

## **Implementation of The Open Group Architecture Framework to See the Readiness of Smart Schools in Pekanbaru**

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### **Abstract**

*Smart Schools are a derivative of smart people in the 6 pillars of Smart City. Smart Schools is also a school concept utilizing information technology used in the teaching and learning process in the classroom and school administration. One of the schools in Pekanbaru City that will implement smart schools is Junior High School 17 Pekanbaru. Currently, the school already has several infrastructures including servers, laboratories, and administrative rooms, but it is necessary to analyze the technology architecture aimed at implementing Smart Schools. The technological architecture would be analyzed using TOGAF (The Open Group Architecture Framework) Framework version 9. The TOGAF framework is a framework for enterprise architecture which is able to develop an enterprise architecture in an organization. Enterprise architecture is an explicit explanation and current documentation of the relationship between management, business processes, and information technology. This research describes the current architectural conditions and target architectures to include the rules, standards, and lifecycle of information systems to optimize and maintain the environment of organizations that want to create and maintain by managing the IT portfolios. The results of this study are to produce an IT blueprint that is used as a school guide in implementing technology architecture to support the implementation of Smart Schools in Pekanbaru City.*

**Keyword:** TOGAF, Junior High School 17 Pekanbaru, Architecture Enterprise, Blueprint IT, Technology

### **1. Introduction**

Smart Schools is a school concept utilizing information technology used in the teaching and learning process in class and administration [1]. Learning technology is packed with the composition of digitalization, humanization, and naturalization. The composition is formulated to create learning that is not only a transfer of materials that merely measure aspects of knowledge and skills but also aspects of attitude. Schools that implement Smart Schools must reach existing infrastructure standards, including; Smart Library, Smart Classroom, and Smart Education [2].

In 2019, the implementation of Smart Schools in Pekanbaru has been carried out. It was marked by the symbolic handover of Smart Madani cards for Smart Schools and KIA by the

mayor to representatives of Pekanbaru Junior High School 4 students. The benefits of the Smart Madani card are identity, savings, and access to services [3]. One of the schools in Pekanbaru City that will also implement Smart School is Junior High School 17 Pekanbaru. Junior High School 17 Pekanbaru is the first high school established since July 1, 1986. The school that has been accredited A since 2016 was named by the Mayor of Pekanbaru, as a Child-Friendly School (SRA) in 2019 [4].

One of the preparations made to build a smart school is to look at the infrastructure owned by SMP N 17. The infrastructure focused on in this research is the technology part. Technology at SMP N 17 can generally be said to be quite good because it has several facilities such as servers, laboratories, networks, and so on. However, the use of this technology has not been maximized for implementing smart schools, so smart schools at SMP N 17 Pekanbaru are not yet running. It is very necessary to carry out a technology analysis to see the potential for implementing new technology that will be applied to the school. One way to carry out technology analysis is to use a framework that contains a technology architecture [5].

Technological architecture is a part of the phase-in TOGAF. This phase explains the desired technological architecture, starting from determining the type of technology candidates needed that include hardware, added with considering the alternatives needed in the selection of technology [6]. Therefore, the implementation of Smart Schools uses architecture enterprise in order to create a good business strategy. This is very necessary in order to improve the quality of service to parents and students. In supporting the strategy, it needs information systems and qualified information technology. Technology can increase students' learning motivation, facilitate and shorten the school management process, so that later it is necessary to create an integrated information system [7]. Enterprise architecture has an important meaning for an organization because one of the results is the realization of harmony between information technology and business needs. Some of the advantages of a good corporate architecture are more efficient information technology operations, profitable investments, reduced risk in terms of deviations to the rules, faster, simpler, and more efficient business operations [6].

Architecture enterprise is a way of composing elements of an enterprise information system in which it can be a set of models and relationships between enterprise elements used in planning, designing, and realizing an enterprise structure, business processes, information systems, and the infrastructure associated therein.

