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ICOMER2021 Secretariat
Mathematics Education Department
Universitas Muhammadiyah Surakarta
Email: icomer@ums.ac.id
Website: icomer.ums.ac.id

PREFACE

Assalamu'alaikum Warahmatullahi Wabarakatuh

Alhamdulillah, Allah SWT has bestowed an outpouring of his grace, pleasure, and guidance so that the Proceedings of The International Conference on Mathematics and Learning Research (ICOMER) is held by mathematics education Universitas Muhammadiyah Surakarta Indonesia is well resolved. It is a follow-up activity of the National Conference on Mathematical Research and Learning (KNPMP) V (see: knpmp.ums.ac.id). The first international theme is "Technology-based Experiential Learning to Enhance 21st Century Math Skills". The conference aims to provide a platform for researchers in mathematics and mathematics education to share research results to be used to solve various problems in the community. The ICOMER proceedings contain a whole collection of papers that have been presented and discussed at the conference. We recognize that there are still many shortcomings and errors in the Proceedings. Therefore, all suggestions, inputs, and criticisms are always expected for improvement in the future. Finally, hopefully, this proceeding can provide benefits for readers, especially observers of mathematics and learning.

Wassalamu'alaikum Warahmatullahi Wabarakatuh.

Surakarta, August 11 2021

Chairman

Dr. Muhammad Noor Kholid, M.Pd

List of Content

Error Analysis of Class VIII Students in Understanding Mathematics Problems in the PISA Model at MTS Terpadu Nurul Hidayah Tangen for the 2020/2021 Academic Year

Nanda Mudi Astuti[1,a)], Slamet Hw[1,b)]

[1]*Muhammadiyah University of Surakarta, Indonesia*
Corresponding author: [a)] *A410170001@student.ums.ac.id*
[b)] *slamethw4648@gmail.com*

Abstract. This study was conducted with the aim of knowing and describing the causes of students making mistakes in understanding the PISA model math problems on the Number Pattern material. This type of research is descriptive qualitative research. The subjects in this study were class VIII MTs Terpadu Nurul Hidayah Tangen students for the 2020/2021 academic year. Data collection techniques used in this study were tests, interviews, and documentation. The validity of the data using triangulation techniques. The data analysis technique was carried out in three stages, namely data reduction, data presentation, and data verification and conclusion drawing. The analytical framework was developed based on the Newman error category. The results showed that the number of errors made by students in understanding the PISA model questions was 23.29%.Factors causing these errors in general are due to the ability of students who cannot interpret the meaning of the questions properly, and the level of understanding and creativity of students is low in identifying problems.

INTRODUCTION

PISA (The Programme for International Student Assesment*)* is an assessment carried out for junior high school students aged 15 years every 3 years organized by the Organization for Economic Cooperation and Development (OECD) or the organization for economic cooperation and development. PISA is an international level assessment that aims to assess abilities, reading skills, mathematics, and science using a literacy approach (OECD, 2019). Mathematical literacy is defined as the ability of students to formulate, apply and interpret mathematics into various contexts.

Mathematics is a subject that is taught from elementary school to university. Mathematics is a field of science which is a tool for thinking, communicating, and a tool for solving various practical problems (Abdurahman, 2009: 256). Nugroho (2017) said that mathematics has an important role because mathematics is the basis for quantitative reasoning and solving. In the 2013 curriculum, mathematics learning is required to use problem solving methods, because students are expected to be able to solve high-level mathematical problems.

In math problems, the PISA model measures reasoning, problem solving, and argumentation skills more than ordinary questions that measure standard technical abilities related to memory and calculation. Therefore, problem solving must be taught from an early age in schools, with the aim of students being

able to think critically, thoroughly, logically, systematically, carefully, effectively, and efficiently in solving a problem.

However, the results of international research on student achievement in Indonesia in solving problem solving problems are still far from expectations. Indonesia is far from the international average, even compared to Malaysia, Singapore and Thailand. Problem solving, critical thinking, and creative abilities of Indonesian students are still low, so students are weak in solving problems related to proving, reasoning, generalizing, and determining the relationship between the facts provided (F. Bidasari 2017). Wardhani (2011).) said that the cause of the weak ability of students to solve problems using the PISA model was that students were not accustomed to doing the correct problem solving process, namely by understanding the problem, implementing problem solving and checking the results of problem solving.

Education has an important role in this. Education is a means of learning that includes knowledge, creativity, and the ability both individually and in groups to educate humans and is also one of the most important factors in increasing competent and competitive human resources. For the final result is not important, but the process in education is the most important, because with this process students can understand and understand better. In Law no. 20 of 2003 concerning the education system, that the purpose of education in Indonesia is to be able to develop students' abilities to become human beings who are useful, responsible, and have faith in God Almighty.

Wijaya (2014) said that in connection with analyzing errors in solving problems in real contexts such as PISA questions, Newman developed a model known as Newman Error Analysis which consists of five categories of errors, namely reading errors, understanding problems, transformation errors, process skill errors. , and errors in writing conclusions.

Utami (2017) revealed that from the many mistakes made by students in working on questions, it can be used as a benchmark for the extent to which students master the material. Therefore, it is necessary to have an analysis of student errors in working on PISA model math problems. So that they can find errors and fix them so that the same error does not occur. Based on this description, the researcher wants to analyze and describe the mistakes of class VIII MTs Terpadu Nurul Hidayah Tangen students in understanding mathematics problems using the PISA model. In the research of Najim Wikan and Sutama (2020), said that errors in understanding were included in the high category. The cause of errors made by students in understanding is the ability of students to understand which is still low and unable to understand keywords well. Abilityunderstanding in understanding the meaning of the question is needed, because if an error occurs it will affect the next work.

RESEARCH METHODOLOGY

This study uses descriptive qualitative, the researcher chose this type of research because it is very suitable for the purpose of researchers who want to obtain natural and in-depth data about students' errors in understanding mathematical problems using the PISA model. The research was carried out at MTs Terpadu Nurul Hidayah Tangen located in Sragen Regency, precisely in Genengsari, Rt 18, Dukuh, Tangen District, Sragen Regency, Central Java Province, 57261. The time from the test to the interview was carried out in the even semester of the 2020/2021 academic year, namely March to April 2021. The subjects of the research were class VIII MTs Terpadu Nurul Hidayah Tangen students. The data collection techniques in this study are, 1) The test is given to obtain data on student work,

The validity of the data using the technique of triangulation method by comparing the results of interviews with tests. This study uses data analysis according to Miles and Hubberman (in Sugiyono, 2010: 337) with the following stages: 1) data reduction, 2) data presentation, 3) conclusion/verification. Data reduction in the form of test results and interviews conducted with students. Then the data is presented in the form of narrative text. Then conclusions were drawn regarding student errors in solving PISA model math problems on the Number Pattern material.

RESULTS AND DISCUSSION

After conducting research and analyzing student test results, it can be seen that students still make many mistakes in solving PISA model math problems on the Number Pattern material. The test questions tested consist of 5 questions in the form of descriptions. The following table and data on student work

from the questions that have been tested are presented. From the results of the analysis of student work, 5 students were selected whose types of errors represented Newman's types of errors, namely reading errors, understanding transformation errors, process skill errors, and errors in conclusions. The following is the number of each type of error in each question.

Table 1. Percentage of Types of Student Errors

About	Reading Error	Misunderstanding	Transforming Error	Error process	Final Answer Error	number of respondents
1	1	7	2	4	3	19
2	1	7	3	5	4	19
3	2	0	3	6	7	16
4	2	2	4	5	8	14
5	0	1	1	4	1	5
	6 (8.22%)	17 (23.29%)	13 (17.81%)	24 (32.88%)	23 (31.51%)	73

Based on the table, it can be seen that students who made errors in reading were 8.22%, who made errors in understanding were 23.29%, who made errors in transformation were 17.81%, who made errors in process skills were 32.88. %, and those who made an error in the conclusion were 31.51%.

Furthermore, it will describe the misunderstanding and the factors that cause errors made by students in understanding the PISA model math problems on the Number Pattern material based on the results of analysis and interviews.

1. Errors in Understanding Problems (Comprehension Error's)

Errors in understanding the questions, namely the stage where students are able to read all the words in the problem but do not master the overall understanding of the words, so that students cannot go further on the right problem solving pattern or students do not know what the questions are about. In understanding the problem, the location of student errors can be seen when students work on questions that are not in accordance with what was asked in the question.

The following are the results of student answers supported by interviews that show the location and causes of student errors in understanding the PISA model of number pattern material.

About

In the picture below is a Sierpinski triangle, which is a black triangle. The triangle divides itself into equal shapes and constantly changing sizes. Here are the stages of how the Sierpinski triangle divides itself from the beginning until it continues to change into smaller sizes. Stage 1 consists of 1 Sierpinski triangle, stage 2 consists of 3 Sierpinski triangles, and so on.

Find the number of Sierpinski triangles in step 5 and the total number of Sierpinski triangles from step 1 -5!

Students' answers to question number 4 can be seen in the picture.

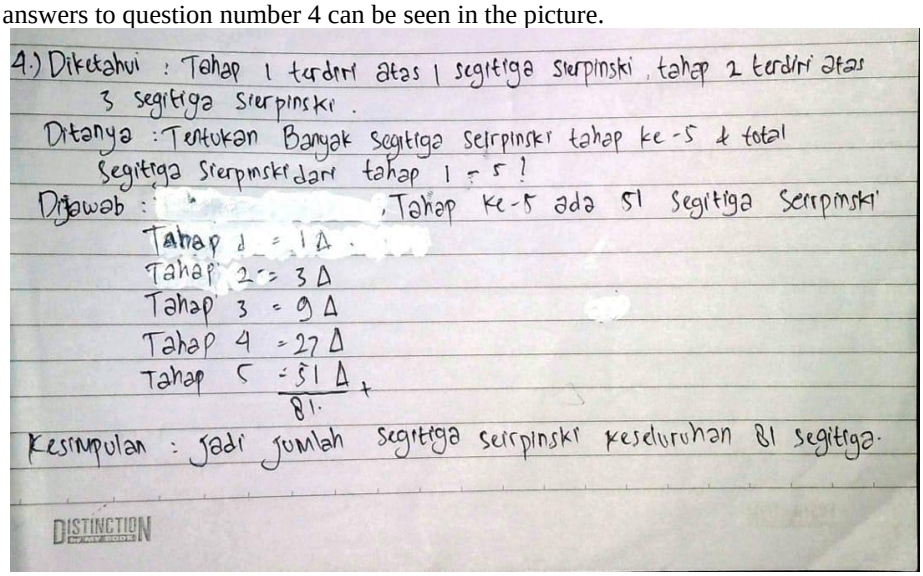

Figure 1. Result of Answer Number 4

For example: P = Researcher
S2 = Student 2

P : *"Dek, what do you understand from question no. 4 ? "*
S2 :*"Find the fifth triangle and the sum of all the triangles ma'am."*
P : *"Right, then what does the deck know?"*
S2 : *"Stage 1 has 1 triangle, stage 2 has 3 triangles, stage 3 has 9 triangles, and stage 4 has 27 triangles ma'am."*
P : *"Fine, but why don't you write a deck?"*
S2 : *"It's been a while bu...hehe"*
P : *"Furthermore, if there is a question in the form of a story like this, it is better to write what is known, asked, answered, and concluded, deck, because it has value"*
S2 : *"Yes ma'am..."*
P : *"Then, do you understand the shape of the number pattern on the question?"*
S2 : *"Not yet ma'am, I'm confused."*
P : *"What makes you confused, deck?"*
S2 : *"I don't understand the material, ma'am, then I also rarely do questions like that."*
P : *"Then, how do you do the deck?"*
S2 : *"I'm doing what I can ma'am, then I'll just add it all right away."*
P : *"Is your answer correct?"*
S2 : *"Not yet ma'am..."*
P : *"Where do you think the fault lies?"*

S2 *: " The mistake was because I didn't write down everything that was known and I didn't use the right method ma'am.."*

Based on the analysis of the results of student work regarding other errors in understanding the problem in number 4, students do not understand the question request and the form of the number pattern used to complete the work. In this case the students did not use the right steps. As said by Sekar Triyas Asih (2015), lack of understanding of question requests sometimes makes students not know what useful information is from the questions. Students who encounter conditions like this, it is possible to feel confused so that students make mistakes in writing down the information contained in the questions, both those asked and those that are known.

This is in line with the research of Suraji, et al (2018), the error in understanding mathematical concepts is caused because students think the questions are difficult and are less enthusiastic about understanding the questions. A small number of students are confused about communicating the known questions into a mathematical model so that students are confused about solving the problem. Meanwhile, in the analysis of mathematical problem solving abilities, students tend to make mistakes in calculations, so that the solution is not correct. Therefore, understanding the meaning of the question from the beginning of the work is very necessary and important, because if students cannot understand the meaning of the question, it will cause other errors at a later stage.

2. Causes of Students Making Errors in Understanding

Students make mistakes in understanding the meaning of the question because students can not interpret the meaning of the question, lack of remembering the material given by the teacher, do not understand the form of patterns used to complete the work, and students are not accustomed to solving various types of number pattern questions. (Hanipa, Akbar, and Sari, 2019) mentioned that the factor that causes students to make mistakes in solving math problems is the students' understanding is still low in mastering the concept.

Factors that cause students to make mistakes, namely internal factors and external factors. The results of interviews with mathematics teachers in this study also explained that the internal factor was from the students themselves who were less interested in the number pattern material because of the many different forms of questions and the various solutions used. While the external factor is the environment. The environment is very influential on the students themselves. If students hang out with other students who are lazy to listen to the teacher's explanation, the students will be lazy too. This results in a low level of student understanding of the number pattern material. This is in line with the research of Dian Rizky Utari, et al (2019) which states that the factors that cause difficulties in learning mathematics are internal factors and external factors. Internal factors include (1) the IQ level of different students, (2) student attitudes in learning, (3) learning motivation, and (4) body health. External factors include (1) teacher variations in teaching, (2) use of learning media, (3) facilities and infrastructure in schools, and (4) family environment.

CONCLUSION

Based on the results of the research that has been described, it can be seen what are the causes of student errors in understanding the PISA model math problems on the Number Pattern material.The cause of class VIII MTs Terpadu Nurul Hidayah Tangen making mistakes in understanding PISA model math problems on Number Pattern material because students cannot interpret the questions, do not understand the form of patterns used to complete their work, and students are not accustomed to solving various types of number pattern questions.Factors causing these errors in general are due to the ability of students

who cannot interpret the meaning of the questions properly, and the level of understanding and creativity of students is low in identifying problems.

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Students' Mathematical Critical Thinking Ability in Group Algebra Structure Course during the Covid-19 Pandemic

Evi Riayuliatun[1, a)] and Sri Sutarni[1, b)]

Author Affiliations
[1]*Muhammadiyah University of Surakarta*

[a)] *a410170100@student.ums.ac.id*
[b)]*ss101@ums.ac.id*

Abstract. Critical thinking skills are very important things that students must have during online learning. Critical thinking skills are useful for solving specific problems and being able to develop in a better direction. The purpose of this study is to analyze students' mathematical critical thinking skills in solving problems in the Group Algebraic Structure course during the Covid-19 Pandemic. The research method used in this research is descriptive qualitative research using written tests and interviews. From the results of the study, it was found that students with very high critical thinking levels were 20%, high critical thinking levels were 50%, moderate critical thinking levels were 23.33%, low critical thinking levels were 3.33% and very low critical thinking levels were 3.33%. Furthermore, from the results of the written test, 5 subjects were taken based on each indicator of mathematical critical thinking skills to be confirmed through interviews. From each student who has very high, high, medium, low and very low mathematical critical thinking skills, students have different achievements from each indicator.

Keywords: Mathematical Critical Thinking Ability, Group Algebraic Structure, Online Learning

INTRODUCTION

Education is a conscious and planned effort to create an effective and efficient learning atmosphere with the aim of facing a better life. The world of education has an important role in preparing quality human resources in the future. One of the factors that determine the success or failure of education is seen from the learning outcomes, especially in mathematics.

Mathematics is a science that is taught to all levels of education in Indonesia. Susanto (2013: 185) argues that Mathematics is one of the fields of study that can improve thinking and argumentation skills to contribute to solving problems that exist in everyday life and can develop science and technology. Mathematics is the queen of science, mathematics is arranged logically, and tiered from the easiest to the most complex level. Mathematics lessons often find difficult questions for students to solve and solve, but not all problems in mathematics are difficult and are seen as problems. However, not everyone feels the same way, difficult for one person is not necessarily difficult for another. In fact, by learning mathematics, everyone is able to hone their thinking skills at a high level. So with these things every person should have higher thinking.

According to Krulik and Rudnick (Fachrurazi, 2011) suggest that thinking skills are categorized into three levels, namely: 1) *basic thinking,* critical thinking, and creative thinking. This shows that one of the higher order thinking skills is to have the ability to think critically. Critical thinking ability can be

interpreted as the ability to analyze ideas and ideas towards a more specific direction, distinguish sharply, select, identify, study, and develop them in a better direction (Taqwa et al., 2019).

Duron et al., (2006) stated that someone who has critical thinking is able to analyze and evaluate information, has very important questions, can formulate problems clearly, and is able to assess relevant information using abstract ideas, able to think openly and can communicate effectively. The industrial revolution 4.0 can make it easier for everyone to get information from various kinds of social media and can get information quickly. The development of information in technology is growing rapidly at this time, one way to take advantage of information technology in higher education is the online lecture method.

Online lectures are where lecturers and students carry out the learning process by not meeting face to face, but lecturers and students study separately using various learning media. Online lectures are one part of online learning methods or learning systems that use the internet network (Mustofa et al., 2019). One of the courses whose learning is through an online system and requires critical thinking skills is the Group Algebraic Structure course.

Group Algebra Structure is one of the compulsory subjects that students of Mathematics Education must take at the University of Muhammadiyah Surakarta in odd semesters. Aisyah (2019) stated that the Algebraic Structure course must be proven and must be understood by students, because usually students are only fixated on formulas, so most students have difficulty solving problems. This course has many theorems that must be proven true, so students need the ability to think logically, creatively, and critically.

The purpose of this study is to analyze students' mathematical critical thinking skills in solving problems in the Group Algebra Structure course during the Covid-19 Pandemic. Mathematics Education Study Program, University of Muhammadiyah Surakarta.

RESEARCH METHOD

This type of research is qualitative research. Qualitative research is a type of research whose findings are obtained through statistical procedures or other forms of calculation that aim to reveal environmental symptoms by collecting data from the natural environment with researchers as the main means (Sugiyono, 2015). The research design used is descriptive research.

The subjects of this study were students of Mathematics Education at Muhammadiyah University of Surakarta who were taking the Group Algebra Structure course for the 2020/2021 academic year online during the Covid-19 pandemic, which consisted of 30 students. This research is in the form of tests and interviews. The test was tested to determine the students' mathematical critical thinking skills, which amounted to 4 questions in the Group Algebra Structure course based on the indicators of the questions that had been validated. After the test results were analyzed, the next stage was conducted with interviews to confirm understanding in solving questions. Subjects totaled 5 students who were taken from indicators of mathematical critical thinking skills in the process of working on written test questions that had been analyzed. In this study the validity of the data used is the credibility test with triangulation techniques which include tests, interviews, and documentation. Triangulation technique is used to test the credibility of the data by using different techniques to examine the data to the same source.

RESEARCH RESULTS AND DISCUSSION

Based on research data that has been carried out, from the results of the written test of 30 students there are 1 student in the very low category, 1 student in the low category, 7 students in the medium category, 15 students in the high category, and 6 students in the very high category . From each student who has very high, high, medium, low and very low mathematical critical thinking skills, there are differences in the achievements of each indicator. (Karim & Normaya, 2015).

TABLE 1. MATHEMATICAL CRITICAL THINKING LEVELS

Interval	Critical Thinking Level
20 – 25	Very high
15 – 20	High
10 – 15	Moderate
5 – 10	Low
0 – 5	Very low

TABLE 2. STUDENT RECAPITULATION LEVEL OF CRITICAL THINKING MATHEMATICS

Thinking Level	Number of Students	Percentage
Very High	6	20%
High	15	50%
Medium	7	23,33 %
Low	1	3,33 %
Very low	1	3,33%
Total	30	100%

The following are the results of the discussion related to research on mathematical critical thinking skills.

1. **The indicator understands what is known and knows what is asked in each problem.**

   The mathematical critical thinking ability possessed by S-19 and S-26 with a very high level of critical thinking, this is related to the indicator of understanding what is known and knowing what is asked in each question. problems, S-19 and S-26 were able to write down what was known and what was asked in the question. According to Ennis (Sumarmo, 2012) the first indicator of critical thinking ability is to focus on questions.

   Furthermore, the critical thinking skills of S-4 and S-30 in the indicators of understanding what is known and knowing what is asked in each problem, are less able to write down what is known and what is asked in the question. Because based on the results of the written test, S-4 and S-30 did not write down what was known and what was asked in the question, but in the results of the interview S-4 and S-30 were able to explain what was known and what was asked in the question.

   S-10 has not been able to fulfill the indicators of understanding what is known and knowing what is asked in each problem, this can be seen from the results of the written test that S-10 does not write down what is known and what is asked in the question. According to Fernanda's research (2019), the ability to focus questions is the ability to find or formulate problems from a given case or phenomenon. From the results of the explanation above, it can be concluded that the subject is able to explain what is known and what is being asked in the question.

2. **The indicator of writing the concepts used in solving each problem**

   S-19 and S-26 have a very high level of critical thinking in writing the concepts used in solving each problem properly and correctly. Furthermore, S-4 and S-30 on indicators write down the concepts used in solving each problem, and have a moderate level of critical thinking. S-4 does not write down the concept when proving whether the integer B is a group against the multiplication operation. While S-30 did not write down the concept when asked to show that $(G, +)$ is a group for addition operations, but S-30 was able to solve problem number 4 correctly, it's just that S-30 did not write down the concept used in solving the problem. According Paradesa (2015) says that students with critical thinking skills capable of identify concept and determine what concepts used to solve the problems. In the indicator of writing down the concepts used in solving each problem, S-10 is less critical in writing the concept of solving each problem in working on the problem. S-10 only writes concepts in problem number 1, but does not write concepts in questions number 2, 3, and 4.

3. **Indicators of formulating problems into mathematical models**

On indicators of formulating problems into mathematical models S-19 and S-26 have very critical thinking skills high, because S-19 and S-26 are able to solve problems by formulating problems into mathematical models properly and correctly. According to research by Paradesa (2015) critical thinking skills are able to determine mathematical equations in applying concepts to answer and are able to give meaning to each symbol of a predetermined mathematical model.

While S-4 has a low level of thinking ability, it can be seen from the results of the work that S-4 when working on problem number 3 does not formulate the problem into mathematics in showing that $(G, +)$ is a group with respect to the addition operation. Furthermore, S-30 has a moderate level of critical thinking, because S-30 is only able to formulate problems into mathematical models in questions number 2 and 3, whereas S-30 does not formulate problems into mathematical models in questions number 3 and 4.

4. **Indicators of solving problems by principles and mathematical models, as well as being able to draw conclusions from each problem.**

Based on indicators of solving problems with mathematical principles and models, and being able to draw conclusions from each problem, S-19 has a very high level of critical thinking, because S-19 is able to solve problems with principles and principles. mathematical model properly and correctly. S-26 and S-4 have a moderate level of critical thinking, this can be seen in questions number 1 and 2 S-26 is less precise in solving problems and less precise in drawing conclusions, as well as S-26.

Furthermore, S-10 and S-30 have low levels of critical thinking in solving problems with mathematical principles and models, and have not been able to draw conclusions from each problem. It can be seen that S-10 when working on problem number 2 is not appropriate in solving problems and drawing conclusions, and for numbers 3 and 4 S-10 has not been able to solve problems and draw conclusions, based on the results of interviews S-10 does not understand related with questions number 3 and 4. While S-30 is not precise in solving and drawing conclusions on questions number 1 and 4, while for number 3 S-30 does not understand about these questions, so S-30 has not been able to solve problems and draw conclusions in question number 3. This is in accordance with Paradesa research (2015) students do not write down the results of the completion and conclude the answers obtained, and students assume that drawing conclusions is not necessary.

5. **Indicators provide further explanation in solving each problem.**

In the indicator providing further explanations in solving each problem, S-19 has a very high level of critical thinking, because S-19 is able to provide further explanations regarding the conclusions drawn in each question. During the interview, S-19 was also able to provide further explanations regarding the conclusions with very good and correct answers. According to Crismasanti's research (2017) the subject is able to provide further explanations regarding the results of the settlement he has obtained.

Furthermore, S-26 and S-4 are less able to provide further explanations in solving each problem. When working on questions 1,2, and 4, S-26 is still not appropriate in providing further explanations regarding the conclusions drawn. While S-4 is still not right in providing further explanations related to the conclusions drawn in questions number 1 and 4, S-4 still does not understand related to question number 4. Based on the indicators that provide further explanations in solving each problem, S- 10 and S-30 can be seen from the results of tests and interviews S-10 and S-30 in working on questions from number 1 to number 5 are still unable to provide further explanations in solving each problem.

CONCLUSION

Based on research on students' mathematical critical thinking skills in the group algebra structure course during the covid-19 pandemic, it can be concluded that students with very high critical thinking levels are 20%, high critical thinking levels are 50%, moderate critical thinking levels are 23.33%, high

critical thinking levels are 23.33%. low critical thinking 3.33% and very low critical thinking level 3.33%. Based on each indicator of mathematical critical thinking skills that have very high, high, medium, low and very low mathematical critical thinking skills, students have different achievements from each indicator.

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Mathematical Reasoning Ability of Junior High School Students during the Covid-19 Pandemic in Solving HOTS Questions for Circle Material

Haris Wahyu Pamungkas[1, a)] and Sri Sutarni[1, b)]

[1]*Muhammadiyah University of Surakarta*

Author Emails
[a)] a410170037@student.ums.ac.id
[b)]ss101@ums.ac.id

Abstract. This study aims to determine the mathematical reasoning ability of junior high school students during the covid-19 pandemic in solving HOTS questions on circle material. This research uses descriptive qualitative method. The research subjects were six eight grade students at SMP Muhammadiyah 1 Kartasura. Data collection techniques using tests and interviews. Data analysis using data reduction techniques, data presentation, and drawing conclusions. The results showed that students with high mathematical reasoning abilities were able to fulfill all indicators of mathematical reasoning well and solve all questions correctly. Students with low mathematical reasoning abilities are only able to fulfill the indicators of presenting mathematical statements well and are not able to able to solve all questions correctly.

Keywords: Circle, Hots, Mathematical Reasoning

INTRODUCTION

Education is a conscious effort of everyone in seeking knowledge in order to develop the skills, personality and potential inherent in a person so that it will be a provision in life. According to (Karim, 2020) education is a planned awareness process in developing the ability of students to become individuals who are devoted, faithful, knowledgeable, and independent and creative. Education is part of each individual's efforts to develop and improve natural abilities in line with human social values, both physically and spiritually (Fajar et al., 2019). Education is very influential on the quality of human resources from an early age, elementary school, middle school to college. The quality of human resources can be improved through successful learning in every educational institution. The better the quality of education in a nation, the better the progress of the nation.

