to-face class sessions to hybrid methods during the pandemic, university students keep sharpening their academic and non-academic capabilities. This is because the development of information technology has served as an alternative amidst the pandemic these days [11]. Furthermore, this ongoing blended learning allows lecturers to deliver interesting and understandable learning methods while students can still access knowledge without being restricted to interaction and time [12].

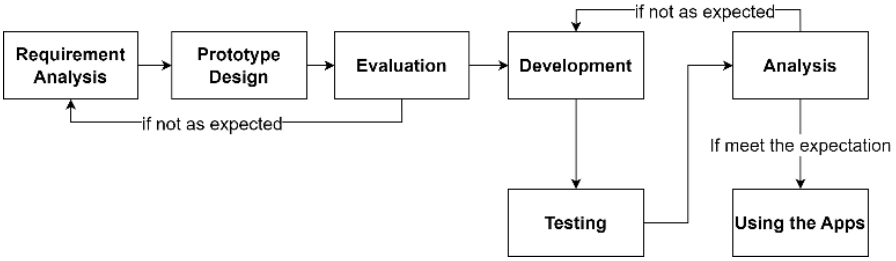

Fig. 1 Workflow of Prototype Method

Previous studies elaborated that emergency measures taken by education institutions during the pandemic to resolve learning issues using an e-learning approach are often referred to as Emergency Remote Education (ERE) which can give solutions to learning amidst the pandemic by adopting blended learning or distance learning comprehensively [13][14].

However, this solution does not always guarantee ease in hybrid learning activities, considering that an internet connection can be unreliable for online learning [15]. Students and lecturers often experience difficulties accessing the internet, and the facilities of learning management restricted to educators present a new problem amidst the pandemic.

This research is focused on developing a blended learning website and app called *Bauran* (www.bauran.id). It is accessible on a website as a blended learning management system to assist and facilitate study programs and lecturers to design curriculum, semester lesson plan (RPS & RPP), and its implementation.

A. Literature Review

Technology these days serves as an effective solution to learning issues during the COVID-19 pandemic [16][17]. A study reported that [18] during the pandemic, education institutions started to implement e-learning to help with learning [19][20]. In addition, the application of information technology in e-learning accommodates varied learning styles among students to change into a "new normal" mode [21].

In education, learning activities are inextricable from the information system of education management [22]. The connection between the two can be described in a way where education serves as a generator of the information system of education management. In contrast, the information system acts as the support system of education. The education management information system cannot be excluded from learning activities.

This management information system is a determining factor in building a complete online education or blended learning environment in the current pandemic [23]. In addition, the availability of an education management information system can also assist lecturers in developing a good learning curriculum. With a good learning curriculum, students can achieve targeted learning outcomes and align with the desired learning outcomes [24]. Also, good curriculum design has a high chance of student learning success.

According to research [25], the curriculum design in this online learning method must be well designed, reflect the principles of education, and meet the requirements of institutions and educational institutions.

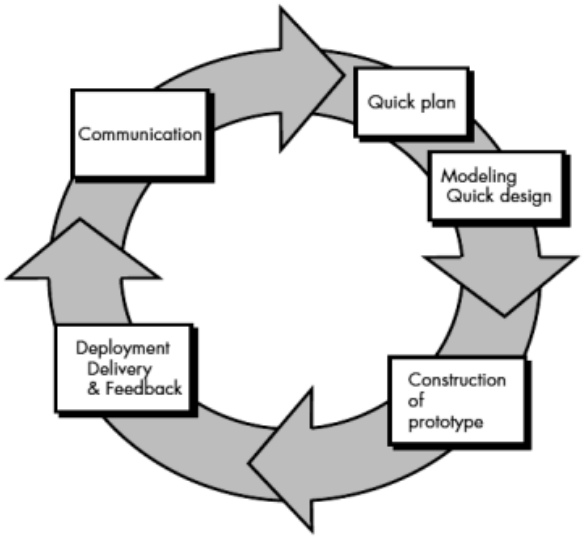

Fig. 2 Prototype Method (Source: Pressman. Software Engineering, 2010)

In addition to designing a good curriculum design, lecturers are also required to design Semester Lesson Plans (SLP) well to create quality education. This SLP is a learning process plan to fulfill one semester of learning in courses to achieve Learning Outcomes (LO). Research [26] explains that quality education is supported by an effective and innovative learning process and adequate human resources, facilities, and infrastructure. The fulfillment of these requirements will create graduates who are competent in their fields.

II. MATERIALS AND METHODS

A. System Development Model

In developing this *Bauran* system, this research employed a prototype method deemed excellent over other methods because it involved direct communication between the developer and client at the stage of the development. Thus, the system created could meet the expectation of the client [27].

Figure 2 shows activities at the development stage using a prototype method, and Figure 1 represents the workflow of the prototype method. Generally, this prototype is further broken down into five steps:

1) Communication

At this stage, both the developer and the client discussed the project description, set general objectives, the needs of the system, and the features required in the system developed.

