REST API and Message Broker RAbbitMQ for Integration of College Academic Information System

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Abstract

Data integration is frequently used in a variety of applications and necessity. In the process of teaching and learning activities, STIMIK ESQ also has a Learning Management System (LMS), which is an e-learning system based on Moodle. For each class period, lecturers must complete a process to enter attendance information into the academic information system (AIS). A web-based system called AIS is used to track academic activity, class attendance, instructors, and student data. The lecturer must extract attendance information from the LMS in the form of an excel file, sort the information, and then categorize the data according to the study plan of each student. Manually entering attendance data takes between five and ten minutes. Processing all attendance for 12–15 courses takes 7–10 seconds after the assessment procedure. The STIMIK ESQ academic administrator downloads the excel file from AIS during the enrollment process and afterward creates a class on the LMS. The downloaded data is modified to fit the template specified for the LMS import procedure. Data entry for enrollment takes roughly 7 to 10 minutes. It takes between 10 and 15 seconds once the testing procedure is finished processing all courses for the odd semester of the 2020–2021 academic year. Data integration has been tested with utilizing RabbitMQ. The flexibility of REST, which can interface with two separate systems, and RabbitMQ, which can divide duties in processing a lot of data, are used in this research. In this study, the integration process is executed using a scheduler that will execute the integration process automatically.

Keywords *— Integration, LMS, Academic System, Rest API, Message Broker, RabbitMQ*

1. INTRODUCTION

Data integration is the process of combining one or more data to make it easier to share and analyze data, in order to support information management within the same ecosystem of work environment[1]. Data integration is frequently used in a variety of applications and is frequently used to test whether two sets of data are same. A system for academic information is available at STIMIK ESQ (ESQ College of Management and Computer Science) (AIS). An illustration of the student AIS website, a web-based AIS system for managing student data, lecturers, class attendance, and student academic activities, may be found in Figure 1.

This system was created using the PHP programming language with the CI framework and uses a MySQL database. The AIS system was used from 2015 to the present, AIS is used by students, lecturers, and staff of STIMIK ESQ.

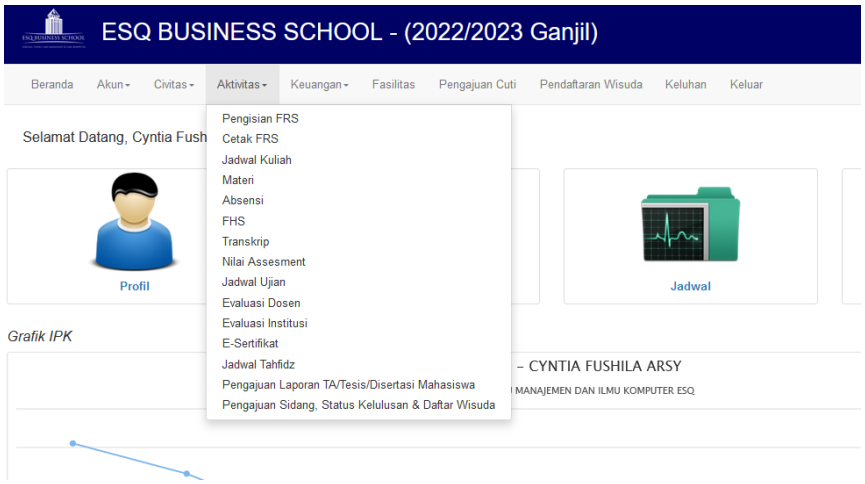

Figure 1. Student Academic Portal

And the next figure shows a student LMS page. As part of its teaching and learning processes, STIMIK ESQ uses an online learning platform called the Learning Management System (LMS) that using Moodle platform. Moodle or (Modular Object-Oriented Dynamic Learning Environment), belongs within the category of learning management systems (LMS) and course management systems (CMS). Moodle is a virtual learning environment (VLE), i.e. a platform for learning, which provides those who teach and those who learn with a comprehensive set of tools for computer-based learning. Among its the advantages are the ability to install educational resources (training materials), provide access to resources and manage them; promote interaction between participants of the educational process in the form of Internet conferences, forums, discussions, and the exchange of messages, which may include, tasks for students, comments on tasks, feedback and assessment[2]. The PHP programming language and the MySQL database are used to create the LMS system. Students, instructors, and academic staff at STIMIK ESQ have been using the LMS system since 2020. Students can fill out attendance forms, gather assignments, and communicate with lecturers and other students via the LMS system. The LMS system makes it easier for lecturers to deliver subject matter, collect assignments, process attendance and can create discussion forums with students.