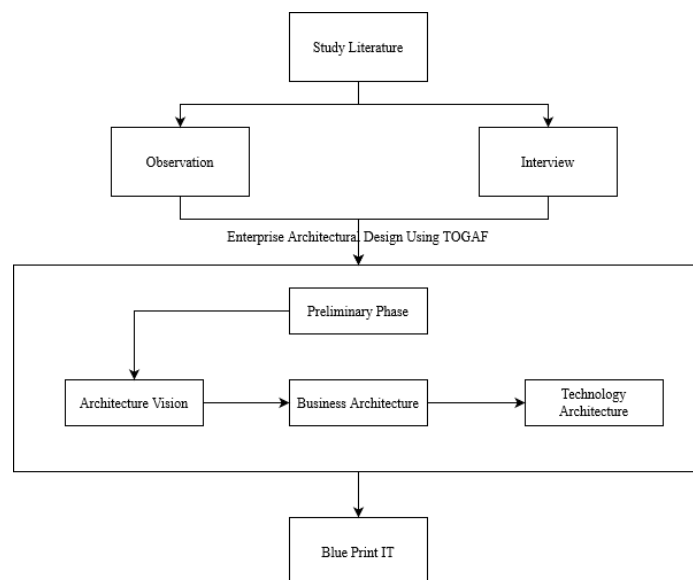
There are several methods or frameworks that are commonly used in designing enterprise architectures, namely The Zachman Framework for Enterprise Architectures [8], The Open Group Architecture Framework (TOGAF) [9], The Federal Enterprise Architecture Framework (FEAF) [10], and Gartner (Meta Framework) [11]. TOGAF ADM is a flexible method that can identify various modeling techniques used in planning because this method can be adjusted to changes and needs during the design. TOGAF ADM also expresses a clear vision and principles on how to carry out the development of enterprise architectures. The principle is used as a measure in assessing the success of enterprise architecture development by organizations [6]. The research conducted by [12] used the TOGAF method utilized to improve the process quality system using the TOGAF framework on STIE XYZ. Also, the research conducted by [13] implemented the TOGAF method used to produce GAP analysis of hardware components, software, and network devices at the Faculty of Mathematics and Science at the University of Riau. And this study used the TOGAF method to produce technological architecture analysis as the application of Smart Schools in Junior High School 17 Pekanbaru.

This research will produce the Preliminary Phase, Architecture Vision, Business Architecture, Information Systems architecture, and Technological Architecture as school guidance in implementing Smart Schools-based schools. Based on the existing problems, namely the management of attendance, value, and payments that are still made manually which have not been integrated by good information technology, it does need a technological architecture design to support the creation of the Smart Schools concept at Junior High School 17 Pekanbaru.

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## 2. Method

A research methodology is a regularly compiled way or technique used by a researcher to collect data or information in conducting research tailored to the subject or object being studied. The process of conducting this research is described in a line of research methodology in Figure 1.



**Figure 1.** Research Methodology

### 2.1. Literature Studies

The study of the literature was the collection of data and information related to technological architecture and TOGAF, especially in organizations engaged in school on websites, journals, and books related to research topics. The data that researchers collect are:

- The concept of implementing Smart Schools that had been carried out in Junior High Schools in Pekanbaru City so that it can be useful to be applied to junior high school N 17 Pekanbaru.
- Collection of journals related to the concept of Smart Schools, TOGAF, and the application of technological architecture.
- Theories needed to be had been outlined in chapter 2 of the literature review.

### 2.2. Data Collection

The data collection stage was used to collect data and information from SMP N 17 Pekanbaru which was needed for research and to obtain the facts and correctness of the description of the discussion material, following the stages in the data collection.

