



Software as a Service-based Integrated Interactive Online Course System

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Abstract

Several online learning platforms use recorded videos as a medium for delivering their material. In addition, several applications, such as Zoom, Google Meet, and WhatsApp, can help communicate interactively during this learning process. However, because the application is still separate from the existing online learning platform, users must switch applications and make the necessary data settings. Another obstacle experienced is that not all online learning service providers can have the infrastructure to use online learning systems, especially if the providers are individuals. This research uses a simple sequential method and aims to build an integrated online course system equipped with an interactive learning management system that many online courses, in general, can use. The main features are submissions of new courses by teachers, ordering courses by students, classes can be held using live video streams, the interaction between teachers and students in real-time with live chat, and a learning management system that includes sending and receiving assignments and quizzes. The test results show that as many as 73.2% of respondents gave the highest score for the built system.

Keywords: cloud computing; learning management systems; live streams; e-learning; configurable system.

1. Introduction

The COVID-19 pandemic has made learning systems in the world and Indonesia increasingly use online learning facilities, including the increasing number of online courses developing during this pandemic [1]. Until now, in the world in general and Indonesia in particular, many online course platforms are well known by the public, starting from Coursera, Udemy, and many other media [2]. Regardless of a pandemic or pre-pandemic conditions, it is undeniable that online learning is increasingly popular [3]. By the end of 2020, the total number of users with the status of students in an online learning platform called Ruang Guru had reached 22 million people [4]. Video has become a learning media widely applied in online learning platforms or courses. However, some are still in the form of recorded videos. Consequently, they cannot interact directly at that time. Until now, the real-time video or live streaming video feature has not been widely implemented on e-learning platforms in Indonesia. Even for some who have implemented live streaming videos, interactions with teachers are still not good because only of comments on the video. Therefore, it is very likely that the teacher missed or did not read, which could not be discussed directly in the current session. Live streaming is similar to live broadcast, where the recording and viewing time

coincide. The development of a good e-learning system is very dependent on the accuracy of a good Learning Management System design [5].

Less interactive learning will tend to be boring, while on the other hand, learning that can increase interaction between participants will make learning outcomes better [6]. In addition, applications that can help increase interactivity, such as Zoom, Google Meet, and the like, are separate from existing online learning platforms; consequently, the data on the online learning platform will not be connected to these additional applications. Whereas system integration in online learning is needed to ensure a learning system can run well [7]. Another problem is that not all teachers who want to open online courses can have their online learning infrastructure, especially if the teacher is an individual.

The development of software as a Service in various industrial sectors [8] can be seen as an opportunity that can also be used on online learning platforms. Moreover, submission of material using live stream video media and live chat features can make online learning more interactive [9]–[15] because there can be direct interaction between teachers and students during the learning process. These are some reasons behind the development of an integrated interactive online course

system based on this software as a service. The goal is that students can interact with teachers directly and can provide interactive interactions with each other during the teaching and learning process. Therefore, it is hoped that later every teacher, both institutional and individual, can use this software service to improve online learning.

Online learning is an activity that can be done without being limited by time and place [16]. This impacts access to learning material activities that can be carried out more flexibly. This learning process is also often referred to as online courses, e-learning, virtual classes, or online tutoring. In order to run better, online learning requires a system known as a Learning Management System. In 2016, Hernawati and Aji explained that the Learning Management System is a computer-based system that can make it easier for users to plan, manage, and represent teaching materials by providing facilities for easy interaction between students and teachers [17].

Meanwhile, in 2011 another study stated that the Learning Management System is a system that can track, design, and provide online learning materials [18]. Another study noted that the Learning Management System is a learning tool containing all learning materials that can be accessed easily without being limited by space and time [19]. However, it should also be noted that several sub-systems must be included in the Learning Management System, namely the sub-system for creating content, the sub-system for distributing content, and the sub-system for accommodating students' work [20]. Therefore, the LMS on the online course site that is created will be equipped with a system that can cover it all. The terms work from home and learn from home are increasingly popular during this pandemic. This is also due to conditions that force everyone not to gather and crowd together. In addition, it is also felt that working from home is more time-saving in some fields of work because there is no need for travel time from home to the office. The Central Statistics Agency noted that the number of people who did not work in Indonesia during the last 1 year from 2019 to 2020 increased by 60 thousand people. This is in line with research conducted in 2011 where it was found that there was an increase in unemployment in Indonesia from 1980 to 2007 [21]. This online learning system is seen as an alternative solution and opportunity to help increase job opportunities, especially for teachers.

