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Pond-based Scientific Approach and Learning Motivation on Student Learning Outcomes

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ABSTRACT

The pond-based scientific approach is a scientific approach for students in the aquaculture area, which requires the support of local wisdom-based learning media. With the many scientific approaches that exist, it does not make it difficult for students to raise local wisdom, namely aquaculture, to be used as research in obtaining student learning outcomes. The scientific approach can also provide learning motivation to students so that students are motivated to study harder in lifting student learning outcomes. This study aims to determine the literature review related to the pond-based scientific approach and learning motivation in improving student learning outcomes. The research method chosen is descriptive quantitative by first testing validity, reliability, classical assumptions, partial (t) and simultaneous (f) testing using the help of SPSS Ver,- 2023 software for windows. Data collection was carried out by interview, documentation and questionnaires distributed to respondents who had a population of 200 respondents of SDN 37 Bulu-Bulu, Pangkajene District and the sample was taken by random sampling using 15% of the population totaling 30 respondents of SDN Bulu-bulu students, Pangkajene District, Pangkep Regency. The results of the study partially test or test (t) and simultaneous test (f) pond-based scientific approach has a significant effect on student learning outcomes SDN 37 Bulu-bulu Pangkajene District Pangkep Regency. Then the partial test or test (t) or simultaneous test (f) student learning motivation has a significant effect on the learning outcomes of students of SDN 37 Bulu-bulu, Pangkajene District, Pangkep Regency.

Keywords: Scientific Approach, Learning Motivation and Learning Outcomes

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1. INTRODUCTION

Education has an important role in creating quality Indonesian human resources. Efforts to improve human quality are aimed at realizing the nation's successors who will carry out future development. The successor of a qualified nation or known as human resources is what determines the success of development. For this reason, one way to create quality human resources is through education by (Mukhriddin Sodirjonov, 2020).

The quality of education is the quality of education that can be seen from graduates of that education because only quality education produces education graduates who are able to build themselves, families, communities, nations and countries. Students must also play an active role in education, because education requires teachers, students, facilities and infrastructure. The teacher in question is a teacher who is professional and competent in his field by (Vanderlinde, et al, 2021).

Teachers in teaching must be good at using a wise and wise approach, not carelessly which can harm students. The teacher's view of students will determine attitudes and actions. Every teacher does not always have the same view in terms of assessing students. This will affect the approach the teacher takes in teaching. Because the success or failure in a teaching and learning process depends on how the teacher chooses a good approach by (Bukit, et al, 2022).

Student success in the learning process can be influenced by factors from within the individual and from outside the individual. Factors from within the individual include physical and psychological, for example psychological factors including motivation. Student learning motivation can support learning success, but low student motivation is an obstacle that can result in low learning outcomes. For this reason, teachers must be able to choose the right model or method in order to create an interesting

learning situation so that it can foster learning motivation and student success in learning is achieved by (Erick Marantika and wahyudin, 2023).

The scientific approach in learning as intended includes observing, questioning, collecting data, associating and communicating, so that students not only know facts or principles, but must be skilled in applying their knowledge in life by (Fitrah, et al, 2023).

Based on initial observations at the research location, it shows that as follows: (1) the learning model is still much dominated by the teacher so that students are less active in following the learning, (2) the method used in learning that focuses on the cultivation of information or concepts learned are told or presented with lectures only; (3) in the process of integrated thematic learning students feel less direction and guidance in independent learning, (4) in the implementation of learning teachers still apply book notes until exhausted, and (5) student learning outcomes have not been satisfactory which is dominated by the achievement of learning outcomes on average 70 percent learning completeness.

Also supported by the results of social studies learning in the last five years from the 2018 to 2022 school year as follows:

Table 1. Percentage of Grade VI social studies learning outcomes in the last 5 years

2018	2019	2020	2021	2022
73,50%	73,56%	73,72%	73,75%	73,75%

Source: *School Data SDN 37 Bulu-Bulu Pangkajene, 2022*

From table 1. it provides a picture that is still less than the maximum student learning completeness, with an indicator that from a student population of 215 children who have experienced the learning process, the percentage of children who already have a learning completeness value or the score meets the minimum completeness criteria set by the teacher is an average of 75%.