#### a. Observation

The observation stage was carried out by making direct observations to Junior High School 17 Pekanbaru, observations which aimed to find out and study the existing technological infrastructure, the design to be built, and information technology policies existing in Junior High School Pekanbaru. The existence of good technological infrastructure can help the teaching and learning process in schools so that the creation of concept of Smart Schools can exist. Technology infrastructure is the main supporting infrastructure for technological resources in the framework of the implementation of the process of disseminating information [14]. There are several stages carried out in this observation, the first is initial preparation to see the existing business processes at SMP N 17 Pekanbaru school. Then at the architectural vision stage, we look at the school's goals in implementing smart schools. Next is the business

architecture to develop business processes that will be developed in the future. And technology architecture is used to look at the existing technology infrastructure to support the implementation of smart schools.

b. Interview

The interview was conducted to get related and supporting data to implement the concept of Smart Schools in Junior High School 17 Pekanbaru. The interview process was conducted in the information and communication technology section and management staff at Junior High School 17 Pekanbaru.

### 2.3. Architecture Enterprise Design using TOGAF

a. Preliminary Phase

This stage explained the preparatory and initiation activities required for the smart school's concept stage that described business processes, principles for building information technological architecture, library studies, problem formulation and goal setting, data collection in the form of observations and interviews, determining the framework and methodology used to model business processes in Junior High School 17 Pekanbaru.

b. Architecture Vision

The "architecture vision" is an early phase of the TOGAF ADM that aligns opinions on the rationale for designing an enterprise architecture to meet the organization's primary goals and outlines the scope of the architecture plan that builds on the research objectives. It was meant to define in addition, this vision architecture was used to define stakeholders and their roles, business objectives, triggers of the organization's business strategy, and organizational architecture vision. The architectural vision phase produces several deliverables, such as a value chain diagram. This artifact has been used to describe groupings of activities based on primary and supporting activities in carrying out organizational operational activities that can create value and competitive advantage for the organization [15]. This study examined the vision of Pekanbaru Middle School 17 and the blueprint of the smart school concept in the form of a value chain to formulate an architectural vision. A value chain is a tool for understanding the value chain that makes up a product [16].

c. Business Architecture

The business architecture stage aims to establish the desired business model or activities based on the organization's specific business scenario. In this stage, three key tasks are carried out. Firstly, determining the perspective to illustrate the relationships between stakeholders. Secondly, identifying the relevant resources such as models and patterns to be utilized. Lastly, selecting and defining the common tools and methods for modeling, such as Unified Modeling Language (UML) and Function Hierarchy Charts, which can be employed to construct the necessary models [17]. This process allows for the depiction of business processes at Junior High School 17 Pekanbaru.

- Primary Business processes (Primary Activities), which are the basic processes of an organization.
- Support activities, which are processes carried out to support the main business processes

d. Technological Architecture

The technological architecture focused on the hardware, software and networks needed to support the technology infrastructure to implement Smart Schools. Currently, the hardware used in technology architecture data to support the implementation of Smart Schools is in table 1.

**Table 1.** Infrastructure Technological Architecture

No.	Hardware	Number (s)
1.	Computer Server	1
2.	Computer Client	24
3.	Router	1
4.	Switch Hub	1
5.	Access Point	4

To apply the concept of *Smart Schools*, the application of technology architecture that has not yet run can be integrated between teaching activities and management activities so that any management activities that require information on teaching processes, facilities management processes, and all activities in the school environment can be accessed [18]. This can make management activities more effective and efficient. As well as, the design of new technology architectures can be used as a learning medium, so as to improve the learning process

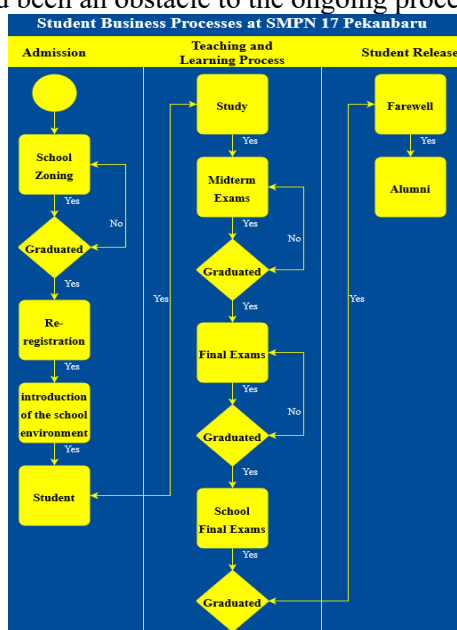
## 2.4. Blueprint IT

Blueprint IT would explain how elements of information technology and information management work together as a unit. Blueprint is useful as a guide or guideline that is useful for decision-makers in designing, planning, measuring, and monitoring the use of information technology in enterprise business processes [19].