In 2020, Fithri et al. analyzed that many schools under Kudus Regency PGRI only rely on face-to-face learning methods without online media. Some schools that already have online media are still separate because every school that can develop e-Learning will develop it themselves. Meanwhile, schools with insufficient budgets to develop and maintain their own e-learning systems are forced to continue relying on face-to-face

learning methods. At the same time, online learning methods can have many advantages because they are not limited by place or time. Therefore, the software as a Service platform is seen as an opportunity that can equalize the use of e-learning in every school under the auspices of PGRI Kudus Regency. In a study by Fithri et al., an e-learning system based on Software as a Service was developed. It is hoped that this system can be used by all schools, exceptionally high schools, under the auspices of PGRI Kudus Regency [22].

In Figure 1, the PGRI Kudus E-Learning administration page shows the main view of the administrator page, where on this page, various menus are displayed for setting student data and data related to learning, namely materials and quizzes. However, this system has not seen any interactive features that can be used by students and teachers to support the teaching and learning process better.

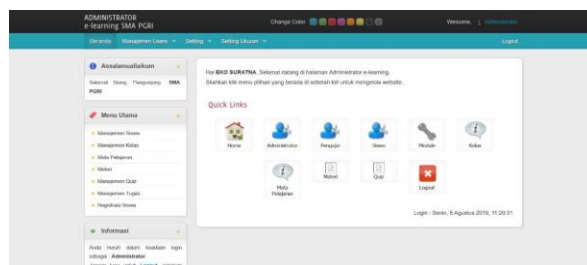


Figure 1. PGRI Kudus E-Learning administration page

Garov et al. researched to develop e-learning based on Software as a Service at Plovdiv University. The thing that underlies this research is the need for a platform to be used as an e-learning course for "Web Programming" by various users. This study uses wordpress as the basis of the website built later [23].

Figure 2 the SaaS-based WordPress e-learning setup page, shows the WordPress settings page that the user can access after registering an account on this e-learning application. Later, after being recorded, the user can manage the material that appears in the courses created. The material can be in the form of text files or video files. However, because it depends on WordPress, the interactive features will also depend on the availability of add-ons provided by the WordPress platform.

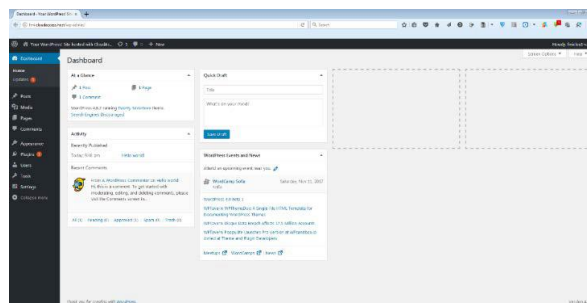


Figure 2. SaaS-based WordPress e-learning setup page at Plovdiv University

In addition, because users can make settings very freely, it has the potential to be challenging to create a manual for using this system. Ultimately, this impacts users who have to learn more about the WordPress platform and the add-ons used.

This research was conducted by Liu et al. in 2020 after analyzing that there are 311 learning centers outside the campus spread over more than 20 provinces in their area. However, not all these learning centers have sufficient funding to build and maintain their e-learning system. So in this research, e-learning will be developed with a Software as a Service approach. It is hoped that this e-learning will be flexible enough to be used by all existing learning centers without the need to provide additional funds for system development [24].

Each learning center must register in advance to obtain its e-learning. After registering, the system administrator will set up login access, teacher data, student data, and various information on the newly registered e-learning. In addition to the system administrator, there will also be a visitor user, who can only see it, as well as students and teachers who can access and provide learning materials in a learning session. Teachers can provide material in the form of text, online streaming video, to Q&A. In Figure 3, the main page of the configured student is shown as the start page of the student who will participate in the learning process. Students will still feel that e-learning belongs to the learning center they are participating in because the system administrator will adjust all menus and settings for each registered learning center. However, in this study, the interactive method offered has not been seen to be integrated directly into existing video features.



