Development of A Mobile-Based Student Grade Processing Application Using the Waterfall Method

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Abstract— One of the public elementary schools in Medan is SDN 064017. At SDN 064017, the procedure for processing student grade data has not been computerized. Gradebooks are used to track and process student grade information. There are still certain problems that arise with this method. SDN 064017 requires a lot of time and effort to process and find information on student scores. The aim of the research is to develop a mobile-based application that will simplify and speed up SDN 064017's processing and searching for student grade data. The system development method used is the waterfall method, which consists of the stages of needs analysis, system design, implementation, testing, deployment, and maintenance, while the system testing method uses the black box testing method. In the process of developing this mobile-based application, it uses the Kodular framework and the Airtable database. The results of the research conducted are an information system that can help SDN 064017 in processing and searching for student grade data to be more effective and efficient through mobile Android.

Index Terms— Android; Grades; Information System, Students; Waterfall.

I. INTRODUCTION

Modern technology is developing rapidly, especially in the field of information technology, which includes mobile technology and the internet [1]. In addition, Android technology, one of the mobile technologies that is currently being developed, On the other hand, because Android is an open-source platform, developers are free to build new applications or modify existing ones [2]. Modernization in schools increases efficiency and makes processes simpler.

One of Medan City's public elementary schools is SDN 064017. The data processing of student scores at SDN 064017 is still manual or not yet digital. The process of recording and processing student grade data is carried out in a grade book. In this way, there are still some problems that occur. SDN 064017 requires a lot of time and effort to record and process student grade information. In addition, finding student-grade information becomes a time-consuming and ineffective task.

The waterfall method, which includes the stages of needs analysis, system design, development, testing, implementation, and maintenance, is used to manually change the student grade data processing system into an Android mobile-based application. Thus, SDN 064017 can process and search for student grade data through an Android mobile device with the help of an application that is being developed using the Kodular framework and the Airtable database.

In 2021, Muhammad Afifudin and Agung conducted similar research. This research examines the processing of grade data, which is still being carried out using a spreadsheet application. As a result, there is still the problem of data hoarding, which has an impact on the difficulty of obtaining information. By using PHP programming language, the CodeIgniter framework, and the MySQL database, this research focuses on creating a web-based information system that can be used to process valuable data quickly [3].

Similar research was conducted by Dedi Irawan and I Putu Arya Aryanto in 2020. Processing student grades using Microsoft Excel, which is discussed in this study, is less effective and efficient, so this study aims to develop a web-based student grade data processing system using the PHP programming language [4].

In 2020, Handini Widyastuti and Rizat Sakmir conducted a similar study. This study looked at the difficulties associated with manually processing student grade data, which is still stored in leger books and report cards and requires a lot of time and work to complete. To overcome these problems, a study was conducted that aimed to create a web-based information system for processing student grades [5].

The research conducted differs from previous studies in several important respects. By using the Kodular framework and the Airtable database, the purpose of this research is to change the manual student grade data processing system into an Android mobile-based student grade data processing application.

II. METHODOLOGY

A. *System Development Method*

The method used in system development using the waterfall approach is preferred because the steps are completed sequentially and continuously. For projects where tool quality is important, the waterfall methodology is highly recommended but requires significant documentation [6]. The stages of the waterfall method can be seen in Figure 1.
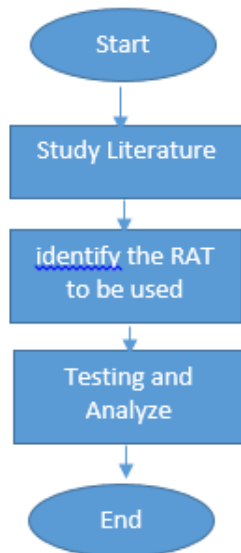

Fig. 1. Research Flowchart

The following is an explanation of each stage contained in the waterfall method [7].
1. Requirements