## 3. Result and Discussion

### 3.1. Preliminary Phase

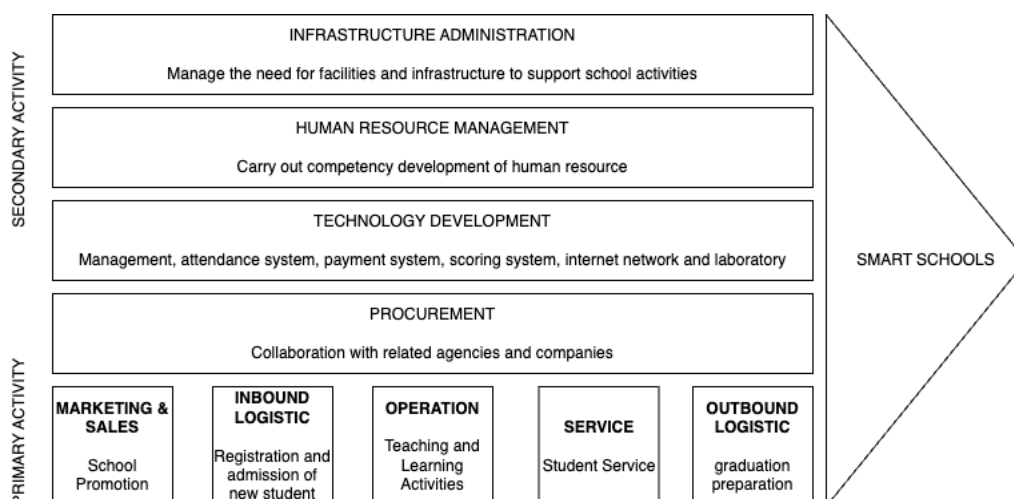
This process began with the collection of analytical data, namely the business process of Junior High School 17 Pekanbaru, especially for students. Business process modeling is done by describing functions and processes in the form of Business Process Modeling Notation (BPMN) [20]. Figure 2 is the existing business process in the school to achieve the vision of Junior High School 17 Pekanbaru needs to be updated with existing business processes. This was done to make improvements that had been an obstacle to the ongoing process.



**Figure 2.** Student Business Process at Junior High School 17 Pekanbaru

### 3.2. Vision Architecture

To build the Architectural Vision in this study, we saw the vision possessed by Junior High School 17 Pekanbaru, namely the realization of Junior High School 17 Pekanbaru as a qualified education center, superior in achievement, based on IMTAQ (faith and piety) and environmentally conscious. To facilitate this process, the main and supporting activities will be divided. To separate these activities, the study used a value chain. Value chain analysis is used to identify key activities and supporting activities [20]. Figure 3 describes the Value Chain activities in accordance with the duties and functions of the organizational structure in Junior High School 17 Pekanbaru.



**Figure 3.** Value Chain of Junior High School 17 Pekanbaru

### 3.3. Business Architecture

This stage explained the development of business architecture to support the vision that has been agreed upon by this research architecture and refers to the vision of Junior High School 17 Pekanbaru. Based on the business processes and value chains, the vision architecture also explained more detail for each process and added some new processes than were already running if needed to produce better business processes.