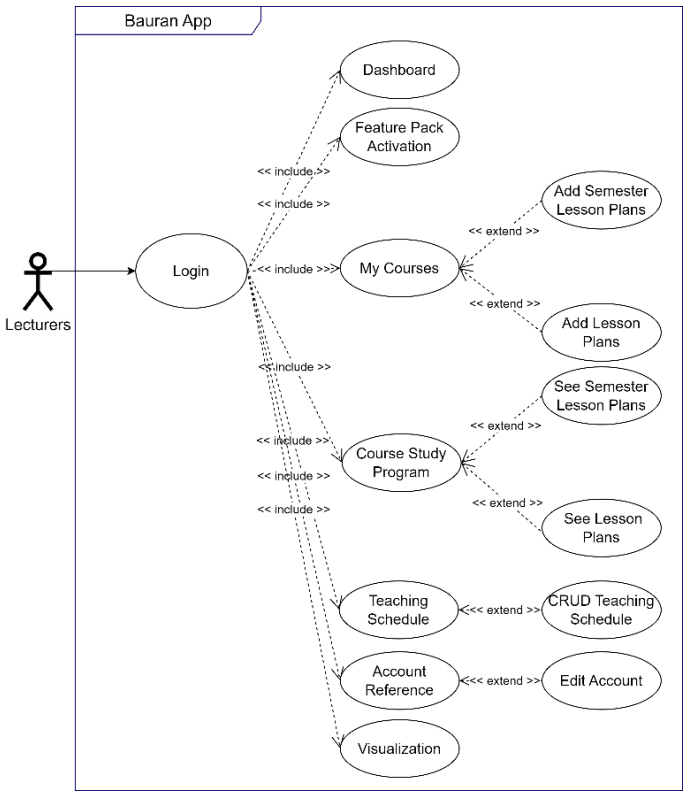

Fig. 3 Use Case Diagram of Lecturer

2) Quick Plan

This stage was further developed, involving all necessary aspects needed by software, and this stage served as the basis of the prototype design.

3) Modelling Quick Design

This stage represents all information on the need of the client collected from the communication stage, followed by the making of the model of the prototype design, showing the working model of the system developed. This stage resulted in the user interface or menu, use case diagram, use case scenario, class diagram, and activity diagram.

The administrator has access to 16 menus or features in *Bauran*, as presented in Figure 4, including managing all reports, adding courses, managing the learning outcomes of the graduates, profiles of graduates, learning materials, and adding a lecturer's account, and many more.

However, lecturers can only manage seven menus or features, as shown in Figure 3. On the *Bauran* web, lecturers can only add teaching schedules and view other menus such as reports and course study programs. If no particular course is shown in the system, the lecturer concerned could confirm a course taught by contacting the administration office staff.

4) Construction of Prototype

This stage involves software development. Framework Laravel and MySQL were used at this stage to design the website-based *Bauran* system. The developer also made a report on testing, implementation, software evaluation that had been prepared earlier, and the last modification from the client so that the software developed could meet the client's expectations and be accessible to users. In addition, software testing was performed at this stage to find bugs