The National Council of Teachers Mathematics (NCTM) states that the process of learning mathematics cannot be separated from reasoning abilities. Reasoning ability is an ability to think based on logic to make new conclusions based on statements that have been proven to be true. Suherman (in Sumartini, 2015) suggests that reasoning is a process of thinking to produce conclusions. One way of logical thinking can be trained through mathematical reasoning abilities. Gardner (in Eka Lestari, 2015) reveals that mathematical reasoning is the ability to analyze, generalize, integrate, synthesize, give appropriate reasons and solve unusual problems.

Based on the survey results from the Trend International Mathematics and Science Study (TIMSS) in 2011 showed that the mathematical ability of Indonesian students was ranked 38 out of 42 participating countries with an average score of 386, still below the TIMSS average score of 500 (Mullis

et al., 2012). The average achievement of Indonesian students in TIMSS 2011 has decreased from the average achievement of TIMSS 2007 which obtained a score of 397. The cognitive domain in TIMSS 2011 which has the lowest average percentage achieved by Indonesian students is the cognitive domain ofreasoning, namely by 17% (Rosnawati, 2013). This shows that the reasoning ability of students in Indonesia is still at a low level. The low reasoning ability of students needs serious attention from all elements of education

Various efforts to improve students' mathematical reasoning abilities can be done, one of which is by providing practice questions that are different from the usual examples. Questions with the Higher Order Thinking Skills (HOTS) type can be used to help improve reasoning abilities. HOTS type questions not only solve problems with standard formulas or algorithms, but encourage students to develop reasoning skills and use mathematics to solve problems of everyday life (Permana et al., 2020). According to (Nugroho, 2018) HOTS is an ability to investigate and process information in the form of facts or ideas by understanding, connecting, categorizing, and evaluating.

According to (Suryapuspitarini et al., 2018) questions with the HOTS category are questions that train high-level thinking skills and involve the reasoning process, thereby increasing logical, critical, reflective and creative thinking skills. With the HOTS type questions, the problems to be solved tend to be complex so it is possible to have more than one solution, the information on the questions uses dynamic, contextual and innovative problems so as to train students to use mathematical reasoning skills. In addition, HOTS type questions encourage students to not only memorize and seek textbook knowledge, but HOTS type questions are also expected to be used to measure the extent of students' mathematical reasoning abilities. From the statements that have been presented, it can be concluded that the HOTS questions train students to think at the higher level at the level of analysis, evaluation and creation.

This study aims to describe the mathematical reasoning abilities of eighth grade students of SMP Muhammadiyah 1 Kartasura during the covid-19 pandemic in solving HOTS type questions with circular material oriented to four indicators of mathematical reasoning, namely presenting mathematical statements, manipulating mathematics, compiling evidence or giving reasons for the correctness of the solution and draw conclusions.

RESEARCH METHOD

This research is a qualitative research with a qualitative descriptive approach. This research was conducted at SMP Muhammadiyah 1 Kartasura with the subject of class VIII students. The data was obtained from the results of tests and student interviews regarding thequestions about hots the circle material. Sources of data in this study were students of class VIII D SMP Muhammadiyah 1 Kartasura.

Data collection techniques used in this study were tests and interviews. The test used in this study was in the form of a description of the type of hots circle material with a total of three questions given to the research subject. The results of students' answers are then assessed based on the assessment rubric and analyzed based on indicators of mathematical reasoning ability to determine the level of students' mathematical reasoning abilities. Interviews were conducted to seek additional information and strengthen the answers obtained by students in working on the HOTS questions on the circle material.

Data analysis techniques used in this study include data reduction, data presentation, and drawing conclusions. Data reduction is an activity to choose the main things needed in the research process. Researchers do data reduction by way of abstraction. Data abstraction is an attempt to summarize the core things, processes and statements must be maintained so that they are still in the research data (Sutama, 2019). Presentation of data is the process of a collection of information presented in a structured manner to draw conclusions. Drawing conclusions in this study is a follow-up to the analysis of the data reduction and data presentation stages that have been carried out previously.

RESEARCH RESULTS AND DISCUSSION

Based on research data that has been carried out, from the results of the written test of 25 students there are 12 student in the low category, 9 student in the medium category and 4 students in the high category. The classification of the mathematical reasoning ability criteria used is based on (Arikunto, 2013) in the table 1. below

TABLE 1. CATEGORY LEVEL OF STUDENT REASONING ABILITY

Value	Attainment of Reasoning Ability	F	Percentage
High	Score > 71%	4	16%
Medium	42 ≤ score ≤ 71%	9	36%
Low	Score ≤ 42%	12	48%
	Total	25	100%

The following are the results of the discussion related to research on mathematical reasoning ability.

1. Mathematical Reasoning Ability of High-Skilled Students (S-T1)

The results of the work of S-T1 on question number 1 can be seen in Figure 1.

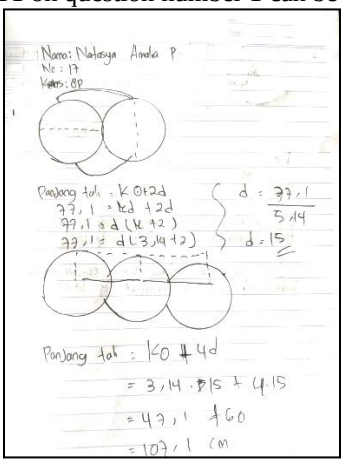

FIGURE 1. THE RESULTS OF ANSWER NUMBER 1 BY S-T1

In Figure 1. it can be seen that the subject S- T1 has completed question number 1 to completion. In the picture, the S-T1 subject immediately worked on the problem without writing down what was known and what was asked, but at the time of the interview, the S-T1 subject was able to explain the mathematical statement completely orally. The following is a snippet of the interview with the subject of S-T1.

P : *Apa yang diketahui dalam soal nomor 1 ?*

S-T1 : *Diketahui Pak Jaya memiliki dua buah pipa sama besar yang diikat dengan panjang tali 77,1 cm, Pak Jaya ingin menambah satu pipa lagi di tengah-tengah dengan ukuran yang sama*

P : *Kemudian apa yang ditanyakan ?*

S-T1 : *Yang ditanyakan yaitu berapakah panjang tali minimum yang dibutuhkan Pak Jaya untuk mengikat tiga pipa*

P : *Bagaimana penyelesainnya ?*

S-T1 : *Pertama saya mencari diameter pipanya dulu mas, habis itu kalau udah ketemu diameternya tinggal menghitung panjang tali untuk mengikat tiga pipa menggunakan rumus keliling lingkaran ditambah 2 kali diameter sama dengan 77,1 cm*

P : *Apa alasan kamu menggunakan cara seperti itu ? coba jelaskan !*

S-T1 : *Alasannya karena pada soal belum diketahui diameternya pipa, sehingga perlu mencari diameternya dulu kemudian busur kanan dan kiri pada pipa sama*

dengan satu keliling lingkaran dan tali yang atas dan bawah itu panjangnya sama dengan diameter

P *Apakah kamu yakin bahwa jawabanmu sudah benar ?*

S-T1 *Kalau menurut saya yakin sih mas*

P *Terus bagaimana kesimpulannya ?*

S-T1 *Jadi, panjang tali minimum yang dibutuhkan Pak Jaya untuk mengikat tiga pipa sama besar adalah 107, 1 cm.*

In the interview excerpt above, it can be seen that S-T1 was able to provide his argument clearly and fluently by describing what was known and what was asked. The interview excerpt shows that the subject of S-T1 is able to perform mathematical manipulation well according to mathematical concepts. In addition, the subject of S-T1 is able to explain a simple way to solve the problem in question number 1 correctly. It can be seen that the subject of S-T1 is able to explain the reasons related to the method used in providing problem solving solutions and is able to draw conclusions correctly. The results of this study are in line with research conducted (Pandu & Suwarsono, 2021) regarding the analysis of reasoning abilities student mathematics in solving math problems limit material. The results of the study stated that subjects with high ability is able to meet all reasoning indicators mathematically in solving a given problem

Based on the results of the exposure and interview excerpts, it can be concluded that the subject of S-T1 is able to fulfill all indicators of mathematical reasoning ability

2. Mathematical Reasoning Ability of Low-Skilled Students (S-R6)

The results of the work of S-R6 on question number 1 can be seen in Figure 2.

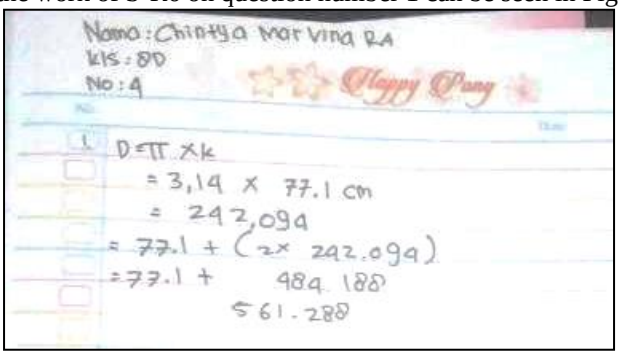

FIGURE 2. THE RESULTS OF ANSWER NUMBER 1 BY S-R6

In Figure 2. it can be seen that the subject of S-R6 have completed question number 1 to completion. In the picture the subject S-R6 immediately worked on the problem without writing down what was known and what was asked, but at the time of the interview the subject S-R6 was able to explain mathematical statements orally. The following is a snippet of the interview with the subject of S-R6.

P : *Apa yang diketahui dalam soal nomor 1 ?*

S-R6 : *Yang diketahui panjang tali Pak Jaya 77,1 cm untuk mengikat dua pipa*

P : *Kemudian apa yang ditanyakan ?*

S-R6 : *Berapa panjang tali minimum yang diperlukan Pak Jaya untuk mengikat tiga pipa tersebut ?*

P : *Bagaimana penyelesainnya ?*

S-R6 : *Pakai rumus*

P : *Pakai rumus apa ? coba jelaskan!*

S-R6 : *Rumus keliling, karena ini bukan kelipatan tujuh pakainya phi = 3,14 terus dikali 77,1 hasilnya 242,094*

P : *Sampai itu saja ?*

S-R6 : *Belum…terus 77,1 ditambah (2 x 242,094) ketemu hasilnya 561,288*

P : *Apa alasan kamu menggunakan cara seperti itu ?*

S-R6 : *Emm…karena saya tahunya seperti itu*

P *Apakah kamu yakin bahwa jawabanmu sudah benar ?*
S-R6 *Kurang yakin*
P *Terus bagaimana kesimpulannya ?*
S-R6 *Jadi talinya harusnya panjangnya 561,288 cm.*

From the interview excerpt, it can be seen that the subject of S-R6 is able to explain a complete mathematical statement. It can be seen that the subject of S-R6 is able to describe what is known in the question and what is asked in the question. However, the subject had difficulty in finding the correct solution. S-R6 subjects are not able to manipulate mathematics correctly and completely. It can be seen that the subject of the S-R6 cannot give a clear reason for the method used. Subjects S-R6 were able to draw conclusions verbally but were incomplete and incorrect. The results of this study are in line with the research conducted (Suprihatin et al., 2018) about ability analysis mathematical reasoning of junior high school students on the material of triangles and quadrilaterals. The results showed that students in the poor category did not achieve good mathematical manipulation indicators. Many students who have difficulty understanding the questions and are confused when doing mathematical manipulation.

Based on the results of the exposure and interview excerpts, it can be concluded that the subject S-R6 is able to fulfill the indicators of presenting mathematical statements, unable to fulfill the indicators of manipulating mathematics and indicators of compiling evidence or providing reasons for the correctness of the solution, able to meet the indicators of drawing conclusions but still incomplete and incorrect.

CONCLUSION

Based on the research and discussion that has been described previously regarding the ability of mathematical reasoning in solving HOTS type questions on circle material, the following conclusions are obtained. Students with high mathematical reasoning abilities are able to fulfill all indicators of mathematical reasoning, namely presenting mathematical statements, mathematical manipulation, compiling evidence or providing reasons for the correctness of solutions, and drawing conclusions. Students with high abilities are able to understand the information referred to in the questions well and are able to solve questions correctly and completely. Students with low mathematical reasoning abilities are only able to meet the indicators of mathematical reasoning presenting mathematical statements well. Students with low abilities are not able to fulfill the indicators of mathematical manipulation correctly and completely, are unable to compile evidence or provide reasons for the correctness of the solution, and are unable to draw conclusions correctly. Students with low abilities are not able to understand the information referred to in the questions properly and are not able to solve correctly and completely on all questions.

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Hypothetical Learning Trajectory (HLT) to Build Understanding of Mathematics Education Students about What is and How to Apply Problem Based Learning (PBL) to Learn Mathematics

Francisca Yenuacrista Surya[1,a)], Friesca Pra Utami Dewi[1,b)], Hongki Julie[1,c)]

[1]*Program Magister Pendidikan Matematika Universitas Sanata Dharma, Yogyakarta.*

[a)] *Corresponding author: franciscacrista@gmail.com*
[b)]*friesca.pud@gmail.com*
[c)]*hongkijulie@yahoo.com*

Abstract. The study aims to (1) find out how Hypothetical Learning Trajectory (HLT) is in problem-solving learning to study the volume and surface area of a cube, (2) find out how the understanding of S1 students who take class D Micro Teaching courses regarding Problem Base Learning models is. The type of this research is design research. The subjects in this study were 15 students who took Micro Teaching courses in class D. The data analysis used in this study, used data analysis steps formulated by Miles and Huberman, namley data reduction, data presentation, drawing conclusion, and verify. In general, the learning steps taken are as follows (1) the researcher conveys the learning objectives, namely helping students understand problem based learning, (2) the researcher gives apperception to the topic used as a problem-solving medium, (3) the researcher conveys the problem to solve the problem completed by students, (4) students solve the problems given and are accompanied by researchers then present them, and (5) evaluate the result of problem solving then students draw conclusions from a series of activities carried out during teaching. Based on the results of interviews after going through the learning process, it can be concluded that eleven students can only explain that PBL must begin with solving problems that aim to find a mathematical concept. Then four students can define how the stages of learning that must be passed by students, starting from giving problems to finding a mathematical concept.

INTODUCTION

Mathematics is one of the subjects that must be studied at all levels of education, starting from basic education to higher education. Mawarsari (2014) argues that efforts to improve the quality of Mathematics teachers as resources that play a role in the Mathematics learning process is to improve the ability of Mathematics education teachers and students as prospective Mathematics teachers. Suggested by Shulman (in Helen Chick, Monica Baker, Thuy Pham, &Hui Cheng, 2006) that the basis for teacing is content knowledge, pedagogy, curriculum, students, educational context and educational goals. Shulman (1987) also mentions that Pedagogic Content Knowledge (PCK) describe a mixture of learning content and pedagogy which is the teacher's domain by involving "an understanding of how certain topics, problems or issues are organized, represented and adapted to the diverse interests and abilities of students and served for teaching" (Helen Chick, Monica Baker, Thuy Pham, &Hui Cheng, 2006).

Profound Understanding of Fundamental Mathemaics (PUFM) is described by Ma (1999, in Helen Chick, Monica Baker, Thuy Pham, &Hui Cheng, 2006) as a basic understanding of Mathematics with

depth, breadth and accuarcy. Teachers with this understanding make connections between concepts and proceduresm approach concepts and problems from multiple perspectives showing an explicit awareness of "simple but powerful basic concepts", and have an understanding of the curriculum as a whole rather than knowledge of the parts to be taught. The National Council of Teachers of Mathematics (NCTM, 1998) formulates the ability to learn Mathematics which is called mathematical power, whish includes: (a) mathematical communication, (b) mathematical reasoning, (c) mathematical problem solving, (d) mathemaical connection, (e) learn to represent. Therefore, if you want to be a good Mathematics teacher, then the teacher must understand, have these five competencies, and know what processes need to be carried out learning Mathematics to develop these five abilities in students.

Mathematical Content Knowledge (MCK) was formulated by Ball etc. (Goos, 2013), (1) common content knowledge, (2) specialized content kowledge, (3) knowledge at the mathematical horizon. MCK and PCK is a combination that needs to be owned by prospective teachers or Mathematics teachers, so that students have good achievements in the field of Mathematics. In research conducted by Merrilyn Goos (2013) PCK has a greater influence than MCK. But PCK cannot be done without MCK. According to the research result of Sofi Nurqolbiah (2016) and Asfi Yuhani, et al (2018) the results show that students who are taught using Problem Based Learning (PBL) show a positive attitude in dealing with problems and their problem-solving abilities are superior to students who are taught using ordinary learing or a scientific approach. Christina Collet and Regina Brother (2006) concluded that with the intervention in the field, problem solving learning leads to an increase in the effect of student learning in students' mathematical performance, especially in problem solving in the competencies taught.

Therefore, Mathematical Education students who are prospective Mathematics teachers need to be prepared in carrying out Mathematics learning using PBL. One of the efforts that can be done to prepare these prospective teachers is to introduce what PBL is and how the process of doing Mathematics learning using PBL in Micro Teaching courses is. In the Micro Teaching learning process in Class D, in one practiccal opportunity, students were asked to teach one of the Mathematics materials in Junior High School, using PBL. From the practice carried out by students, researchers obtained the following problems: (1) when students had difficulty solving problems, the teacher explained how to solve the problem and the teacher did not provide guidance to students, (2) the teacher explained the concepts that would be built by students through the problem solving process, so that from the process of solving the problem into the process of implementing knowldege, which should be built through the problem, and (3) the teacher explains the knowledge that should be built by students through the problem, after that the teacher does not give a problem but immediately gives practice questions to implement what explained by the teacher.

The existence of problem in the practice of Micro Teaching Class D as described above, makes researchers plan to develop a learning trajectory that can help students understand what PBL is and how to teach Mathematics using PBL. According to rezky (2019) the learing trajectory must describe how Mathematics edocators (teachers, researchers, and curriulum developers) are oriented towards a constructive process, how mathematics teachers help students to design problem solving strategies and impelment these strategies so that students can build the expected mathematical concept. Simon (in Nurdin, 2011) argues that a learning trajectory must include three main components, namely learning objecties, a set of tasks to achieve these goals, and hypotheses about how students learn and how students think. In the learnng trajectory that will be built by the researcher, the researcher will use the volume and surface area of the cube as a vehicle to bring students to understand what PBL is and how teach Mathematics using PBL. PBL have five stages, namely (1) introducing students to problems; the educator conveys the learning objectives to be achieved, checks students' perceptions by asking questions about the previous material, and provides motivation, (2) organizes students to learn, (3) assisting independent and group investigation; educators provide support and encourage students to collect data and conduct experiments independently or ini groups, (4) develop and present their work, and (5) analyze and evaluate the problem solving process (Arends in Hilyatin and Qohar, 2015)

Based on the existing problems, it can be concluded that the formulation of the problem in this research is (1) how to make a learning trajectory to help students understand what PBL is and how to teach volume and surface area of a cube using PBL?, and (2) how to understand S1 Students of Mathematics Education at Sanata Dharma University who are taking Micro Teaching vourses in class D about what PBL is and how to teach the volume and surface area of a cube using PBL?

RESEARCH METHODS

This research using design research. Design research is appropriate to be used in this study because in this study the researcher builds a learning trajectory that helps students to understand what PBL is and how to teach the surface area and volume cube material using PBL, and the researcher looks at the impact of the learning trajectiry made by the researcher on the understanding of the students about what PBL is and how to teach surface area and volume cube material using PBL. The subject in this study were 15 students of the Mathematics Education study Program at Sanata Dharma University who took the Micro Teaching course in class D. The data in the study were obtained from questionnaires distributed after learning was carried out and interviews with research subjects related to understanding what PBL is and how to teach the surface area and volume of a cube material using PBL. The process of analyzing research data is carried out according to the stages of data analysis according to Miles and Huberman (1992), namely (1) data reduction, (2) data presentation, and (3) drawing conclusions/ verification.

RESULTS AND DISCUSSION

The learning process of the research class lasted in one session for 2 x 50 minutes (100 minutes). The aim of this learning is to help the university student understanding what the teaching and learning process is and how to teach about the formula of cube's surface large and its volume through the teaching and learning process. The subject of this research class is 18 students, and it has been held on 10 May 2021. On this learning there were two cases concerning with solid cube. They are as follows:

Case 1

There's a solid cube, its side is 4 cm. That cube will be painted in terms of these:

a. There were 3 different colors to paint it, but it's not allowed to paint 3 sides with the same color.
b. Every side of the cube is painted with the same color.
c. After being painted and dried, the solid cube was cut into smaller cubes in 1 cm long.

The questions:

a. How many small cubes which set the solid cube?
b. How many small cubes which were painted with a color, 2 colors, 3 colors? How many small cubes which was painted.

Case 2

Based on the first case

a. How many small cubes which have 2 sides colored?
b. How many small cube which have 2 sides colored?
c. How many small cubes which has a side colored?

The process which happened in the class based on the cross learning which has been arranged by the researcher as follows:

1) Phase 1: Giving such orientation about the case to the student's
   a) The teachers started the learning by reviewing the student's readiness and sharing the aim of the learning which are going to do that is the students will construct the case relates to the cube to know the learning process through problem based learning.
   b) The teachers invited the students to recall the characteristics of the cube. The researcher provided a picture of a cube in the form of a cube frame on a slide and then asks verbally "Do you still remember, what are the characteristics of the cube?"
   c) Some students tried to answer that the cube has 6 sides that are square, the cube has 12 edges which eacg side being the same length, the cube has 8 corner.

d) The teachers invited the students to know solid cubes by displaying a picture of a cube that is different from the first cube. Then the teacher will ask the students verbally "What is the difference between the first and the second cube?"
e) Some students tried to answer spontaneously, “The picture of the first cube is just a cube frame while the second cube looks solid or all space are filled and no gaps”.
f) The teachers gawe problems related to the cube

2) Phase 2 : Organizing the students
   a) The teachers asked the students what have the students understand about the problems which were presented and were there any misunderstandings experienced by students about the problems presented. Then the teachers gave the opportunity to the students to find initial ideas in constructing the problems
3) Phase 3 : Guiding individual or group investigations
   a) After the teachers knew clarification from students regarding of students’ understanding on problem, the teachers asked the initial idea that students will di to solve the problem.
   b) The students explained the selected coloring pattern, “I used first color for 2 sides, second color for 2 sides and third color for 2 sides cube.”; “I used first color for 3 sides, second color for 2 sides and third color for 1 side cube.”
   c) The teachers gave a time for the students to solve the problems which have been presented by occasionally asking whether there were difficulties experienced by students, if there is no answer the teachers will call several name of the students to ascertain wheter there are difficulties or not.
4) Phase 4 : Presenting the result
   a) The teachers asked the students to compile the results that have been obtained.
   b) The teachers asked the students several times to make sure whether the students have solved the problem and compiled it or not.
   c) The teachers asked the students in order to know who have finished and asked then to send the answers to the class chat group.
   d) When the time is up, the teachers gave the opportunity to students who are willing to present the result.
   e) The teachers provided clarification on the answers obtained by the students.
   f) The teachers asked the students if there were different answers, some students got different answer and not correct result, then the teachers provided support to guide students to get the right result.
5) Phase 5 : Analizing and Evaluating the problem-solving process
   a) At this pahse, the teachers helped the students to reflect and evaluate the learning process and results of the investigations which students have done by asking this question: “What did you find from today’s learning process?”. The following are the result of sharing from five students:
      i. “We reviewed the characterize of the cube and what a solid cube was”, “We should solve the cube’s problems where the solid cube was painted, cut and found how many small cubes are there and how many sides of the small cube are painted”.
      ii. “We mentioned volume and surface area from the problem has given, where the volume described from the number of small cubes and surface area from the total number of all painted cube’s sides.”
      iii. “Today's learning has used problem-based learning, because in the previous learning it was started with a problem and then the problem will be solved by students so that they can discuss a certain achievement."
      iv. “Today's learning has used the PBL approach, we were given a problem before then we experimented to solve the problem.”

v. "Today's learning has implemented PBL, because at the beginning we were given a problem, then we were directed to do what it was like, then we worked on and solved the problem after that we also presented the results of our answers and at the end we did reflection on learning."

b) Furthermore, the teacher also gives reflection questions in the form of google form to students. The questions on the google form are as follows: "In your opinion, what is PBL, and how to teach Mathematics using PBL?"

Description of Students Learning Results in Research Classes

The research was carried out on 6th semester students in the Class D Micro Teaching course, a total of 18 students with different abilities. Students aregiven two problems to study as a support in understanding problem based learning. Researchers analyzed the test results based on the results of students work using the researh data analysis process according to Miles and Huberman, as follow:

(a) Students Learning Results on First Problem.

Based on the collection of the results of problem solving 1, 11 of 18 students have collected the results of the solution and there are three groups of answers based on the solution of the given problem, namely (1) the first group of answers there are nine students with the same annswer, in this group of answer, the cube is painted with the pattern 2,2,2. As well as mentioning that the number of small cubes that make up a large cube is 64 small cubes, and the number of sides of a small cue tahat is painted is 96 sides of a small cube. Or it can be interpreted that the sirface area of the cube is 96 cm^2. (2) the second answer group consisted of two students with a pattern of painting done was 3,2,1. As well as mentioning that a cube that is partitioned into small cubes with many small cubes is 64 pieces or calculated by $4 \times 4 \times 4 = 64$ which represents the volume of a cube with a side lenght 4 cm is 64 cm^2 and the numbe of sides of a small cube that is exposed to paint is 48 + 32 + 16 = 96 sides. (3) the third answr group, there are two students who have not been able to find a solution to the problem presented.

For the first and second answer groups, the researcher can conclude that both groups have successfully solved the problem and obtained the right results, the two groups of answers have fulfilled the five mathematical content knowledge according to (NCTM, 1998) namely (1) mathematical communication, at this stage students communicate the problems presented to teachers, (2) mathematical reasoning, at this stage this group of students find initial ideas in solving problems, (3) mathematical problem solving, at this stage the students group has used various strategies to solve problems, (4) mathematical connection, at this stage the students group has linked their knowledge with ideas obtained to solve the problem, and (5) learning to be representative, at this stage the students group is able to represent mathematical ideas in solving problems.

The third group of answers is a group of students who have not been able to solve the problems given. This group of students has not fully fulfilled by students in tne third group are, (1) mathematical communication. Students have also tried to communicate their understanding of the problems, and (2) mathematical reasoning, at this stage students have tried to convey the initial ideas they found to solve the problem. This group of students have not been able to relate the initial

Ideas they found with their ability to solve problems, so this group of students have not been able to solve the problems.

(b) Students Learning Results on the Second Problem.

For the second problem, 11 out of 18 students have collected the resultsof the solution and there are three groups of answers based on the solution og the given problem, namely (1) the first group of answers is the group of students with the correct completion steps, (2) the second group of answers is the group. They are less thorough in analyzing the problems given, (3) the third group is students who have not been able to solve the problem and given.

Based on students learning outcomes in first problem and second problem, it can be concluded that students in the first and second answer groups for first problem and students in the first group for secomd problem meet the indicators of MCK formulaed by Ball etc. (Goos, 2013) in solving problems abou the surface area and volume of a cube, where students have; (1) common content knowledge, where students are in the field of mathematic, (2) specialized content

knowledge, where students understand the characteristics, surface area and volume cubes, and (3) knowledge at the mathematikal Hrorizon.