This research activity begins with analysis. The analysis carried out includes an analysis of future system requirements as well as problems that arise in the current student grade data processing system.
2. Design

The design of Android mobile applications that will be developed using UML (Unified Modeling Language) tools consisting of use case diagrams, sequence diagrams, activity diagrams, and class diagrams
3. Implementation

The Kodular Framework and Airtable database are used to create Android-based mobile applications, translating the design results into a language that computers can understand.
4. Verification

At this stage, a black box testing approach is used to test the applications that have been developed to evaluate the efficiency and precision of each process they contain.
5. Maintenance

Maintenance is carried out on applications that have been built to ensure the application functions properly and no errors occur when used by the user.

B. *Method of Collecting Data*

This study uses data collection techniques or procedures in addition to system development methodology. Without knowledge of data collection techniques, it is certain that researchers will not be able to collect data that meets predetermined standards. Data collection techniques are the main techniques in a study, starting with obtaining data, which is the main goal of research [8].

The following methods were used to collect data for this study:
1. Observation

To record, process, and find data on student scores at SDN 064017, direct observations were made at the research location, looking for problems that might arise during the procedure.
2. Interview

Direct questions and responses from SDN 064017 teachers and staff members about the procedure for recording and processing grade data as well as any issues that came up during the process served as the basis for the data collection process.
3. Literature review

For the theories needed for research activities related to the creation of Android-based mobile applications, data collection was carried out by searching books, journals, the internet, and other sources.

III. RESULTS AND DISCUSSION

A. *Problem Analysis*

The first stage is to analyze the running system before starting the design stage. The analysis is centered on student assessment procedures at SDN 064017 Medan. Student grades are written in a grade book as part of the assessment process, which is still done manually or not digitally. The low level of protection for student grade data, lost or damaged student grade books, as well as the time, effort, and costs required to process and search for student grade data at SDN 064017 Medan, are some of the remaining problems.

B. *System Requirements Analysis*

Based on the findings of the system analysis, a process of identifying several problems was carried out, especially those related to the time, cost, and effort required to process and search for student grade data. The research aims to develop an Android-based student grade data processing application to process and search for student grade data at SDN 064017 Medan. The Kodular framework and Airtable database, which can be accessed online via an Android phone, are used to develop the application.

C. *Design System*

By using use case diagrams, sequence diagrams, activity diagrams, and class diagrams, researchers

establish the general architecture and design details of the applications that will be made at this stage.

1. Use Case Diagram

Use case diagrams show how a system should operate, while use cases show how actors and systems interact. A person or actor is a human or technological entity that communicates with a system to perform a certain task [9].
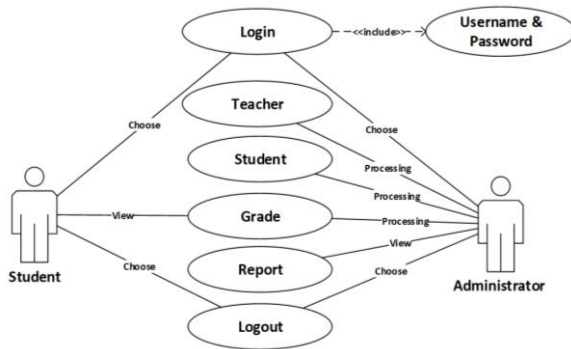

Fig. 2. Use Case Diagram

Figure 2 illustrates the use case diagram of the application to be built. Use case diagrams to describe what actors can do in the application to be built. Android-based student grade processing applications can be accessed by administrators and students. Administrators can log into the application by entering the specified username and password. Administrators can process teacher data and student data. Administrators can process student grade data processing and can view student grade data reports that have been processed. Students can see the grades that have been processed by the administrator, after logging in to the application by entering the specified username and password.