Figure 3. Configured student homepage design at Liu et al. research

2. Research Methods

This study uses a simple sequential method, as shown in Figure 4. After a literature study of similar e-learning systems has been carried out, a new approach is immediately developed [25],[26], with various advantages compared to the system analyzed in the

literature study. The development stage is divided into two sub-stages: backend development, which will contain multiple features for administrators, and frontend, which includes various components for teachers or students. This division into two sub-stages is done so that the development per sub-stage can be more focused, and the backend part is also the basis of the frontend part. First, programming is done on all the main features and supporting features. The next stage enters the trial and evaluation stage. At this stage, testing of the entire system will be carried out. Tests will be conducted to look for bugs, errors, and problems. If bugs, errors, and issues are found, they will be immediately addressed until no more bugs, errors, or problems are found. The evaluation section will be carried out by involving the general public to finally be asked to conduct an assessment of the system created. After the trials and evaluations have been completed, conclusions and suggestions for further research development can be drawn up.



Figure 4. Research method flow

3. Results and Discussions

The result of this research is to create an online course system that is equipped with an interactive live stream. The system will be built using the PHP programming language with the Laravel 8.0 framework with a DBMS using MySQL. There are four main features, namely submitting courses for teachers, ordering courses through the store, a learning management system that is also equipped with live stream and quiz features, and the last one is live chat. After the system is successfully implemented, an evaluation of the system that has been built will be carried out. The built features will be explained through the following points.

3.1 Course Submission

This feature is only given to teachers. Teachers who wish to apply for a course can submit a new course via the Workspace page. Teachers only need to fill out the form provided, which the admin will check to consider whether they will be accepted or not. In addition, the teacher must enter the live stream schedule if the proposed course is a live stream course. Approved course submissions will be entered on the Shop page. Figure 5 Course Submission Form is a display of the course submission page, where on this page, the user can fill in the course title and description. On this page, users can also enter the price of the course, as well as a cover image which will later appear as the identity of this course and can attract users to take this course.

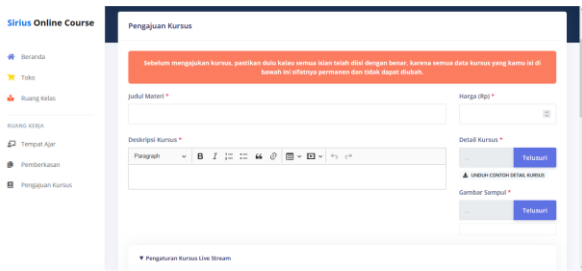


Figure 5. Course application form

Figure 6 Live Stream Schedule Form is a live stream schedule that teachers need to add. In this form, the user can fill in the date range of the live stream that will take place. After that, you can also fill in each day's starting and ending hours.



Figure 6. Live Stream Schedule Form

3.2 Store

The system developed is an online course, so a shop feature is needed so that students can order the courses they want to learn. The store will display all regular courses and live stream courses with scheduled status, equipped with a filtering function to make course search easier. The payment gateway in this store feature will use iPaymu. The display of the Shop page can be seen in Figure 7 Shop Page. On this page, an online course looks like an online store that sells a wide variety of materials that prospective students can follow and study. Each material product will have a pre-arranged image.



Figure 7. Shop page

Meanwhile, Figure 8 of the Cashier's Page from iPaymu shows the payment methods supported by this e-learning platform. iPaymu is the preferred payment portal platform, and through this portal, you can see various payment method options. This variety of payment methods is expected to make it easier for users to transact on this e-learning. In addition, the use of

third-party payment portals is expected to increase user confidence in the e-learning platform that was built.

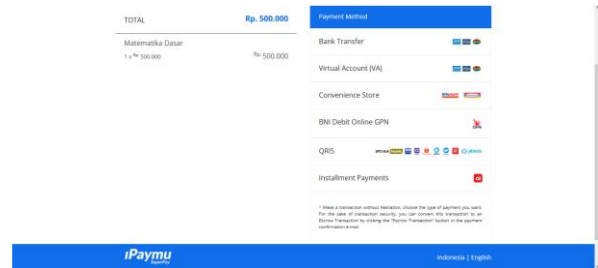


Figure 8. Cashier page of iPaymu

3.3 Learning Management System

This feature includes all the features that handle the delivery of learning materials, the delivery and completion of assignments, the creation and completion of quizzes, and the teacher's assessment of student assignments and quizzes. The Learning Management System in the online course that has been built is called an Activity. Activities used to deliver material are Link, File, Video, and Live Stream Activities. Assignment Activities (Online Text), Assignments (File Upload), and Quiz are used to submit assignments. Although link and File Activities are only displayed in the form of buttons, the display can be seen in Figure 9 Link Activities and File Activities. On that page, students can download assignments or view links provided by the teacher.