#### A. New Student Admission Business Process

The business process focused on managing new students starting from school zoning. The implementation of the zoning system policy in PPDB is regulated in Permendikbud No. 14 of 2018 [21]. This system regulates public schools owned by local governments must accept prospective students who are domiciled in the radius of the nearest zone of the school at least 90% (Ninety percent) of the total number of students received. In its implementation, the basis or basis of zone/region development can be divided into 2 (two) types, namely:

##### Administrative Boundary-Based Zone

Administrative boundaries are the development of areas based on educational services by the bureaucracy on a tiered basis from the center to the region. Administrative boundaries consist of: national, provincial, district/city, sub-district/district, and village/village.

##### Theme/Substance Based Zone

Theme/substance boundaries are the development of regions based on regional characteristics based on geographical and demographic indicators. The theme zone/substance consists of: service zone, cover zone, namely forest zone, settlement zone, watershed zone (WATERSHED) and others [22].

After the zoning process was carried out, the process of re-registration to the school was performed. After that the student will go through the PLS (Introduction to the School Environment) period and become a student at Junior High School 17 Pekanbaru. The following grouping of existing activities and updates that have been added can be seen in table 2. The blue item means that the business process will be developed, while the black item has been carried out by Junior High School 17 Pekanbaru.

**Table 2.** Student Admission Business Process

No.	Types of Activity	Detail Activities
1.	School Zoning	- Students enroll in the nearest school in the neighborhood
2.	Re-Register	- Register offline or online through PPDB - Complete registration documents



- |    |                           |   |  |
|----|---------------------------|---|--|
| 3. | School Orientation Period | - | School Orientation team formation            |
|    |                           | - | School Orientation monitoring and evaluation |
|    |                           | - | Introducing the school environment (PLS)     |
| 4. | Becoming a student        | - | Print a new student admission report         |
|    |                           | - | Students get uniforms from the school        |

#### B. Business Process of Teaching and Learning

This process was a learning process ranging from studying, taking the midterm exam, the end of semester exam, the final school exam, to graduation. Table 3 is a teaching and learning business process.

**Table 3.** The Business Process of Teaching And Learning

No.	Types of Activity	Detail Activities
1.	Learning	<ul style="list-style-type: none"> <li>- Students and teachers carry out the absenteeism process through the school attendance system</li> <li>- Students and teachers do absenteeism manually</li> <li>- Teachers carry out the process of absenteeism on the DAPODIK system (Basic Data of Education)</li> <li>- Students and teachers carry out the teaching and learning process</li> </ul>
2.	Midterms	<ul style="list-style-type: none"> <li>- Students carry out the midterm exam process</li> <li>- Teachers recapitulate test scores through the assessment system</li> </ul>
3.	End of Semester Exam	<ul style="list-style-type: none"> <li>- Students carry out the final semester exam process</li> <li>- Teachers recapitulate test scores through the assessment system</li> <li>- Teachers recapitulate test scores manually</li> </ul>
4.	End of School Exam	<ul style="list-style-type: none"> <li>- Students carry out the final school exam process</li> <li>- Teachers recapitulate test scores through the assessment system</li> <li>- Teachers recapitulate test scores manually</li> </ul>

#### C. Student Release Business Process

After the teaching and learning process, the last stage of the student's business process at Junior High School 17 Pekanbaru was the process of releasing students. Here table 4 is the business process of releasing students

**Table 4.** Student Release Business Process

Types of Activity	Detail Activities
Release of Students	<ul style="list-style-type: none"> <li>- Graduation planning</li> <li>- Establishment of a graduation committee</li> <li>- Degree creation</li> <li>- Graduation ceremony</li> <li>- Determination of graduating students</li> <li>- Determination of student resignation</li> </ul>