2. Sequence Diagram

Scenarios that are performed in response to an event to create a particular output are described using sequence diagrams. What causes the action, what internal processes and changes occur, and what results are all considered first [10].
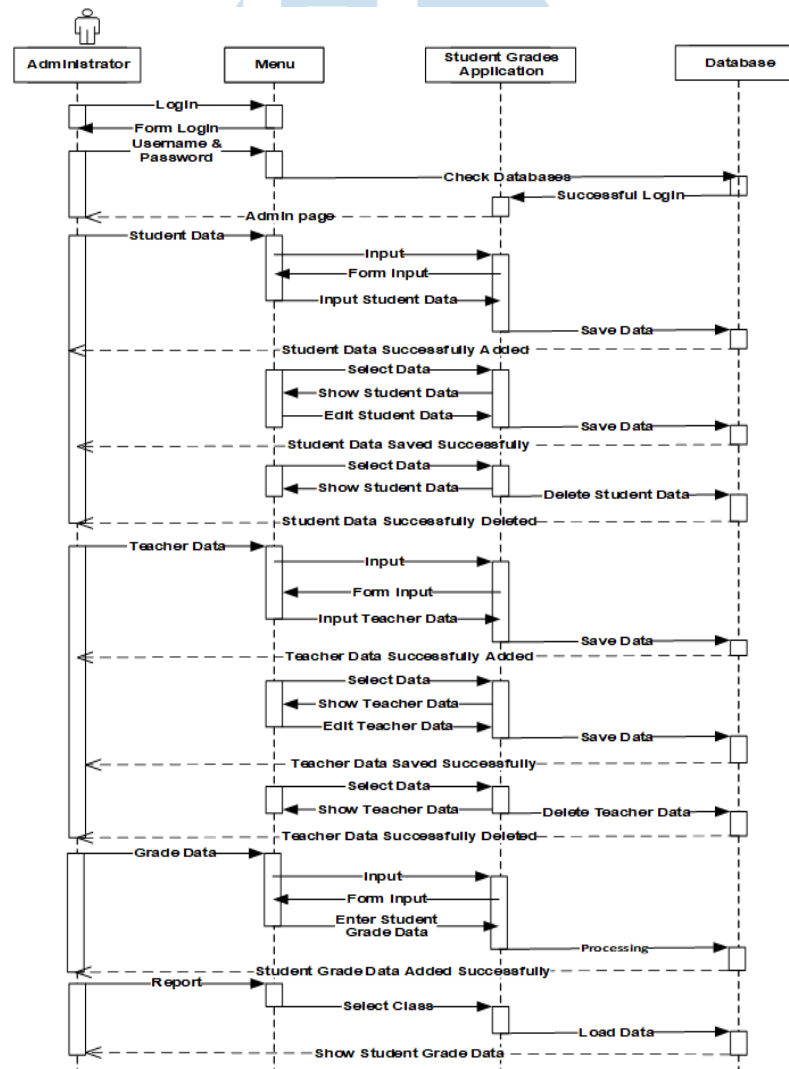

Fig. 3. Sequence Diagram

Figure 3 illustrates the sequence diagram of the application to be built. The sequence diagram of the Android-based student grade processing application that will be built begins when the administrator logs into the application. When the administrator enters the username and password used in the login process, the system will check the username and password data in the database. Then the administrator will enter the administrator page. When the administrator selects the student menu or teacher menu, the administrator can process student data or teacher data consisting of input, editing, and deleting. In the input student data or teacher data options, the administrator can fill in student data or teacher data on the form provided by the application and save the data into the database, in the edit option, the administrator can select student data or teacher data and make changes to the selected data and save the results of the changes in the database, in the delete option, the administrator can select student data or teacher data to be deleted and delete the data in the database. On the grade menu, the admin can process student grade data by selecting student name, teacher name, and subject, entering the number of student scores, and then storing student grade data in the database. On the report menu, administrators can see a summary of student grade data reports that have been processed.