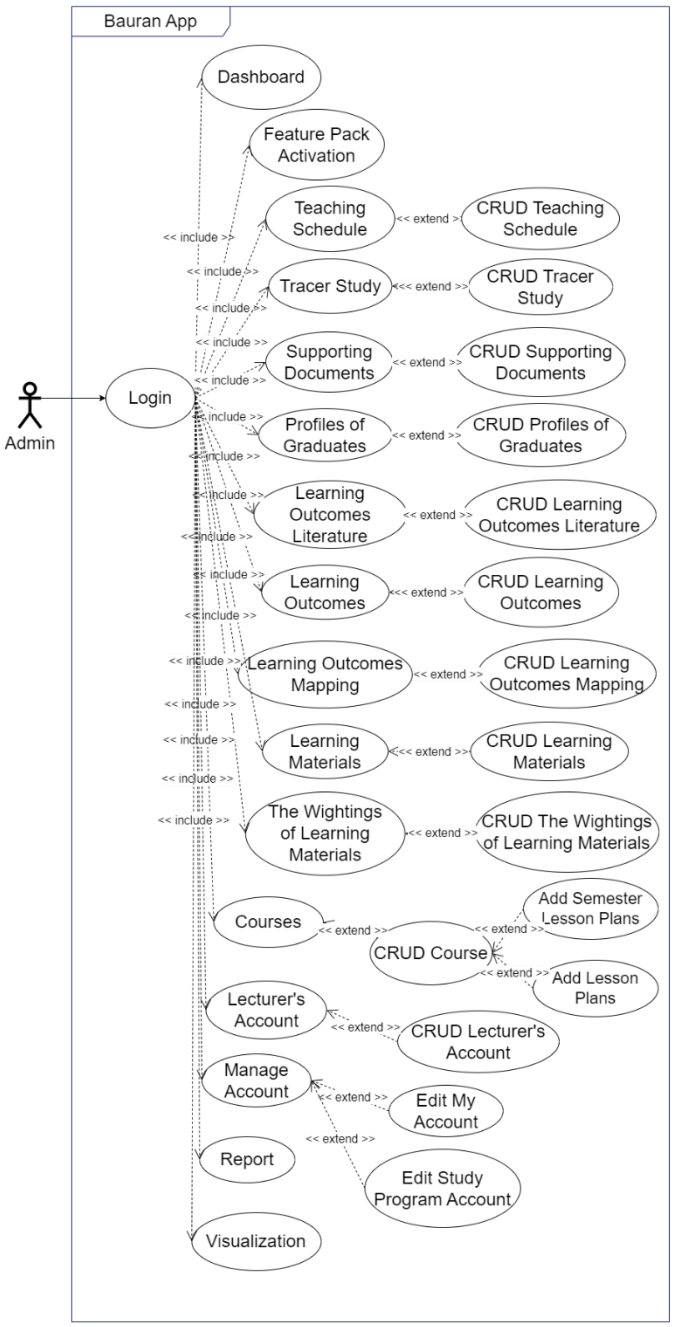

Fig. 4 Use Case Diagram of Admin

that probably existed in the software and to fix the bugs. To perform the testing, this research uses the Blackbox method in functional testing of the system to observe the input and output of the software. This testing process was vital to ensure that the software was free from bugs or errors [28][29]. Meanwhile, for non-functional testing, researchers used the Stress Testing method to observe the reliability availability (response time). In addition, this test method marks the system's durability and handling interference under burdensome load conditions [30].

5) Deployment Delivery & Feedback

The prototype was further evaluated comprehensively by the client in terms of its strong points and shortcomings. These evaluation results serve as references for the systems of the following fixing process [31]. At this stage,

the developer also made a report in the form of a summary of how the software operated. This report might also involve operational evaluation, system, and user interaction.

B. Evaluation Procedure

This research employed the ISO 25010 model to evaluate the software already developed. The evaluation process involved 15 lecturers, one application developer, and a website. The evaluation process involves the following:

- Demonstrating the application and website.
- Allowing lecturers and developers to try all website and application features.
- Let lecturers and the developer assess the trial's results using numeric scales as shown in Table I on a google form.
- Summing up all numeric scales of the demonstration to calculate average scales.

TABLE I
NUMERIC SCALES OF EVALUATION RESULT ASSESSMENT

Numeric Scale	Remark
4.51 – 5.00	Very Good
3.51 - 4.50	Good
2.51 - 3.50	Fair
1.51 - 2.50	Bad
1.00 - 1.50	Very Bad

III. RESULT AND DISCUSSION

Bauran was designed using a prototype method, requiring the communication process with a client to get the picture of the software designed with the features needed in the software, followed by the prototype construction stage or software development to software evaluation designed in the earlier stage. This step was intended to meet the need of the client. The design of this software resulted in two applications, namely Bauran.id on a website and *Bauran* Application on Android.

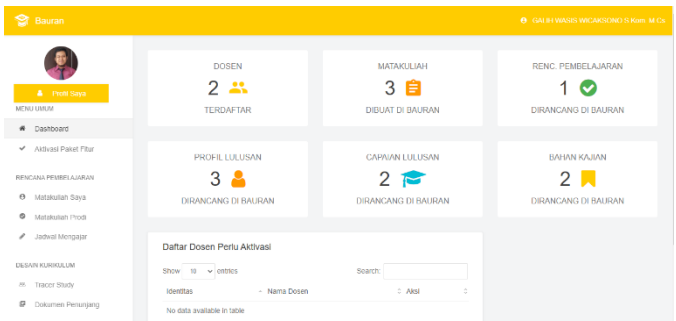

Fig. 4 Bauran.id Dashboard

Figure 5 shows the appearance of the admin page on the *Bauran* website. The administrator could manage about 16 features grouped into four parts: *MENU UMUM*, *RENCANA PEMBELAJARAN*, *MENU KELOLA*, and *VISUALISASI*. With these 16 features, the administrator could work on reports, Semester Lesson Plans, and Lesson Plans. A course can also be added, similar with the addition of a lecturer's account, to allow for the management of the Semester Lesson Plan and Lesson Plan in the course, learning outcomes, and others can be added as well.

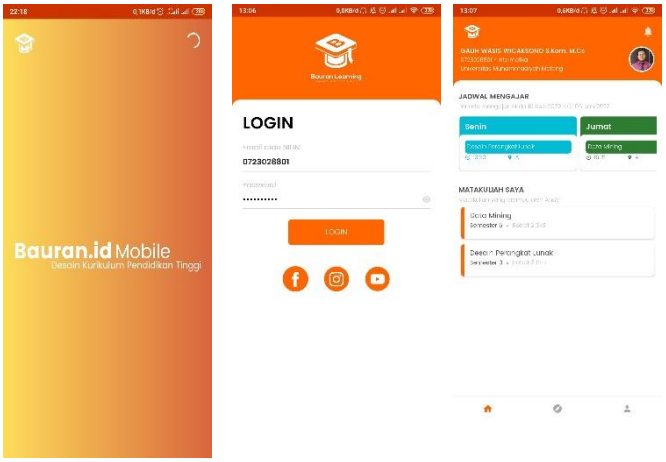

Fig. 6 *Bauran* App

In addition to the website, *Bauran* is also designed as a mobile phone application to ease lecturers to access the app on Android-based smartphones, as shown in Figure 6. This app has several features that are helpful for lecturers in their teaching activities, including a teaching schedule reminder sent in a minute depending on the time set when the teaching schedule is made on the *Bauran* website.