Figure 2. Learning Management System

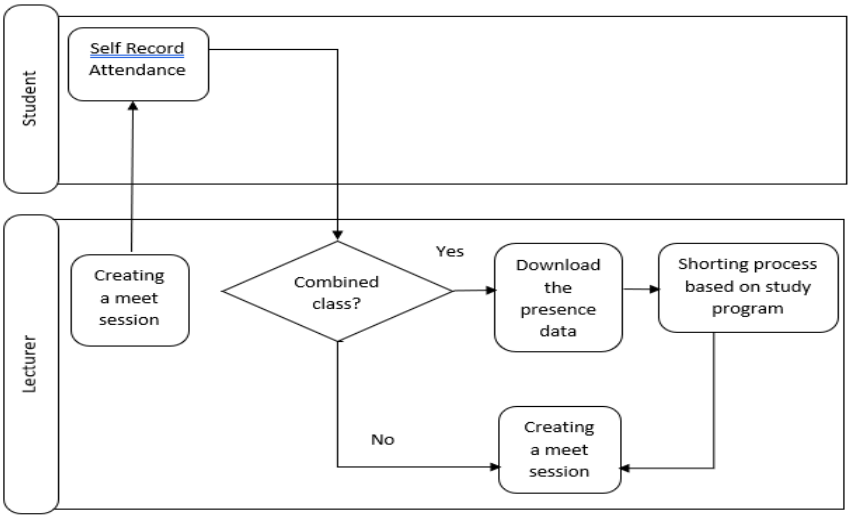

Figure 3. Attendance Process

The attendance procedure that takes place in the AIS and LMS systems is depicted in Figure 3. The lecturer must obtain attendance data from the LMS in the form of an excel file for the attendance procedure, sort the data, and then group the data according to the study program. The lecturer sorts the students, enter their information, and saves the attendance data based on the class session to the AIS system. If the class is not combined, however, the process is straightforward. The lecturer can view the attendance data from the LMS or enter the data immediately because the students have already learned it. There is no need to download and sift attendance data. The lecturer sorts the students, enters their information, and saves the attendance data based on the class session to the AIS system. If the class is not combined, however, the process is straightforward. The lecturer can view the attendance data from the LMS or enter the data immediately because the students have already learned it. There is no need to download and sift attendance data.

Based on the results of interviews and observations it takes about 5-10 minutes per session for combined courses. This is known based on an interview with one of the lecturers of the STIMIK ESQ character course. Course that have small class (not including combined classes) lecturers require a short time of about 2-5 minutes. This is because the lecturer had to memorize the students, then the lecturer input the attendance data into AIS by entering the data for students who did not enter that day. Cross-study programs make up the subject participants in the combined class, which has between 76 and 113 students enrolled. Small classrooms, with enrollment ranging from 3 to 67 persons, are frequently attended by students from a single study program.

Based on research connected to this subject from the past. The Moodle External Database Plugin, Simple Object Access Protocol (SOAP), Representational State Transfer (REST), and RabbitMQ are a few of the technologies that can be employed in this study. The benefit of using an external Moodle database is that it makes the integration process easier; nevertheless, the integration procedure is only one-way (Moodle System into Academic System). The advantages of SOAP have strict standards, but this method has strict standards, the drawback is that it requires a lot of adjustments when integrating an existing system[3]. REST has the advantage of being flexible, fast in performance, and can accept in several

formats including XML, JSON, and plain text[4]. RabbitMQ has the advantage of reducing the server load when the integration process is running. This method uses the concepts of queues and message-brokers[5]. Based on that, the author chose to use REST and RabbitMQ because of the flexibility of REST which can communicate with two different systems and RabbitMQ to divide tasks in processing a lot of data.