3. Activity Diagram

The amount of activity flowing through the system, the start of each activity, the potential fork, and the conclusion of the program are all described using activity diagrams [11].
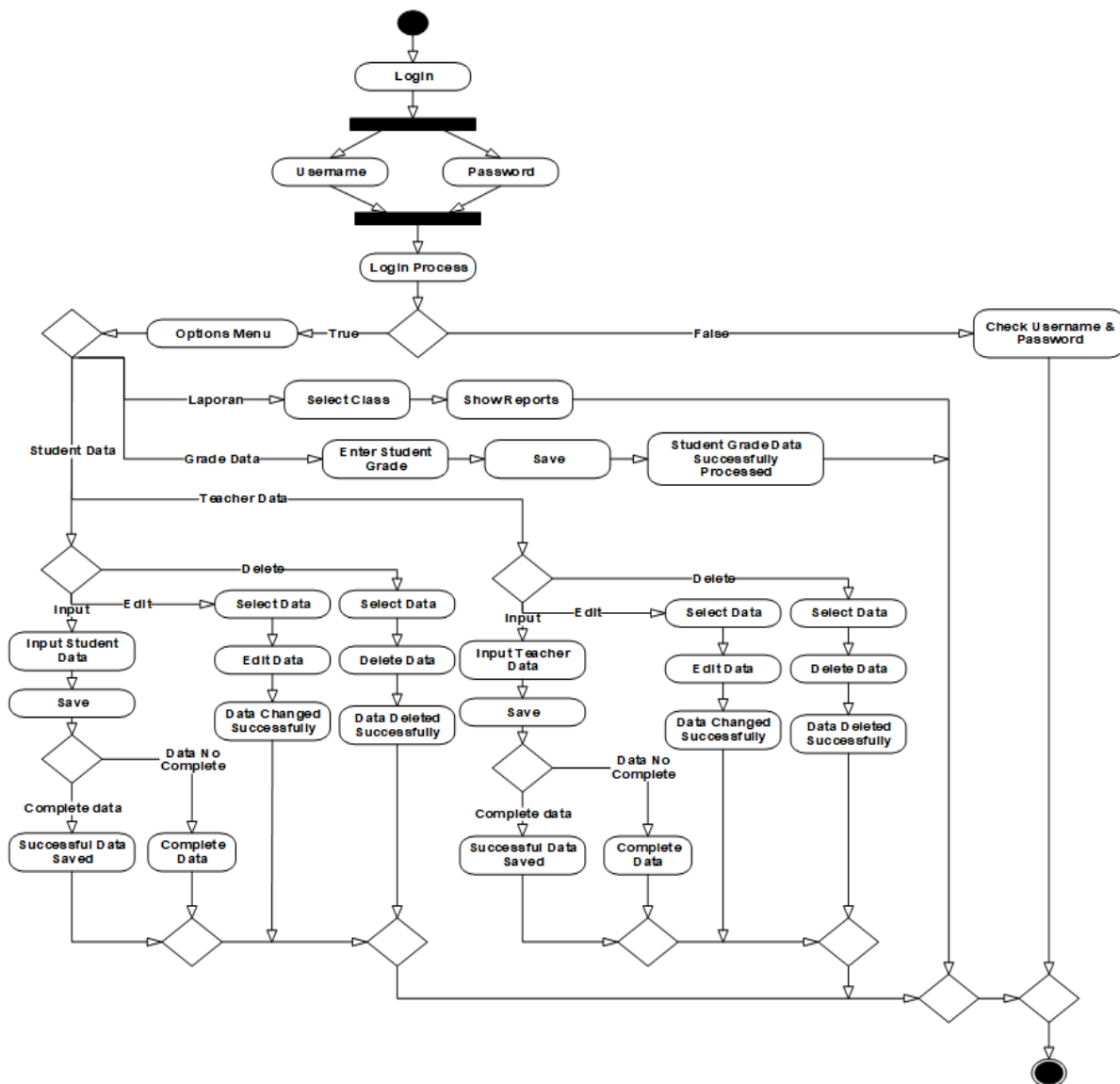