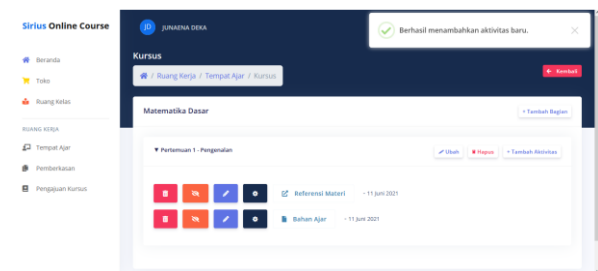


Figure 9. Link activities and file activities

For Video Activity and Live Stream, it is shown on another page which for Video Activity can be seen in Figure 10 Video Activity. On this page, students can view videos uploaded by the teacher on YouTube and then insert the YouTube link into this e-learning.

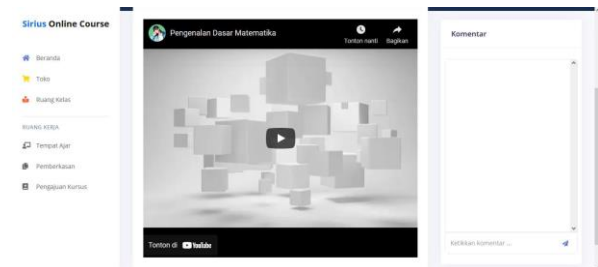


Figure 10. Video Activities

As seen in Figure 10, in this video activity, students can also leave comments that can be read by the teacher or by other students. This is done to increase interactivity between e-learning users.

Figure 11 Live Stream Activities shows the real-time live stream model supported by this e-learning platform. This feature will take advantage of Youtube Live, which has been integrated into this e-learning platform. This feature allows teachers to teach directly on a predetermined schedule regularly. Youtube was chosen as an integrated streaming platform because it can adjust the quality of streaming video with the speed and stability of the internet and its users. This keeps users from being able to take online lectures well because the video will not immediately disconnect even if the internet connection suddenly drops. Still, the video will only adjust the resolution. So that online lectures will continue to run with lower video quality but not be interrupted.

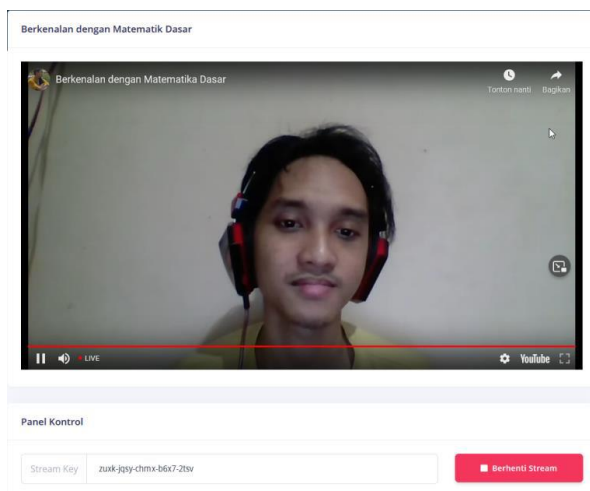


Figure 11. Live stream activities

Assignment Activity Display (Online Text) can be seen in Figure 12. Users can enter narration or sentences using the Rich Text Editor on this page. Therefore that users can perform standard formatting on the writing. Possible formats include bold, italic, numbering, creating tables, and creating hyperlinks from the text that point to other web pages.

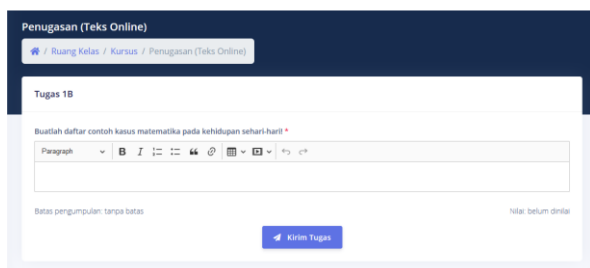


Figure 12. Task activities (online text)

In contrast to the assignment activity in the form of online text, the file upload assignment activity page can be seen in Figure 13. On this page, navigation is made as simple as possible so that users will not be confused using it. There is an input to be able to enter the file and a button to send the file. While at the bottom, there is a list of files that have been successfully uploaded related to the collection of assignments in the form of files.