Interview Result : The Understanding Problem Based Learning

Because of there were some student who did not fill out the Google Form, the researchers conducted an interview by Whatsapp through the students. Based on the results of interviewed 15 students with the question "In your opinion, what is PBL, and how to teach Mathematics using PBL?", we found that there are three groups of answers. The following is an excerpt from an interview from each group:

1) The First Group's answers:
   The following is an excerpt from an interview with one of the five students in the first group of answers:
   Q : " In your opinion, what is PBL, and how do you teach Mathematics using PBL?"
   M1: "Problem-based learning model is a learning model that at the beginning of learning we start with contextual problems (daily life) and the teacher expect that students can solve the problems by using their thinking skills so that students can be brought to the formation of mathematical concepts".
2) Second group's answers:
   The following is an excerpt from an interview with one of the six students in the first group of answers:
   Q : "In your opinion, what is PBL, and how do you teach Mathematics using PBL?"
   M2: "As far as I know PBL is learning that emphasizes the process of forming mathematical concepts that begins with giving students problems to solve and through this process students are expected to be able to think critically so they can find these concepts"
3) Third group's answers:
   The following is an excerpt from an interview with one of the four students in the first group of answers:
   Q : "In your opinion, what is PBL, and how do you teach Mathematics using PBL?"
   M3: "According to what I understand about PBL based on lessons learned on May 10: (1) students are given a problem related to the topic of the cube. (2) students are helped to solve the problem, with the help and guidance of the teacher to get information from the questions given. (3) students are then asked to convey the results of solving the problems given; (4) students and teacher made conclusions from the learning that has been done."

Based on the explanation above, we can conclude that (1) five students said that PBL is learning that begins with contextual problems which students are then brought to the process of finding mathematical concepts. These five students in this group have not demonstrated PCK ability, because they do not explain how the process or steps that must be taken by both students and educators starting from the process of giving problems to finding concepts; (2) the second group's answers (six students) said that PBL is learning that begins with presenting problems that are designed in a context that is relevant to the material being studied, and makes students able to think critically so that they can find a concept. These six students did not explain how the process or steps that must be taken by both students and educators starting from the process of giving problems to finding concepts and do not explain why the process of giving problems can make students able to think critically. This shows tahat the six students in this group have met the characteristics of PCK according to Shulman (1987) that Pedagogic Content Knowledge (PCK) describe a mixture of learning content and pedagogy which is the teacher's domain by involving "Understanding of how certain topics, problems or issues are organized, represented and adapted to the interests and abilities of diverse learners and presented for teaching" (Helen Chick, Monica Baker, Thuy Pham, & Hui Chng, 2006). Students understand the learning that is being carried out, namely to understand what PBL is and knowledge about PBL an be able to represent; and (3) the third group's answers (four students) said that PBL is a learning process with the following steps: (a) students are given a problem related to the mathematics material to be discussed; (b) students are guided by the teacher to obtain information from the questions were given, so that students can solve the problem; (c) students are asked to convey the results of solving the problems given; and (d) students and the teachers make conclusions from the learning that has been done. The four students have explained

the steps experienced by students in the learning process using the PBL learning model, but have not explained that through this process students are invited to carry out the process of constructing mathematical knowledge related to the problems solved by this study. The four students in this answer group have done content knowledge, but have not fulfilled the pedagogical knowledge. Where students know what topics are being studied but have not been able to represent what PBL is.

CONCLUSION

Based on the research that has been done, it can be conluded as follows:

1. The steps to teach Mathematics using PBL to find the volume and surface area of a cube are as follow;
   a. The teachers expalined the learning objectives that will be carried out.
   b. The teachers gave apperception so that students get an idea related to solving the next problem.
   c. The teachers gave two problems about the process of painting solid cube using three colors for students to solve and the theacher provides support for students.
   d. Students presented the result of problem solving they get, then the teacher evaluate the result of broblem solving obtained by students.
   e. At the end of the lerning the teacher and students were doing the reflection of what have been experienced during the learning process, and conclude that the way to find the volume of a cube is to multiply the lenght of the side of the cube by the lenght of the side of the cube and multiply it again by the lenght of the side of the cube and how to find outer surface of the cube is six time the surface area of one side of the cube.
2. From the results of interviews with fifteen students, the following results were obtained:
   a. Five students did not explain how the process or steps that must be taken by both students and teacher starting from the process of giving problems to finding concepts.
   b. Six students did not explain how the process or steps that must be taken by both students an teachers starting from the process of giving problems could make students able to critical thinking.
   c. Four students have explained the steps experienced by students in the learning process using the PBL , but have not explained that through this process students ar invited to carry out the process of constructing Mathematical knowledge related to the problems solved by these students.

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Analysis Strategy Online Learning of Applied Mathematics at Civil Engineering of Politeknik Negeri Malang

Mutia Lina Dewi[1, a)], Rif'atul Khusniah[1,b)], Rofila El Maghfiroh[1, c)]

[1]*Politeknik Negeri Malang, Indonesia*

[a)]*mulinde13@gmail.com*
[b)]*rifatulkhusniahkurniawan23@gmail.com*
[c)]*rofila.elma@gmail.com*

Abstract. This study used a qualitative approach with the object of research was the second semester students of the Construction Engineering Management for the 2021/2022 academic year, class 1TRKJJ1 as the research subject. The research instrument consisted of test scores, questionnaires, and discussions between mathematics lecturers from the other departments. The purpose of this research is to find the online mathematics learning strategy. The results showed that the average score of the mathematics test for class 1TRKJJ1 was Test 1 = 98 by random multiple choice questions and Test 2 = 76 by essay questions. Many students cheat, it can be seen from the same answers. Mathematics lecturers are required to provide a variety of applications, correcting carefully because many answers are correct but the process are mistakes due to writing errors. The results of the mathematics lecturer's questionnaire were 42.9% math allocation 2 hours/semester, 85.7 % zoom meetings, 71.4% making learning videos, 0% you tube, 71.4% discussing questions with student presentations, 100% experiencing internet network problems, and 57.1% giving essay test questions. The results of the discussion between mathematics lecturers about assessment were that students presented individual presentations when answering practice questions, different test questions, handwritten answers, many questions are given, and students choose their own questions, each answer has the student's signature. The learning strategy are (1) use various applications such as zoom, google. meet, and google classroom, (2) use application facilities such as white board, share, and video, (3) give a test with different questions and handwritten.

INTRODUCTION

Almost two years of the covid-19 outbreak coming in the world, many victims, vaccine administration is in progress but the outbreak does not know when it will end. It's not easy teaching math during a pandemic. In normal times, many students have difficulty in mathematics. Lecturers are required to provide appropriate models, strategies, and learning methods during the COVID-19 pandemic. Various learning models had been provided as an effort to improve students' abilities, such as the Polya Model (Dewi, 2005); STAD Cooperative Learning Model (Mudjiono, 2006); and Jigsaw (Dewi, 2009); and Mathematical Incubation (Dewi, 2019); with students as research objects. All of these learning models are in normal times, no Covid-19 outbreak. During the Covid-19 pandemic, there was leadership suggestion to use the LMS (Learning Management System) application facilitated by the institution. Unfortunately, this LMS has many problems, especially interruption network, and frequent errors. Therefore, there are many variations of applications used by lecturers starting from SMS, email, whatsApp, zoom, google meet, and google classroom. This study aims to find an online learning strategy for Applied Mathematics during the COVID-19 pandemic. Data collection from the results of questionnaires, test scores, and discussions with mathematics lecturers. The expected benefits are that mathematics lecturers teach easily according to the curriculum targets and students enjoy learning Applied Mathematics.

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RESEARCH METHODS

The focus of this research is to find the online learning strategy of Applied Mathematics during the Covid-19 pandemic. Thus, relevant research is qualitative approach. This is because the study focuses on the acquisition of data that is factual, natural, and more directed to the process than the result. According to Bogdan and Biklen (in Mujianto: 2007) states, that qualitative research has characteristics: (1) natural, (2) researcher as the main instrument, (3) descriptive, (4) more verbal data, (5) more emphasizing on the process than the outcome, and (6) the analysis is inductive. The design of this study uses Classroom Action Research (PTK), because the research is conducted based on the problem of learning in the class.

The presence of researchers in this study is very important, because they act as teachers, observers, and data collectors. To obtain optimal observation, field notes are added. Thus there are no missing data which may be useful for supporting research problem solving.

The data collections in this research are as follows: (1) the results of a questionnaire about the online learning process, (2) the results of math test scores using Google Form, and (3) sharing with mathematics lecturers from the other department by Zoom Meeting. The data source of this research is one class out of seven classes of D4 Civil Engineering students, which is 1TRKJJ1 in even semester of 2020/2021. This is based on the consideration, that this class schedule goes first as Monday.

Data analysis was performed using qualitative data analysis techniques developed by Miles and Huberman (in Mujianto: 2007) consisting of three steps of activities performed sequentially are reducing data, presenting data, and draw conclusions and verify data. The description is as follows.

1. Reduce Data

   Reduce the data is an activity to do the selection and simplification of all data from the beginning to the preparation of reports in order to obtain accurate conclusions.

2. Presentation of Data

   The presentation of data is done by arranging the narrative reduction result, which is described in verbal sentences so as to enable to make conclusion and take action.

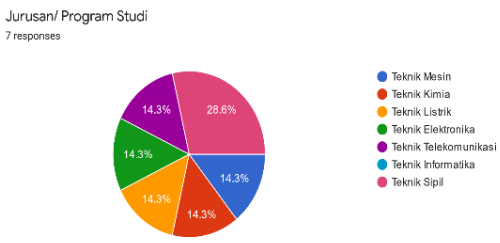
3. Conclusions and Verify Data

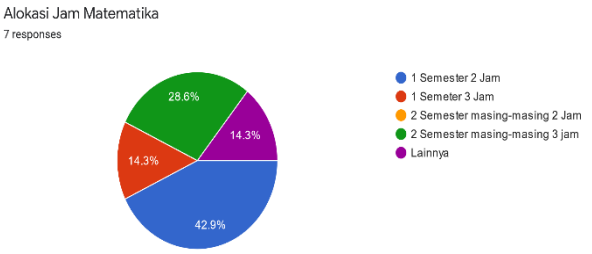
   Drawing conclusions is an activity in giving conclusions to the results of interpretation and evaluation. This activity includes searching the meaning of data along with explanation, while data verification is an activity to test the validity of data

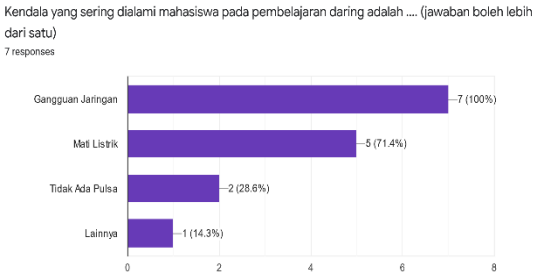
RESULTS AND DISCUSSION

The results of the mathematics lecturer's questionnaire for all majors are as follows:

Conclusion







The results of Mustakim's research (2020) stated that students rated learning using media as very effective (23.3%), most of them rated it as effective (46.7%), and rated it as average (20%). For mathematics, it is not easy to provide online learning. There are many problems, such as limited exercises and material, time allocation, network interruption, and others. Fitriyani (2020) stated that in the midst of the covid-19 pandemic that hit the world, there was no reason for students to have high learning motivation.

At the Civil Engineering Department, mathematics is given one semester with an allocation of 2 hours/week with the subjects of Real Number System, Determinant, Equation, Trigonometry, Geometry, Derivative, and Integral. During online learning, use the zoom meeting and google classroom. There are many problems but online mathematics learning must continue with all the lack. Lecturers are required to choose the appropriate learning strategy during a pandemic. Online learning is a dilemma for mathematics lecturers, a difficult and unfavorable situation. When learning in class, many students have difficulties in solving math problems, especially virtually with many limitations. This is a challenge for mathematics lecturers, how to improve students' abilities during a pandemic. According to the Indonesian Dictionary, the meaning of a dilemma is a difficult situation that requires people to make a choice between two possibilities that are both unfavorable; difficult and confusing situations. Research results (Irfan, 2020); who stated that the most widely used system-based learning management platform was google classroom, zoom video conferencing was the second choice, while the LMS on campus was less attracited to lecturers.

The results of the discussion of the mathematics lecturer from the Department of Civil Engineering, Electrical Engineering, Mechanical Engineering, and Chemical Engineering obtained the following suggestions.

1. Students answer practice questions with individual presentations one by one.
2. The questions are made differently based on the NIM number or attendance number
3. If there is the same answer that is corrected, the one who collects it first
4. Answers are handwritten
5. The questions are given many number, students choose the questions themselves.
6. Answers are sent via email with a time limit.
7. Each answer has the student's signature.
8. Different questions for each student

CONCLUSION

Based on the description of the research results above, the conclusions are described as follows.

1. Online learning of applied mathematics in the Civil Engineering through zoom meetings and google classroom.
2. Assessment based on presentation of practice questions, test scores, and assignments. The form of multiple choice and essay tests with on camera provisions and time restrictions.
3. The average results of the math test scores for class 1TRKJJ1 are Test 1 = 98 random multiple choice questions and Test 2 = 76 essay questions.
4. The results of the mathematics lecturer's questionnaire (7 respondents) were taken from the largest percentage, obtained as follows.
   42.9% math allocation 2 hours/ semester
   85.7% online learning through zoom meeting
   71.4% make learning videos
   0% you tube
   71.4% discussion of questions with student presentations
   100% experiencing internet network problems
   57.1% gave essay test questions
5. The results of the discussion between mathematics lecturers about assessment are students presenting individual presentations when answering practice questions, different test questions, handwritten answers, if there is the same answer, it is corrected to collect it first. questions are given, quite a lot of students choose their own questions, answers are sent via email, each answer has the student's signature.
6. The learning strategy is (1) use various applications such as zoom, google. meet, and google classroom, (2) use application facilities such as white board, share, and video. (3) give a test with different questions and handwritten answers.

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The Development of Problem-Based Student Worksheets To Improve Mathematical Reasoning Ability In Class XI Students Of SMA Negeri 6 Surakarta

Intan Rofi'ah[1, a)]

[1]*Universitas Sebelas Maret, Indonesia*
[a)] *intanrofiah@gmail.com*

Abstract. This research aims to develop a valid, practical, and effective problem-based Student Worksheet (LKPD) to improve students' mathematical reasoning ability in class XI IPS 1 SMA Negeri 6 Surakarta. The development research method used is a 4-D model, including Define, Design, Develop, and Dissemination. The subjects in this study were students of class XI IPS 1 SMA Negeri 6 Surakarta. Data collection techniques used interviews, questionnaires, observations, and tests of mathematical reasoning abilities. This research analyses the validity, practicality, and effectiveness of LKPD using criteria scores and test results of mathematical reasoning abilities through a t-test with a significance level of 5%. Based on the analysis results, the developed LKPD meets the criteria of being valid, practical, and effective. Problem-based LKPD declared valid with 79% between the average results of expert assessments and readability tests; practical rated 86% in the intermediate results of observations of the implementation of learning and student responses; effective because there is an increment in students' mathematical reasoning abilities after using LKPD with an adequate level of 0.47 including in the medium category.

Keyword: LKPD, problem-based, mathematical reasoning, linear programming

INTRODUCTION

Mathematics learning continues to develop and demand humans to be more creative and innovative. Mathematics is considered as the key to stimulating thinking and human reasoning ability. As stated before, mathematics develop methods of thinking and reasoning in concluding investigation, exploration, experimentation, and showing similarities, differences, consistency, and inconsistencies [1]. Mathematics has a unique characteristic, emphasising deductive processes that require logical and axiomatic reasoning [2]. Reasoning is important in the learning process [3].

Reasoning is a thinking process that starts from sensory observations (empirical observations) in drawing conclusions that produce several concepts and understandings [4]. The reasoning ability is necessary in making decisions in various scientific social problems [5]. Reasoning was described as a special kind of thinking and drawing conclusions based on premises [6]. It means that reasoning is a thinking process to draw conclusions or construct a new statement by referring to a true statement. Furthermore, the implementation of mathematics learning must be applied based on five mathematical abilities: connection, reasoning, communication, problem-solving, and representation [7]. Also, according to Romberg and Chair, the indicators of mathematical reasoning ability are: (1) drawing logical conclusions; (2) providing an explanation using models, facts, traits, and relationships; (3) estimating answers and solutions; (4) using

patterns and relationships to analyze mathematical situations, drawing analogies and generalizations; (5) constructing and testing conjectures; (6) giving a counterexample; (7) following the rules of inference; (8) checking the validity of arguments, compiling valid arguments; and (9) establishing direct, indirect and indirect use of mathematical induction [8]. Therefore, mathematical reasoning is a necessary aspect of the mathematics learning process to train and develop continuously. The reasoning makes students able to solve problems quickly, precisely and build their minds to master mathematical concepts [2]. Through mathematical reasoning in learning, students practice proposing suspected solutions to problems, finding patterns of completion and using them, providing explanations for patterns, models, images, or properties, checking the truth of an argument, and drawing conclusions correctly and appropriately. In consonant with the statement before, mathematical reasoning skills must be discovered and developed.

Conversely, mathematical reasoning is essential and needs to be recognized, but students' mathematical reasoning is still low. Based on the PAMER UN for the 2016/2017 academic year, the absorption capacity of indicators in solving reasoning problems related to linear programming in SMA Negeri 6 Surakarta students is 36.68% in the national scope. This value belongs to the less category, which indicates that students' reasoning ability is low. In addition, based on the results of the pre-test of mathematical reasoning abilities of students in class XI IPS 1 SMA Negeri 6 Surakarta, as many as 58% of students were unable to provide explanations for models, pictures, traits, or patterns, 77% of children were unable to check the truth of an argument, 79% of students were not able to draw logical conclusions. Based on the five indicators of mathematical reasoning ability, the three indicators obtained from the pre-test results are low. Research results by experts show that students' reasoning skills, especially in mathematics, are significantly weak [9][10][2]. This condition happened because mathematical reasoning abilities are not steady at the secondary school level, a large number of studies show the low mathematical reasoning of students in secondary schools [10]. This result also indicates that the tendency that causes students can't understand the subjects in mathematics. This condition causes by the lack of understanding and usage of decent reasoning in solving the problems given [11]. In proportion to the statement before, the lowest average proportion Indonesian students can achieve is the cognitive domain at the reasoning level of 17% [12].

To train reasoning skills, the teacher can create learning that systematically develops problem-solving, reassures the activation of previous knowledge to build new self-directed understanding, and encourages students to apply various strategies in solving a problem with the correct procedure. During the learning, the teacher should try so that students are skilled in applying concepts or formulas and are more encouraged towards achieving a higher level of reasoning [1]. The learning model that can be used to improve reasoning ability is a problem-based learning (PBL) model. PBL is designed to help students develop thinking, problem-solving, and intellectual skills [13]. PBL can trigger previous understanding to build new knowledge and elaborate on both pieces of knowledge.

Both knowledges can be used to solve a problem so people can absorb them in long-term memory [14]. PBL aims to develop the ability of students to solve a problem or case systematically [15]. Through PBL, students are qualified to solve a real problem by using previous knowledge and constructing new knowledge independently and systematically.

Teaching materials can help students understand concepts that are arranged systematically according to the competencies that students achieved. The teaching materials used in learning mathematics at SMA Negeri 6 Surakarta were guided by the Mathematics Book published by the Ministry of Education and Culture. Based on the observations, the given material and the presentation of the application with the concepts studied are incomplete. Of course, to develop mathematical reasoning abilities, appropriate teaching materials are needed. However, the facts show that the availability of student worksheets that focus on improving mathematical reasoning abilities does not yet exist, the circulating worksheets do not emphasize the process, have not developed students' creative thinking skills [16][17][18]. LKPD can be a solution to improve mathematical reasoning skills because it can be designed in a structure to find conclusions based on the problems.

Based on the explanation above, this article aims to determine how the development of problem-based student worksheets (LKPD) is valid, practical, and effective in improving students' mathematical reasoning abilities.

RESEARCH METHODS

This research uses research and development (R&D) methods. Research and development methods (Research and Development / R & D) are research methods used to produce specific products and test the effectiveness of these products [19]. The development model used is a 4-D model, including defining, design, development, and dissemination. In this study, the development of LKPD only reached the development phase.

The initial stage is the define stage. The define stage is completed by determining and defining the development requirements. The definition is completed through development needs analysis activities. Determination of product development requirements tailored to user needs. The definition stage in this research included needs analysis, student characteristics analysis, material analysis and formulating learning objectives.

The analysis needs to determine the fundamental problems encountered in learning. Interviews conducted the research to assess the needs of teachers and students for teaching materials that can help the learning process. The analysis of student characteristics aims to identify the characteristics of students regarding the level of ability or level of cognitive development of students, and background knowledge. And also the material analysis aims to build concepts on the materials to be delivered to achieve Core Competencies (KI) and Basic Competencies (KD). The material analysis is done by identifying the main material that needs to be taught, collecting and selecting relevant material, and rearranging it systematically to formulate learning objectives.

The development stage consists of the design and development stages. The design stage is done by arranging the LKPD (draft 1) initial draft, research instruments, lesson plans, and mathematical reasoning tests. This LPKD adopts PBL learning steps, namely presenting problems, prerequisite materials, and directive patterns to solve problems. The development stage starts from validating draft 1 LKPD to experts, readability test, and testing for class XI students. LKPD has implemented in class XI IPS 1 at State Senior High School 6 Surakarta in the academic year of 2018/2019.

To assess the validity of the LKPD, the assessment is done based on expert judgment. The instruments use material expert validation questionnaires, media expert validation questionnaires, and readability test sheets. Expert validation in the form of validation of material experts and media experts. The initial draft of the LKPD was validated by material experts on aspects of content feasibility, language feasibility, presentation feasibility, and elements of the PBL approach. After LKPD has been revised and validated by the material expert, LKPD evaluated by a media expert. Media experts validate the LKPD on appearance appropriateness, clarity of writing and images, language assessment, and structure. After that, suggestions and inputs given from experts were using as revision material and draft 2. Draft 2 of the LKPD was tested for legibility on class XII students as users, in which they had studied linear programming material. The readability test was led to determine whether the LKPD could remain in class XI linear programming learning. The readability test assessment instrument is assessed based on material, appearance, language, and benefits. The measurement scale of the validity assess ment instrument is in the form of a Likert scale with five assessment criteria, namely (5) excellent, (4) good, (3) sufficient, (2) less appropriate, (1) significantly less appropriate. The quantitative assessment results are converted back into qualitative data by using the guidelines for converting the assessment results to the Benchmark Reference Assessment (PAP) in Table 1.

TABLE 1. Conversion of Assessment Results with Benchmark Reference Assessment (PAP)

The assessment result (%)	Average result (%)
$0 \leq P < 45$	significantly less appropriate
$45 \leq P < 60$	less appropriate
$60 \leq P < 70$	sufficient
$70 \leq P < 80$	high
$80 \leq P < 100$	excellent

LKPD is declared valid if the results obtained from the analysis of the results of the validity assessment are included in the category of sufficient, high, or excellent ($P \geq 60$)

The practicability of the LKPD was evaluated based on the results of learning observations with the LKPD and student response questionnaires after using the LKPD. The instruments that are used to assess the practicality of LKPD are observation sheets and student response questionnaires. The measurement scale of the practicability assessment instrument used a Likert scale with four assessment criteria. The assessment results in the form of quantitative are then converted back into qualitative data by using guidelines for converting the results of the assessment to the Benchmark Reference Assessment (PAP). LKPD is declared practical if the results obtained from the observer's assessment and response questionnaire have a $P \geq 60$.

The effectiveness of the LKPD was assessed based on the pre-test and post-test results of mathematical reasoning abilities before and after using the LKPD. The effectiveness test was conducted to determine the level of success of the product in improving students' mathematical reasoning abilities. The reasoning ability test instrument consists of 3 items each of the description questions arranged based on reasoning ability indicators. The test instrument is given after students use the LKPD in learning.

Before the test instrument, the content validity is already checked by the validator, item analysis is done to determine the validity and reliability, level of difficulty, and discriminating power. After that the test instrument can be used to collect data. The test results data were analyzed using statistical tests. Before testing the hypothesis, a prerequisite analysis test is carried out, so the result that the data being tested is typically distributed and homogeneous. Prerequisite analysis test in the form of normality test, homogeneity test and independence test. The normality test used the Liliefors test, the homogeneity test used the F test to compare the variance between the pre-test and post-test scores, while the independence test used the Chi-square test, and the significance level was 5%. The analysis in this study used a t-test with a single sample. The t-test was conducted to determine whether there was a difference between the results of the pre-test and post-test, to analyze the growth of student reasoning ability, the test was performed using a normalized gain test.

LKPD is declared effective if 1) on the t-test, there is a significant difference between mathematical reasoning abilities before and after using LKPD. This condition means that the average post-test value is higher than the pre-test value; 2) The normalized gain test value results are included in the high or medium category.

RESULTS AND DISCUSSION

The results of this study are student worksheets based on problems in class XI linear programming material. The development is completed using a 4-D model, which includes define, design, development.

Define

In the define stage, an interview was completed by a mathematics teacher at SMA Negeri 6 Surakarta. From the results of the interview, The teacher used the textbooks published by the ministry of education for teaching material, there were no other teaching materials used. In addition, the teacher said that there were still weaknesses and misconceptions in the textbooks used. Therefore, other teaching materials are needed in addition to textbooks published by the Ministry of Education.

Student of class XI in SMA Negeri 6 Surakarta aged around 15-18 years old. According to cognitive development steps and constructivist theory by Piaget, someone older than 14 years old is included in the operational step and can construct knowledge through assimilation and accommodation process. Giving help is needed within building knowledge is one by teacher in learning process.

LKPD was chosen as the teaching material developed in this study because it can be arranged systematically according to the learning objectives. LKPD can be used by student directly and give them chance by constructing knowledge through homework. In its implementation, LKPD can provide direction through questions in accordance with learning activities so that students can expand and deepen their understanding [20]. Learning activities must be contained mathematical reasoning indicator such as, (1) submit alleged answers and solutions; (2) finding and using patterns to make generalizations; (3) provide an explanation of the model, image, nature, or pattern; (4) draw logical conclusions (5) check the truth of an argument.

Design

The LKPD is organized using the website www.canva.com which contains various student worksheet templates. The initial results of the preparation are a draft which includes cover, introduction, table of contents, learning objectives and concept maps of prerequisite materials, four worksheets of prerequisite material, practice questions, learning objectives, and primary material concept maps, six worksheets of the main material, summaries, practice questions, and bibliography.

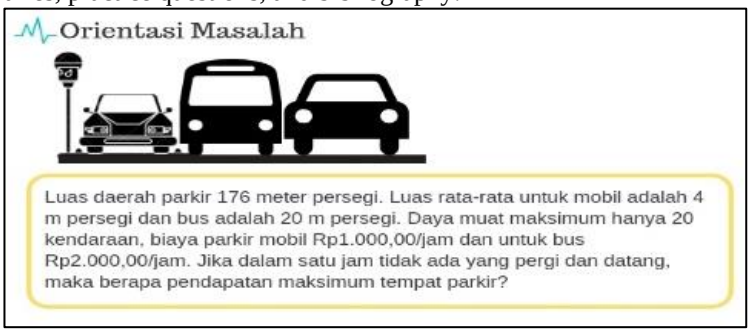

FIGURE 1. The orientation step

LKPD is arranged based on problem-based learning steps. In each stage of learning contains indicators of mathematical reasoning. In Fig. 1, the learning step starts from the problem orientation step; students were asked to submit an alleged solution to the problem of determining the maximum income of a parking lot. This stage stimulates students' mathematical reasoning abilities, namely proposing apparent answers and solutions.