These conditions as a result of evaluating the learning process, apparently have not had a good impact on increasing student motivation and learning outcomes. This is because the learning process carried out is still using methods and models that do not attract students' attention, so that a learning model that is creative and involves students in learning through a pond-based scientific approach is needed, in the archipelago where SDN 37 Bulu-Bulu Kec. Pangkajene Pangkajene Islands Regency is located.

Some research results that link the relationship between the scientific approach and learning outcomes are research that aims to determine the effect of Indonesian language textbooks with a scientific approach on student learning outcomes in scientific writing in terms of students' academic ability. This research is a pseudo-experimental research by (Suprihatin, et al, 2023). Where previous research explains the effect of Indonesian language textbooks using a scientific approach that has a significant impact on student learning outcomes in line with our research on Pond-Based Scientific Approach and Learning Motivation affecting Student Learning Outcomes the existence of pond-based scientific knowledge coupled with high motivation from students will greatly impact the learning outcomes of students of SDN 37 Bulu-Bulu, Pangkajene District, Pangkep Regency. Then learning motivation to learning outcomes is a study that aims to determine the relationship between learning independence and learning motivation with social studies learning outcomes. This research uses an experimental method with an associative quantitative approach, which explains whether or not there is an influence between various variables based on the size of the correlation coefficient. This research was conducted on grade V students in the first semester of SD Gugus V Ciracas District, East Jakarta in the 2022/2023 school year by (Sulaksana, et al, 2023). Where in previous studies, learning independence really helped students to be more independent in learning coupled with student learning motivation will have a significant impact on the learning outcomes of SD Gugus V, Ciracas District, East Jakarta. In line with our research that the Pond-Based Scientific Approach and Student Learning

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Motivation affect Student Learning Outcomes with the existence of pond-based scientific knowledge through independent learning coupled with the existence of high motivation from students, it will greatly impact the learning outcomes of students of SDN 37 Bulu-Bulu, Pangkajene District, Pangkep Regency.

2. RESEARCH METHODS

The research was conducted at SDN 37 Bulu-Bulu, Pangkajene District, Pangkep Regency in June - July 2023. The research population can be interpreted as the whole of the object of research focus is all 200 students at SDN 37 Bulu-Bulu, Pangkajene District, Pangkep Regency. The sampling technique in this study was random sampling (randomly) totaling 30 students of SDN 37 Bulu-Bulu, Pangkajene District, Pangkep Regency consisting of class IV students with 10 students, class V with 10 students and class VI students with 10 students using the Slovin formula theory (Slovin, 1960). Here is a picture of the sample of student respondents of SDN 37 Bulu-Bulu, Pangkajene District, Pangkep Regency.

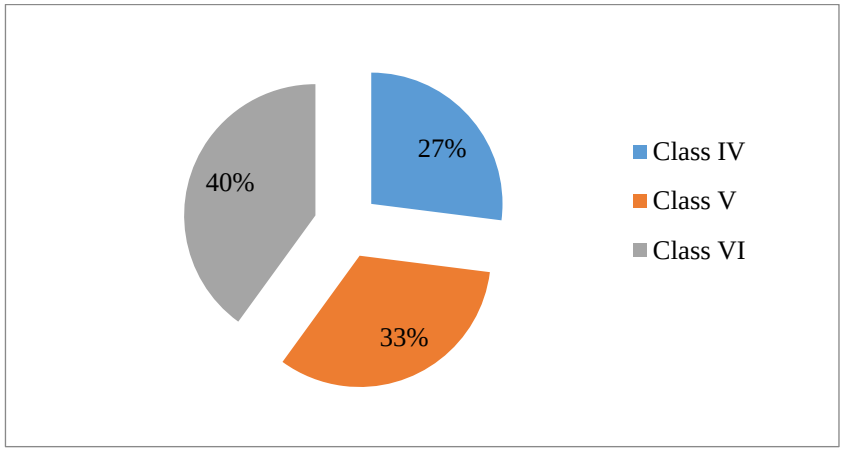

Fig 1. Population and Sample Data (Random Sampling)