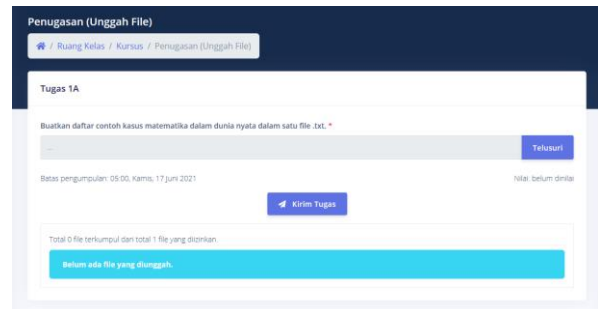


Figure 13. Task activities (file upload)

The final part of the activity input is the Quiz Activity which can be seen in Figure 14. Each quiz question that the teacher has made for students is displayed on this activity page. Students can submit their answers via this page as well. On this page, there is also navigation to move between questions more easily on the right. In addition, this page also displays the countdown time of each quiz that will be taken by students so that through this time information, students can easily make estimates in working on each existing quiz.

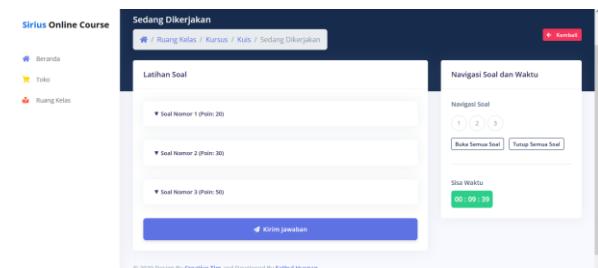


Figure 14. Quiz activities

The assessment of assignments from the Assignment Activity is done easily by using the assessment pop-up, as shown in

Figure 15. In this pop-up window, the teacher can directly fill in the value for each student's work, and then there is a button to save the score.

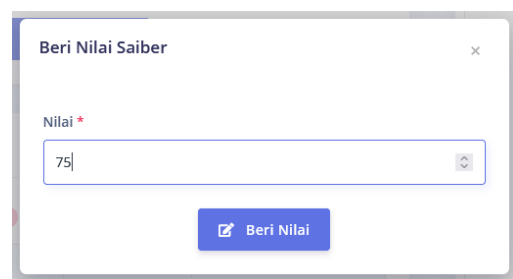


Figure 15. Assessment of assignments

Grades must be filled in before committing; in other words, the teacher cannot empty the grades from students in the assessment of this assignment activity.

The assessment of the quiz work will be slightly different from the assessment of the work of the assignment. In the quiz assessment, if the quiz is in the form of multiple-choice, the assessment can be done automatically by the system. Later, the teacher can also add additional notes to the assessment of each existing quiz question. As shown in Figure 16, a column for each system assessment result allows teachers to provide additional notes regarding the assessment results. In addition, on this assessment page, there is also navigation between questions, making it easier for teachers to move from one question to another.

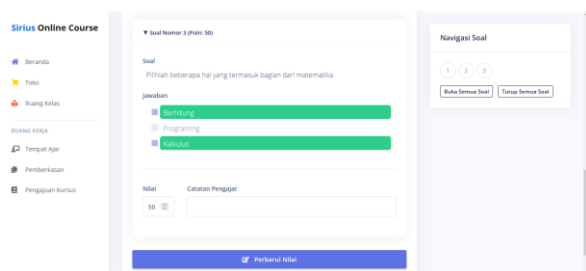


Figure 16. Assessment of Quiz Work

3.4 Live Chat

This feature will be used as a communication medium between teachers and students while teaching is in progress. This feature will be placed on each Video Activity, Live Stream Activity, and Assignment Activity so that teachers and students can interact with each other in real-time while learning is in progress. This live chat feature will never be closed and will be opened later in the learning session.

Figure 17 shows the live chat feature that is implemented on the online course site that has been developed. On this chat feature page, use the chat bubble design as in chat applications in general.