FIGURE 2. Let's learn and investigate step

To start cracking the problem, let's learn and investigate step is conducted to determine the purpose of the problem. In Fig. 2, students were asked to determine the mathematical model of the issues presented in the previous stage. This stage stimulates mathematical reasoning skills, namely the indicators of finding and using patterns to make generalizations.

FIGURE 3. Let's work step

After students investigate the problem's solution, they explain the answer at the let's work step. In Fig. 3, students describe the problem-solving area. This stimulates the mathematical reasoning ability of indicators providing explanations for models, pictures, traits, or patterns.

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Develop LKPD

In developing, draft 1 LKPD was designed to obtain valid, practical, and effective LKPDs. The following are the results of LKPD development in the form of an analysis of the validity, practicality, and effectiveness assessments.

LKPD Validity

The initial draft of the LKPD was validated by experts consisting of material experts and media experts. The validation results are used to revise the initial design. The material experts consist of 1 lecturer in Mathematics Education, Faculty of Teacher Training and Education, Sebelas Maret University and 2 mathematics teachers at SMA Negeri 6 Surakarta. The assessment is calculated based on the average value of each expert. Table 2 shows the assessment of each aspect by material experts.

TABLE 2. Value of Each Aspect of LKPD by Material Expert

Assessment aspect	**Average value (%) by each expert**		
	1	**2**	**3**
Content eligibility	75,71	80	82,86
Performance eligibility	78	80	72
Language assessment	80	80	70
PBL assessment	76	78	78
Average	77	80	76
Category	**High**	**Excellent**	**High**

Based on Table 2, the value of each aspect exceeds 70% with the content feasibility having an average of 79.52%, presentation feasibility 76%, language assessment 76.67%, and PBL assessment 77%. So it can be said that every aspect has high criteria.

The media expert assessment instrument is assessed based on aspects of appearance, clarity of writing and images, language covered in LKPD, and structure. There are two material experts include LKPD editors and layout editors. The average value of each expert determines assessment. Table 3 shows the assessment of each aspect by media experts.

TABLE 3. Value of Each LKPD's Aspect by Media Experts

Assessment Aspect	**Average value (%) by each expert**	
	1	**2**
Display eligibility	78	62,5
Word and picture clarity	76	64
Language assessment	75	80
Structured aspect	73	80
Average	75,3	73,5
Category	**High**	**High**

Based on Table 3, the presentation feasibility has an average value of 70.25%, clarity of writing and pictures 70%, language assessment 77.5%, and 76.5% structured. So it can be said that every aspect has high criteria.

The readability test was carried out to six students of class XII, who were taken at random, 2 people each for each level of high, medium, and low academic ability based on report cards for the even semester of the 2017/2018 school year. Table 4 shows the analysis of the value of each aspect of the readability test.

TABLE 4. Value of Each LKPD's Aspect Readability Test Results

Assessment aspect	Average value (%)
Material	87
Display	82
Language	97
Benefit	85
Average	88
Category	**Excellent**

In Table 4, the average of the total scores for each aspect of the readability test is 88. Based on the benchmark reference assessment (PAP), the readability test results are classified as very high. In addition to providing an assessment of the product, students are asked to provide comments and suggestions.

Based on the three assessments above, the average assessment from material experts, media experts, and readability tests is classified as high criteria so the LKPD is declared valid and can be used in field trials after going through a revision process based on suggestions and input from experts.

LKPD Practicality

The practicality of LKPD was analyzed based on the results of observations and student response questionnaires. Observations were made to assess the implementation of LKPD during class learning. The observation sheet was assessed based on conformity with the lesson plan, the use of the LKPD, and the activities of the students with the LKPD. Observers consist of teachers and students. The assessment is determined from the average rating of the observer.

TABLE 5. Results of Observation of Learning Implementation

Assessment aspect	Average value (%)
RPP suitability	93
The use of LKPD	81
Student activity using LKPD	77
Average	84
Category	**Excellent**

In Table 5, the results of the assessment of each aspect have an average of 84. Based on the rules for converting the evaluation results to the benchmark reference assessment (Penilaian Acuan Patokan/PAP), practical LKPD with very high criteria. Student response questionnaires were assessed based on aspects of the material, appearance, language, and benefits.

TABLE 6. Results of Student's Response Questionnaires to LKPD

Assessment aspect	Average value (%)
Material	85
Display	94
Language assessment	89
Benefit	85
Average	88
Category	**Excellent**

Based on Table 6, the assessment results of each aspect have an average of 88, which includes very high criteria. The students' responses stated that they enjoyed using LKPD and made it easier to understand linear programming material.

Based on the assessment above, the average results of observations and student responses are classified as very high so the LKPD is declared practical and can be used in class XI linear programming learning.

LKPD Effectiveness

The effectiveness test uses the results of the LKPD implementation trial on linear programming learning for students in class XI IPS 1 SMA Negeri 6 Surakarta. Data were collected using a one-group pretest-posttest design, namely pre-test before using LKPD and then post-test after implementation of LKPD in one group of subjects. The statistical test used was divided into three stages: the test of the question instrument, the analysis of prerequisites, and the effectiveness test.

The test instrument test analyzes the mathematical reasoning ability test instrument for validity, reliability, level of difficulty, and discriminating power. Validity is assessed based on internal consistency. Of the 3 pre-test items consisting of 14 sub-items, there is 1 question with $r_{xy} < 0{,}3$ so that item is not used. Of the 3 post-test items composed of 14 sub-items, there are 2 questions with $r_{xy} < 0{,}3$ so that these items are not used. The pre-test questions that are declared valid are then calculated for reliability. Based on the reliability test, the value of $r_{11} = 0{,}79$ was obtained so that the pre-test questions were declared reliable. Post-test questions are declared valid have a value of $r_{11} = 0{,}75$ so that the post-test questions are stated reliable. The difficulty level analysis obtained two sub-items of the pre-test with an elementary level of difficulty, one sub-item with a challenging difficulty level. There are two sub-items with a very easy level of difficulty in the post-test questions so that these sub-items cannot be used.

The analysis prerequisite test was carried out before testing the hypothesis. Prerequisite tests include normality test, homogeneity test, independence test with a significance level of 5%.

The results of the normality test on the pretest data obtained $\bar{x} = 47{,}08$, $s = 19{,}94$, $L = 0{,}15$, $L_{tabel} = 0{,}173$ at the 5% significance level, so DK = $\{L|\mathrm{L} > 0{,}173\}$. Due to $F \notin$ DK, it can be concluded that the pre-test data is normally distributed.

The results of the normality test on the posttest data obtained $\bar{x} = 71{,}88$, $s = 17{,}56$, $L = 0{,}11$, $L_{tabel} = 0{,}173$ at a significance level of 5% so DK = $\{L|\mathrm{L} > 0{,}173\}$. Due to $F \notin$ DK, it can be concluded that the post-test data is normally distributed.

The results of the homogeneity test showed that the variance of the pretest value was ${s_1}^2 = 397{,}65$, the variance of the posttest value was ${s_2}^2 = 308{,}288$, $F = 1{,}2898$, the value of $F_{tabel} = 2{,}41$, DK = $\{F|F > 2{,}41\}$. Due to $F \notin$ DK, it can be concluded that the sample comes from a homogeneous population.

The results of the independence test obtained $\chi^2 = 31{,}19$, and ${\chi^2}_{tabel} = 35{,}2$, DK = $\{\chi^2|\chi^2 > 35{,}2\}$. Because $\chi^2 \notin$ DK, it can be concluded that the pre-test data is independent of the post-test data.

The effectiveness test results were analyzed based on the pre-test and post-test tests of mathematical reasoning abilities. Table 7 shows the data on the results of the mathematical reasoning ability test.

Table 7. Comparison of Pre-Test and Post Test Results

Descriptive parameter	Pre-test value	Post-test value
Average	47,08	71,88
Variances	19,52	17,19
Highest value	90	95
Lowest value	15	35

Based on Table 7, the average mathematical reasoning ability test scores have increased. The post-test variance that is smaller than the pre-test variance indicates that students' mathematical reasoning abilities after using the LKPD are more uniform. The results of the t-test obtained that the t value is -4.67 and the t_{table}value with a significance level of 5% is 2.021. Based on the results of the $t < t_{table}$ is obtained so it can be said that there is a significant difference between the pre-test and post-test results. The result shows that there is a difference between mathematical reasoning abilities before and after using LKPD. LKPD is effective if there is an increase in the mathematical reasoning ability test value after using the LKPD. The level of effectiveness of LKPD in learning is calculated using a normalized gain score. The result of calculating the gain score is 0.47. This score is included in the moderate criteria so that problem-based worksheets effectively improve students' mathematical reasoning abilities.

LKPD is considered suitable to improve students' scientific thinking skills and problem-solving. Problem-solving ability comes from the basis of students' mathematical reasoning abilities. Therefore, various studies have been developed to improve problem-solving abilities [21][22][23].

Each student has different mathematical reasoning abilities, but their reasoning plays a vital role in solving problems. Moreover, this mathematical reasoning ability is an essential skill of mathematics that is needed for several purposes, namely, to understand mathematical concepts, use mathematical ideas and flexible procedures, and reconstruct mathematical understanding [24]. Generally, in class, students' abilities can be grouped into three types: high, medium, and low ability groups [25].

The reasoning is a tool to help understand mathematics, and this mathematical understanding can be used to solve the problems presented in the LKPD. In this study, there were differences in students' reasoning abilities between the pre-test and post-test results, especially before and after using the LKPD. This statement proves that reasoning is a specific part of problem-solving work so it is an essential part of the mathematical process [26][27].

Students should be accustomed to reasoning from the first day at school to increase awareness that every statement requires a justification. In addition, students' curiosity will trigger questions such as why so, how can the answer be correct or how to do it, things like this will help sharpen the reasoning abilities of students [27].

CONCLUSION

Based on theoretical studies and supported by the results of data analysis and referring to the formulation of the problem described in the previous chapter, here are the conclusions. LKPD development uses a 4-D model up to the development stage. In the define stage, it is known that the problem at SMA Negeri 6 Surakarta is that teachers need LKPD as a guide for teaching materials in addition to textbooks published by the Ministry of Education. The design stage is in the form of drafting 1 LKPD based on a linear programming contextual problem. At the development stage, the LKPD that has been designed is then developed through development tests and field trials.

Problem-based worksheets were developed to meet the criteria of being valid, practical, and effective in improving students' mathematical reasoning abilities. Based on the development results obtained valid LKPD with an average rating of 82% with a very high category. LKPD is declared practical with an average assessment of the results of observations and student responses is 86% with a very high category. LKPD is effective in improving students' mathematical reasoning abilities based on the results of increasing post-test results.

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THE DEVELOPMENT OF STEAM-INTEGRATED TEXTBOOK IN STATISTICS MATERIALS

Risma Gita Maharani Putri[*1, a)] & Mohammad Asikin[1, b)]

Universitas Negeri Semarang, Kampus Sekaran Gunungpati, Semarang, 50229

[a)] rismagita80@students.unnes.ac.id
[b)] asikin.mat@mail.unnes.ac.id

Abstrak. This research aims to develop and determine the quality of integrated mathematics textbook for science, technology, engineering, art, and mathematics (STEAM) in statistics materials. The research method uses the modified Sugiyono development model, including, 1) potential dan problems; 2) data collection; 3) product design; 4) design validation; 5) product test (readability test); and 6) the final product. The data were collected by a questionnaire and a readability test. To determine the practicality of the textbook, the questionnaire was validated by six experts while the readability test was given to students. The result showed that the teaching materials were valid with a validity test percentage of 88,99% and a readability test percentage of 80,62%. Thus, integrated textbook for STEAM are of high quality because they meet the suitability of characteristics, valid to use, and are practical or easily understood by students.

INTRODUCTION

Education is one of the efforts to improve the quality of human resources (HR) to ensure the development of a nation (Kusjuriansah & Yulianto, 2019). Education plays an important role in facing developments in the 21st century. The 2013 curriculum as the present curriculum has been an effort to develop education in Indonesia (Milaturrahmah et al., 2017).

Mathematics is a discipline that contributes greatly to everyday life (Indrawati, 2020). Mathematics is expected to contribute towards the development of students' abilities so that they can participate in improving the quality of education. However, mathematics is often considered as a difficult subject (Fitriasari, 2017). Students will find it difficult to master further concepts if they have not mastered the basic concepts (Suherman, 2015). This is a factor in mathematics that is considered to be a difficult subject.

Mathematics should be a challenging subject so that it attracts students' interest in learning and curiosity. The results of the PISA study in 2018 states that the average math and science achievement scores of Indonesian students are far below the international average. Indonesia is ranked 72 from 78 countries with a score of 379.

21st-century learning prepares students to face future competition. The three main subjects in 21st-century learning including, 1) learning and innovation skills, 2) information, media, and technology, 3) life and career skills (Mu'minah & Suryaningsih, 2020). Teachers and students must be ready to face the development of an increasingly sophisticated era. Education with STEAM (science, technology, engineering, arts, and mathematics) learning can be an alternative to prepare students who are able to compete in the 21st century (Yuni et al., 2020).

Textbook can be a solution in developing the world of education. The success of learning, apart from depending on the method used, is also very dependent on the learning device (Utami et al., 2018). Textbook are part of the learning device. Textbook are all forms of materials used to assist teachers in carrying out the learning process (Sari et al., 2018). Textbook have 4 categories, namely, 1) printed textbook, for example,

handouts, modules, books, student worksheets, brochures, and pamphlets; 2) audio textbook, for instance, cassettes, radios, vinyl records, and audio compact disks; 3) audiovisual textbook, for example, video compact disks and films; 4) interactive textbook, for instance, compact disk interaction (Depdiknas 2008). Students can understand the concept of learning through textbook. Learning with the STEAM approach is considered to be able to make it easier for students to understand the concepts presented (Yuni et al., 2020).

STEAM is a learning approach that allows students to expand knowledge, science, and humanities at the same time to develop 21st-century skills such as communication skills, critical thinking skills, leadership, teamwork, creativity, resilience, and other skills (Zubaidah, 2019). Science, technology, engineering, art, and mathematics are similar fields of study because problem solving involves a creative process and does not involve only one method. STEAM learning strengthens student learning across all disciplines and through these disciplines, students have the opportunity to explore the relationship between science, technology, engineering, art, and mathematics (Henriksen, 2014). The 2013 curriculum is deemed appropriate to implement the STEAM approach. This is in line with the research of Mu'minah & Suryaningsih (2020) which states that, in the 2013 curriculum where learning is implemented thematically integrated, it is suitable for integrating STEAM-based learning.

The textbook developed in this study are mathematics textbook related to aspects of STEAM. STEAM integrated mathematics textbook have characteristics that distinguish them from mathematics textbook in general. STEAM integrated mathematics textbook are arranged based on problems related to science, technology, engineering, art, and mathematics by taking into account the format of student-book analysis published by the Ministry of Education and Culture, namely, 1) aspects of conformity with the scope of Basic Competencies; 2) the breadth, depth, current, and accuracy of the learning materials in each chapter of the student's book; 3) show examples of learning materials (factual, conceptual, and procedural knowledge) in each chapter of the student's book; 4) learning activities in each chapter of the student's book; 5) assessment in each chapter of the student's book. Therefore, STEAM integrated mathematics textbook cover a wider range of discussions and developments than general mathematics learning materials. This STEAM integrated teaching material is expected to be able to improve students' ability to relate mathematics materials to other fields such as science, technology, engineering, and art.

Based on the background that has been described, it is necessary to conduct research "The Development of STEAM-Integrated Textbook in Statistics Materials". The purpose of this study was to determine the quality of STEAM integrated teaching materials based on the suitability of characteristics, validity, and readability.

RESEARCH METHODS

This research method uses a modified Sugiyono's development method including, 1) potential and problems; 2) data collection; 3) product design; 4) design validation; 5) product test (readability test); and 6) the final product. The research was carried out at SMP N 7 Semarang from March to May 2021. The subjects in this study were students of class VIII A of SMP N 7 Semarang as a readability test class. Data collection in this study used a questionnaire and a gap test. The questionnaire used at the validation stage consisted of a characteristic suitability and validity questionnaire. The design validation phase involved 1 UNNES postgraduate student, 2 teachers, and 3 UNNES mathematics lecturers. The gap test aims to measure the readability of STEAM integrated textbook.

RESULTS AND DISCUSSION

Potential and Problems

Identification of the problem in this study was obtained from the results of interviews with teachers of SMP N 7 Semarang. Learning mathematics in this school uses a book entitled "Mathematics for SMP/MTs grade VIII Semester 2" and a summary of the material that has been made by the teacher. The two learning resources do not contain the STEAM aspect as a whole. The factor of limited time and energy is a separate obstacle for teachers in providing learning resources that can provide learning about the mathematical perspective associated with STEAM.

Data collection

At the data collection stage, a literature study was conducted to obtain information related to core competencies, basic competencies, indicators of competency achievement, learning objectives, materials, and problems related to STEAM. The basic competence used in the textbook is 3.11. On the development of the STEAM integrated textbook, statistics materials in this research were obtained from several sources of student books in the Regional Library of Blora Regency.

Product Design

The STEAM integrated teaching materials for statistics materials are written in the dominant Times New Roman font, size 12-24 pt. The initial design of textbook contains 34 pages which consisted of the a front page, a preface, a table of contents, core competencies, basic competencies, indicators of achievement, learning objectives, concept maps, linkages of the material with aspects of STEAM, motivation letters, statistics materials, exercises, summaries, competency tests, glossaries, and bibliography.

The preparation of the initial draft aims to organize learning materials from a competency into a systematic whole. The textbook contain a discussion of statistics materials related to the STEAM aspect that has been adapted to the characteristics of the textbook based on the student book analysis format published by the Ministry of Education and Culture.

Design Validation

The test of the characteristics of the STEAM integrated textbook was carried out by six validators. The textbook have met the suitability of characteristics, but some revisions are still needed. Several revisions were made, such as adding instructions for the use of textbook, linking competency achievement indicators and learning objectives with STEAM, linking motivation letters with STEAM aspects, and presenting material according to data and facts. After revision, the STEAM integrated textbook in statistics materials have met the conformity of characteristics based on the format of student-book analysis published by the Ministry of Education and Culture and has been modified.

The validity test of the STEAM integrated textbook was carried out by six validators. The test consisted of 3 aspects, namely content validity, presentation validity, and linguistic validity. The validity of textbook is assessed based on the modified aspects and criteria of the National Education Standards Agency (BSNP) assessment criteria. Validity is carried out to obtain valid textbook (Nurhidayat & Asikin, 2021). Assessment of the validity of textbook can be seen in the table below.

TABLE 1
Validity Results of STEAM Integrated Teaching Materials

Aspect	**Precentage score (P)**	**Criteria**
Content Validity	87,52 %	Excellent
Presentation Validity	91,68 %	Excellent
Language Validity	87,78 %	Excellent
Average	88,99 %	Excellent

Assessment on the aspect of content validity consists of four indicators, namely, 1) the suitability of the material with competency standards and basic competencies; 2) the accuracy of the material; 3) supporting learning materials; and 4) material updates. Table 1 shows the average percentage of content validity of 87.52% with excellent criteria. This score shows that the STEAM integrated mathematics textbook in statistics materials contain the suitability of the material with SK and KD, the accuracy of the material, supporting learning materials, and the up-to-date of the material in excellent criteria.

Assessment on the aspect of presentation validity consists of four indicators, namely, 1) presentation techniques; 2) presentation support; 3) presentation of learning; and 4) completeness of presentation. Table 1 shows the average percentage of presentation validity of 91,68% with excellent criteria. This score shows that the STEAM integrated mathematics textbook in statistics materials contain presentation techniques, presentation support, learning presentations, and presentation completeness with excellent criteria.

Assessment on the aspect of language validity consists of six indicators, namely, 1) straightforward; 2) communicative; 3) dialogical and interactive; 4) conformity with the level of development of students; 5) coherence and coherence of the line of thought; 6) use of terms, symbols or icons. Table 1 shows the average percentage of presentation validity of 87,78% with excellent criteria. This score indicates that the STEAM integrated mathematics textbook in statistics materials contain straightforward, communicative, dialogical, and interactive language indicators, conformity to the level of development of students, coherence, and integration of the flow of thought, and the use of terms, symbols, or icons with excellent criteria. Submission of information in textbook to students will be easy if the textbook use effective, standard, and simple language (Rahmawati et al., 2016).

The results of the validity test above show that STEAM integrated textbook in statistics materials get an average score percentage of 88.99%. Based on the validity category, the textbook are included in the valid category.

Product Trial

The readability test was carried out by 26 students of class VIII A of SMP N 7 Semarang. The readability test of STEAM integrated textbook on statistics materials aims to determine whether the textbook are practical or easy to understand by students. The results of the readability test get a percentage value of 80.62% with an average of 40 correct answers so that the textbook are included in practical criteria or easy to understand. The readability score that meets the criteria is caused by the material presented in the language and vocabulary that students can easily understand so that it does not cause multiple interpretations (Kusjuriansah & Yulianto, 2019). A reading with a readability level that is easy to understand will affect the readers in increasing interest in learning and memory (Khairil et al., 2017).

The final product

The final product in this research is STEAM integrated teaching materials on statistics materials in the form of a textbook that can be used in learning.

CONCLUSION

Based on the results of the research and discussion, it was found that the STEAM integrated mathematics teaching materials in statistics materials are of high quality because they meet the characteristics according to the format of student book analysis published by the Ministry of Education and Culture. Thus, the textbook are valid, practical, easy for students to understand and can be used in learning.

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Preservice Primary Teachers' Common Errors in Solving Mathematics Literacy Problems

Enditiyas Pratiwi [1, a)], A.Wilda Indra Nanna [1, b)], Mardyanto Barumbun [1, c)]

[1]*Universitas Borneo Tarakan, Tarakan City, Indonesia*

[a)] Corresponding author: enditiyasp@borneo.ac.id
[b)] wildaindrananna@borneo.ac.id
[c)] mardyantobarumbun@borneo.ac.id

Abstract. Understanding the information on the problem presented in the form of pictures is not an easy task for preservice primary teachers to lead to errors. However, preservice primary teachers can also answer correctly if given a mathematical model directly. Preservice primary teachers' errors can be determined using a process point of view in solving mathematical problems. In a qualitative context, this study describes and analyzes the mistakes of preservice primary teachers traced through errors in solving mathematical literacy problems. This research is qualitative research, where analysis is needed to broaden the understanding of the errors that occur when solving mathematical literacy problems. The results showed that preservice primary teachers experienced errors on each indicator in four types of errors when solving mathematical literacy problems. This research found one new type of error, namely carelessness, which is an error with different types of the four types of errors that exist. Further research can be carried out by designing strategies used to improve the ability of preservice primary teachers to solve mathematical literacy problems.

INTRODUCTION

NCTM states that students' ability and skills in solving math problems must be mastered since elementary school and are essential in learning mathematics (1,2). There are five competencies in mathematics learning developed by NCTM, namely problem-solving, communication, reasoning, connections, and representation. By referring to the five competencies in mathematics learning, especially in the ability and skills to solve mathematical problems, mathematical literacy is one of the 21st-century mathematics learning skills.

The Organization for Economic Cooperation and Development (3) defined mathematics literacy as a personal ability to analyze and recognize the implications that mathematics plays in society, to consider excellently verdicts, and to interact in mathematics in accordance with the demands of such an individual's immediate and potential life as a constructive, involved, and introspective individual. Mathematical literacy is interpreted as the capability of an individual to establish, implement and describe mathematics in a variety of contexts, such as the potential to deliver mathematical reasoning and also use ideas, strategies, and evidence to identify, justify or predict phenomenology (4). Mathematical literacy refers to students' knowledge and ability to use and determine mathematical knowledge and skills acquired from class to experience their daily lives to understand the conditions involving mathematics. Because mathematical literacy is one of the most critical life skills, it is a fundamental ability that is just as essential as literacy (5). As a result, mathematics instruction in schools should improve mathematical comprehension and each student's ability to use and use mathematical skills to solve real-world problems or scenarios.

After this, students can understand and integrate basic mathematics in their everyday lives due to studying mathematics (6).

Ability and skills in solving math problems, especially mathematical literacy problems, are not easily mastered by students because they have low information literacy (7). One of the significant aims of educational organizations in schools was to encourage mathematical literacy. Mathematics education is sought schools provide students with mathematical comprehension and the opportunity to use their skills in real-life scenarios outside of the classroom. Mathematical literacy has a distinct identity that distinguishes it from substantive mathematics. Mathematics in classrooms concentrated on substantive substance, while mathematical literacy emphasized how to apply mathematics in daily situations (8). Elementary school students can understand mathematical concepts but cannot apply them to real-life problems or mathematical literacy problems (9). Ability and skills in solving math problems can be influenced by self-concept. The self-concept possessed by these students can cause math anxiety, which will harm students' mathematical literacy (10). Furthermore, the research results related to students' visual reasoning of mathematical literacy show that the use of pictures or diagrams accompanied by written information can play a role in understanding students to solve a given problem. Besides, 60% of junior high school mathematics teachers still have insufficient knowledge of mathematical literacy (11). Furthermore, the data obtained from the research results show that junior high school mathematics teachers better understand the learning process compared to the process of assessing mathematical literacy.

The explanation above shows that the abilities and skills of students and teachers in solving mathematical literacy problems have not been well mastered. Some studies focus on the abilities and skills of students and teachers only in solving mathematical literacy problems. However, only a few studies have discussed the abilities and skills of preservice primary teachers in solving mathematical literacy, especially those focusing on errors in understanding mathematical literacy problems, which provide information only in the form of pictures or diagrams. Therefore, it is imperative to know in advance the abilities and skills of preservice primary teachers to trace the mistakes of preservice primary teachers in solving mathematical literacy problems, which are presented in the form of pictures. The research question to support this condition is how preservice primary teachers' common errors in solving mathematics literacy problems.

METHODS

This research is a qualitative study that describes preservice primary teachers' work in solving mathematical literacy problems. Furthermore, the research focus is on the errors made by preservice primary teachers in solving mathematical literacy problems. Errors in solving mathematical literacy problems were observed using the point of view of error analysis (12) based on Newman Errors Analysis, namely (1) comprehension; (2) transformation; (3) mathematical processing; and (4) encoding which is further described in Table 1.

TABLE 1. Coding Scheme for Error Types when Solving Mathematical Literacy Problems

Error type	Code	Indicator
Comprehension	C1	What they had been asked to do was wrongly interpreted by the student
	C2	The student could not discern information that was disadvantage
Transformation	T1	Students were found to use a mathematical procedure directly without analyzing it
	T2	Students used math/concepts that are not appropriate to the tasks
	T3	A picture was treated as a literal picture of a situation
Mathematical processing	MP1	Error in calculation
	MP2	Students have used a correct form or procedure but have not completed it.
	MP3	Students do not use the right form or procedure
Encoding	E	This error has been represented in an unrealistic response

The research subjects were preservice primary teachers who made mistakes in solving mathematical literacy problems. Twenty-six preservice primary teachers are asked to solve two maths literacy problems related to geometry. This math literacy problem was given after the preservice primary teachers took the geometry course programmed at the beginning of the learning semester. To investigate the type of error that occurred, only use the data on the preservice primary teachers' worksheet for whom the error occurred. Then, to obtain the percentage of error types, an analysis was performed on the preservice primary teachers' worksheet for two math literacy problems. The analysis was performed by adjusting the indicators for four types of problem-solving errors and dividing them by the total preservice primary teachers who participated in solving math literacy problems.