Source: *Data processed by student respondents*

From the figure above with a population of 200 students of SDN 37 Bulu-Bulu, Pangkajene District, Pangkep Regency, with a sample of 30 SDN 37 Bulu-Bulu, Pangkajene District, Pangkep Regency consisting of grade IV students of 8 students or 27%, grade V students of 10 students or 33% and grade VI students of 12 students or 40%. Data collection in this study used a questionnaire method. Respondents' answers were measured using a 5-point Likert scale. The data analysis technique uses multiple linear regression using the SPSS software program which first tests validity, reliability, classical assumptions, simultaneous F test and partial t test.From the figure above with a population of 200 students of SDN 37 Bulu-Bulu, Pangkajene District, Pangkep Regency, with a sample of 30 SDN 37 Bulu-Bulu, Pangkajene District, Pangkep Regency consisting of grade IV students of 8 students or 27%, grade V students of 10 students or 33% and grade VI students of 12 students or 40%. Data collection in this study used a questionnaire method. Respondents' answers were measured using a 5-point Likert scale. The data analysis technique uses multiple linear regression using the SPSS software program which first tests validity, reliability, classical assumptions, simultaneous F test and partial t test.

3. RESULTS AND DISCUSSION

This section describes the results of research consisting of validity, reliability, classical assumption tests, multiple regression tests and hypothesis tests as well as research discussions.

A. Validity Testing

Testing using the first SPSS software program validity is a test used to measure the instrument in the questionnaire and can be used to measure what should be measured by (Wainer and Braun, 2013). The

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validity test is used to measure the validity of a questionnaire, a questionnaire is declared valid if the questions / statements on the questionnaire are able to reveal something that will be measured by the questionnaire. The validity test can be used a correlation coefficient whose significant value is less than 5% (level of significance) indicates that the question / statement has been declared valid as an indicator shaper. The test results are obtained as follows:

Table 2. Validity Test Results

Variable	t-count	Description
Scientific Approach	0,699	Valid
Learning Motivation	0,687	Valid
Learning Outcomes	0,710	Valid

Source: Data processed SPSS Ver Program, 2023

The validity test results show that all question/statement items to measure the scientific approach variable (X.1), learning motivation (X.2), and learning outcomes (Y) in this study have a correlation coefficient greater than t_{table} = 1.70 (ttable value for n = 30). So, it can be concluded that all items in the indicator questions/statements of the scientific approach variable (X.1), learning motivation (X.2), and learning outcomes (Y) of SDN 37 Bulu-Bulu, Pangkajene District, Pangkep Regency are valid.

B. Reliability Testing

The second test Reliability is how much the degree of the test measures consistently the target being measured. Reliability is expressed in numerical form, usually as a coefficient. A high coefficient means high reliability by (Julie Pallant, 2020). A questionnaire is declared reliable if someone's answer to a statement is consistent or stable over time. Testing the reliability in this study is to use the alpha formula. The results of the reliability test for each variable obtained the following data:

Table 3. Reliability Test Results

Variable	Cronbach's Alpha if Item Deleted	Description
Scientific Approach	0,789	Reliabel
Learning Motivation	0,880	Reliabel
Learning Outcomes	0,910	Reliabel

Source: Data processed SPSS Ver Program, 2023

The results of the reliability test show that the questions/statements for the variable value of the scientific approach items, learning motivation and learning outcomes of students of SDN 37 Pangkajene District, Pangkep Regency have a Cronbach's Alpha value at . 990 and Cronbach's Alpha If Item Deleted above 0.7 and above the rtable value of 0.30 (rtable value for n = 30) and so it can be stated that the question / statement items for the scientific approach variable, learning motivation and student learning outcomes of SDN 37 Pangkajene District, Pangkep Regency as a data collection tool and as a measuring tool.