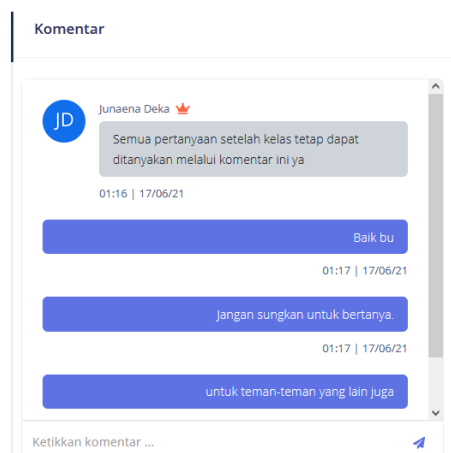


Figure 17. Live chat features

The information that appears is the user's name and the date and time of each chat sent. In contrast, the column for writing chat has the same form as chat applications in general, namely an input text and a button to send a chat that has been typed.

Evaluation is done by the validation method. This process involved 41 respondents, with 31 as students and ten people acting as teachers. Students come from people with various backgrounds, education, interests, and expertise. The age range of the student respondents was between 15 and 21 years old, with junior high school to tertiary education levels.

Teachers are people who have at least taught, been an assistant to a teacher, or have spoken in public. The age range for teacher respondents is between 19 and 40 years old, with jobs as teaching assistants, teachers, and lecturers. Validation is done using a questionnaire whose questions are about how easy it is to use the site's main features that have been developed after the respondents have tried these main features.

Table 1 shows the results of the questionnaires that the 31 students have filled out. From the questionnaire results, it can be concluded that most students feel that the main features provided are easy and very easy to use.

Table 1. Questionnaire results with student respondents

No	Features	Rating of Each Feature Based on Ease of Use			
		Very difficult	Difficult	Easy	Very Easy
1	Order a course in the Store	3.23%	6.45%	35.48%	54.84%
2	Take a live stream class		6.45%	25.81%	67.74%
3	Interaction with students via live chat	6.45%	9.68%	19.35%	64.52%
4	Send and receive assignments		6.45%	35.48%	58.06%
5	Take quizzes, exams, and tests		6.45%	32.26%	61.29%

The results of the questionnaire obtained from 10 teachers can be seen in Table 2. From the results of the questionnaire, it can be concluded that most teachers find it easy and very easy to teach activities on the online course site that has been developed. However, some say it is challenging to run live streams because the process requires 3rd party applications to broadcast the stream. Some people also say that using live chat is difficult, but it is not how you use it but because there are no notifications.

Table 2. Questionnaire results with teacher respondents

No	Features	Rating of Each Feature Based on Ease of Use			
		Very difficult	Difficult	Easy	Very easy
1	New course submission			50%	50%
2	Submit material			10%	90%
3	Running a live stream	10%	20%	60%	10%
4	Communication with students		10%	30%	60%
5	Submit an assignment				100%
6	Create quizzes, exams, and tests			10%	90%
7	Assignment assessment			10%	90%
8	Assessment of quiz, exam, or test results			10%	90%

All respondents were also asked to rate the entire system from 1 to 4, where one was "Very Bad," and four was "Very Good." Although, as shown in Table 3, of the 41 respondents, most of the respondents said that the site that had been developed was very good, even when asked for criticism, suggestions and messages, some respondents hoped that the site that had been developed could replace the online learning system on campus or school.

Table 3. System overall score questionnaire results

System Overall Rating			
1	2	3	4
		26.8%	73.2%

4. Conclusion

Conclusions are drawn based on what has been done when verifying and validating the site that has been developed. Based on this, it can be concluded that the online course site has been created according to the original purpose of this system. Every main feature on the site that has been developed has been successfully created with an easy flow for most people to follow. But it needs to be re-optimized for ordinary people. The wider community can use the system if it is seen from the number of respondents who rate the entire system with the highest score.

Some suggestions are obtained after considering the possibility of improving the performance of the site that has been developed. And some other suggestions were also received based on the respondents' opinions. The suggestions in question are to make live chats from special students only to teachers with notifications in the form of sound, set live stream latency, and send notifications via email to students when a new live stream class waiting room is created. In addition, suggestions from respondents were also found to be able to carry out class activities through third-party online meeting applications and reconsider how to recruit new teachers through the system.

Acknowledgment

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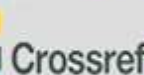
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