In order to assess the time needed and data accuracy of the LMS and AIS integration system, we will build a system to integrate LMS and AIS utilizing the REST API and Message Broker (RabbitMQ) approaches.

1.1. REST API

A REST API (also known as RESTful API) is an application programming interface (API or web API) that conforms to the constraints of REST architectural style and allows for interaction with RESTful web services. REST stands for representational state transfer[6]. In this case, the REST API once implemented for Academic Information System with two servers, it was explored how the performance with two parameters, which is response time and also throughput[7]. The REST API also used around 500 sites for developing their sites[8]. REST API is also used in other studies to develop e-learning systems to help online learning process during the Covid-19 pandemic, the result of its process is more easily synchronizing existing data and have a wider database storage[9].

1.2. Message Broker

Message Brokers are used for low latency communication various application hence, relieving the application from the burden of communication and focus on task at hand. Traditional messaging systems are incapable of handling the volume of big data[10]. The other study, message brokers were used to design a crawler system by implementing the distributed task architecture to get lots of data with optimization way[11].

1.3. RabbitMQ

RabbitMQ is a message-queueing software also known as a message broker or queue manager. Simply said; it is software where queues are defined, to which applications connect in order to transfer a message or messages. A message can include any kind of information. It could, for example, have information about a process or task that should start on another application (which could even be on another server), or it could be just a simple text message[12]. RabbitMQ acts as an intermediary between the various services. It is used to reduce the load and delivery time on server web applications by delegating tasks that would normally take a lot of time and resources[13]. In the other study, RabbitMQ is an efficient and scalable implementation of AMQP (Advanced Messaging Queuing Protocol) which is possible implemented in multiple queue[14]. AMQP (Advanced Message Queuing Protocol) is an informing convention that empowers adjusting client applications to speak with accommodating informing middleware representatives[15].

2. RESEARCH METHOD

There are various stages that must be completed in order to complete the trial phase of this study. This served on the illustration below of each step taken in the execution of this research.