C. Classical Assumption Testing

The classical assumption test is a requirement that must be met in the OLS linear regression model so that the model becomes valid as an estimation tool by (Billy Nugraha, 2022). The following table tests normality, linearity and the coefficient of determination:

Table 4. Normality Test Results

Variable	Sig (2-tailed)	Decision	Description
Scientific Approach	0,390	>0,05	Normal
Learning Motivation	0,364	>0,05	Normal
Learning Outcomes	0,529	>0,05	Normal

Source: Data processed SPSS Ver Program, 2023

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The results of the data normality test with Kolmogorov-Smirnov by comparing the probability number value or Asymp. Sig (2-tailed) with a significance level of 0.05 or 5% with decision making if the significance value is less than 0.05 or 5% then the data distribution is abnormal. Based on the calculation of the SPSS software program for the scientific approach variable, learning motivation, and learning outcomes of SDN 37 Bulu-bulu students, Pangkajene District, Pangkep Regency, the probability value or Asymp. Sig (2-tailed) with a significance level above 0.05 or 5%, the data is declared normally distributed. The following table 5. linearity test data.

Table 5. Linearity Test Results

Variable	Uji F	Deviation From Linearity	Decision	Description
Scientific approach > Learning Outcomes	1.533	0.161	0.161 > 0.05	Linier
Learning Motivation > Learning Outcomes	1.445	0.281	0.281 > 0.05	Linier

Source: Data processed SPSS Ver Program, 2023

The results of the linearity test between the learning outcomes variable and the scientific approach obtained the deviation from linearity sig value is 0.161 greater than the sig value of 0.05, it can be concluded that there is a linear relationship between the scientific approach and learning outcomes. As well as the learning motivation variable and learning outcomes obtained the deviation from linearity sig value is 0.281 greater than the sig value of 0.05, it can be concluded that there is a linear relationship between learning motivation and learning outcomes.

Table 6. Test Results of The Coefficient of Determination

Variable	Coefficient's Determination Value (R^2)	Description
Scientific Approach	0.845	Independent
Learning Motivation		
Learning Outcomes		Dependent

Source: Data processed SPSS Ver Program, 2023

The results of testing the value of the coefficient of determination (R2) and the error variable (e) In the calculation of the total coefficient of determination obtained of 0.845, it is concluded that 84.5% of the learning outcomes variable of SDN 37 Bulu-bulu students in Pangkajene District, Pangkep Regency is directly influenced by the scientific approach and learning motivation while the remaining 15.5% is influenced by other factors not included in the research model or outside the research model.

D. Multiple Regression Testing

Multiple regression testing is a statistical technique that simultaneously develops a mathematical relationship between two or more independent variables and the dependent variable (Billy Nugraha, 2022). The following are the results of the partial t-test multiple regression test as follows:

Table 3. F-Test Results (Simultaneous Test)

ANOVA[A]

MODEL		Sum of Squares	df	Mean Square	F	Sig.	F-TABEL
1	Regression	147.791	2	492.264	18.684	.000	**3.33**
	Residual	253.119	96	2.637			
	Total	400.910	99				

A. DEPENDENT VARIABLE: LEARNING OUTCOME
B. INDEPENDENT VARIABLE: SCIENTIFIC APPROACH AND LEARNING MOTIVATION

Source: Data processed SPSS Ver Program, 2023

From the table above, the simultaneous test above together shows a regression value of 147.791, residual 253.119, df 2, mean square 49.264, the value of f count is 18.684 with sig.000 which means that together directly the scientific approach and learning motivation have a direct and significant influence on student learning outcomes. The following are the results of the partial t-test multiple regression test as follows:

Table 4. T-Test Results (Partial Test)

COEFFICIENTS[A]

MODEL		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	T-TABEL
		B	Std. Error	Beta			
1	(Constant)	3.877	.994		20.793	0.183	
	Scientific Approach	1.241	.043	0.798	31.233	0.001	1.70
	Learning Motivation	3.170	.059	0.355	23.441	0.005	

DEPENDENT VARIABLE: LEARNING OUTCOME

Source: Data processed SPSS Ver Program, 2023

From the table above, partial testing, the structural equation can be formulated as follows: Y1 = 0.798 X1 + 0.355 X2 e1 The structural equation can be interpreted as: (1) The scientific approach has a t value coefficient of 31.233 with a sig of 0.001 <0.005 which means that the scientific approach has a significant effect on student learning outcomes, meaning that if the scientific approach increases, it has an impact on improving student learning outcomes. (2) Learning motivation has a t value coefficient of 23.441 with sig 0.005 - 0.005 which means that learning motivation has a significant effect on student learning outcomes, meaning that the higher the learning motivation, the higher the student learning outcomes.