RESULTS

A total of 26 preservice primary teachers who solved two math literacy problems experienced errors in four types of errors. Based on the coding carried out on each error indicator, the error of the transformation type on the T1 and T2 indicators were the most carried out (96.2%). In contrast, the errors in mathematical processing, especially in the MP2 indicator, were rarely done (11.5%) (see Table 2).

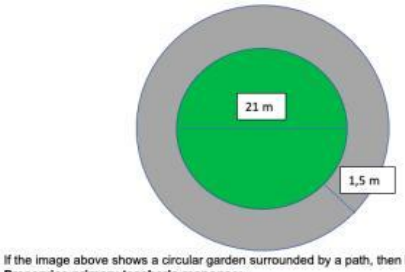
TABLE 2. Types of Student Errors in Solving Mathematical Literacy Problems

Type of Errors	N	%	Indicator Type of Errors	%
Comprehension	26	94,2	C1	94,2
			C2	94,2
Transformation	26	95,5	T1	96,2
			T2	96,2
			T3	94,2
Mathematical Processing	26	61,5	MP1	88,5
			MP2	11,5
			MP3	84,6
Encoding	26	100	E	100

Comprehension

Errors in this type of comprehension occur when preservice primary teachers cannot understand a given mathematical literacy problem. Table 2 shows that the error in this type of comprehension, both on indicators C1 and C2, has the same percentage, 94.2%. The percentage means that the preservice primary teachers cannot correctly interpret the problem given. As a result of the inability to interpret these problems, preservice primary teachers cannot determine information advantages that can be used to solve mathematical literacy problems.

Figure 1 is an example of a preservice primary teachers' worksheet showing errors in comprehension types. In a given mathematics literacy problem, the preservice primary teachers cannot interpret the information given to the mathematics literacy problem. In the worksheet, it can be seen that the preservice primary teachers cannot interpret the problem, so they do not use the appropriate information to determine the solution to the problem. The worksheet also shows that preservice primary teachers use the information in the picture without interpreting it first. In this part of understanding, preservice primary teachers should find that the information in the problem shows the diameter of the park is 21 m, and the width of the path is 1.5 meters. Meanwhile, to understand how to find the path area, it does not directly use information in the form of numbers on the given problem.



If the image above shows a circular garden surrounded by a path, then how wide is the path?
Preservice primary teacher's response:

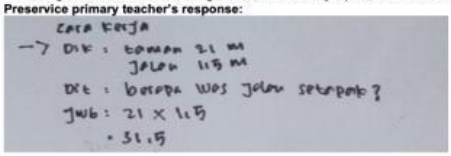
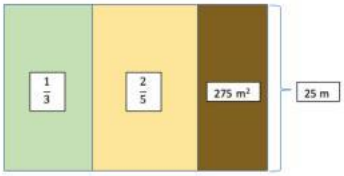


FIGURE 1. Example of Comprehension Error

Transformation

The error in this type of transformation has the percentage of indicators that are not much different, the T1 and T2 indicators with the highest error percentage (96.2%) and the lowest T3 indicators (94.2%). This condition indicates that the preservice primary teachers cannot conduct a deeper analysis of the determination of the strategy used, so that they are unable to model the problem given in a mathematical form. Besides, preservice primary teachers are incapable of developing and using simple methods to solve problems.

Figure 2 is an example of a preservice primary teachers' worksheet showing errors in this type of transformation. In the mathematics literacy problem given, the preservice primary teachers did not conduct a deeper analysis to determine the procedure to solve the problem, likewise using concepts to support specified procedures. The transformation error shown in Figure 2 shows that the preservice primary teachers can understand the information given, namely, adding up all the parts to get the length. To get the area, the preservice primary teachers perform the multiplication procedure of the length obtained by the width that already exists in the problem information. However, when modeling into mathematics, there is a misconception, namely, directly adding up all the information given to the problem. In this transformation section, preservice primary teachers should find the right strategy to solve the given problem by first finding the area width already known. By knowing the width, preservice primary teachers can find the overall width of the area.



If the image above shows Father's plot of land distributed to his three children, how much land is the father's plot?
Preservice primary teacher's response:

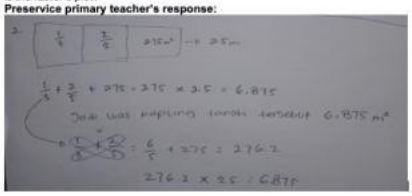


FIGURE 2. Example of Transformation Error

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Mathematical Processing

Errors in this type of mathematical processing have very far different percentage indicators. The MP1 indicator (88.5%) and MP3 (84.6%) have a high percentage, while the MP2 indicator has a meager percentage (911.5%). It is clear from the preservice primary teachers' worksheet (see Figure 3) that very few preservice primary teachers solve problems using the correct formulas or procedures. MP2 indicator is different from the high percentage of the MP1, and MP3 indicators, which are caused by errors in calculations, and the procedures used to solve the problem are not correct. Besides, two preservice primary teachers showed different errors in solving problems. The preservice primary teacher does not experience errors in the comprehension and transformation types, but the errors are initiated in the mathematical processing type.

Furthermore, errors that occur are not included in the MP1, MP2, and MP3 indicators determined. If observed further (see Figure 4), errors that occur in the preservice primary teacher are caused by "carelessness" in the process of solving problems, namely errors in writing numbers. This shows that the error in the form of "carelessness" dramatically affects the following type of error and results in errors in the final answer. To strengthen the condition of "carelessness", short questions were asked to preservice primary teachers. The following are examples of the questions and answers given.

> Researcher: Are you sure about this completion process? (Points to answer sheet)
> Preservice primary teacher: (while looking at the answer sheet) When I solved this problem, I was sure, but now I realized that there was an error caused by carelessness in using the information in the problem.

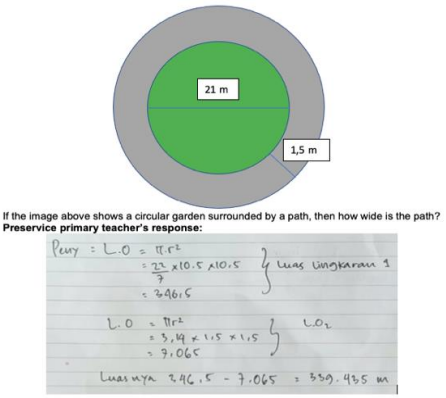

FIGURE 3. Example of MP Error (Careless)

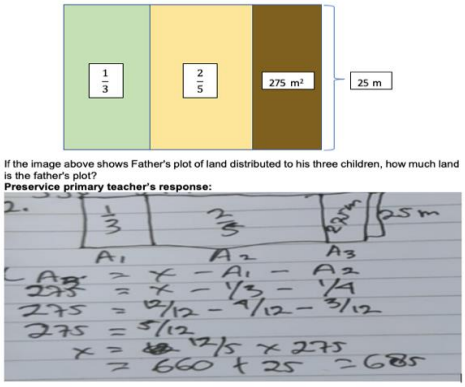

FIGURE 4. Example of MP Error

Encoding

Error in encoding type has a percentage of 100%, which means that all preservice primary teachers experience errors in solving math literacy problems (see Figure 5). Even though the type of transformation of preservice primary teachers is correct, if there is an error in the mathematical processing type, the encoding type error also experiences an error. In this type of encoding error, it can also be seen that all preservice primary teachers experience errors in solving math literacy problems as a whole, both in the first and second problems.

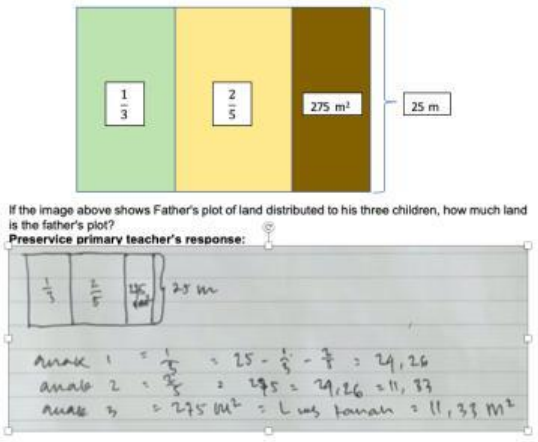

FIGURE 5. Example of Encoding Error

DISCUSSION

This study aims to describe the errors of preservice primary teachers better when solving math literacy problems. The results of the data analysis show that the tendency for errors begins with the comprehension type. Errors in this type of comprehension indicate the characteristics of the error made, namely, being unable to understand the keywords used in the question. This condition is in line with the results of research which show that one of the sources of errors in solving problems is understanding questions (13,14). Besides, errors are an inability to integrate real-life problems into understanding the problems given. This condition results in not using the information on the problem to be used in solving a given mathematical literacy problem. Other studies have found that if teachers can use real-life problems, it can be a starting point that encourages students to understand better the problems given (5). Even though preservice primary teachers cannot use the information on the problem given on the answer sheet, there are no doubts that can be seen from the scribbled answers in solving the mathematical literacy problem. This condition shows that the preservice primary teachers believe that they have understood the problem given.

Contrary to the research results, which states that the self-confidence of preservice teachers about mathematics literacy is still below average (15). Despite this fact, the belief that preservice primary teachers have in solving math literacy problems leads to mistakes. However, the belief that they have can be the initial capital for preservice primary teachers because, as mathematics teachers, they must plan to learn. It is stated that literacy can support mathematics learning (16).

Errors in this type of transformation indicate the characteristics of the errors carried out; namely, they did not carry out a deeper analysis of the given problem. This condition results in the inability to use concepts and methods to solve the given mathematical literacy problems. Other studies have found that if students can develop their models or methods, they can solve mathematical literacy problems (5). In line with the research results, which states that a teacher must be able to choose the right strategy to solve mathematical literacy problems (9).

Errors in this type of mathematical processing show the characteristics of the errors carried out, namely, not using forms or procedures to solve the right problem. In mathematical processing in this study, it was found that there were errors that were not in the three predetermined indicators. The error that occurs is carelessness, in which two participants do not experience errors in the comprehension and transformation types. However, in research, this wild type of error only occurs in mathematical processing situations. In fact, carelessness is very likely to occur in four types of errors (17).

Errors in the type of encoding indicate the characteristics of the error being committed, namely, the appearance of the answers that are not following what they should be. Errors in encoding types are strongly influenced by the three types mentioned above of errors, namely comprehension, transformation, and mathematical processing. In research, if there is an error in just one type, it can result in an error in the encoding type. This resulted in all participants experiencing errors in the type of encoding because the

conclusions drawn by all participants experienced errors in line with (18). They stated that student errors in determining conclusions marked encoding errors.

CONCLUSION

Based on the analysis and discussion results, the solving of mathematical literacy problems carried out experienced errors in all four types. This condition shows that more profound errors can be found by analyzing the process when solving mathematical literacy problems. Besides, the research found errors with a new type, namely, carelessness. Error in the type of carelessness indicates that even though the comprehension, transformation, and mathematical processing types are correct when there is an error on the wild type afterward, the final result still experiences errors and results in errors in the last type, namely encoding. Then, the analysis and discussion results also show that there is a relationship between errors that occur in solving mathematical literacy problems. If an error occurs starting in the comprehension type, then an error occurs on all subsequent error types.

Further research that might be done is designing strategies for preservice primary teachers in solving math literacy problems, especially in types of comprehension errors. This type of error can be decisive for solving a given problem appropriately. So, more attention is needed to pay attention to error comprehension types. Besides, because of the high percentage of errors in the types of transformation errors, it is necessary to carry out further research on participants who do not experience comprehension type errors by scaffolding them in learning to use the right concepts in solving mathematical literacy problems.

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Maintaining Character Education During And After Pandemic

Abdul Aziz[1,a)], Iswahyudi Joko Suprayitno[1,b)], Rully Charitas Indra Prahmana[2,c)], Puguh Wahyu Prasetyo[2,d)]

[1,2]*Faculty of Math and Science, Universitas Muhammadiyah Semarang, Kedungmundu Raya Street No.22, 50273 Semarang, Indonesia*
[3,4] *Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Kapas Street No.9, 55166 Yogyakarta Indonesia*
[a)]abdulaziz@unimus.ac.id, [b)]iswahyudi@unimus.c.id
[c)]rully.indra@mpmat.uad.ac.id, [d)]puguh.wahyu@mpmat.uad.ac.id

Abstract: The focus of education during the COVID-19 pandemic is more likely to be cognitive and learning. There has been no maximum effort in strengthening character education. The limited face-to-face meetings in learning have an impact on character education. This situation also applies at the university level. Prospective mathematics teachers who are currently studying have an essential role in building good character education. This study will see how future mathematics teachers' character in producing culture-based learning videos will be seen. The theme in the video that was made was ethnomathematics. The subjects in this study were prospective mathematics teachers who had implemented campus teaching programs and educational internships. With the teaching experience that is owned, it will be seen how the character of the prospective teacher during making learning videos and what character values are contained in the tape so that it can have a positive impact on students. Based on observations during the manufacturing process, most of the prospective teachers have central character values . The results of ethnomathematics-based learning videos are one of the media that can instil character values for students.

Keywords: character, pandemic, ethnomathematics

INTRODUCTION

In the world of education, one aspect that needs to be considered is character. The character has an essential role in the world of education. The symbols contained in the learning process must be regarded as in realizing quality national education, the quality in question is trustworthiness, integrity, enthusiasm, and reliability [1]. Good character can be achieved because the surface is something that can be observed and felt useful.

Serious attention is needed if this character is expected to provide benefits, because character education is a behaviour that needs to be developed optimally [2][3]. Character education is not something new. One of the characters can also be shaped by the environment and circumstances. In a normal and conducive environment, the character can grow well. During the COVID-19 pandemic, of course, it was different from the previous situation. Many aspects have changed due to the COVID-19 pandemic, not only health aspects but also social, cultural, economic, scientific, and technological aspects [4], including character.

Character education has an essential role in realizing meaningful learning because character values include respect, justice, and responsibility[5]. This character value will undoubtedly continue to be instilled and develop better even though the world community is struggling to adapt and innovate during the Covid 19 pandemic [6]. Adaptation and innovation are also carried out in education, which initially used the face-to-face learning method to switch to online learning-oriented learning. Of course, electronic devices are needed that support online learning activities. Online learning is designed using the Learning Management System. It can continuously change prospective teachers' character and habits in making learning videos about ethnomathematics in the lectures they attend.

Before the COVID-19 pandemic emerged, prospective teachers who took lessons in making learning videos could have direct face-to-face discussions and interactions. Through this kind of interaction, understanding and knowledge can be well received and builds character that is unyielding, innovative, and builds a high social sense [7]. The application of the Learning Management System in making learning videos will affect the character of prospective teachers. It will be an opportunity to observe the surface of future teachers [8], especially in implementing the Learning Management System during the COVID-19 pandemic and understand emerging behaviours and characters [9]. Social changes will occur due to the surface formed because the character is a real engine of social change[10].

METHODS

The research used in this research is qualitative. The data used is information related to character education values in making learning videos with ethnomathematical themes. Data sources were obtained through prospective mathematics teachers who made learning videos, ethnomathematical video content, the regional culture that inspired producing videos, and several ethnomathematical studies that strengthened the range of learning videos.

Data was collected through questionnaires, interviews, and analysis of the process of making learning videos. Making learning videos is carried out when determining the local culture used as content and linking the learning culture with mathematics material. The data used is information related to the values of character education in making learning videos about ethnomathematics. The data analysis process carried out includes data reduction, data analysis, and concluding.

This research was conducted in Semarang, Central Java, Indonesia, involving 40 prospective mathematics teachers who have carried out educational internships and teaching campuses. The data source was obtained by purposive sampling technique by selecting nine future mathematics teachers based on the complexity of the resulting learning videos and the uniqueness of the highlighted culture. The collected data was validated using source triangulation and method triangulation. Source triangulation is done by asking the same thing from different sources, namely prospective mathematics teachers. Method triangulation is done by collecting data through questionnaires, interviews, and analysis of making learning videos and reports on making learning videos. Furthermore, the data is analyzed using interactive techniques, including data reduction, presentation, and conclusion [11].

RESULTS

This section explains prospective teachers' perception of the importance of integrating character education values in ethnomathematical learning videos, strengthening character education during the pandemic, and strengthening character education after the pandemic.

1. Teacher Perspective Perceptions about the Importance of Integrating Character Education Values in Ethnomathematical Learning Videos

Based on the results of the questionnaire analysis and interviews with prospective mathematics teachers, it was stated that all prospective teachers considered it essential to integrate character education into ethnomathematics learning videos. Future teachers can be grouped into two reasons related to the

implementation of character education in the school environment and logic associated with character education performance in the community. These reasons are presented in Table 1 below.

Table 1. Teacher's Reasons About the Importance of Character Education

No.	Character education in school	Character education in society
1	Students are motivated to respect their friends who have different cultural backgrounds	Students respect cultural activities carried out in the community and took part in preserving that culture
2	Students can respect the opinions of friends in their class	Students appreciate cultural activities carried out in the community and took part in preserving that culture
3	Strengthening character education in schools that are still lacking	Students can find the character values contained in the learning video
4	Penanaman pendidikan karakter sejak dini di sekolah langkah strategis dalam mewujudkan persatuan dan kesatuan bangsa.	Through video learning, students have a sense of nationalism
5	Planting character education early in schools is a strategic step in realizing national unity and integrity.	Have empathy for social conditions that occur in society
6	Increase caring and sharing	Knowing the importance of caring and sharing in society through learning video content
7	Have a respectful attitude towards teachers through the values contained in the learning videos	Have respect for parents
8	Can balance intellectual intelligence, emotional intelligence, spiritual intelligence in the school environment	The process has a balanced composition between intellectual intelligence, emotional intelligence, and spiritual intelligence from the process of social life

Based on Table 1, almost all prospective teachers consider that character education must be integrated into learning videos. In general, character education can be integrated into all subjects to appreciate differences, have sensitivity, have a sense of caring, balance intellectual intelligence, emotional intelligence, and spiritual intelligence, and preserve regional culture, which results from the community thought. Character education is essential to be integrated into learning videos to know their role in social life.

In other words, prospective mathematics teachers have the assumption that somebody's character education can be taught through learning videos. Teachers have an essential role in facilitating students' learning process, especially in strengthening character education. [12]states that the support of a good teacher has a very positive impact because the teacher is the spearhead of education who has a unique role in instilling tolerance and being a role model. [13]also stated that prospective teachers at the Faculty of Education, Canakkale Onsekiz Mart University think there is a need for character education in the form of tolerance, both in society and the education system.

Implementing character education in the community illustrates that the values of tolerance need to be integrated into all activities and all subjects at school. Mathematics material [14] found that character education values can be integrated through all issues. The importance of character education can be integrated into religious subjects [15]. This follows one of the nine central values of priority character initiated by the

Indonesian Ministry of Education and Culture through a character education strengthening program: Cooperation, religion, integrity, independence, and nationalism.

2. Aspects of Strengthening Character Education

In determining learning videos with ethnomathematical content, prospective teachers start by digging up information about their local culture, which is spread over the islands of Java, Sumatra, Sulawesi, and Lombok domicile live in. From this cultural information, prospective teachers determine the appropriate mathematics material and link character education in their videos. Overall, character education based on regional culture adopts the format for strengthening character education initiated by the Ministry of Education and Culture of the Republic of Indonesia. The framework for supporting regional culture-based character education through ethnomathematical learning videos can be observed from Figure 1 below:

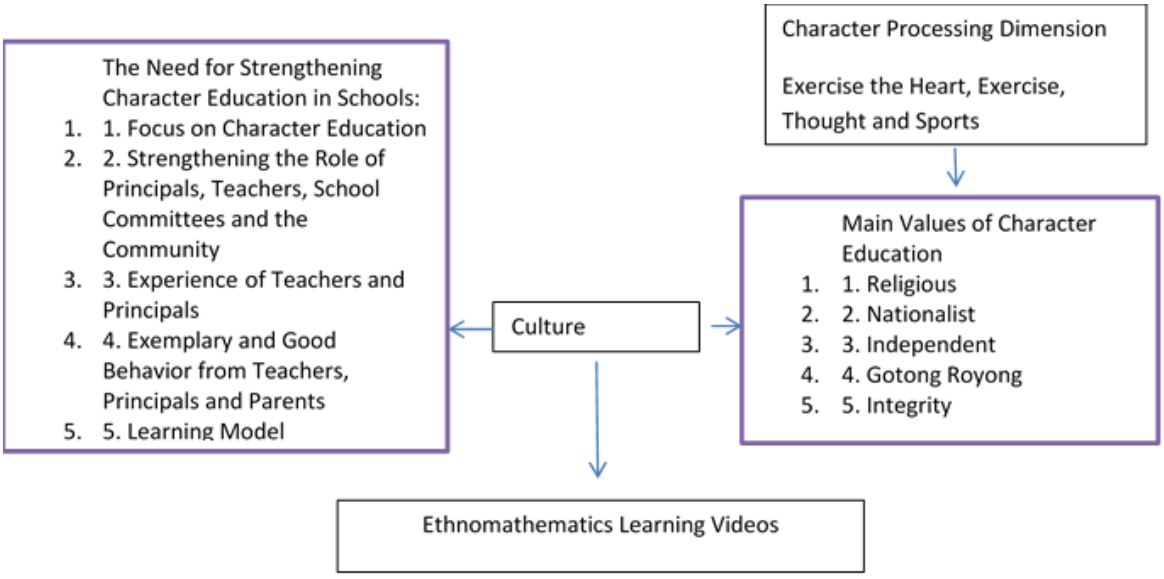

Figure 1. Framework for Strengthening Character Education with Ethnomathematical Learning Videos

In the next sub-discussion, the results of responses from prospective teachers will be presented, which are devoted to aspects of character education needs and the central values of strengthening character education in a pandemic and after a pandemic, considering the need for continuous strengthening of character education amid the difficulty of the straightforward learning process because it is still there are limitations in carrying out the teaching and learning process.

Focus on Character Education

During the Pandemic, Character education that I focused on in the use of videos was the first to be Independent because, during the pandemic, all learning activities (KBM) were carried out online. Hence, students inevitably had to practice an attitude of independence in their learning. With this culture-based learning video, students are expected to learn independently by watching videos at home to understand the material.

After the Pandemic, Having Curiosity, after the pandemic there is an activity called "new normal" where people are allowed to carry out activities as usual but still have to comply with the Prokes; of course, students can make efforts to implement or implement culture-based learning in the surrounding environment by studying something to know more deeply and more broadly than previously learned, heard, and seen.

Strengthening the Roles of Principals, Teachers, School Committees and the Community

During the Pandemic, The principal plays an essential role in determining the direction, process,

and implementation of character education in schools. The part of the principal during a pandemic in learning is in the form of designing a learning curriculum that is appropriate to the emergency conditions of the COVID-19 disaster, for example, with an education based on the culture of the surrounding environment. as well as providing all components to ensure the implementation of learning in different situations and conditions, for example ensuring all teachers and students have to zoom or google meet accounts and providing assistance in the form of internet quotas. Then the principal also needs to communicate regarding the online system task report at the Education Officer and the Education unit.

The teacher's role in learning is to carry out teaching and learning activities and carry out their responsibilities properly. Management of subjects, classroom mastery, evaluating learning/guiding for students is also vital. With culture-based knowledge, it is hoped that teachers will give students assignments and be creative and innovative to make learning media. And the teacher is a role model for students. Therefore the teacher must provide an example of good and correct attitudes and behaviour to instil character education in students.

The role of the school committee in strengthening character education is to assist principals and teachers in preparing all aspects of school needs, support the programs that are being carried out, set an excellent example for students, and guide students always to be active. The role of the community in learning to strengthen character education during the pandemic, namely providing support to students in doing things related to learning in culture-based schools. For example, students are working on a project about cultural characteristics in the surrounding environment, and the people here are willing to be interviewed even though they are online.

After the Pandemic The role of the principal in instilling character education in schools is to ensure that when students enter school, they are disciplined to comply with health protocols such as carrying masks and carrying hand sanitisers as well as preventing crowds so that during the ceremony there must be the distance between students. The role of the teacher is to master the class as much as possible and monitor students during learning. Putting order in class is like arranging the seats between students so that they are not too close. Provide understanding that cannot be done online, for example, practicum in the laboratory. Teachers must take advantage of new typical situations for learning.

The role of the post-pandemic school committee is to discuss or hold meetings with teachers and parents about new regulations that will be implemented in schools. Since the situation was different from before, some things needed to be changed or renegotiated. The role of the community in strengthening character education after the pandemic is to provide broad space for students to develop their potential through literacy activities and extracurricular activities in the community around them. Then the community plays a role in empowering the potential of the environment as a source of student learning, such as the existence and support of art and cultural activists, community leaders, alumni, the business world, and the industrial world with various programs that exist within the scope of academia, education activists, non-governmental organizations, and information institutions.

Experience of teachers and principals

During a pandemic: Facing the challenges of the era that is currently entering the period of the industrial revolution 4.0, which is full of advances in digitalization technology, planting and strengthening the nation's character is very vital and urgent. Of course, during a pandemic like this, all activities are carried out online. Teaching and learning activities must also use FaceTime applications such as zoom, google meet, and others. The integration of character values and the development of learning materials demands teachers' creativity in carrying out learning. Therefore, teachers must have the ability and a lot of experience in the IT field because, in the learning process, several things are needed to prepare learning strategies, organize learning content (effects, images, audio, video, and simulations), provide a learning management system (google classroom, zoom). , Webex, etc.).Meanwhile, the experience that principals need to have is by participating in online training or webinars/seminars related to the formation of character education in schools so that principals can shape the character of students well at school. As well as webinars on school management.

After the Pandemic: The post-pandemic teacher's experience is participating in teaching pieces of training to improve the ability to carry out learning in the classroom. And read a lot or look for book references about ethnomathematics-based learning at the school so that the teacher can place some things according to their portions. The experience that post-pandemic principals need to have experience in preparing policies and innovations that will be applied to optimize learning activities. Because we know that learning is not

optimal during the pandemic, the principal must have sufficient experience after the pandemic.

Good Example and Behavior

During the Pandemic: Positive behaviour that needs to be carried out by school principals and teachers is to apply a disciplined attitude, discipline which refers to the obedience and orderliness of students in obeying the rules. The teacher always maintains communication with students, for example, with a reprimand or greeting every morning. This activity aims to keep the spirit and remind again that the teacher is continuously monitoring and showing that a friendly attitude is essential. Next is to increase the sense of discipline. This can be applied when the teacher is doing the learning. Usually, the learning time is scheduled, the teacher can do the teaching according to the specified time without reducing or increasing the hours of the subject. And the last is a sense of responsibility; a sense of responsibility will arise when teachers and students understand the task, the teacher teaches, and the students follow it. Thus they can complete their respective tasks independently.

While the behaviour that parents must carry out in educating children like a teacher at home, ensuring that children always follow KBM and study at home. Because parents and teachers must have the same goal so that the expected education can be achieved, parental monitoring of children in using technology is also essential. For example, how to manage time in using cellphones when studying and playing so that children don't focus on the wrong functions of cellphones for learning activities.

After the Pandemic: Positive behaviour that needs to be carried out by teachers and school principals post-pandemic is to be disciplined in complying with Health protocols to set an example for students always to maintain cleanliness. Then the teacher can also give an example of how to shake politely without having to touch, and this is intended so that the student's character is adequately maintained.