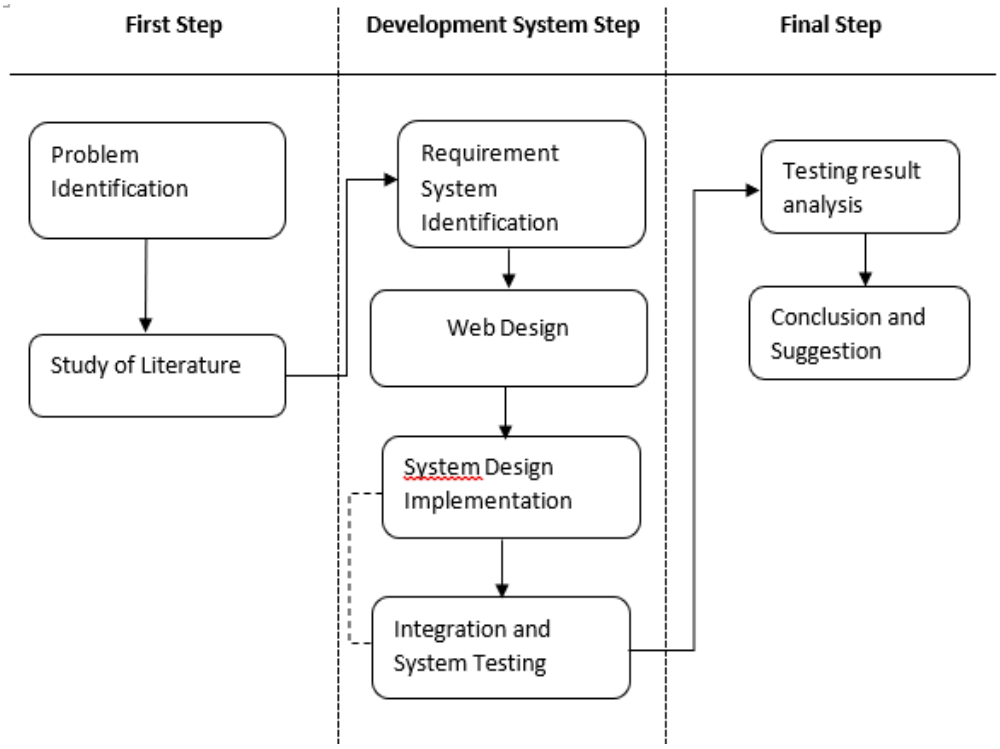

Figure 4. Research Method

According to Figure 4, this research stage's process is separated into three phases: the initial phase, the system development phase, and the concluding phase. The problem identification phase and the literature review were completed at the beginning. The lack of data integration between the AIS and LMS systems, as well as vice versa, caused the data entry procedure happened twice, which the researcher noted as a concern.

Researchers conducted interviews with the IT of ESQ Group Company team, which includes the person in charge of the LMS and AIS STIMIK ESQ, as well as the LMS and AIS STIMIK ESQ admin employees, at various stages of the system needs identification process. The system design process comes next when the system requirement identification step is finished. At this point, the system will be created based on the goals of the study and the determination of the system needs.

Up till the integration process and system testing are successful, the system implementation process is repeated. The system is implemented by building a web service using the PHP programming language, the Lumen framework, and the RabbitMQ message broker. Researchers also use git and the text editor Visual Studio Code to develop the system. The final step is to examine the study findings, come to conclusions, and provide recommendations after the system development stage has gone well.

3. RESEARCH RESULTS AND DISCUSSION

3.1. Running Attendance Process

The current flow of the attendance procedure is shown in Figure 5. The attendance data file from the LMS must be downloaded for courses with combined classes and multiple student study programs after the lecturer in order to classify student attendance according to the study program. The attendance data must then be entered for each study program and each course session. However, if it is not a combined class, the process is simple, the lecturer can directly enter attendance data because he already knows the students who take the class by heart or view attendance data from the LMS without having to download and sort attendance data.