E. Hypothesis Test

Hypothesis 1

Based on hypothesis testing, it is proven by the t-value of 31.233> 1.96 with Sig 0.001 <0.05 (5%), this shows that the scientific approach has a significant effect on student learning outcomes, which means that the first hypothesis is accepted.

Hypothesis 2

Based on hypothesis testing, it is evidenced by a t-value of 34.441> 1.96 with Sig 0.005 - 0.05 (5%), this shows that learning motivation has a significant effect on student learning outcomes, which means that the second hypothesis is accepted.

Hypothesis 3

Based on hypothesis testing together, it is proven by a square value of 492.264. f-value of 18.684 and a significance of 0.000 <0.005 (5%), this shows that together the scientific approach and learning motivation have a significant effect on student learning outcomes, which means that the third hypothesis is accepted.

DISCUSSION

A. The Effect of the Scientific Approach on Student Learning Outcomes

The scientific approach is a learning process designed in such a way that students actively construct concepts, laws or principles through the stages of observing (to identify or find problems),

formulating problems, asking questions or proposing hypotheses, collecting data with various techniques, analyzing data, drawing conclusions and communicating concepts, laws or principles found by (Bairagi and Munot, 2019). So it is concluded that the scientific approach is based on several steps, namely 1) Observe (to identify or find problems), 2) formulate problems, 3) propose and formulate hypotheses, 4) collect data with various techniques, 5) analyze data, 6) draw conclusions and 7) communicate concepts. Communicating concepts.

The results showed that the scientific approach through partial testing had a significant effect on the learning outcomes of students of SDN 37 Bulu-bulu, Pangkajene District, Pangkep Regency with a beta value of 0.798 with a t-value of 31.233> 1.96 significance 0.001. This means that if the scientific approach will be enabled, it will affect student learning outcomes. The achievement of student learning outcomes is inseparable from how the scientific approach used by students of SDN 37 Bulu-bulu, Pangkajene District, Pangkep Regency is based on ponds. Where the scientific approach of ponds through students is able to develop the potential in themselves in order to become human beings who are knowledgeable, critical, characterized, creative and fact-based thinking that can provide reinforcement at SDN 37 Bulu-bulu Pangkajene District Pangkep Regency. If you look at the results of research showing that the pond-based scientific approach has a significant effect on student learning outcomes, then SDN 37 Bulu-bulu Pangkajene Sub-district, Pangkep Regency by raising student learning outcomes through intellectual skills, cognitive strategies, attitudes, verbal information and motor skills.

The results of testing the final stage of the pond-based scientific approach consist of indicators that students are able to develop potential in themselves in order to become knowledgeable humans, with critical, character, creative and fact-based thinking which requires SDN 37 Bulu-bulu Pangkajene District Pangkep Regency to apply this pond-based scientific approach method at school. Furthermore, student learning outcomes with intellectual skills where each student learner needs to show intellectual operations that can be shown and performed, cognitive strategies that students need to show complex performances in a new situation, where little guidance is given in choosing and applying previously learned rules and concepts, attitudes of students learners need to provide behavior that reflects the choice of action towards science activities, verbal information students learners need to have verbal knowledge that can be stored as a network of propositions and motor skills students learners not only include physical activities but motor activities combined with intellectual skills.

In line with several studies that emphasize the scientific approach to student learning outcomes, among others, the research results are: 1) Indonesian language textbooks with a scientific approach affect student learning outcomes in the psychomotor and affective domains; 2) academic ability has no effect on student learning outcomes in writing scientific papers, and 3) the interaction between Indonesian language textbooks with a scientific approach and academic ability has no effect on student learning outcomes in scientific writing by (Suprihatin, et al, 2023). Furthermore, research on the use of e-plantbooks in the learning process can encourage student-centered learning because students are more active and students can learn independently by (Magfiroh, et al, 2023).

B. The Effect of Learning Motivation on Student Learning Outcomes

Learning motivation is an encouragement from within students and stimuli from outside students that cause changes in behavior to achieve a certain goal. it is concluded that learning motivation is an encouragement that arises both from within and outside the student, which is able to generate enthusiasm and enthusiasm for learning and provide direction to learning activities so that the desired goals can be achieved by (Hoffman, 2015).