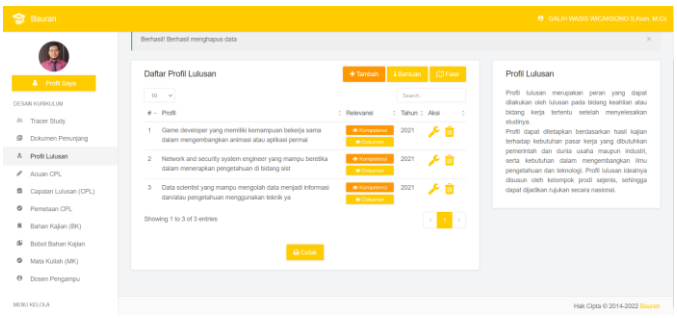

Fig. 7 Step 1 for setup Learning Outcomes (LO)

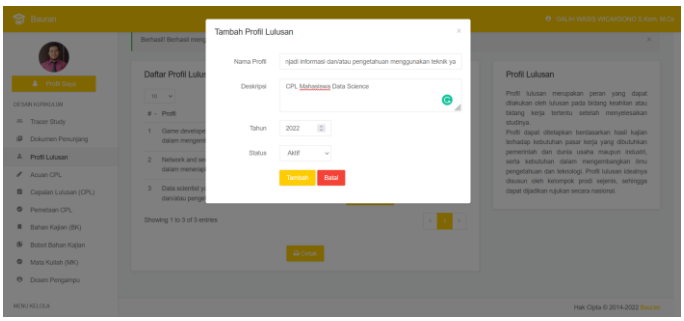

Fig. 5 Step 2 for setup Learning Outcomes

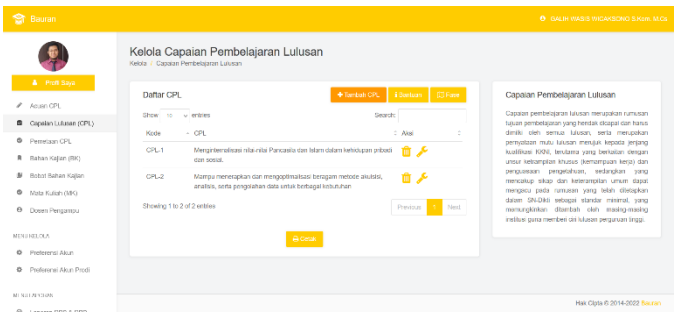

Fig. 6 Formulating Learning Outcomes (LO)

A. Designing Curriculum Document

To design curriculum documents, the administrator must perform the following steps:

a. Formulating Learning Outcomes (LO)

This step requires the administrator to set the profiles of the graduates in the system. It can be done by selecting *Profil Lulusan* in the menu system and clicking "*Tambah*," as shown in Figure 7. The next step is filling in the required information to design the profiles of graduates, as in Figure 8. Furthermore, formulating the LO requires setting the skills derived from a profile. This step should cover four elements: attitude, knowledge, general aptitude, and specific skill, as outlined in the Regulation of Minister of Education and Culture Number 3 of 2020 concerning National Standards of Higher Education (SN-Dikti) [32]. The final step of this stage is designing LO. This step can be performed by clicking "*Tambah CPL*" on the CPL menu, as shown in Figure 9; then, the data needed should be given, such as LO code, formulation, and others.