Parents can provide many guidelines for students when they are in the home environment. For example, when there is a beggar or busker on the street and then gives him money, this aims to teach students that being generous and sharing is necessary. Then another example is to invite students to go to the gallery or tour around to learn about the culture and ethnicity around us. Even though it is rare for people to visit, but this can add insight to students.

Learning Model

During a Pandemic: The learning model that will be used must, of course, be adapted to the situation and conditions during a pandemic like this. Several character-based learning methods can be used online, including Character-Loaded Active Learning, Character-Loaded Contextual Teaching and Learning (CTL), Character-Loaded Inquiry Learning Strategies, Character-Loaded Problem-Based Learning, Character-Loaded PAKEM, Innovative Learning Strategies Loaded with Character, Affective Learning Strategy Loaded with Character, and Quantum Learning Loaded with Character.

After the Pandemic: The learning model that can be used post-pandemic for learning can be done by using the curriculum before the pandemic, but aspects that are not possible must be changed.

Religiosity

During the pandemic, to strengthen the sense of religiosity of students, this can be done by conducting studies or events with a religious background (e.g., Isra Mi'raj) with online-based media (e.g., zoom). It aims to provide students with valuable knowledge. After the Pandemic: How to strengthen religious values can be done by being obedient individuals in carrying out the teachings of their religion, being tolerant of the implementation of worship of other religions, and living in harmony with adherents of other faiths. A daily example that can be applied is performing dhuha prayers and reading the Koran before starting lessons or other worship according to the students' trust.

Nationalist

During the Pandemic, We can show a nationalist attitude by acting and behaving that offers a sense of loyalty, concern, and high appreciation for the language, physical, social, cultural, economic, and political environment of the nation, such as by practising the values of Pancasila and the 1945 Constitution in everyday life. Day, and always obey the existing regulations. Another example is preserving the surrounding culture (e.g., traditional games) not to be easily forgotten even though there are modern games (such as online games). And can be reached by taking the theme of learning related to Indonesia.

After the Pandemic, After the pandemic in the new normal, of course, schools have been allowed to hold ceremonies to honour the heroes. But you must continue to implement the Health protocols and keep your

distance.

Independent

During a Pandemic, Independent nature can be applied by giving individual assignments instead of groups. Because they cannot do face-to-face learning, students have to work independently, which can train them to depend on others easily.

After the Pandemic, Ways to strengthen students' independent attitudes can be done by providing learning motivation to students, increasing students' self-confidence, giving guidance and direction on learning.

Cooperation

During the Pandemic, Cooperation maximizes technology during a pandemic. This means that we can innovate and be creative in this digital era to make programs from the government successful. Mutual Cooperation to make learning at home successful. The Ministry of Education and Culture has helped to provide a free internet quota per month during the KBM.

Mutual Cooperation helps students who are having difficulties. Limited quota and limited ownership of a smartphone or smartphone. This requires the active role of various elements of society to help students who are experiencing obstacles during the pandemic jointly. For example, donations to provide free wifi, purchasing smartphones, to volunteering to assist students while studying at home.

After the Pandemic, Because they have carried out new normal activities, students can learn at school by complying with the prokes. Therefore, students can work together to clean a class that has not been inhabited for a long time. Mutual Cooperation supports new programs from post-pandemic schools. For example, various competitions are held.

Integrity

During the Pandemic, Integrity is essential for students, primarily when learning is carried out online. The notion of independent learning is a learning activity that is more driven by one's ability, self-choice, and responsibility for learning. This means that each student must be able to take responsibility for the results of their respective work. Because all learning is carried out online in the pandemic period, students can train themselves to create and prepare all media that will be used for learning. After a Pandemic, Post-pandemic integrity can be done by applying the material/learning obtained to make direct observations and learn about the culture in the surrounding environment that is more widespread.

One of the focuses of character education is to direct an independent and critical attitude. Of course, the teacher becomes a prominent role in improving the mentality of these students[16]. Of course, the synergy between teachers, in schools and parents, in strengthening character education needs to be done during a pandemic like this because in learning activities during a pandemic, there needs to be special treatment [17], especially in character strengthening. This synergy can work well if teachers and schools have experience [18] in dealing with problems like this, which is not only during the pandemic but will also be experienced in synergizing each role after the pandemic ends. Good example and behaviour are also essential items that students can observe and imitate directly, and this can also be demonstrated through appropriate learning models, which of course also adapt to the current pandemic period and the post-pandemic period because learning models that can adapt to the pandemic are inappropriate learning model [19].

Strengthening character education does need to be carried out following the explanation above, considering the strengthening of character education needs to be maintained during the pandemic; under these circumstances, it is necessary to cultivate the central values of character education, namely religion, Cooperation, nationalism, independence and integrity [20]of course to survive in the current pandemic and need to be addressed wisely, because the benefits of strengthening character education will be great if this strengthening can run well and will, of course, produce students who are tough and can overcome all kinds of problems with ease. The right solution, because strengthening character education is one of the efforts to improve the nation's quality.

DISCUSSION

The initial goal of character education was to set an excellent example of character for students and among them found positive results from implementing character education programs in schools, including higher academic achievement, fewer suspensions and dropouts, and fewer student risk behaviours [5]. The

overall good development of students shows that character education programs must be one of the essential components embedded in the current curriculum. [21]Through interview techniques and questionnaire responses, the participants of the character education program claimed that the learning experiences they gained were beneficial in developing the ethical, experiential, and intellectual foundations of character and those experiences. , continues to expand throughout their lives. One alternative to promote character education is to use literature studies because stories serve as role models that connect knowledge and morals [22]. This is also part of the learning video about cultural contexts. A promising foundation for carrying a character education framework is to "make a critical connection between the lessons of greater social sympathy in the classroom and acts of benevolence in community life" [10],

Constraints and Controversies in the Implementation of Character Education During the Pandemic and Post-Pandemic

We live where there is currently a pandemic going on, and of course, it affects the pattern of character education of students, which is also with a democratic government system. Children's freedom in learning is limited due to the lack of direct interaction between teachers and students. Through the independent learning program, it is hoped that obstacles in applying character education can be minimized. With the independent learning program, it is expected that strengthening character education can be carried out correctly. It is considering that students can have good character during this pandemic period even though face-to-face learning is still limited. The strengthening of post-pandemic character education can be followed by continuing the program to strengthen culture-based character education.

CONCLUSION

Culture-based learning media, in this case using ethnomathematical learning videos, is one alternative that can be done to strengthen character education during the pandemic. Innovative teachers will be able to instil character values in their students. Several central character values need to be maintained, including religion, independence, Cooperation, nationalism, and integrity, which come from the dimensions of taste, thought, heart, and sport. Supporting character education with ethnomathematical learning videos is one of the breakthroughs that implies supporting character education in all aspects.

SUGGESTION FOR FUTURE RESEARCH

Further research can be done to strengthen culture-based learning media by using a learning management system that can be integrated with character education. Considering that the digitalization era has entered several aspects, supporting character education can also be done digitally. Access to information and telecommunications has become increasingly sophisticated. Therefore this has both positive and negative impacts. Of course, future research can take advantage of the sophistication of information and communication technology to strengthen character education

CO-AUTHOR CONTRIBUTION

Rully Charitas Indra Prahmana (ethnomathematical analysis and scientific article writing)
Puguh Wahyu Prasetyo (mathematical modeling analysis)
Abdul Aziz (video analysis of learning and character education)
Iswahyudi Joko S (Mathematics content analysis)

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Visualization of Rectified Sine Waves and Triggering Angles on Thyristor Using Geogebra

Djoko Untoro Suwarno[1, a)]

[1]*Electrical Engineering, Faculty of Science and Technology, Sanata Dharma University*
Paingan, Maguwoharjo. Sleman 55282, Indonesia

[a)] Corresponding author: Joko_unt@usd.ac.id

Abstract. GeoGebra is a tool that is widely used among academics to solve mathematical problems. GeoGebra can be visually generated in the form of graphs and computational results easily and quickly. In the field of electronic power, there is a problem with directed waves and waves triggered by a certain angle on the device thyristor. This paper will be discussed about visualization of rectified sine waveforms, triggering angles as well as integral values of directional waves in thyristor and three-phase source animation. With the GeoGebra tool, students can understand mathematical equations and make wave visualization on electronic power.

INTRODUCTION

Visualization is a way to visually show an event or equation. Visual appearance can make it easier to understand something. Mathematical equations use symbols that are often difficult for students to understand. To help students understand mathematical equations, visualization is required. GeoGebra is a web-based tool for geometry issues or other mathematical problems that are expected to help students in learning materials related to mathematics. Power electronics is one of the courses in electrical engineering related to voltage sources, rectifiers, and electric motors. Power Electronics talks about sine wave sources or signals, looking for average voltage, effective voltage, voltage rectifier, ripple voltage, different phases on three-phase sources.

GeoGebra is a web-based tool and application related to graphing, Geometry, 3D, and more. Through this tool makes it easy for users to create charts, users can try to change the parameters to instantly see the changes that occur, perform calculations directly. Paper articles related to GeoGebra include: Geometry Learning using GeoGebra (Dian, 2015), GeoGebra in Mechanical Engineering (Diyan, 2018), Interactive Physics Simulation (Tom, 2017), GeoGebra on Polygon material (Miftah, 2018), GeoGebra in mechanism (Iriante, 2014), GeoGebra in Transistor Amplifier (Zamora, 2020), Exploring Polar Curves with GeoGebra (Tuyetdong, 2012)

The problem faced is how to create visualizations (images, animations) to show mathematical equations in the field of power electronics using GeoGebra. The novelty of this study is that GeoGebra as a mathematical tool is applied in the field of power electronics to describe one-phase and three-phase voltage sources, rectified voltages, one-phase, and three-phase sine wave motion animations. Rotating field on an electric motor, calculation of RMS voltage and DC voltage

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METHODS

The visualization that will be discussed is the sine wave before rectified and after rectified for one phase and three phases. Dynamic sine visualization (animation) and representation in phasor form. Trigger angle visualization for SCR and Thyristor rectifiers. Visualization of rotating fields on electric motors. Visualization results in the form of graphics, animations, and construction protocols (how to arrange, step steps on GeoGebra). The result of the graphic compared to the textbook, whether it matches.

Diode Rectifer, SCR, Thyristor

Diodes are electronic components that function to rectify AC voltage into DC voltage. A diode has two terminals namely anode and cathode. The diode becomes connected when it gets a forward bias voltage (Anode voltage is more positive compared to the cathode voltage) as shown in figure 1a. Diodes are disconnected (OFF) when they get a refractive voltage. Anode voltage is lower compared to cathode voltage. Diodes have a minimum voltage to become ON i.e. Vdiodes of 0.7V to simplify the use of ideal Diodes.

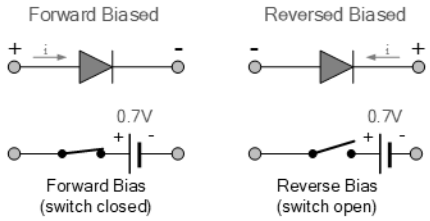


Figure 3. *a) diode in ON condition b) diode in OFF condition*

Mathematical equations for the rectifier diode as shown in Eq.1

$$Vout = \begin{cases} ON, & V_{anode} > V_{cathode} \\ OFF, & V_{ande} < V_{cathode} \end{cases} \quad (1)$$

SCR (Silicon Controlled Rectifier) is a diode-like component that has a Gate terminal pin as shown in figure 2. SCR works for semi-wave rectifiers (positive parts only) and is used on AC dimmers (light dimmers, motor speed slowing)

A thyristor is a 2-SCRs component that is mounted anti-parallel as shown in Fig.3. Thyristor also named Triac has 3 pins namely MT1, MT2, and gate. A thyristor is used as a full-wave rectifier that can be controlled when it becomes ON through the triggering angle of the sinus wave.

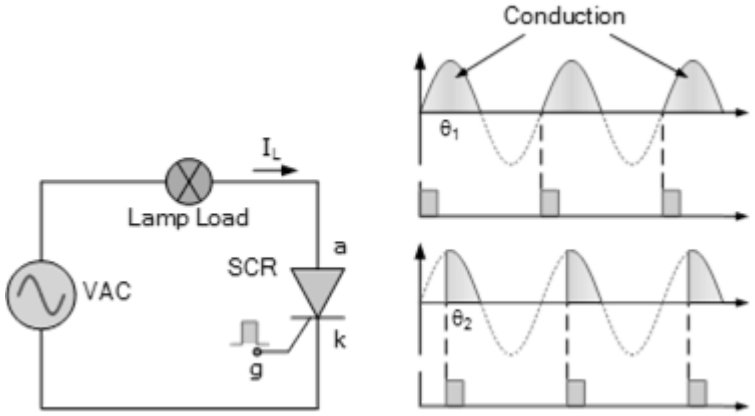


FIGURE 4. *trigger angle on SCR*

SCR can be ON when the Gate pin is activated and anode voltage is higher than cathode voltage.

$$SCR = \begin{cases} ON, & Va > V_k, \quad Vg = \delta(t-\theta) \\ OFF, & V_a < V_k \end{cases} \tag{2}$$

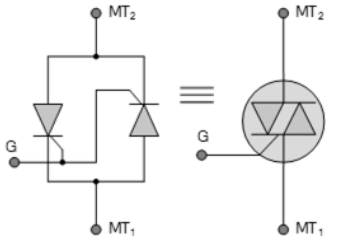
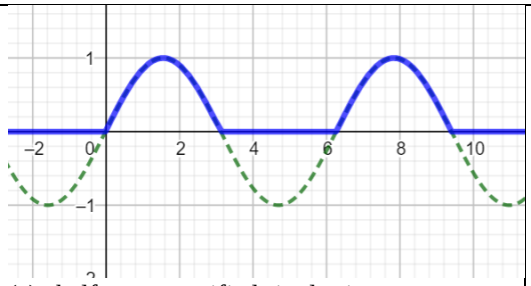
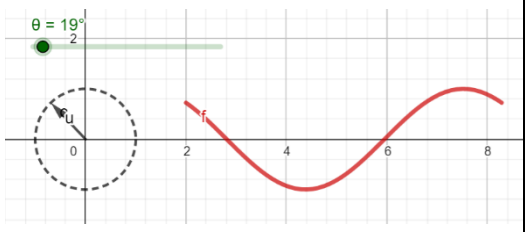


FIGURE 5. *Thyristor symbol and equivalence to SCR*

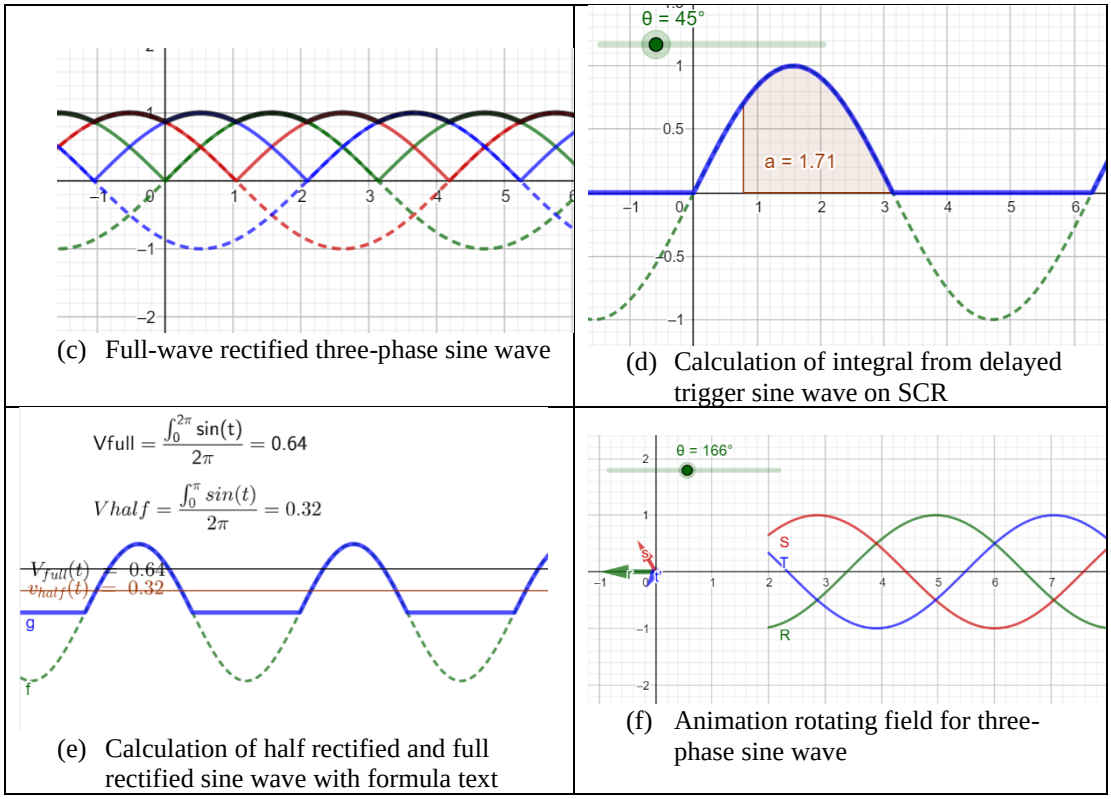
RESULTS AND DISCUSSION



(a) half-wave rectified single sine wave



(b) Animated phasor and single sine wave



(c) Full-wave rectified three-phase sine wave

(d) Calculation of integral from delayed trigger sine wave on SCR

(e) Calculation of half rectified and full rectified sine wave with formula text

(f) Animation rotating field for three-phase sine wave

FIGURE 6. *visualize various graphics using GeoGebra*

The equation for the sine function is shown in equation (3)

$$f(t) = A\,sin(2\pi f\,t + \theta) \tag{3}$$

The equation for the half-wave rectified sine wave is shown in equation (4) and Fig.4(a)

$$f(t) = A\,|sin(2\pi f\,t + \theta)| \tag{4}$$

In figure 4. (b) Visualization can be an animation of a moving sine wave. The Construction Protocol for creating sine wave animations is shown in Fig.5. The sine graph that moves $f(t) = sin(t + \theta)$ with the value θ repeat value increase from 0 to 360°, normal speed of 1. The change in the speed of movement is determined by the speed on the slider. Sine movement is constructed from vector rotation with radius R and angular velocity ω.

For a 3-phase voltage source, each phase has a 120° difference is shown in figure 4.c. The original sine wave graph is shown on the dashed line, the rectified sine wave is indicated as a thin line while the result rectified sine wave is shown as a thick line.

The equation for the three-phase sine wave is shown in equations (5)-(7)

$$V_R(t) = A\,sin(\omega t) \tag{5}$$
$$V_S(t) = A\,sin(\omega t + 120°) \tag{6}$$
$$V_T(t) = A\,sin(\omega t - 120°) \tag{7}$$

The equation of three phases rectified sine wave is shown in equation (8)

$$Vout(t) = \begin{cases} V_R, & if((V_R(t) > V_S(t)) \cap \left((V_R(t) > V_T(t)\right)\right) \\ V_S & if((V_S(t) > V_R(t)) \cap \left((V_S(t) > V_T(t)\right)\right) \\ V_T & if((V_T(t) > V_S(t)] \cap \left((V_T(t) > V_R(t)\right)\right) \end{cases} \quad (8)$$

Construction protocol for an animated single sine wave is shown in Fig.5

	Name	Description	Value
1	Angle θ		θ = 19°
2	Function f	If(2 < t < 2 + 2π, sin(t + θ))	f(t) = If(2 < t < 2 + 2π, sin(t + 19°))
3	Vector u	Vector((0, 0), (1; 2 + θ))	u = (-0.69, 0.72)
4	Circle c	Circle with center (0, 0) and radius 1	c: x² + y² = 1

FIGURE 7. *Construction Protocol for animated sine wave*

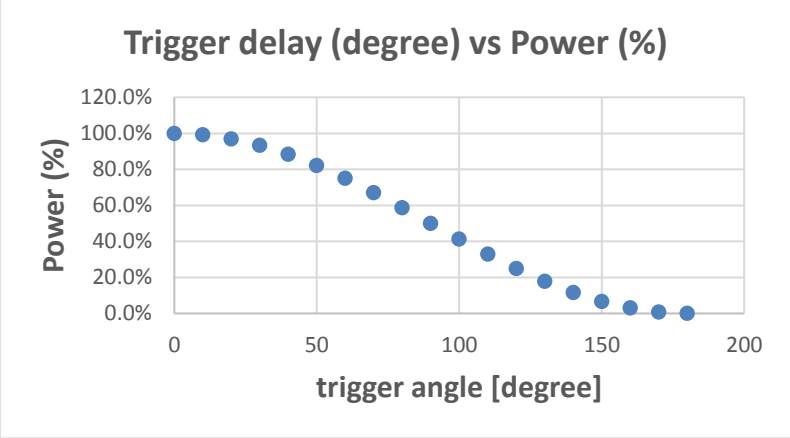


FIGURE 8. *Trigger delay vs Power*

Fig.4d is a sine wave with a delayed trigger. Visualization is performed by calculating integral operations of a sine wave with a lower limit value of θ (in angular units) of the delayed trigger used in the SCR (Silicon Controlled Rectifier) component as shown in Fig.6. The delay starts when zero-crossing reaches a certain angle of θ. After triggering occurs then SCR becomes ON and sine waves can flow.

Calculation of half-wave rectifier voltage, full-wave rectifier, and RMS voltage are shown in Eq.(9)–(11)

$$V_{rms}(t) = \sqrt{\frac{\int_0^{2\pi} \sin^2(\omega t)\, dt}{2\pi}} \quad (9)$$

$$V_{half}(t) = \frac{\int_0^{\pi} \sin(\omega t)}{2\pi} \quad (10)$$

$$V_{full}(t) = \frac{\int_0^{\pi} \sin(\omega t)}{\pi} \quad (11)$$

The display on the graphics with a formula latex format is shown in figure 7.

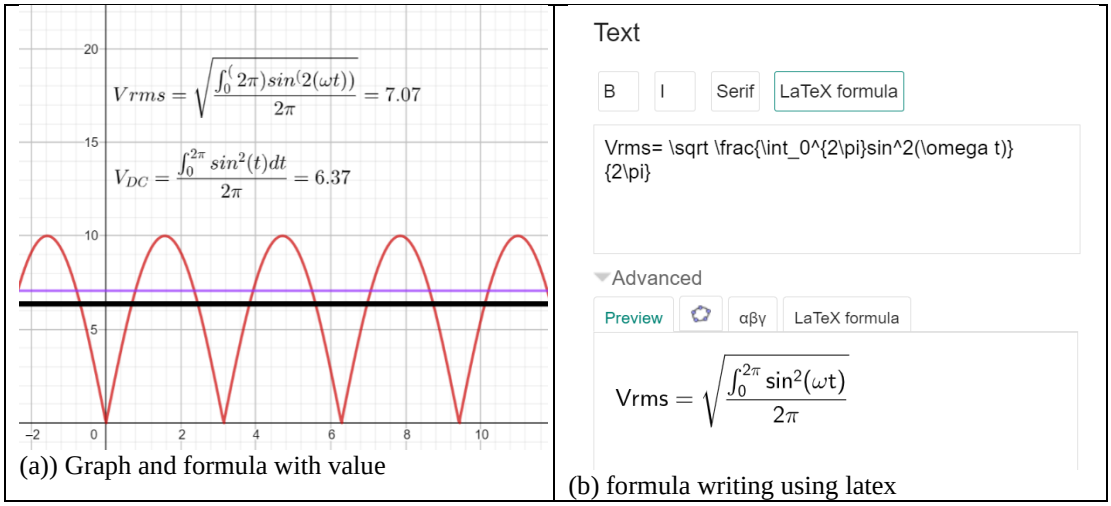


FIGURE 9. *Display graphics with formula text and latex construction*

The rotating field visualization uses variables phasor amplitude with fixed phasors angle at a three-phase voltage source. This visualization is used on three-phase induction motors. 3 phasers are representing three voltage sources. Each phase is a difference of 120 degrees. Phasor magnitude is a function of sine amplitude. From the phasor movement, the rotation that occurs is CW or CCW depending on the phasor sequence.

CONCLUSION

From the results of the experiments that have been conducted, it can be concluded as follows

1. Visualization of voltages before rectified or after rectified voltage for single-phase voltage and 3 phases are shown graphically using GeoGebra.
2. Visualizations in GeoGebra can be static graphics and dynamic graphics (animations). Animations in GeoGebra use sliding facilities that can be adjusted at speed.
3. Calculation of the average voltage values of halfwave and full-wave, trigger angle visualization for sine voltage was successfully performed using GeoGebra.
4. To display the text formula on the chart is done using latex format, then students need to learn the use of latex to write mathematical equations

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Development of Warehouse Data Models to Support JNE Delivery Services

Maria Atik Sunarti Ekowati[1, a)] and Kristyana Dananti[1, b)]

[1] *Surakarta Christian Univercity*
Robert Wolter Monginsidi Street No. 36-38 Jebres Mill,
Surakarta, Central Java, Indonesia. Postal Code 57134

[a)] *Corresponding author: maria.atik@uks.ac.id*
[b)] *Kristyana@uks.ac.id*

Abstract. In order to help improving the performance of JNE business communities in this globalization era, it is necessary to encourage them to compete with each other in acquiring technology to support all their work activities so that they can be carried out as effectively and efficiently as possible, due to the increasingly dominant role and technology. The data warehouse is one of the concepts oriented to the core components of a business, that is, data can be categorized as a strategic supporting aspect because through the formation of a data warehouse an output can be obtained in the form of a report that can be used as analysis material for the executive in the decision-making process. The objectives to be achieved in this research are to formulate a data warehouse model and application design in accordance with the results of the needs analysis, which can support JNE business actors as a delivery service, as a case study JNE Klaten is used as research object. The methodology used in this study uses analysis and design methods. The method of analysis is carried out by studying literature, conducting surveys and interviews, identifying information needed by executives in decision making, and defining data warehouse requirements which will be built based on Nine-Steps Methodology. The design method is carried out by designing a data warehouse application, as a display interface that contains supporting features from the user side. The results of the research are in the form of data warehouse models and applications that are built based on operational data, which are processed in various dimensions, so that they can form a report to meet the needs of the executive about information and using the data warehouse, the executive can analyze the reports generated from multiple viewpoints easily, and can also be used as a reporting tool.
Keyword: Design, Analysis, Data Warehouse, Strategic, Delivery Service

INTRODUCTION

The need for the presentation of information today must be integrated and continuously increasing. In line with increasingly fierce competition, it requires an optimally integrated system both in terms of information technology that supports the entire process of presenting information, as well as the source of the information produced. The results of all operational data processing that are processed must be in accordance with the needs of the company. The company's ability to obtain information quickly and accurately can be used as a company's competitive advantage in facing the existing competition. In the decision-making process for both short- and long-term periods, business owners of JNE delivery services require various kinds of collaboration data stored in the operational database of this service business. This synergy will certainly require space from the operational database itself. However, the space from the database capacity used to accommodate operational data must have been prioritized in supporting ongoing operational activities. If the operational database is used generating data analysis needs, it will cause problems in the data generation process. These problems occur because the capacity of operational activities and the report generation process are in the same source, thus it slows down transaction operations and hinder the analysis process in decision making. In addition, the information needs usually involve several points of view (dimensions) to be analyzed. However, if you use data from an

operational database, the resulting report format cannot be previewed multidimensionally. To overcome this problem, the JNE Service Owner as a business, engaged in shipping goods by sea, land and air (domestic) requires the participation of a data warehouse in integrating various data spread over many tables in the company's operational database. Thus, the presentation of the information needed in the decision-making process will be faster and easier. In addition, by implementing a data warehouse system, it can provide positive value for business owners of JNE delivery services including:

1. Can be used as a company's competitive advantage. Competitive advantage is obtained by enabling decision makers to be able to access data that was previously unavailable, unknown, or unrecorded information because of the possibility that the information is spread throughout the distribution of existing databases, thus requiring a data warehouse to integrate all of the data. In addition, by implementing a data warehouse, it is believed that the rate of return on investment obtained will be high for companies that successfully implement the data warehouse.
2. Increased productivity of decision makers for JNE delivery services. A data warehouse that integrates data from various separate systems into a form that provides a complete view of a company. Through the process of converting data into more meaningful information, data warehouses enable executives to perform more substantial, accurate, and consistent analysis so that they can support the decision-making process.
3. Through this research, reset warehouse model and application will be formed that can assist executives in analyzing integrated data in the form of reports with representations not only in the form of data, but also being able to view reports in the form of graphs that will facilitate in understanding the contents of the report, so that it can be useful as consideration in the decision-making process carried out.