### 3.4. Technology Architecture

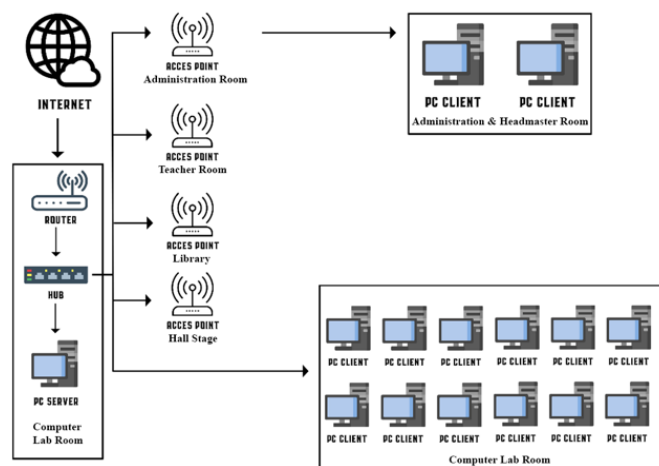
This stage explained the development of technological architecture carried out. Technological architecture served as a mapping of the current technological architectural conditions needed to see the condition of the network infrastructure used in the design of architectural models in the future [6].

Mapping the current condition of technological architecture was needed to see the condition of the network infrastructure that will be used in the design of architectural models in

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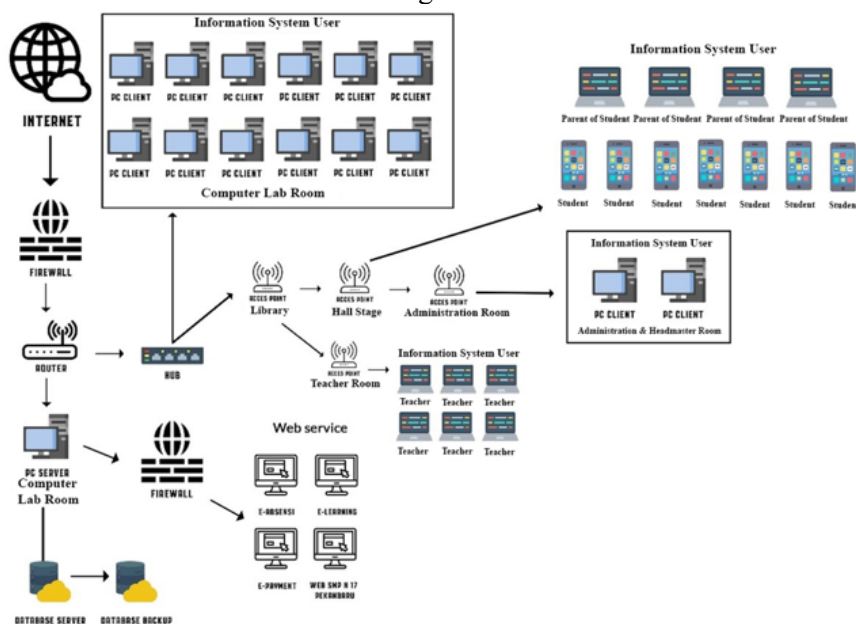
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the future to support the concept of *Smart Schools*, whether the current computer network architecture was adequate or not. Here figure 4 is an analysis of the condition of technological architecture in Junior High School 17 Pekanbaru.



**Figure 4.** Junior High School 17 Pekanbaru Network Architecture

From the results of the analysis, the current technology architecture had not supported the planning of the *Smart Schools* concept. Proposals for enterprise system architectures used open-source web service technology, which served as attendance management, assessment, and payments. The following is a design of the technology architecture proposed for the implementation of Smart Schools in Junior High School 17 Pekanbaru.