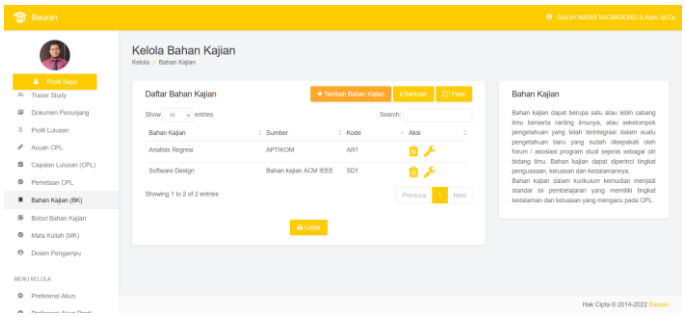

Fig. 7 Adding Study Materials

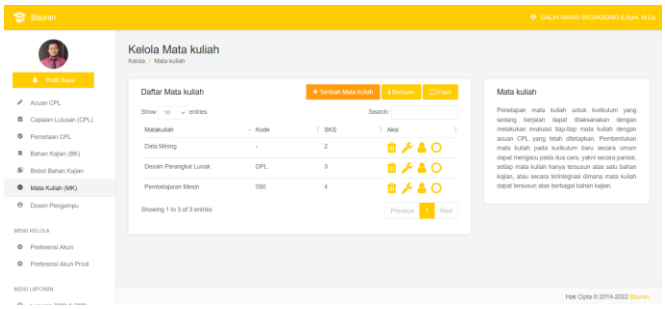

Fig. 11 Adding A Course

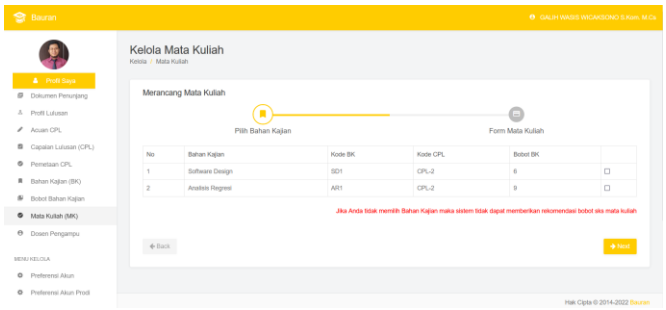

Fig. 12 Selecting Learning Materials for A Course

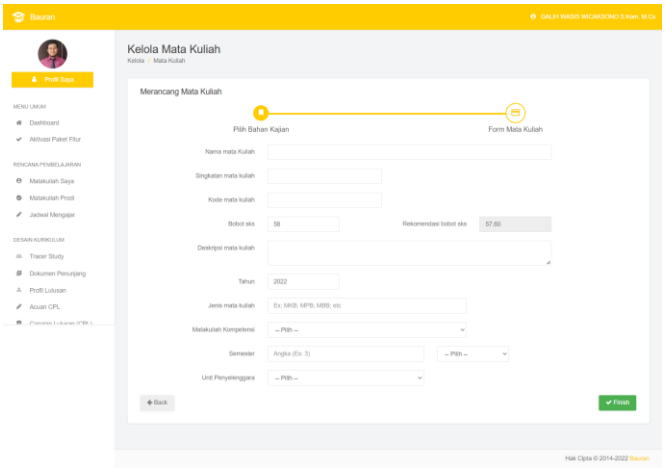

Fig. 13 Setting Credits on A Course

b. Programming a Course

This stage is divided into three activities, selecting study materials, and learning materials, where the administrator has to add a study subject if the subject is empty. This can be done by choosing the menu "*Bahan Kajian"* (BK), as shown in Figure 10. Furthermore, information such as the code of Lesson Material (LM) and others needs to be inserted. This step is then followed by setting the course. This activity is to form a course according to the LO made earlier. Adding a course can be done by clicking "*Tambah Mata Kuliah*" in the menu "*Mata Kuliah,"* as shown in Figure 11, then selecting lesson material made earlier, as shown in Figure 12. The final step of this stage is determining the credit weight of a course, where the administrator must add a course and select the study subject as done in activity 2. Furthermore, the administrator could fill the credit weight in Bauran.id, as shown in Figure 13, with the following conditions:

i) The skill level achieved must be presented in Course Learning Outcomes (CLO).
ii) The depth and width of learning materials must be adjustable to the time needed for learning activities to achieve each point of LO of a course.
iii) It should involve the learning form and method selected.

c. Arranging Curriculum Structure in An Organization

To arrange the curriculum structure, the administrator must perform the previous steps and fulfill the requirement of the Guidelines of Curriculum Drafting for Higher Education:

1) Learning step of a course planned to fulfill the learning outcomes of graduates.
2) Consistent positions of courses adjusted to the coherence of skill level and integration between courses either vertically or horizontally.
3) Students' learning weightage ranges from 8 to 10 hours per day and per week, equal to 17 to 19 credits per semester.

4) The arrangement involves all lecturers of study programs before the study program approves it.

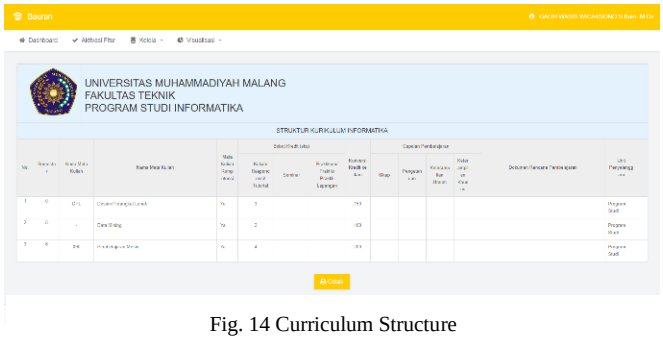

Fig. 14 Curriculum Structure

After fulfilling the above requirements, the administrator could check the curriculum structure made in the menu "*Struktur Kurikulum"* from the course added, as shown in Figure 14.

B. Test Case Result

To ensure the software features run normally, a BlackBox is carried out for all the features on the website and mobile application for testing; the test results are presented in Table I. The results of this step prove that all the features on the website and application run well without any errors or bugs.