Data is a basic description of things, events, activities, and transactions that are recorded, classified, and stored but not organized to produce a specific meaning. The involvement of data in the implementation of the company's current operations has played an important role in supporting every activity carried out [1]. Therefore, a container is needed to integrate the existing data. The system that can support the company's operational activities is known as a database system. Database is a collection of data and descriptions of logically related data designed to meet the information needs of a company [3]. Through the application of a database system, it can certainly make it easier for users to process data, display data, and reduce the possibility of errors that will arise in the implementation of company operations. In line with the passage of time, the number of transactions has increased significantly, indicated by the increase in the number of records in each table in the database. An increase in data can lead to a decrease in the performance of the company's operational system, therefore efforts are needed to maintain historical data. On the other hand, the existence of historical data is used as a reference to find out future forecasting patterns based on data that has already occurred.

The data warehouse is superior when compared to database. The database is a collection of data that is managed in such a way based on certain interrelated provisions so that it is easy to manage. Through this management, users can find it easy to find information, store information and dispose of information. The database provides speed and convenience in selecting data so that it can get the required information in a short time. However, the speed of obtaining information depends on the database design. While the data warehouse is a database system commonly used for reporting and data analysis. The database also stores current and historical data with a single place used to generate analytical reports In application, the data warehouse system can have a positive impact on the JNE delivery service business manager, including the analysis process or information management based on historical data contained in JNE shipping services, making strategic decision-making processes faster based on accurate analysis processes because based on historical data that has occurred before. Data warehouse is a collection of data that is subject oriented, integrated, time variant, and non-volatile in supporting the decision-making process.

Subject-oriented data warehouses are identified and compiled based on the main subject in the JNE delivery service business environment, and not oriented to process or application functions as is the case in the operational environment. The second and most important characteristic of a data warehouse

is integration[2]. Data taken from separate sources, entered into the data warehouse. The retrieved data will be changed, formatted, rearranged, and summarized, repeatedly and continuously, in order to support the operation of the data warehouse system in producing integrated reports, while the data that enters the data warehouse in various ways and has inconsistencies with the application. will not be entered into the system. Forms of data consistency include naming, key structure, attribute size, and physical characteristics of the data. The result of data integration, in the data warehouse only has one form according to the predetermined format. Nonvolatile means that the data does not change, even though the operational data changes. That way, the old data is still stored in the data warehouse. The last characteristic, namely Time Variant, implies that each data in the data warehouse is always accurate within a certain period. The time limit in the data warehouse is much longer than the operational system database because of the difference in the time limit, the data warehouse accommodates more historical data than the operational database. Broadly speaking, the significant differences between operational databases and data warehouses can be seen in the table description below:

Table 1. Differences between operational databases and data warehouses

Characteristics	OLTP System	Data Warehouse System
Main objectives	Support operational processes	Support process analysis
Data age	Current data	Historical data
Data latency	Real time	Depends on cycle length data in data warehouse
Data granulation	The data is detailed	The data is detailed, weighty, and has been
Process Data	Pattern query, insert, delete, update	Less predictable/patterned shape Executed query
Predicted Reports	one dimensional, shape static report	Unpredictable, multidimensional, the report is dynamic
User	Used by all operations	Used on a number of parties executive

The main components in a data warehouse include [4]:

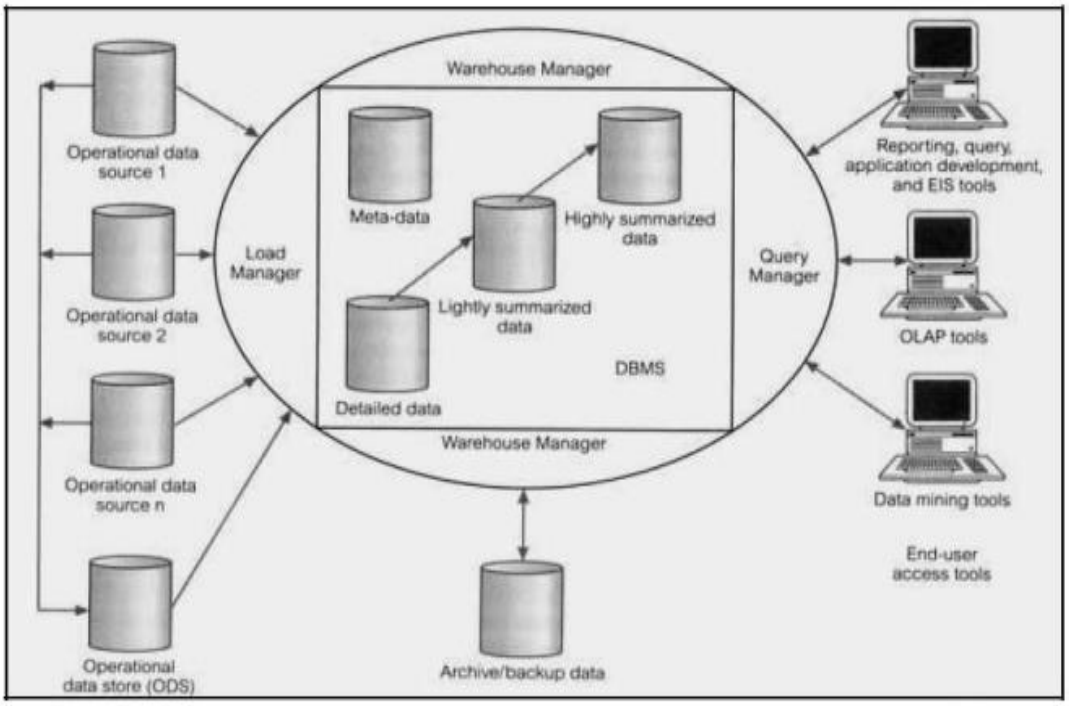

Figure 1 Data warehouse architecture

1) Operational Data
The data for the data warehouse comes from:
   a. Mainframe operational data contained in the first generation, namely hierarchies and network databases.
   b. Departmental data residing on file systems, such as VSAM, RMS, and relational DBMSs (such as Informix and Oracles).
   c. Personal data residing on personal workstations and servers.
   d. External systems such as the Internet, commercially available databases, or databases that are dealing with the company's suppliers or customers.
2) Operational Data Store
Operational Data Store (ODS) is a place to store the latest and integrated operational data, used to meet the needs of the analysis. ODS stores data that has been extracted and has been cleared from the data source. Thus, the process of integrating and restructuring data for data warehouse becomes simpler.
3) ETL Manager
The ETL manager performs all operations related to the ETL function (Extract, Transform, Loading) data into the data warehouse. Data can be extracted from data sources or in general taken from the Operational Data Store.
4) Warehouse Manager
Warehouse manager performs all operations related to data management in data warehouse, such as: data analysis to ensure consistency, transformation and unification of data sources from temporary storage media to the data warehouse table, form indexes and views on the table, generate denormalization process, generate aggregation, and back up and archive data.
5) Query Manager
Query manager performs all operations related to setting the entered query by users. The operations performed by this component are in the form of directing queries on the right tables and query execution scheduling.
6) Detailed Data
This component stores all the detailed data in the database schema. In general, some data are not stored online, but can be done in aggregation. Periodically detailed data is added to the data warehouse to support data aggregation.
7) Lightly and Highly Summarized Data
This component stores all data that has been summarized (aggregated), which is generated by the warehouse manager. Data needs to be summarized in order to speed up query performance. Data summary continues updated as new data enters the data warehouse.
8) Archive / Data Backup
This component stores detailed data and summary data for the purpose of storing and backing up data. Although summary data is obtained from detailed data, summaries need to be backed up when the data is stored beyond a certain period in the storage of detailed data.
9) Metadata
This component stores all metadata definitions (information about data) used in the data warehouse processes. Metadata is used for various purposes, including: extracting and loading processes, metadata is used to map data sources in the warehouse; in the warehouse management process, metadata is used to automate the creation of summary tables; as part of the process in query management, metadata is used to direct a query to the right data source.
10) End-User Access Tools
The main purpose of a data warehouse is to support the strategic decision-making process in business. Users interact with the data warehouse using end-user access tools. Based on their use, there are four categories of end-user access tools, namely: Reporting and Query Tools, Application Development Tools, Online Analytical Processing (OLAP) Tools, and Data Mining Tools

RESEARCH METHODS

In this study, the methodology used to support the implementation of decision making by the owners of the JNE delivery service business consists of two types of methods, including:

a) Method of Analysis The analysis process is carried out through several stages, including:
   1. Literature study, namely studying the literature that discusses the methodology for establishing a data warehouse.
   2. Conduct a survey on the current system which is carried out by conducting interviews with parties who support the company's operations and executives who will use the data warehouse system that was formed.
   3. Analyzing the information needed by executives in making decisions, which will later be used as a reference in designing the data warehouse system.
   4. Identify the prerequisites for the system requirements to be built to match the existing requirements.

b) Data Warehouse Design Method. At the design stage, JNE delivery services, models and applications are designed based on the results of the analysis of the problems encountered. The data warehouse design method used consists of nine stages known as the Nine-Steps Methodology approach introduced by Ralph Kimbal.

RESULTS AND DISCUSSION

In the establishment of a data warehouse system at JNE Delivery Services, it involves four main components of an interconnected system, consisting of:

1) Data source is the source of origin of the company database used in the formation of the data warehouse. In designing this data warehouse, the data source is data from the company's transactional database related to the company's main processes, namely the process of selling goods delivery services, the process of shipping goods, and the billing process at PT JNE.
2) Data transformation is the process of converting data that originally came from the operational database into the appropriate form in the data warehouse system. This process is known as the ETL (Extract, Transform, Loading) process. Extract is the process of taking operational data and selecting the data to be used in the data warehouse. Transformation is carried out so that the data has a consistent nature and its integrity is guaranteed so that it can produce precise and accurate information. Loading is the process of storing data that has been transformed into a data warehouse. The stages of data transformation from an operational database into a data warehouse are as follows.
   - Read and select data from operational databases related to the sales process for delivery services, delivery processes, and billing.
   - Uniform certain data to make the data consistent and integrated, and perform calculations on the data according to the output that will be generated by the data warehouse.
   - Perform the data transformation process so that the data is ready to be entered into the data warehouse. This process is carried out using the Data Transformation Services (DTS) facility contained in the SQL Server DBMS
3) Users are end users who access or use data warehouse applications that have been designed.
4) The data warehouse system makes it easier and faster for end users to obtain the data needed in the form of reports to support analysis needs on the executive side.

Stages of Data Warehouse Design for the owner of the JNE freight forwarding service:

1. Selecting Process

   Based on the results of the analysis that has been carried out, it can be concluded that the orientation of the formation of a data warehouse system is carried out when the goods delivery service process is carried out by JNE. In this data selection process, the required components of this Data Warehouse are:

   1. Data Source/Data Source : Source data is a data warehouse that comes from various sources, such as from internal data / external data, archived, and other data.

2. Stagging data : The extracted and loaded data is in the same format but does not change the value of the data.
3. Data Storage : Media for storing data from staging data.
4. Metadata : Components that provide an explanation of a data that exceeds the data dictionary. The types of metadata are Metadata Transformation and Extract, User Metadata and Operational Metadata.
5. Information Delivery : The process of conveying information to users which can be through online, email and intranet techniques.
6. Management and Control : Is the process of managing and controlling contained in the data staging and metadata stages.

2. Choosing Grains

Grain is data of prospective facts to be analysed. through grain selection, it can be decided what things will be represented in the fact table records. The grains contained in the design of this company's data warehouse system include:

- Sales. In this process, the data analysed includes which branches are the most productive in selling services, what types of services are most often chosen by customers, what types of goods are often sent, and the number of service sales transactions that occur. Measurements were made using the Linkert scale. Respondent data by gender, shown in the table 2. below:

Table 2. Respondents by gender

Gender	Number of people	Percentage (%)
Man	45	45%
Girl	55	55%
Amount	100	100%

While the presentation table based on age can be seen in table 3. below:

Table3. Presentation table based on age

Age	Number of people	Percentage (%)
17-19 Year	20	20%
20-22 Year	25	25%
23-25 Year	35	35%
26-28 Year	20	20%
Amount	100	100%

And in Table 4. shows the presentation of respondent data based on work.

Table 4. Presentation of respondent data based on work.

Profession	Number of people	Percentage (%)
Student	25	25%
Employee	25	25%
Entrepreneur	45	45%
Etc	5	5%
Amount	100	100%

And the number of respondents based on the frequency of JNE users is shown in table 5. Below:

Table 5. Respondents based on the frequency of JNE users

JNE Users	Number of people	Percentage (%)
2-5 Times	46	46%
Above 5 times	54	54%
Amount	100	100%

- Delivery. The data analysed includes which cities most frequently carry out shipping transactions and become delivery destinations, which cities are often used as transit points, the routes that are often used, the average time period required to deliver goods to the destination city, as well as the factors that often the reason the delivery is not accepted by the recipient. In the JNE delivery service, the number of respondents to consumer satisfaction can be shown in the table 6.

Table 6. Respondents to consumer satisfaction

Butir	SS		S		KS		TS		STS		Total	Total
	F	%	F	%	F	%	F	%	F	%	F	%
26	10	10%	51	53%	21	22%	10	10%	8	5%	100	100%
27	10	11%	66	68%	17	17%	2	2%	5	2%	100	100%
28	39	40%	52	54%	5	5%	0	0	4	1%	100	100%
29	15	15%	62	64%	15	16%	4	4%	4	1%	100	100%
30	16	16%	43	44%	27	28%	10	11%	4	1%	100	100%

- Billing. If the delivery of goods is by COD, then the billing process from the analysed data includes the number of customers who make credit, which customers have passed the due date, the number of billing transactions, and the maturity period of each invoice.

3. Identification and adjustment of dimensions. Shown in table 7. below:
   At this stage, the dimensions are adjusted to the existing grain.

Table 7. Identification and adjustment of dimensions

Grain/Dimension	Branch	Service	Item s	Time	Reason	Route	Customer	Status
Productive Branch	√			√				
Service Type Favorite		√		√				
Item Type Favorite			√	√				
Number of Transactions Sales	√	√	√	√				
Favorite Route				√		√		
Favorite Home Town				√		√		
Transit City Favorite				√		√		
Destination City Favorite				√		√		
Time Delivery Items by JNE				√				
Reason				√	√			
Falling Customers Tempo				√			√	√
Number of Transactions Billing	√			√			√	√
Maturity Status							√	√

4. Selection of facts
   In this stage, the selection of facts according to needs is carried out. Every fact that formed, consisting of dimension attributes and measure data. Further identified facts will be formulated

in the form of reports, diagrams, or graphs that can represent data in a form that is easy to understand for users. The facts that are formed from the design of this data warehouse are:

- Sales, including TIME, CODE_BRANCH, CODE_SERVICES, CODE_PRODUCT, TOTAL_TRANSACTION
- Delivery, including TIME, ROUTE_CODE, REASON_CODE, DURATION, TRANSACTION_NUMBER
- Billing, including TIME, CUSTOMER_CODE, BRANCH_CODE, STATUS, TOTAL_BILLING, TOTAL_INVOICE, DURATION_PAYMENT

5. Saving pre calculations in fact table
The pre calculations made in the design of this data warehouse include shown in table 8. below,

Table 8. The pre calculations made in the design of this data warehouse include

FACTS	ATTRIBUTE	PRECALCULATION
SALES	TOTAL_TRANSACTION	COUNT(NO_SHIPMENT_RECEIVE)
SHIPPING	DURATION	DATE_RECEIVE–DATE_NOTE_SHIPPING
BILLING	QUANTITY_BILLING	COUNT(NO_INVOICE)
	TOTAL_INVOICE	AMOUNT_SALES-(DISCOUNT*(TOTAL_SALES))
	DURATION_PAYMEN	DATE_PAY_DATE_INVOICE

6. Complete the dimension table.
At this stage, a text description is added to the dimensions. The description should be easily understood by she user. The following is a text description of the dimension table, and shown in table 9. below:

Table 9. The description should be easily understood by she user.

Dimension	Attribute	Description
Time	CODE_TIME DATE DAY SUNDAY MONTH SEMESTER YEAR	Reports can be viewed by time period determined, which can be based on the year, semester, month, week, day, and date.
Reason	CODE_REASON DESCRIPTION_REASON	Reports can be viewed based on reason data which often happens at the time of delivery.
BRANCH	BRANCH_CODE DESCRIPTION_BRANCH CITY NAME	Reports can be viewed based on existing branches in the company.
Route	CODE_ROUTE ROUTE_START NAME_CITY_START ROUTE_TRANSIT CITY_TRANSIT ROUTE_DESTINATION CITY_DESTINATION	Reports can be viewed by routes used in the process of shipping goods from one place to another.
Customer	CUSTOMER_CODE BRANCH_CODE CUSTOMER'S NAME	Reports can be viewed by customer who carry out the transaction of delivery of goods.
Service	CODE_SERVICE NAME_SERVICE	Reports can be viewed by type of variation services available to the company.

Item	ITEM CODE DESCRIPTION_BARANG TYPE_ITEM	Reports can be viewed by type items frequently sent by customers.
Status	STATUS	Reports can be viewed by fall status the time when the payment is made.

7. Selection of database duration.
   The time period of the data used in this data warehouse is shown in table 10 below:

Table 10. The time period of the data used in this data warehouse

Database Name OLAP	Name Databases OLTP	OLTP Time Period Data	Transformation to the data warehouse	Data duration warehouse
OLAP_ATR	DB_ATR	2007	2007-2010	4 Years

8. Track changes from dimensions slowly
   Observing changes in the dimensions of each dimension table can be done through three ways: method, namely replacing directly on the dimension table, forming a new record for every change that occurs, and changes in the data that form a new, different column. In this design the second method is used, namely if there is a change in the attributes in the table, it will cause creation of a new record. For example, such as a change in the customer's address, it will. This results in adding a new record to the dimension table while still keeping the old record. This is done to keep the old data stored, so it can be known changes that occur from start to finish.

9. Deciding the priority and mode of the query
   In this stage, we discuss the ETL (extract, transform, and loading) process, backups are carried out periodically, and analyze the capacity of data storage media. shown in table 11 and 12 below

A. ETL (Extract, Transform, and Loading) Process

Table 11. ETL (Extract, Transform, and Loading) Process

Insurer Answer	Intensity Activity	Description
Division Information Technology(IT)	Once a Month	Process ETL into this dimension and fact table will carried out by the IT division, outside of office operating hours, every end of month

B. Backup process

Table 12. Backup Process

Insurer Answer	Intensity Activity	Information
Division Information Technology(IT)	Once a Day	The backup process of the data contained in the data warehouse and operational database will be carried out by IT division, outside office hours jam

C. Analysis of storage media capacity

In the data processing process, the capacity of the storage media is one of the factors that need to be considered be taken into consideration. Transactions that occur every day on transactional/operational data (OLTP) will lead to data growth in the company's operational database, which will also affect the growth of data in the data warehouse. Therefore, it is necessary to analyze the growth of the data to assist in estimating the size of the media data storage needed for several years to come. This is done with perform calculations on the number of records generated per each existing table for a certain period, then accumulated

by using the size of the space based on the type the data used for each attribute contained in the table formed in the databases. So that it can be taken into consideration in the process of implementing a system that done later.

CONCLUSION

Example, Implementation and Results

Examples and implementation of data warehouse services in this JNE delivery service, can be displayed in the logical architecture design of the data warehouse. The source of the data used is the source of the data obtained from the operational data of the delivery service. RDBMS, which is used for service operational data storage. From the ODS (Operational Data Store) data source, a selection process is carried out. The selection process is the process of selecting the data needed in the data warehouse system from the data source. Not all data from data sources are used in this data warehouse, for that the selection process is carried out. The next process after selection is extraction, moving the sorted data into a separate database system from the operational database system. The separation of this database is so that the operational system is not disturbed by the processes in the data warehouse. The selected data is then carried out a cleansing process, namely the data cleaning process and the transformation process, both of which are carried out data staging or temporary databases. Then the loading process, which is the process of entering the data from the previous process into the data warehouse. MyJNE implementation can be seen in Figure 2.

Figure 2. MyJNE implementation

MY JNE app function

1. Checking JNE shipping rates throughout Indonesia
2. Checking JNE delivery status
3. Check the nearest JNE location lokasi
4. Conduct buying and selling transactions between sellers and individual buyers

How to use the MY JNE app

1. Download the MYJNE application on Google Playstore and search for the MYJNE application or click the link: https://goo.gl/Hy4DrD , complete the requested information. MY JNE will send a confirmation email and the customer must click the link contained in the email. The customer's account will be active after filling in all the required fields and the customer's phone number will be directly connected to his JNE shipment.
2. **My Shipment feature,** JNE customers will find it easy to view shipping history, this facility is only for registered users (Registered User).
3. **The Check Tariff feature,** this tariff or shipping fee checking service facility can be used by both registered users (registration) and as users without logging in (Guest User). The user can enter the city of origin in the From column, and the destination city in the destination/destination column (To), and the application will inform the shipping rate according to the desired city.
4. **JNE Nearby feature** , this service facility to find the location of the nearest JNE outlet/service point to you can be accessed by both registered users (Registered User) and users without logging in (as Guest User). This service facility is available in the JNE Nearby menu. Make sure you have activated the GPS feature on your smartphone to use this service facility.

5. **My COD Features,** My COD (Cash On Digital) is a feature in the MY JNE application that provides online shopping payment services with an escrow system. MY COD Act as a neutral transaction mediator to minimize the risk of loss that can be experienced by the seller or buyer. This COD service facility is intended for registered users and this service facility can be found in the My COD menu. After downloading the MYJNE application, customers can make transactions by registering as a user on the MYJNE application. When REGISTRATION, customers can make MYCOD transactions. Without MY COD REGISTRATION, it will be INACTIVE. By using MYCOD, the data of sellers and buyers are directly recorded in the MYJNE system and connected to their phone numbers.
6. **The My COD Wallet feature,** you can press the red round button with a picture of a cube at the bottom of the MY COD WALLET page to get started. The facilities available at MY COD WALLET include transferring funds to fellow MY COD wallet users (TRANSFER), topping up or adding funds to a virtual account (TOP UP), disbursing funds to a designated account (CASH OUT), and viewing transaction history. been done in MY COD WALLET (HISTORY). This MY COD WALLET service facility is intended for registered users (Registered User) and this service facility is found in the My COD WALLET menu.

The implementation of the JNE delivery service can be seen in Figure 3.

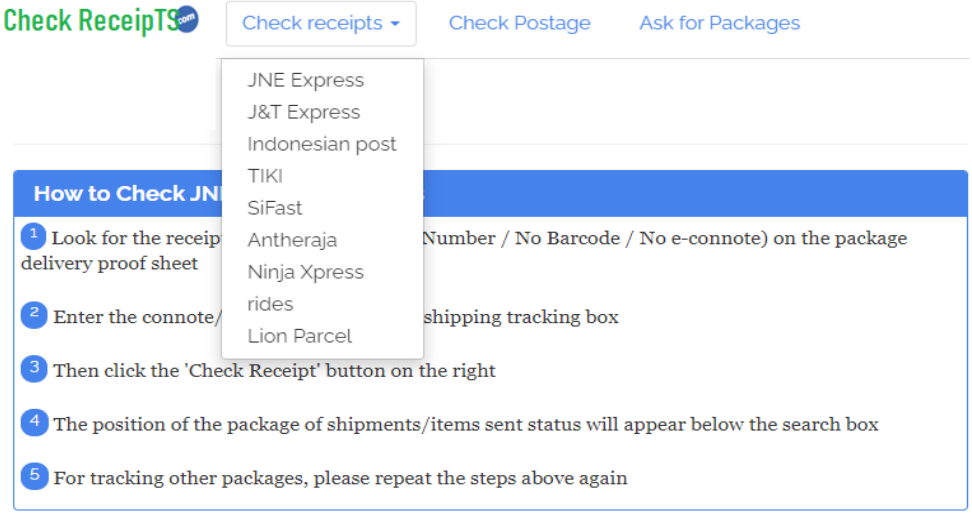

Figure 3. The implementation of the JNE delivery service

An example of data on delivery of goods through the JNE delivery service can be seen in Figure 4.