Fig. 4. Activity Diagram

Figure 4 illustrates an activity diagram. The activity diagram of the student grade processing application that will be built begins when the administrator logs in to the application by entering the specified username and password. Then the application verifies the username and password entered by the administrator, if the

username and password are correct, then the administrator can enter the options menu page and select an available menu. If the username and password are incorrect, the administrator cannot enter the application and must re-check the username and password entered. The application provides several menu options that can be selected by the administrator. When the administrator selects the student menu or teacher menu, the application will provide input options and edit and delete student or teacher data. In the input options, the application checks the completeness of the student data or teacher data entered by the admin, if the data is complete, then the data can be processed and stored in the database, but if the student data or teacher data is incomplete, then the data cannot be processed and the admin must complete the data first. In the edit and delete options, the application will save the results

of changes to student or teacher data made by the admin. When the admin selects the grade menu, the admin chooses the class, student name, teacher name, and subject, then enters the student grades and saves the grade data that has been entered by the admin. On the report menu, the application will display the results of the grade data recapitulation that has been processed by the admin.

4. Class Diagram

The system structure is depicted in a class diagram in the form of classes that will be developed to build the system. The features of a class include attributes and methods or activities [12]. The class diagram is the foundation of object-oriented development and design because it is a specification that, when instantiated, creates an object [13].
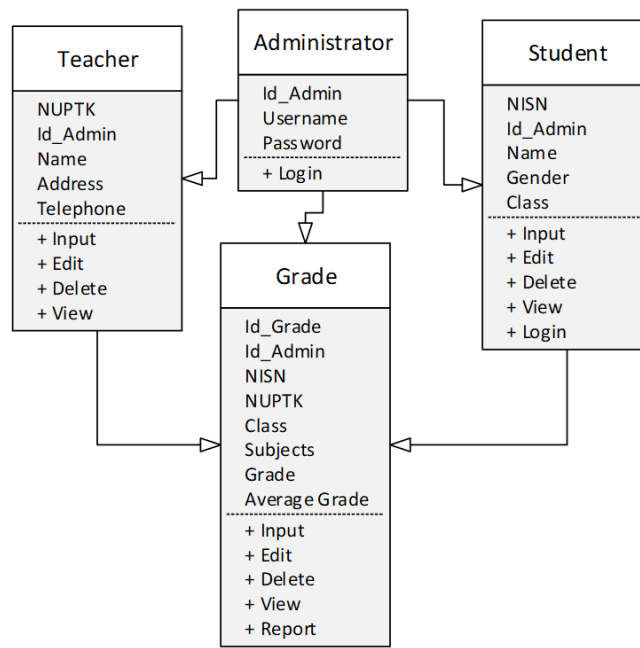

Fig. 5. Class Diagram

Figure 5 illustrates the relationship between each table in the student grade processing application at SDN 064017. The admin table structure consists of id_admin, username, and password, the student table structure consists of NISN, id_admin, name, gender, and class, the teacher table structure consists of NUPTK, id_admin, name, address, and telephone, the grade table structure consists of id_grade, id_admin, NISN, NUPTK, and class. subjects., grade and average grade. The class admin can process teacher data in the teacher class, student data in the student class, and grades in the grade class. Class teachers can enter grade data according to their respective subjects in class grades. Class students can see the grade data that has been processed by the teacher in the teacher class or admin in the admin class.

D. System Implementation

The process of translating the design based on test results into a specific programming language and deploying a system that functions in the actual environment is known as the system implementation step. The following is a display of the student grade processing application. The appearance of the application consists of displaying the login page, student data page, teacher data page, grade data page, and report page.

1. Login Page

The administrator must login on the login page using the username and password before he can access the student grades application. The login page can be shown in the Figure 6.