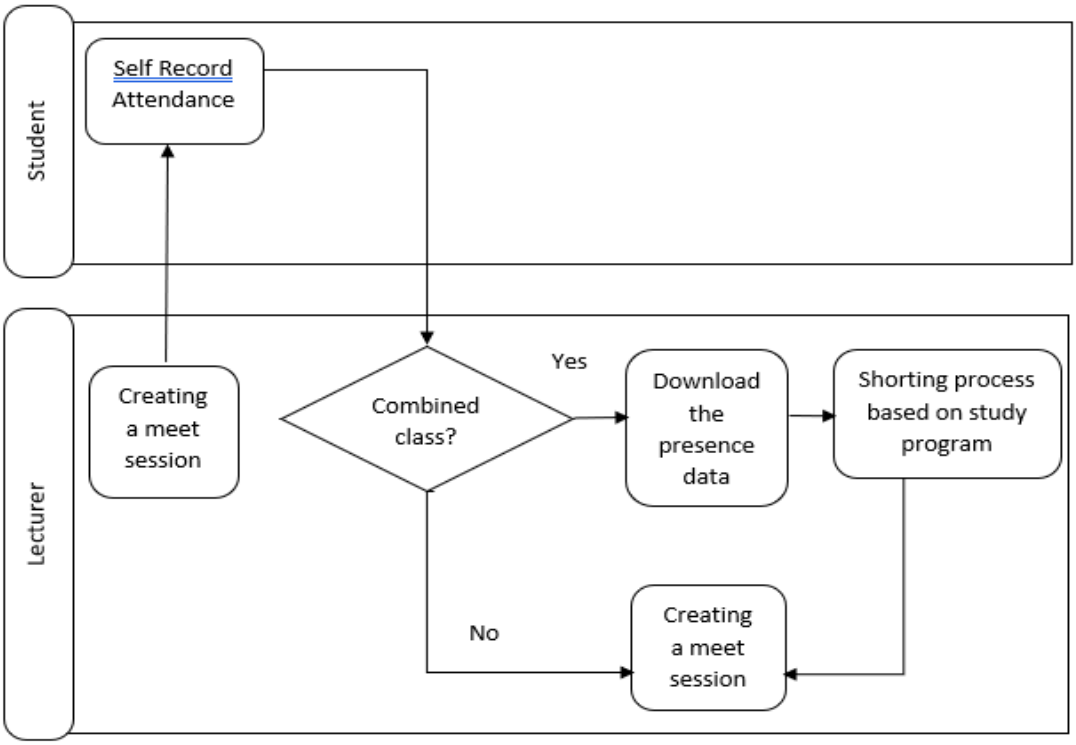

Figure 5. On going Attendance Process

3.2. Proposed Attendance Process

Figure 6 shows the flow of the attendance process proposed in this study. The process of integrating attendance data is carried out using a scheduler set every 23.00 hours, at that time all lecture sessions have been completed on that day. The integration process that occurs in the LMS system is getting course data on that day, getting class session data on that day, and getting attendance data for all sessions on that day. The data is sent by the integration system to RabbitMQ one by one, all session attendance data for courses are queued to be executed by RabbitMQ. Furthermore, RabbitMQ will run a queue to perform attendance on the AIS system based on student id, time schedule and courses.

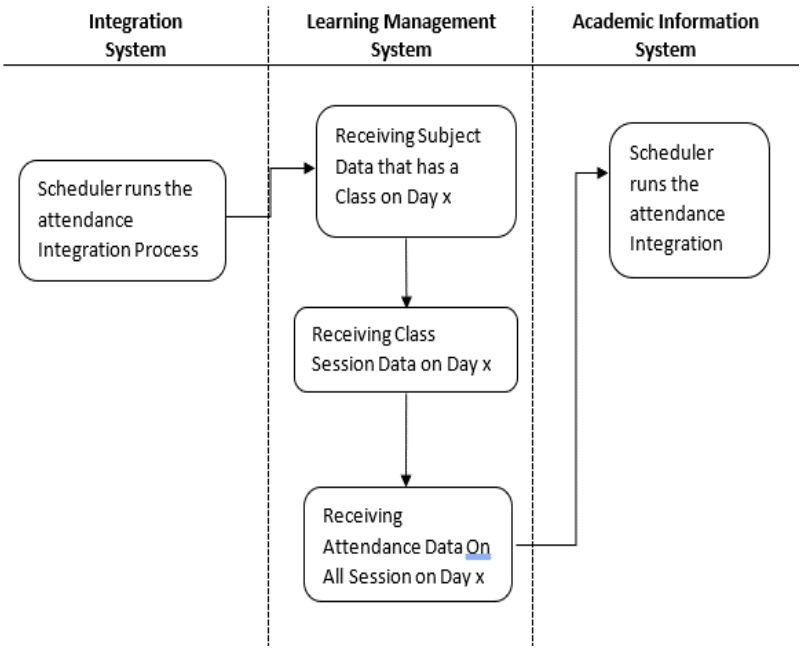

Figure 6. Attendance Process

3.3. Ongoing Enrollment Process

Figure 7 depicts the enrollment process, which is the procedure whereby a student completes a student study form in a particular semester with chosen courses and in accordance with the number of credits that have been determined based on the GPA/Social Studies scores from the previous semester. When the academic administrator opens the enrolling process, the student then submits a study form to the mentor lecturer for approval. Additionally, the academic administrator of STIMIK ESQ obtains the excel file from AIS once the registration period has ended. The downloaded data is changed to the template that has been provided for the LMS import procedure before it being used to create a new class.