TABLE II
TEST CASE RESULT

No	Functionality	Test Technique	Status
Admin			
1	Login Page	Blackbox	Accepted
2	Dashboard	Blackbox	Accepted
3	Feature Pack Activation	Blackbox	Accepted
4	Teaching Schedule	Blackbox	Accepted
5	Tracer Study	Blackbox	Accepted
6	Supporting Documents	Blackbox	Accepted
7	Profiles of Graduates	Blackbox	Accepted
8	Learning Outcomes Literature	Blackbox	Accepted
9	Learning Outcomes	Blackbox	Accepted
10	Learning Outcomes Mapping	Blackbox	Accepted
11	Learning Materials	Blackbox	Accepted
12	The Weightings of Learning Materials	Blackbox	Accepted
13	Courses	Blackbox	Accepted
14	Lecturer's Account	Blackbox	Accepted
15	Manage Account	Blackbox	Accepted
16	Report	Blackbox	Accepted
17	Visualization	Blackbox	Accepted
18	Logout	Blackbox	Accepted
Lecturers			
1	Login Page	Blackbox	Accepted
2	Dashboard	Blackbox	Accepted
3	Feature Pack Activation	Blackbox	Accepted
4	My Courses	Blackbox	Accepted
5	Course Study Program	Blackbox	Accepted
6	Teaching Schedule	Blackbox	Accepted
7	Account Reference	Blackbox	Accepted
8	Visualization	Blackbox	Accepted
9	Logout	Blackbox	Accepted
Bauran App			
1	Login Page	Blackbox	Accepted
2	Notification	Blackbox	Accepted
3	Teaching Schedule	Blackbox	Accepted
4	My Courses	Blackbox	Accepted
5	Semester Lesson Plans	Blackbox	Accepted
6	Lesson Plans	Blackbox	Accepted
7	Curriculum Structure	Blackbox	Accepted
8	Learning Outcomes	Blackbox	Accepted
9	Profiles of Graduates	Blackbox	Accepted
10	Tracer Study	Blackbox	Accepted
11	Logout	Blackbox	Accepted

Fig. 15 Performance test results from *Bauran*.

The evaluation process is carried out using the stress testing method by trying to create 20 virtual users by testing for 1 minute using the k6.io tool. This process is carried out to determine the performance of *Bauran* if 20 users are accessing it simultaneously. The results obtained from this process are the maximum response time value of 5327 milliseconds for 20 virtual users. The average time obtained during the test is 1880 milliseconds, and the 95% testing process takes less than 5263 milliseconds, as shown in Figure 15.

Fig. 16 Performance review on *Bauran*.

Meanwhile, the average response time of the tested system was 615 milliseconds, and 750 requests were made at an average rate of 11 requests per second. The results are shown in Figure 16.

C. *Evaluation Result*

After testing all the features that have been made on the website-based *Bauran* and also the Android application-based, before the software can be used publicly by lecturers in designing curriculum and lesson plans, an overall evaluation of the Bauran is carried out using the ISO 25010 Model. Evaluation using this model will be tested based on functionality, usability, reliability, efficiency, portability, and compatibility. This evaluation involved 15 lecturers and one software developer; the evaluation results based on each criterion are shown in fig. 17.

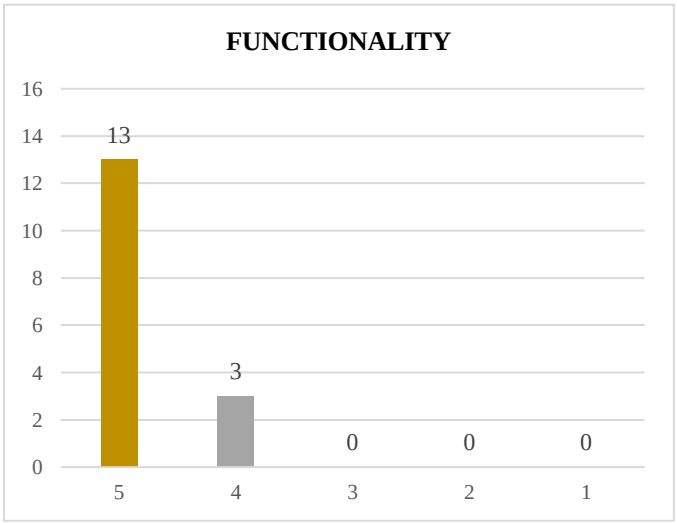

Fig. 17 Functionality evaluation results on *Bauran*

Figure 17 above shows the results of the user's evaluation of the Functionality of *Bauran*. These results indicate that 13 users choose a scale of 5, and 3 choose a ranking of 4. If the average is calculated from the overall ranking using the following mean formula:

$$\boldsymbol{mean} = \frac{\boldsymbol{Sum\ of\ all\ values}}{\boldsymbol{Total\ number\ of\ values}} \quad (1)$$

Then the mean is obtained as follows:

$$\boldsymbol{mean} = \frac{(\mathbf{13}\times\mathbf{5}) + (\mathbf{3}\times\mathbf{4}) + (\mathbf{0}\times\mathbf{3}) + (\mathbf{0}\times\mathbf{2}) + (\mathbf{0}\times\mathbf{1})}{\mathbf{16}}$$

$$\boldsymbol{mean} = \frac{\mathbf{77}}{\mathbf{16}} = \mathbf{4,81}$$

From these calculations, the functionality criteria on Bauran get a mean of 4.81.