Fig. 6. Login Page

2. Student Data Page

Administrators can process student data consisting of input, edit, delete, and view student data on this page. The student data page can be shown in the Figure 7.
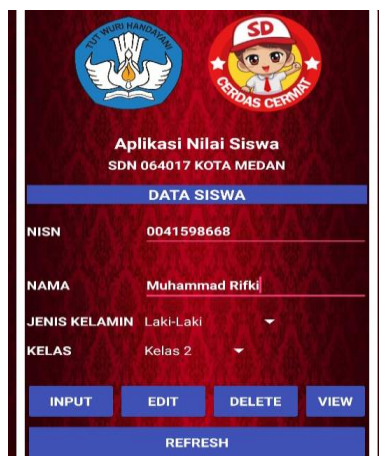

Fig. 7. Student Data Page

3. Teacher Data Page

Administrators can process teacher data consisting of input, edit, delete, and view student data on this page. The teacher data page can be shown in the Figure 8.

Fig. 8. Teacher Data Page

4. Grade Data Page

Administrators can process student grade data by selecting a class, student name, teacher name, and subject name, and entering student grades on this page. The grade data page can be shown in the Figure 9.

Fig. 9. Grade Data Page

5. Report Page

Administrators can view student grade reports that are processed by class on this page. The report page can be shown in the Figure 10.

Fig. 10. Report Page

E. System Testing

Application testing is carried out to check the functionality of the application being developed and look for deficiencies or errors. The black box method is used in testing this research. Black box testing is a type of testing based on application specifications [14] comprising the user interface or external look of the program, process performance, input, processing, and output generated by the application, and how to use application features in the user environment, followed by validation testing [15]. The results of blackbox testing can be seen in the Table I.

TABLE I. System Test Table

Testing Module	Testing Procedures	Input	Output	Conclusion
Login Admin	- Open Application - Entry the username "sirka", password "admin" - Click Login	Username "sirka", password "admin"	Admin can enter into the application select the available menu	Valid
Student Data	- Open Application - Login - Select the student menu - Entry complete student data - Click input	Complete student data	Student data successfully added	Valid
Teacher Data	- Open Application - Login - Select the teacher menu - Entry complete teacher data - Click input	Complete teacher data	Teacher data successfully added	Valid
Grade Data	- Open Application - Login - Select the grade menu - Select class, student name, teacher name and subjects - Entry student grade data - Click input	Complete grade data	Data student grades successfully processed	Valid
Report	- Open Application - Login - Select the report - Select class	Class Data	View student grade reports	Valid

In addition, testing the application on an Android smartphone The application is tested in terms of appearance, process, and performance when installed on different Android smartphone devices. The classification of Android devices determined in this test consists of the operating system and Android smartphone brand used by the user, which consists of ten devices: two Android devices version 8, two Android devices version 9, two Android devices version 10, two Android devices version 11, and two Android devices version 12. The results of application implementation testing can be seen in Table II.

TABLE II. Table of Testing the Application on Android Devices

Devices	Android Version	Information System Display	Information System Process	Information System Performance
Infinix Hot 6 Pro X608	Version 8	Success	Success	Success
Xiaomi Redmi 6A	Version 8	Success	Success	Success
Samsung Galaxy A10	Version 9	Success	Success	Success
Realme 3 Pro	Version 9	Success	Success	Success
Xiaomi Redmi Note 8	Version 10	Success	Success	Success
Xiaomi Mi 8 Pro	Version 10	Success	Success	Success
Xiaomi Redmi 10	Version 11	Success	Success	Success
Vivo V20	Version 11	Success	Success	Success
Redmi 10 Prime	Version 12	Success	Success	Success
Vivo V60 Pro	Version 12	Success	Success	Success