Figure 4. An example of data on delivery of goods through the JNE delivery service

And in Figure 5 below is the implementation of sending data via JNE

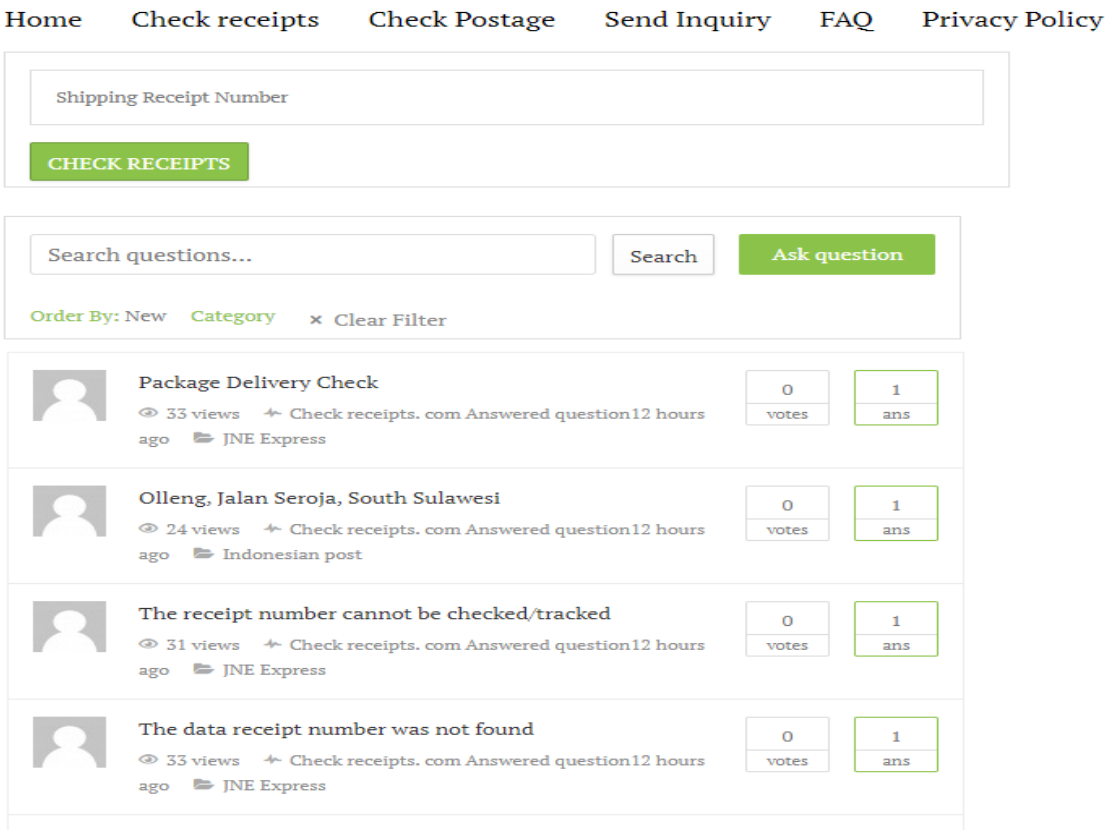

Figure 5. below is the implementation of sending data via JNE

In the establishment of a data warehouse system at JNE Delivery Services, it involves four main components of an interconnected system, consisting of: 1). Data source is the source of origin of the

company database used in the formation of the data warehouse. In designing this data warehouse, the data source is data from the company's transactional database related to the company's main processes, namely the process of selling goods delivery services, the process of shipping goods, and the billing process at PT Atlas Transindo Raya. 2). Data transformation is the process of converting data that originally came from the operational database into the appropriate form in the data warehouse system. This process is known as the ETL (Extract, Transform, Loading) process. Extract is the process of taking operational data and selecting the data to be used in the data warehouse. Transformation is carried out so that the data has a consistent nature and its integrity is guaranteed so that it can produce precise and accurate information. Loading is the process of storing data that has been transformed into a data warehouse. The stages of data transformation from an operational database into a data warehouse are as follows. 3). Read and select data from operational databases related to the sales process for delivery services, delivery processes, and billing. 4). Uniform certain data to make the data consistent and integrated, and perform calculations on the data according to the output that will be generated by the data warehouse. 5). Perform the data transformation process so that the data is ready to be entered into the data warehouse. This process is carried out using the Data Transformation Services (DTS) facility contained in the SQL Server DBMS.

Schematic Design

In designing the data warehouse system, this company uses a star schema, where the fact table placed in the center, surrounded by dimension tables. The use of this star scheme was chosen because of the shape of the This schema is easy to understand and use, making it easier to perform the query formation process. The star scheme produced in this study consists of three schemes, namely the sales scheme, the shipping, and billing schemes. The sales scheme and goods delivery scheme through JNE can be seen in Figure 6 and Figure 7 below.

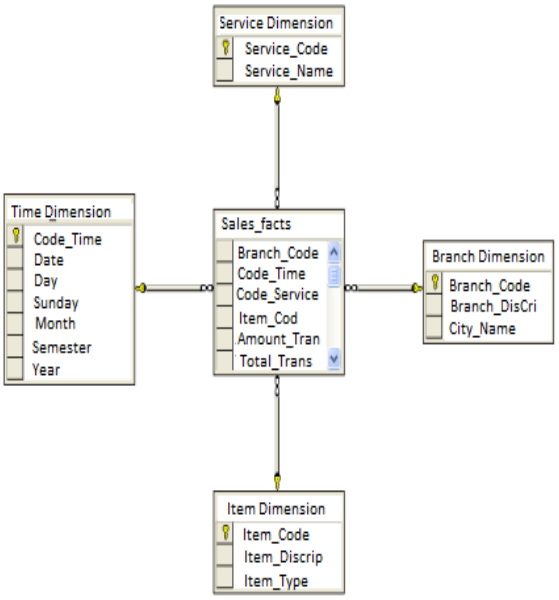

Figure 6. Sales Star Schematic

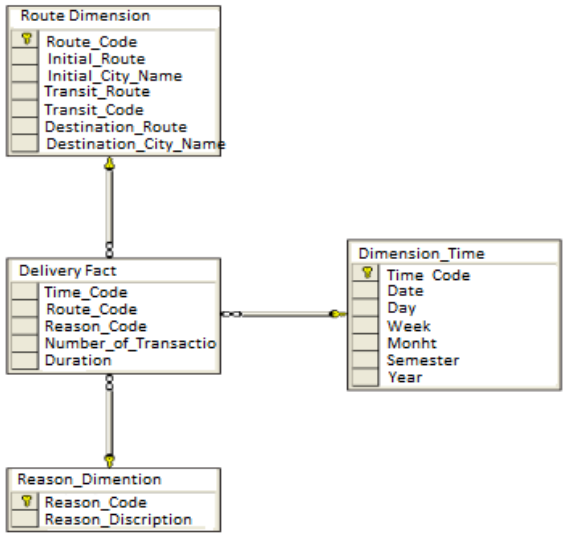

Figure 7. Freight Forwarding Scheme

Figure 8. below is an example of goods delivery data with JNE.

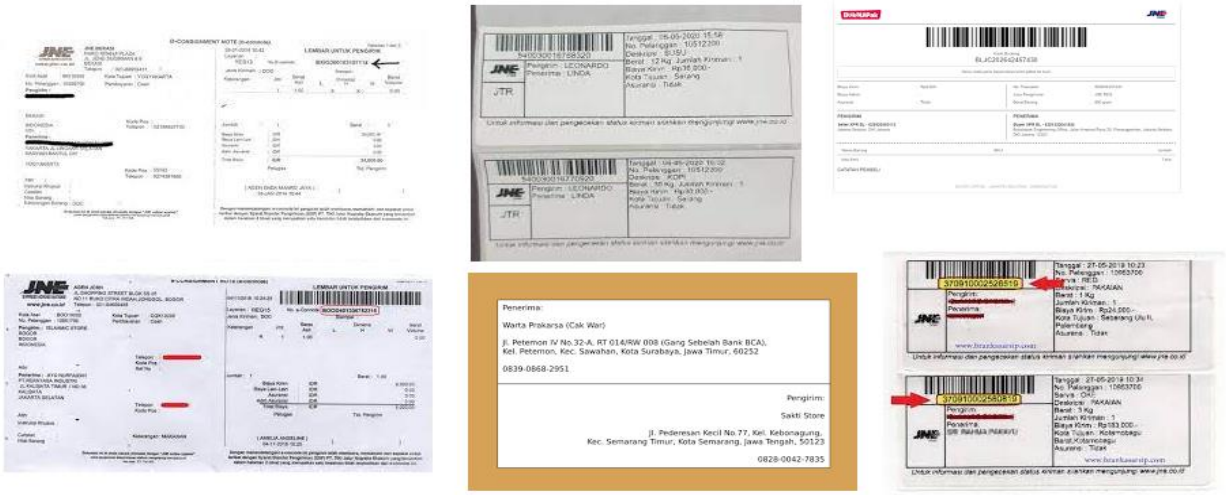

Figure 8. below is an example of goods delivery data with JNE.

Figure 9. shows the OLP design of Freight for delivery

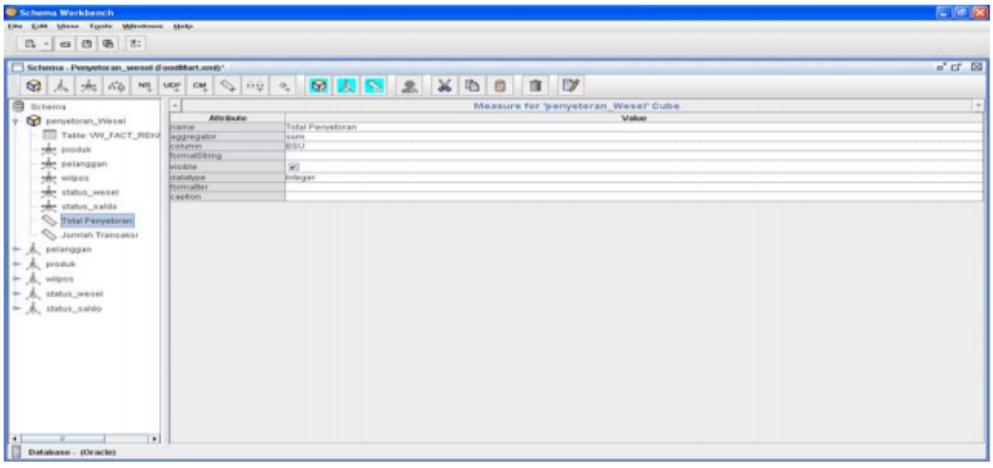

Figure 9. shows the OLP design of Freight for delivery

JNE is one of the shipping service companies that many people use to deliver goods. This delivery service is indeed very familiar with online business people who often send their merchandise out of the region. JNE has again made it easy by launching the JNE application on an Android phone, namely My JNE. This application allows you to check delivery packages such as check receipts, postage rates, and much more. Features of the JNE, My JNE Application on Android Smartphones include: 1. JNE Nearby; 2. Tracing & Tracking; 3. Check Tariff; 4. My Shipments; 5. My COD (Cash on digital); 6. My COD Wallet; 7. MY JOB (JNE Online Booking).

The advantages of this My JNE Android Application User: (1). The appearance of the JNE Application is Light and Simple; (2). Air Waybill Tracking Features Shown in More Details; (3). Faster Scanning Barcode Tracking Air Waybill; (4). Can Monitor Package Delivery Status with My Shipment; (5). Check Your Postage Fees; (6). Finding the Nearest JNE Location with JNE Nearby; (7). Transaction Media named My COD.

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IMPLEMENTATION PLAN

In implementing this data warehouse system, the need for specifications is needed appropriate hardware and software, so that it can support operations optimally. Following minimum required specifications: Server computer : Processor: Intel® Itanium® Processor 9000 Sequence, Hard disk: 1 TB, Memory: 8GB, Monitor: 20" LCD; Client computer: Processor: Intel® Core 2 Duo 3.2 Ghz, Hard disk: 1TB, Memory: 4GB, Monitor: 20" LCD; Operating system: Windows Server 2018 Service Pack 3; DBMS: SQL Server 2018; Supporting software: Microsoft Visual Studio 2018. KDD (Knowledge Discovery in .) process database) can be broadly explained as follows shows on Figure 10. The Planning Implementation Flow Chat is shown in Figure 11 while the analysis on the implementation of the implementation can be shown as in Figure 12.

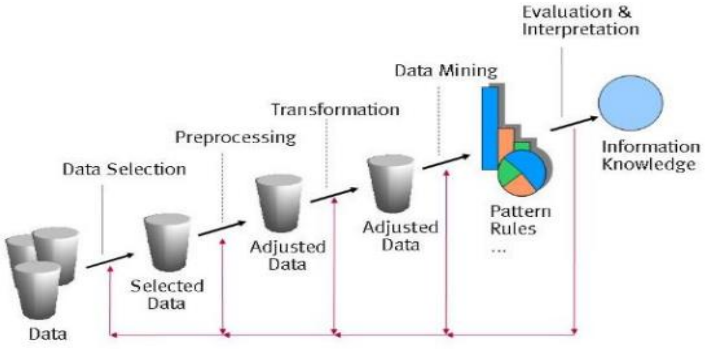

Figure 10. Data Mining Process

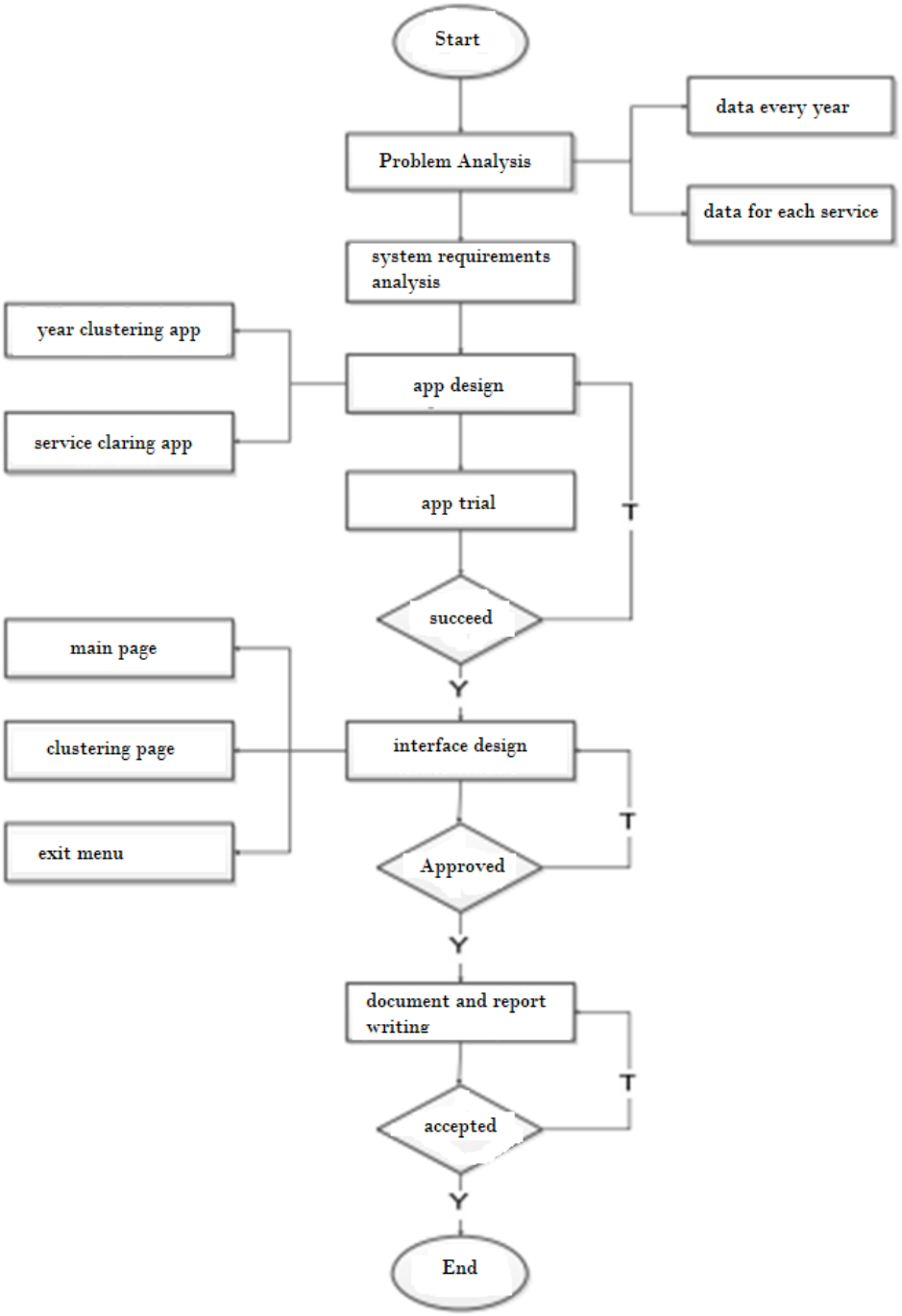

Figure 11. The Planning Implementation Flow Chat

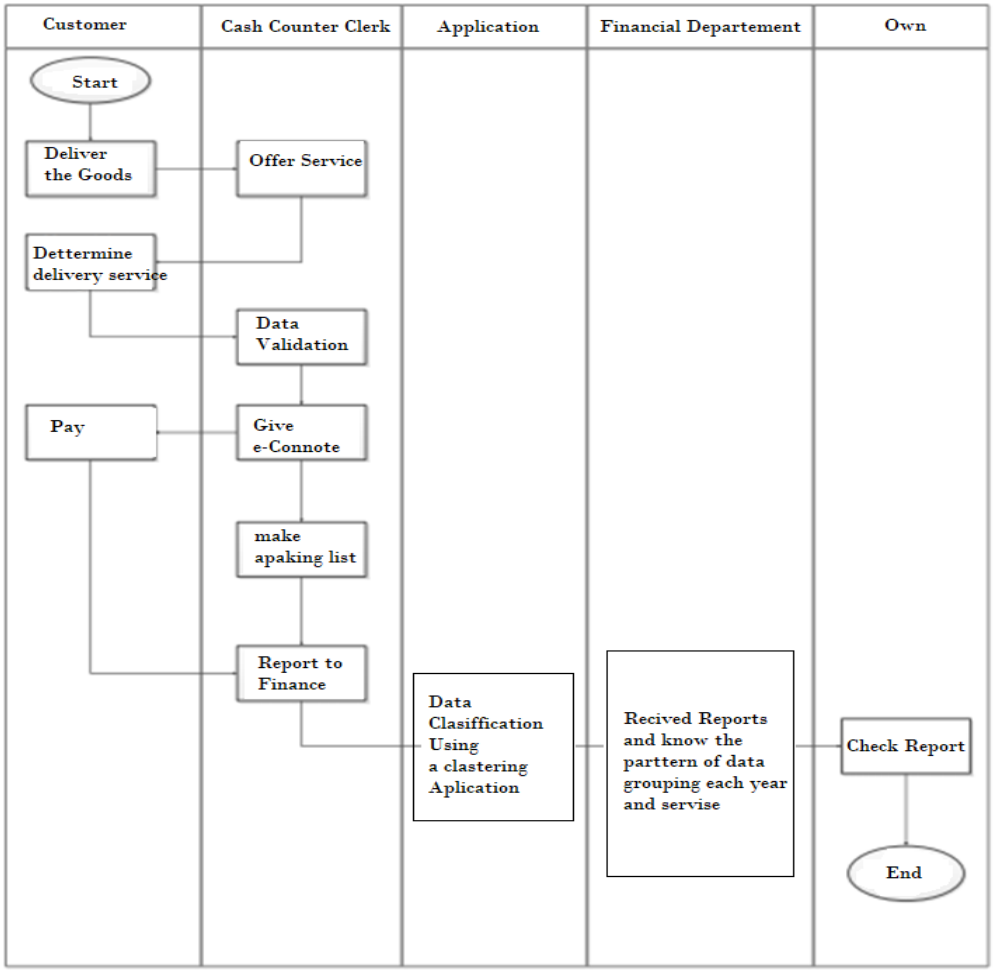

Figure 12. The analysis on the implementation

Input Needs Analysis The data used is a data service PT. JNE Agent Klaten in the last three years, namely from 2019 until 2021. The following is an example of data service REG (Regular), OKE (Economy Shipping) and YES 2019, which is shown in Table 13:

TABLE 13. Data service YES,REG and OKE

		Reg	Yes	Oke
2019	1	8788	2788	2348
	2	8541	1887	2484
	3	8885	1854	3079
	4	9093	1785	3888
	5	9763	1685	4158
	6	10400	1997	4331
	7	10502	1994	5731
	8	10487	2819	4025
	9	10593	2061	4618
	10	12116	2306	5461
	11	11671	2543	5463
	12	13010	2545	6139
	Total	132849	26264	52725

		Reg	Yes	Oke
2020	1	23610	3527	7361
	2	23244	3600	6380
	3	16046	2894	7431
	4	16661	2874	6774
	5	16258	2849	4282
	6	16699	2806	3981
	7	19275	3133	4430
	8	15102	3240	2296
	9	17884	3049	3606
	10	14061	2556	5363
	11	24346	4266	2906
	12	13490	2848	4657
	Total	216676	37642	59467

		Reg	Yes	Oke
2021	1	21506	4678	4252
	2	20991	4800	3805
	3	22400	3281	3112
	4	23255	3781	3446
	5	23898	3696	3784
	6	22590	3631	3275
	7	22984	4475	2822
	8	18356	3785	2017
	9	23509	4050	2770
	10	24912	4484	2433
	11	23854	4262	2417
	12	23060	4340	2677
	Total	280235	58263	54810

While the state transition diagram can be drawn, as shown in Figure 13 below:

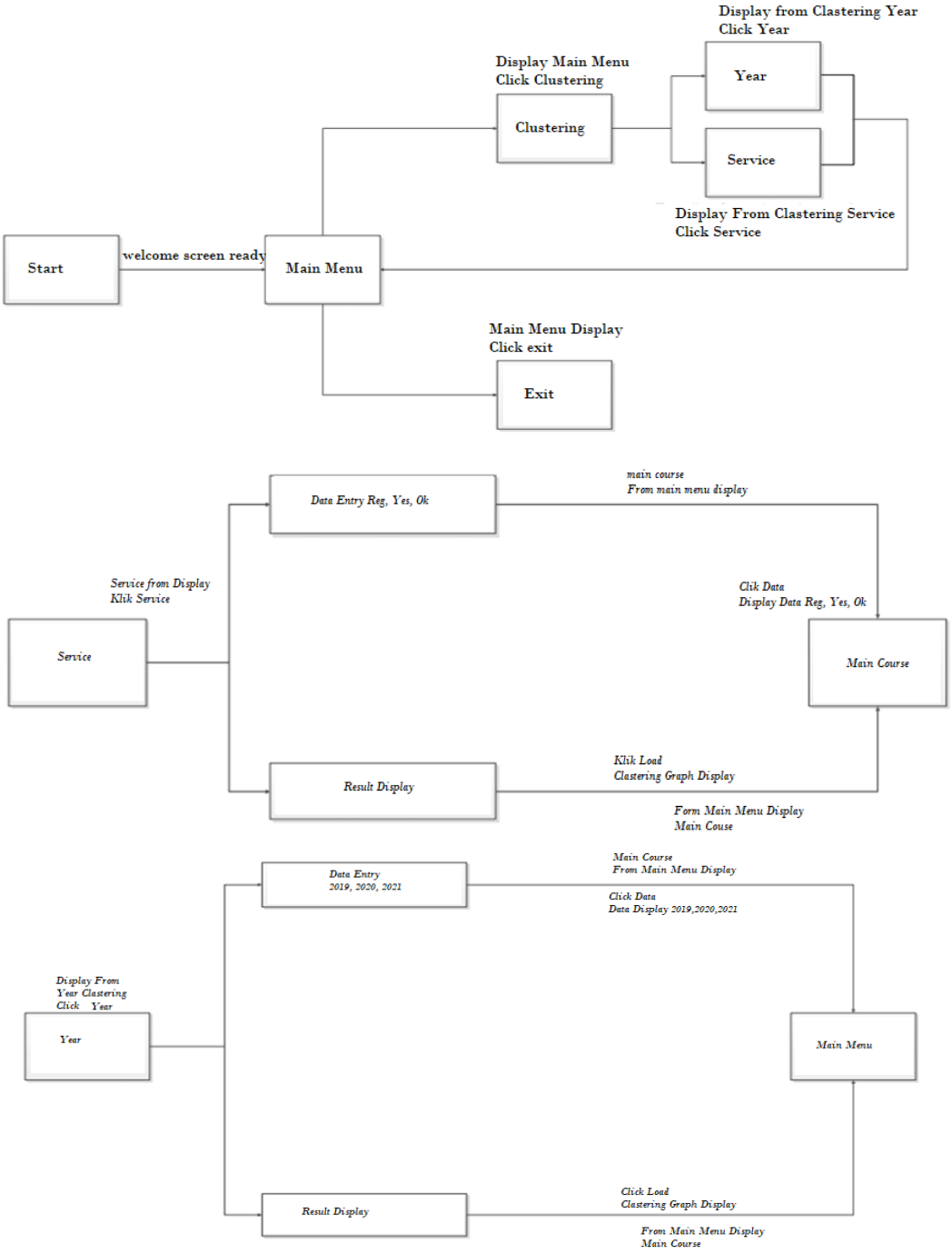

Figure 13. The state transition diagram

An overview of the implementation of year clustering year 2019, 2020,2021 can be shown in Figure 14 below:

Figure 14. The implementation of year clustering year 2019, 2020,2021

Delivery Service ERD on JNE can be seen as shown in Figure 15 below:

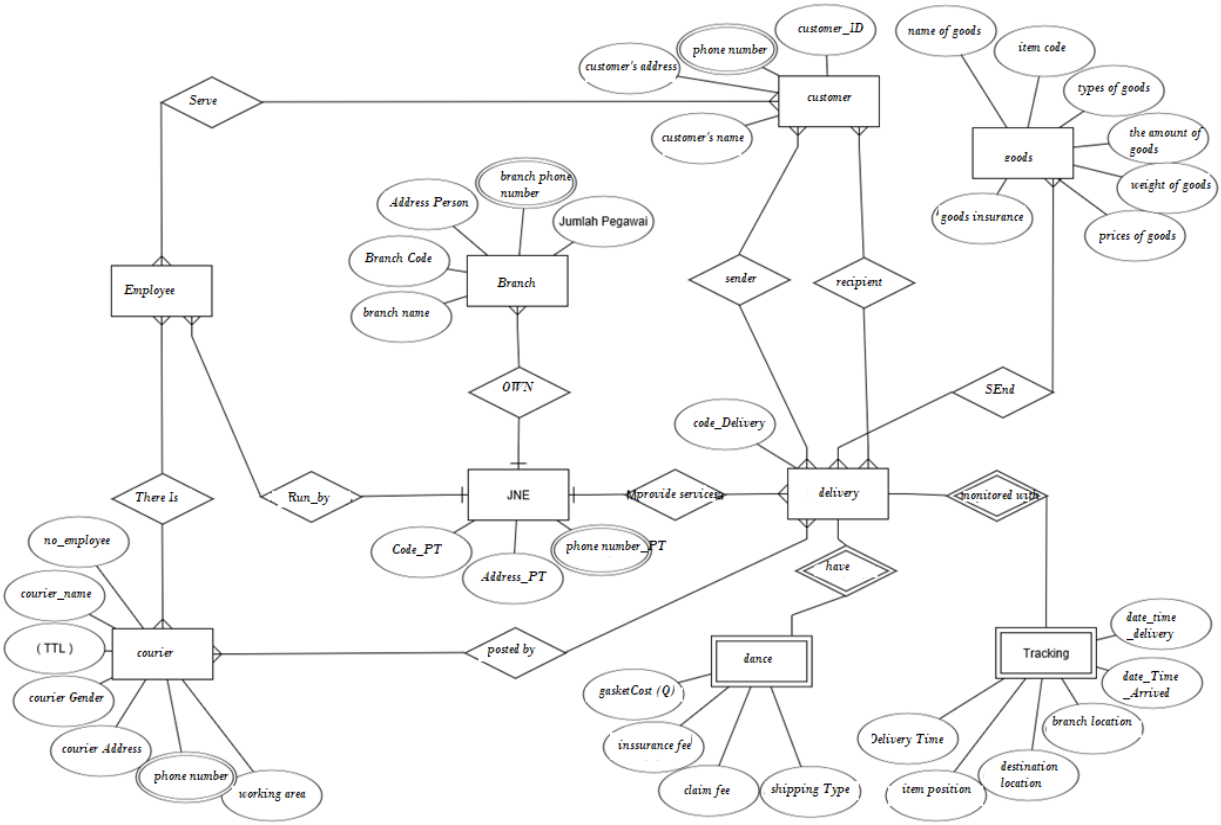

Figure 15. Delivery Service ERD on JNE

ACKNOWLEDGMENT

In designing the data warehouse system, this company uses a star schema, where the fact table placed in the center, surrounded by dimension tables. The use of this star scheme was chosen because of the shape of the This schema is easy to understand and use, making it easier to perform the query formation process. The star scheme produced in this study consists of three schemes, namely the sales scheme, the shipping, and billing schemes.

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