Furthermore, on the usability criteria, the scale of the data obtained from the respondents is in the following chart:

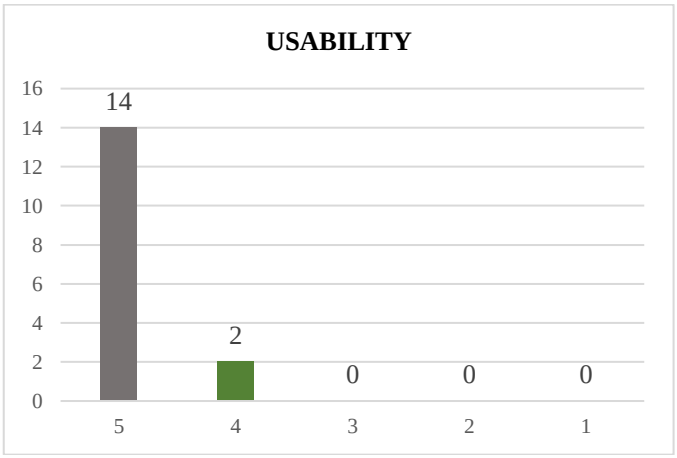

Fig. 18 Usability evaluation results on *Bauran*

Figure 18 above shows the results of user evaluation of usability on *Bauran*. These results indicate that 14 respondents (users) chose a scale of 5, and the remaining 2 chose a scale of 4.

$$\boldsymbol{mean} = \frac{(\mathbf{14}\times\mathbf{5}) + (\mathbf{2}\times\mathbf{4}) + (\mathbf{0}\times\mathbf{3}) + (\mathbf{0}\times\mathbf{2}) + (\mathbf{0}\times\mathbf{1})}{\mathbf{16}}$$

$$\boldsymbol{mean} = \frac{\mathbf{78}}{\mathbf{16}} = \mathbf{4,87}$$

From the results of these calculations, usability criteria get a mean of 4.87.

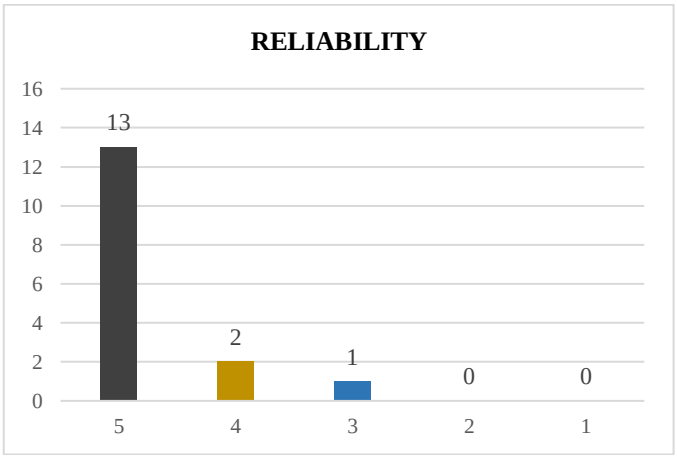

Fig. 19 Reliability evaluation results on *Bauran*

The results of the evaluation of the reliability criteria are shown in Figure 19. These results show that 13 respondents (users) chose a scale of 5, 2 respondents chose a scale of 4, and the remaining 1 chose a scale of 3.

$$\boldsymbol{mean} = \frac{(\mathbf{13}\times\mathbf{5}) + (\mathbf{2}\times\mathbf{4}) + (\mathbf{1}\times\mathbf{3}) + (\mathbf{0}\times\mathbf{2}) + (\mathbf{0}\times\mathbf{1})}{\mathbf{16}}$$

$$\boldsymbol{mean} = \frac{\mathbf{76}}{\mathbf{16}} = \mathbf{4,75}$$

From the calculation of the mean on the Reliability criteria, the result was 4.75.

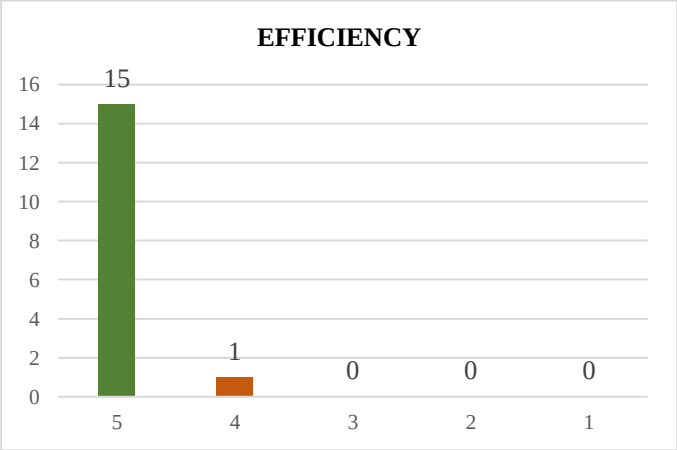

Fig. 20 Efficiency evaluation results on *Bauran*

The evaluation results on the Efficiency criteria showed that as many as 15 respondents (users) chose a scale of 5, and the remaining 1 chose a scale of 4, as shown in Figure 20.

$$\boldsymbol{mean} = \frac{(\mathbf{15} \times \mathbf{5}) + (\mathbf{1} \times \mathbf{4}) + (\mathbf{0} \times \mathbf{3}) + (\mathbf{0} \times \mathbf{2}) + (\mathbf{0} \times \mathbf{1})}{\mathbf{16}}$$

$$\boldsymbol{mean} = \frac{\mathbf{79}}{\mathbf{16}} = \mathbf{4,94}$$

The mean obtained from the calculation results on the Efficiency criteria is 4.94.