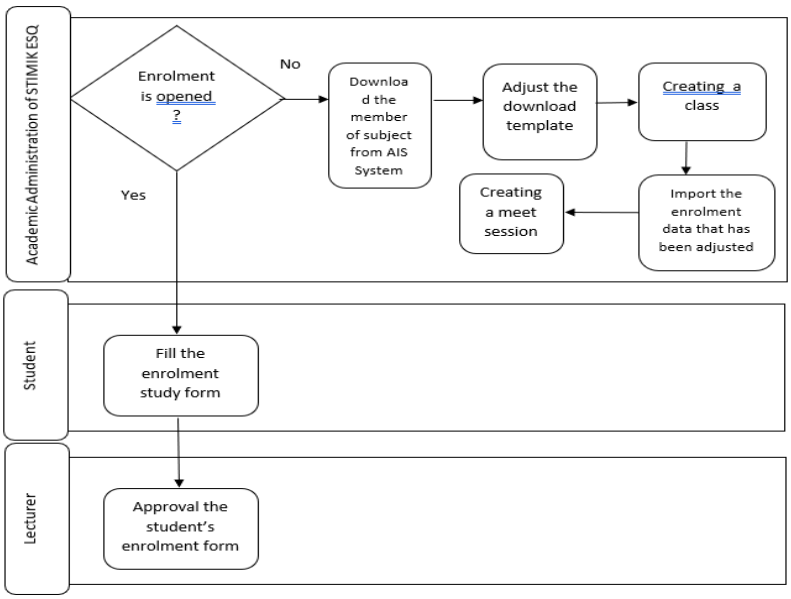

Figure 7. Enrollment Diagram Process

3.4. Submitted Enrollment Process

Figure 8 depicts the suggested enrollment procedure flow from this study. A scheduler is used to carry out the integration of enrollment data once the enrollment timetable has ended. The enrollment integration process will be finished by all students whose enrollment has been approved by their guardian lecturer. The enrollment integration procedure for the AIS system will compile data on current curricula, course timetables, lecturers who will teach the courses, students, and participants. This enormous amount of data is transmitted to RabbitMQ by the integration system, where it is processed separately. The lecturer's teacher enrollment procedure comes next. Once the lecturer process is finished, creating a student account or obtaining a student ID if you already have one is the next step. The account is then registered as a student. The next step is to schedule classes and courses, whether they are theory or practicum, based on the information in the AIS system.

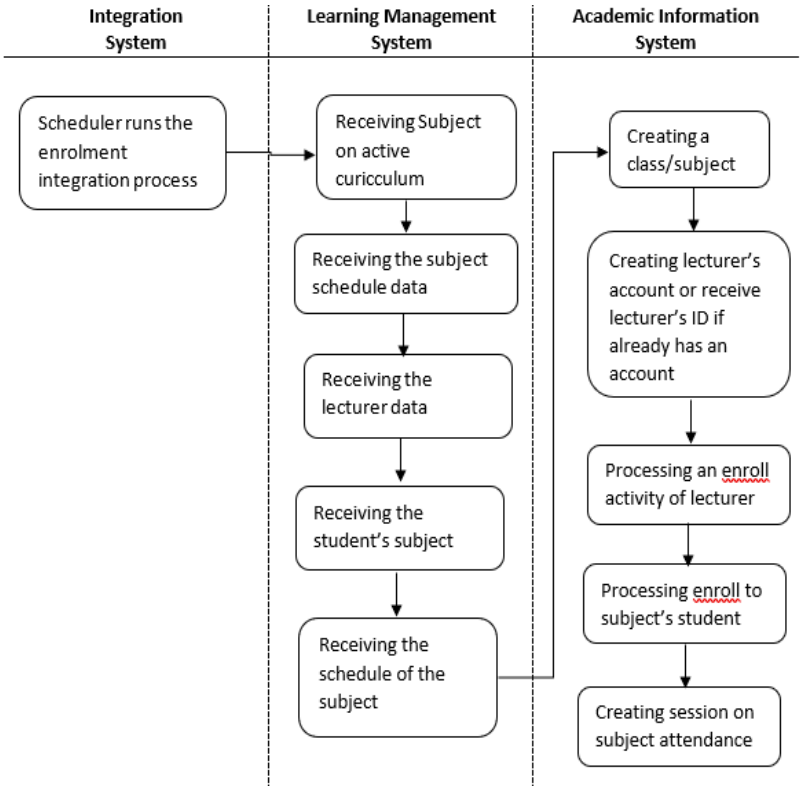

Figure 8. Enrollment Process Diagram

3.5. Integration Architecture

The system integration architecture employed in this investigation is shown in Figure 9. The server uses the scheduler to automatically start the integration system. The researcher employs a web function that is utilized for attendance integration to link with the Moodle LMS while the integration system is directly connected to the AIS database. Data is transmitted to RabbitMQ for processing after it has been obtained from LMS and AIS. Sending messages to the queue based on the routing key is the direct system used by the exchange system or data exchange in this study. The LMS system and AIS database integration process queue will be run by RabbitMQ.