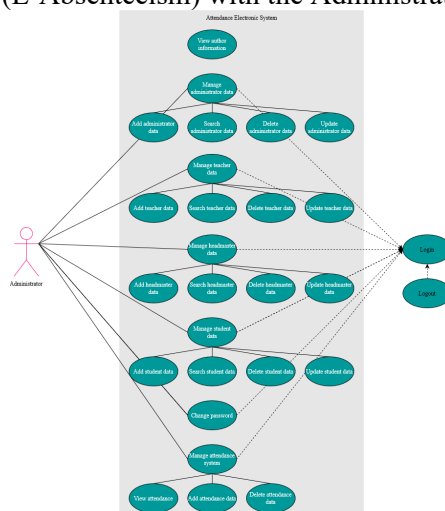


**Figure 5.** Smart School's technology architecture

Based on the image above, it produced a web-based e-attendance, e-learning, and e-payment design and was integrated directly by a server computer that served as a solution to the problems in Junior High School 17 Pekanbaru in building technological architecture to implement *Smart Schools*. E-attendance is one of the systems that can be used to overcome problems in the absenteeism process. By utilizing the e-attendance system, not only cheating in the absenteeism process will be reduced, the possibility of damage and loss of absence can be minimized. Not only that, the e-attendance system will allow savings on places, paper and ink because the absent data will be stored in the form of digital files [23]. The use of e-attendance at Junior High School 17 Pekanbaru will serve as a means for students and teachers who teach to

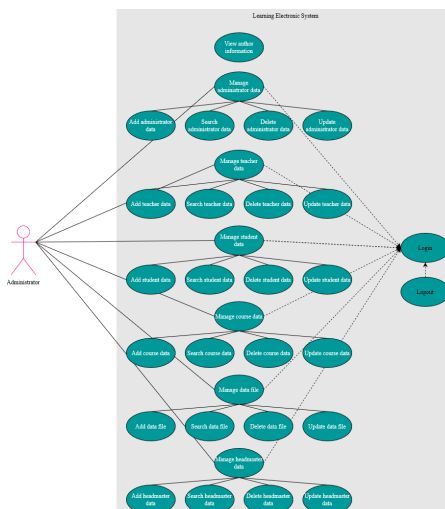


do attendance more practically and efficiently and the management of attendance data can be recap properly so that there is no data loss if at any time there is a problem such as a fire disaster. Also, it eases parents to monitor their children's attendance at school in order to improve student learning performance and increase cooperation between parents and the school. The application of the e-attendance system can be seen use case diagram as a sequence activity process flow. *Use case diagram* is a system model intended to describe the functional needs of the system [23][24]. The form of the design of the *use case diagram* of the Electronic Attendance (E-Absentee) system can be seen as in figure 6, which is a *Use Case Diagram* of the Electronic Absentee System (E-Absenteeism) with the Administrator Actor.



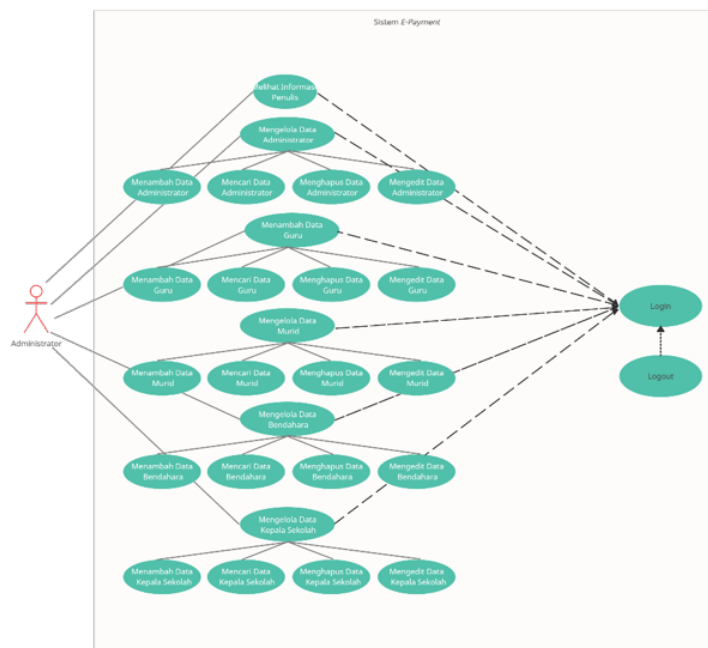
**Figure 6.** Use Case Diagram E-Attendance of Administrator actors

After the *use case diagram* of the E-Absentee, the next is *E-learning*. *E-learning* is as learning carried out online, both in the form of access to learning materials, task collection, and discussion [25]. The implementation of *e-learning* in Junior High School 17 Pekanbaru aimed to support the teaching and learning process in schools to support the smart classroom concept. This was also a support for learning facilities during the coronavirus disease 2019 (*COVID-19*) pandemic outbreak that occurred today. During this pandemic, students must study at home. Therefore, the concept of *E-Learning* was the right solution to support and increase student learning motivation at Junior High School 17 Pekanbaru. The application of the *e-learning* system can be seen use case diagram as a sequence activity process flow. The form of the design of the *use case diagram* of the Electronic Learning (E-Learning) system can look like in figure 7.