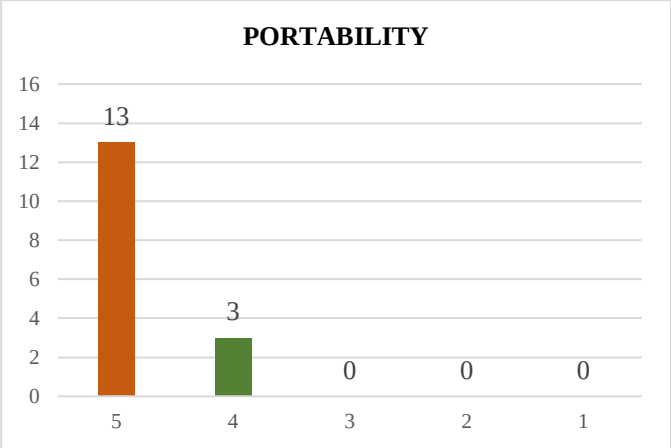

Fig. 21 Portability evaluation results on *Bauran*

The results of the evaluation of respondents (users) obtained from the Portability criteria, as shown in Figure 21, are the same as the Functionality criteria, namely as many as 13 users chose a scale of 5, and 3 of the rest chose a scale of 4.

$$\boldsymbol{mean} = \frac{(\mathbf{13} \times \mathbf{5}) + (\mathbf{3} \times \mathbf{4}) + (\mathbf{0} \times \mathbf{3}) + (\mathbf{0} \times \mathbf{2}) + (\mathbf{0} \times \mathbf{1})}{\mathbf{16}}$$

$$\boldsymbol{mean} = \frac{\mathbf{77}}{\mathbf{16}} = \mathbf{4,81}$$

The mean obtained from the *Bauran* evaluation on the portability criteria is 4.81.

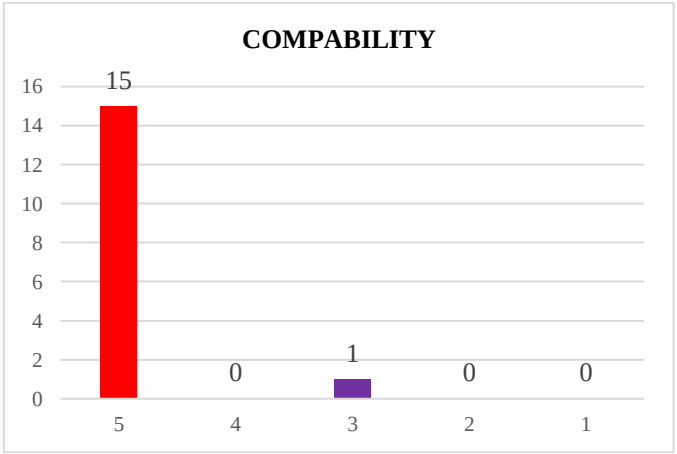

Fig. 22 Compability evaluation results on *Bauran*

The final evaluation process is carried out on the Compatibility criteria. The results obtained from users on this criterion show that as many as 15 users chose a scale of 5, and the remaining 1 chose a scale of 3, as shown in Figure 22. To find out the mean obtained on these criteria, the following calculations are carried out:

$$\boldsymbol{mean} = \frac{(\mathbf{15} \times \mathbf{5}) + (\mathbf{0} \times \mathbf{4}) + (\mathbf{1} \times \mathbf{3}) + (\mathbf{0} \times \mathbf{2}) + (\mathbf{0} \times \mathbf{1})}{\mathbf{16}}$$

$$\boldsymbol{mean} = \frac{\mathbf{78}}{\mathbf{16}} = \mathbf{4,87}$$

The results obtained from the calculation of the mean on the Compatibility criteria are 4.87. These results are the same as the evaluation process on usability criteria carried out previously.

The average final result of the evaluation calculation process using the criteria in the ISO 25010 model can be seen in Table III below.

TABLE III
BAURAN EVALUATION RESULTS USING ISO 25010 MODEL

Criteria	Mean	Qualitative Description
1. Functionality	4.81	Very Good
2. Usability	4.87	Very Good
3. Reliability	4.75	Very Good
4. Efficiency	4.94	Very Good
5. Portability	4.81	Very Good
6. Compatibility	4.87	Very Good
Overall Mean	4.84	Very Good

The final result of the calculation process shown in Table III shows that *Bauran* gets an average score of 4.84 out of a total of 5. It can be concluded that *Bauran* has worked well, has good quality, and is by the needs of lecturers in designing the curriculum.

IV. CONCLUSION

Bauran is an application of the results of Excellent Applied Research in Higher Education (henceforth referred to as PUTPT) activities that have been developed to assist lecturers throughout Indonesia in designing Learning Outcomes (LO), learning lesson material, and also Blended Learning Schedules during the COVID-19 pandemic. 19. This software is created using the prototype method because it can adapt and be flexible to changes requested by the client during the

development stage. From the user software testing process, *Bauran* can run well, and all the features are working correctly. In addition, in the evaluation process using the ISO 25010 model involving as many as 15 lecturers and one software developer, *Bauran* got an excellent overall average, so it can be concluded that the software is ready to be used by lecturers in designing curriculum and lesson plans. In further research, it is hoped that there will be developments in the evaluation process using the ISO 25010 model, and it is expected that there will be additional tools used in the software testing process.

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