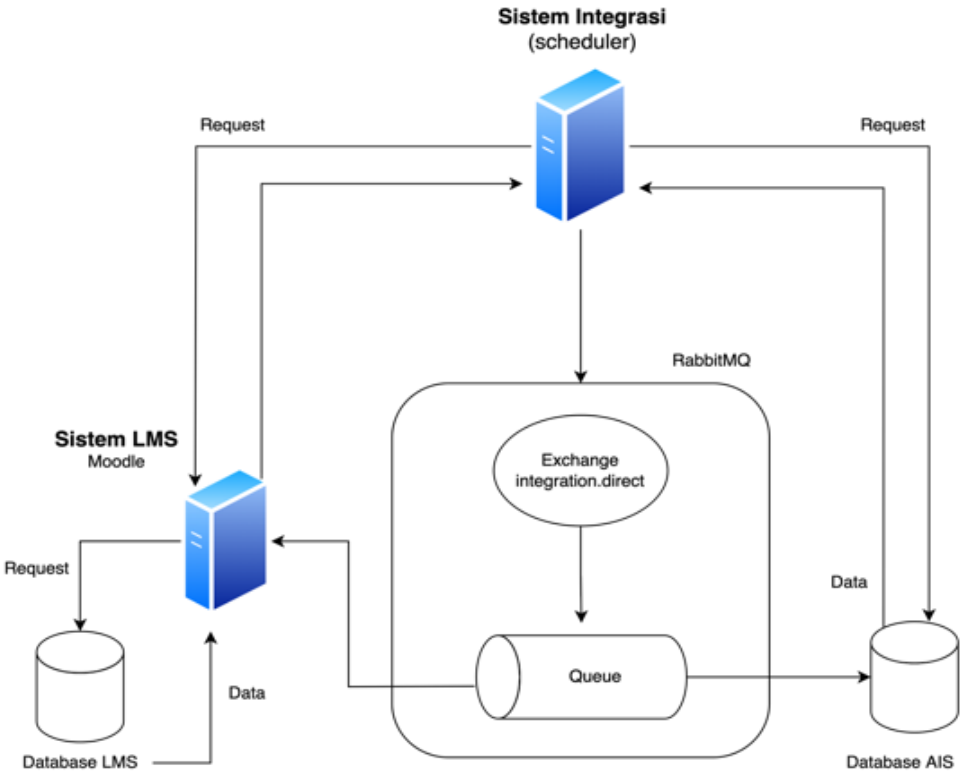

Figure 9. Integration System Architecture

3.6. Mapping System Data Integration

The data mapping that takes place in the LMS and AIS integration systems is displayed in Table 1. This mapping process is crucial for being able to adjust to the data already present in each database. In this study, there are 3 tables that need to be changed, and there are a total of 7 fields that need to be changed.

Table 1. Integration System Data Mapping

No	Learning Management System's Table	Learning Management System's Field	Academic Information System's Table	Academic Information System's Field
1	Course	Shortname	Curriculum detail	MKKode
		Fullname		Name
2	User	Username	Student	NPM
		Fullname		Name
		Email		Email
		Phone1		Phone
3	Attendance _status	Description	Student Presence	IDPresenceType

3.7. Enrollment Test Results

a. The Results of Enrollment Tests on Combined Classes

Figure 10. Enrollment Test Result on Combined Class

Figure 10 shows the results of the enrollment test in the combined glass. The data used in this test is real AIS data for the academic year 2020/2021 odd semester. In the combined class there are 8 courses, based on the results of testing the integrated data according to the data in AIS.

b. Enrollment Test Results in Computer Science Study Program

Figure 11 shows the results of the entrance exam for the computer science study program. This test was developed using actual AIS data from the odd semester of the academic year 2020-2021. There are nine courses in the computer science study program based on the outcomes of data testing that is integrated in line with the data in AIS.