After testing is done, the next step is to make a questionnaire to get evaluation results from the use of the application that has been built. The questionnaire was given to the teachers and students of SDN 064017. The questionnaire instrument was related to the ease of use of the application, the appearance of the application, and the performance of the application in helping to facilitate the process of processing student grades at SDN 064017. The results of the questionnaire can be seen in Figure 11, Figure 12 and Figure 13.
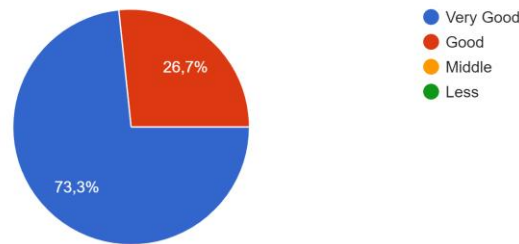
Ease of using the application
15 jawaban

- Very Good
- Good
- Middle
- Less

Fig. 11. Application Usage Survey Results

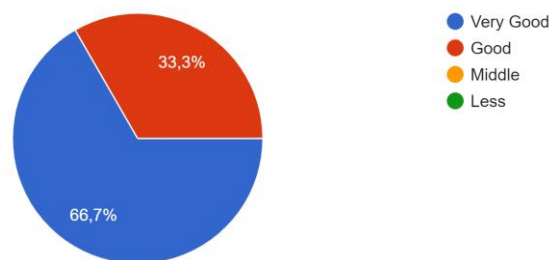Appearance attractive and easy to understand
15 jawaban

- Very Good
- Good
- Middle
- Less

Fig. 12. Application Design Survey Results

The application helps in processing student grade data
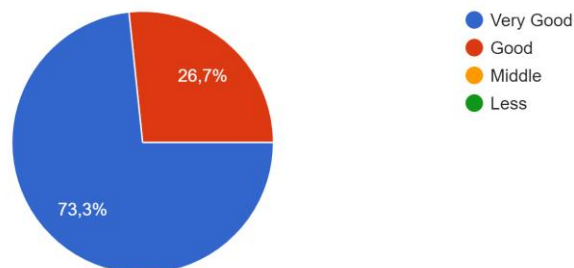15 jawaban

- Very Good
- Good
- Middle
- Less

Fig. 13. Application Benefits Survey Results

IV. CONCLUSION

Conclusions that can be drawn regarding the development of student grade data processing applications at SDN 064017 based on mobile Android that have been built after conducting this research are based on the stages contained in the waterfall method. A study of its utilization produces applications that function properly according to user needs. The student grade processing application that was built can replace the manual grade data processing system at SDN 064017 Medan City with an information technology-based grade data processing system using Android mobile devices. Based on the results of a questionnaire of the fifteen respondents who filled out the questionnaire form, more than 73.3% answered very well for the ease of use of the application, and 26.7% answered well for the ease of use of the application. 66.7% of respondents answered very well regarding the appearance of the application, and 33.3% of respondents answered well regarding the appearance of the application. 73.3% of respondents answered that the benefits of the application were very good in facilitating the processing of student grade data, and 26.7% of respondents answered that the benefits of the application were good in facilitating the processing of student grade data. So it can be concluded that 71.1% of respondents answered very well about the application that was built in terms of ease of use, appearance, and benefits to facilitate the processing of

student grade data. In addition, conclusions that can be made from the processing of student grade data before and after using the application can be seen in the Table III.

TABLE III. Before and After Using The Application

Indicator	Before using the app	After using the app
Grade data processing time	The processing time for student grade data is longer because it is done manually by writing and counting one by one	Processing time for student grade data is faster because it is done automatically by the application
Search student grade information	The process of searching for student value data takes longer because it is done manually by searching data one by one and sequentially	The process of searching for student value data is faster because the application is equipped with a search feature so that it can perform searches quickly based on the keywords entered
Making student grade reports	Making student grade reports takes longer because it is done manually by creating and writing one by one from the processed student grades	The application provides a report feature, so student grade reports are available
Distribution of student grade reports	Student grade reports that have been made are then printed and distributed or delivered directly to those who need them, such as the school principal.	The application can be accessed by various types of users, so that those who need student grade data can directly obtain it through the application that has been accessed

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