**Figure 7.** Use Case Diagram E-Learning Actor Administrator

Then the electronic money payment system (*e-payment*) is a method of non-cash payment instruments stored in a server-based (e-wallet) or chip-based (e-money). With the aim, it can make it easier for users when making payment or transfer transactions [26]. The implementation of e-payment in Junior High School 17 Pekanbaru aimed at managing finances to be systematically integrated with each other by the system so that finances can be managed properly. This payment system was intended to the entire payment process carried out by students such as Student Worksheet book money (LKS) which can be monitored by parents and school management. The application of the *e-payment* system can be seen from *use case diagram* as a sequence activity process flow. The form of the design *use case diagram* of the Electronic Payment (E-Payment) system can be seen as in figure 8.



**Figure 8.** Use Case Diagram E-Payment

### 3.5. Discussion

This research began with observations and interviews with various stakeholders, including the school principal, head of the laboratory, teachers, students, and parents. Following the interviews, the current existing business processes were identified. However, it was found that there are some weaknesses in these processes that need to be addressed to ensure the successful implementation of smart schools at SMP N 17 Pekanbaru.

In the new student admission process, the school needs to introduce a team formation process for Personal Learning Spaces (PLS), as well as monitoring and evaluating PLS. In addition, in the teaching and learning process, improvements include the use of an application system for attendance to centralize data on a single server. For grading, teachers are also required to enter grades into the application system to expedite and streamline the grade compilation process.

Furthermore, the current technological architecture at SMP N 17 Pekanbaru is not equipped to support the implementation of smart schools. Therefore, development efforts should include the addition of components such as a firewall, database server, web service, and additional access points. This development will enable teachers to access the system more easily, and parents will be able to monitor their children's learning process.

SMP N 17 does not currently possess an application system to support the establishment of smart schools. Therefore, this research recommends the development of an application system that can be implemented. The first application to be developed in this context is an

electronic attendance system (e-presence). This application involves several actors: an administrator responsible for entering all the necessary master data to manage e-presence, teachers and students recording attendance, the school principal reviewing attendance reports, administrative staff processing student attendance records, and parents being able to view their child's school attendance.

In addition to the attendance system, e-learning is also recommended for the establishment of smart schools. In the e-learning system, various actors have their respective roles: administrators, whose tasks are similar to those in the e-presence system, enter all the necessary master data. Teachers enter and manage subject-wise grade data, administrative staff handle the processing of all subject grades, students are responsible for submitting assignments given by teachers, and the school principal and guardians can monitor the grades of SMP N 17 Pekanbaru students.

Furthermore, the implementation of an e-payment system is recommended in this research, as the school still conducts financial transactions for books and uniforms. E-payment involves several actors, including administrators, students, and guardians who can view payment lists, check payments made, and outstanding payments. The school treasurer is responsible for inputting payment types and validating completed payments, and the school principal can monitor payments within SMP N 17 Pekanbaru.

#### 4. Conclusion

Based on the results of the discussion that has been delivered in accordance with the research stages in each of the results and discussions, the previous condition was that the school did not have an attendance system, payment system, and assessment system, so a new concept of technological architecture design was obtained for the design of the system data. This study also obtained a design monitoring system in the form of e-attendance, e-payment and e-learning that serves as monitoring student activities during school that could be accessed by parents. This research only focused on Technological Architecture which is one of the phases of TOGAF. The hope is to be developed by using the tools in TOGAF so that it gets complete and comprehensive results and implements.

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