Figure 11. Enrollment Test Results in Computer Science Study Program

c. The Results of Admissions Test of Business Management's Study Program

Figure 12. Enrollment Test Results in the Business Management Study Program

The enrollment test results for the study program in business management are summarized in Figure 12. Real AIS data from the odd semester of the academic year 2020–2021 was utilized to create this test. Based on the outcomes of data testing that is integrated in accordance with the data in AIS, there are 17 courses in the study program for business management.

d. Results of The Enrollment of Information System Program

Figure 13. Enrollment Test Results in the Information Systems Study Program

3.8. The Results of The Attendance Test

The attendance test results on April 7, 2022 are shown in Figure 14. The LMS attendance dummy data were the information used in this test. In this test, it was discovered that the data in the AIS system matched up with the number of absentees who attended but did not register in the LMS.

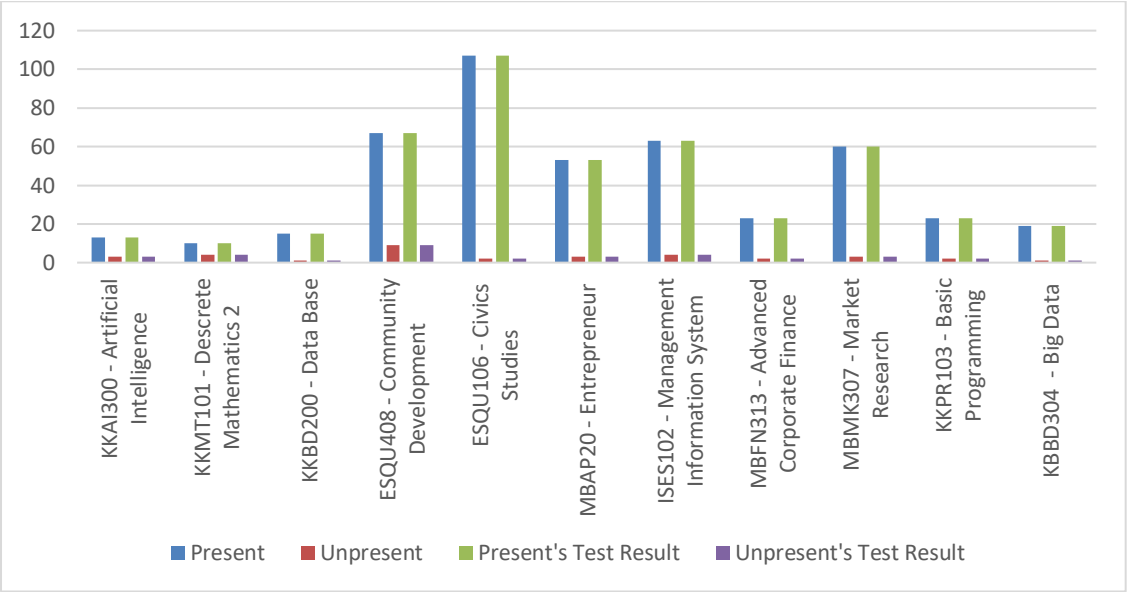

Figure 14. Attendance Test Results

3.9. Enhancement Suggestions

If there are students who unenroll, it has not been addressed in enrollment integration study. If there is a change in the course schedule, attendance integration has not been taken into account in this study. It is therefore hoped that additional study will fix this problem.

4. CONCLUSION

The following conclusions can be drawn from the findings of the analyses and experiments that have been done: Based on the test results, the duration of the attendance integration procedure is between 2.6 and 10 seconds. Based on the test findings, the enrollment integration procedure will take 7 to 15 seconds. Several tests that were conducted in this study and the corresponding test results were used to determine if the data on attendance integration and enrollment integration were accurate.

An overview of the enrollment test results for the study program in information systems is shown in Figure 13. Real AIS data from the odd semester of the academic year 2020–2021 was utilized to create this test. Based on the outcomes of testing the data that is integrated according to the data in AIS, there are 13 courses in the study program for information systems.

The following conclusions can be drawn from the findings of the analyses and experiments that have been done: Based on the test results, the duration of the attendance integration procedure is between 2.6 and 10 seconds. Based on the test findings, the enrollment integration procedure will

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