The results showed that learning motivation through partial testing had a significant and significant effect on the learning outcomes of students of SDN 37 Bulu-bulu, Pangkajene District, Pangkep Regency with a beta value of 0.355 with a t-value of 23.441> 1.96 significance 0.005. This means that if learning motivation will be enabled, it will affect student learning outcomes. The achievement of student learning outcomes is inseparable from how the learning motivation of students of SDN 37 Bulu-bulu, Pangkajene District, Pangkep Regency is based on ponds. Where learning motivation through the desire to succeed, needs in learning, ideals, appreciation and learning environment. If you look at the results of research showing that learning motivation has a significant effect on student learning outcomes, then SDN 37 Bulu-bulu Pangkajene District Pangkep Regency by

raising student learning outcomes through intellectual skills, cognitive strategies, attitudes, verbal information and motor skills.

The results of testing the final stage of learning motivation consist of indicators of the desire to succeed, every student must want to succeed in everything they do, then the need to learn is important for students to meet their every need, the ideals of every student need to get appreciation because moving on from dreams needs to be supported and realized, It is also necessary for students to be rewarded for what they have done and it is also necessary to be supported by a comfortable and adequate learning environment to help students in receiving well the lessons at school requires SDN 37 Bulu-bulu, Pangkajene District, Pangkep Regency to be able to provide space and infrastructure for students to be able to explore their abilities according to their respective fields which in turn can improve student learning outcomes through intellectual skills, cognitive strategies, attitudes, verbal information and motor skills.

In line with several studies, among others, the results of the analysis show that the level of learning independence and learning motivation together has a strong and positive correlation with the learning achievement of fifth grade elementary school students in Gugus V, Ciracas District, East Jakarta. In other words, the higher the level of children's independence, the higher the learning achievement. Likewise with learning motivation, in turn improving learning outcomes by (Sulaksana, et al, 2023). Furthermore, the conclusion that: 1) There is a significant influence of school culture on science learning outcomes, with an influence of 42.1% and an effective contribution of 20.7%. 2) There is a significant effect of learning interest on science learning outcomes, with an effect of 44.4% and an effective contribution of 18.5%. 3) There is a significant effect of learning motivation on science learning outcomes, with an effect of 44.1% and an effective contribution of 17%. And 4) Together there is a significant influence of school culture, learning interest, and learning motivation on science learning outcomes, with an influence of 56.2% by (Purnadewi, et al, 2023).

4. CONCLUSION

Based on the results of the testing and discussion above, the conclusion of this study is that the pond-based scientific approach through partial tests has a significant effect on the learning outcomes of students of SDN 37 Bulu-bulu, Pangkajene District, Pangkep Regency, this needs to be applied and carried out by the school so that in the future the pond-based scientific approach can be applied such as knowledgeable, critical, character, creative and fact-based thinking to strengthen the students of SDN 37 Bulu-bulu, Pangkajene District, Pangkep Regency. Then learning motivation through partial tests has a significant effect on the learning outcomes of students of SDN 37 Bulu-bulu, Pangkajene District, Pangkep Regency, it needs to be maintained by the school so that the learning motivation of students with the desire to succeed, needs in learning, ideals, appreciation and learning environment can be improved again by students of SDN 37 Bulu-bulu, Pangkajene District, Pangkep Regency so that the targets to be achieved by the school, especially students, can be realized. As well as together the pond-based scientific approach and learning motivation test simultaneously have a significant effect on the learning outcomes of students of SDN 37 Bulu-bulu, Pangkajene District, Pangkep Regency can be realized by collaborating with each other between ideas and responsive communication between students and school parties. And it is hoped that in the future for this research there will be further development.

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Implementation of the Computer-Based National Assessment-Oriented School Literacy Movement Policy for Elementary School Students in Bireuen District

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ABSTRACT

The school literacy movement (SLM) is more than just reading and writing but includes thinking skills according to stages and literacy components. SLM aims to develop student ethics through the development of a literacy ecosystem, so that students become lifelong learners. But the problem is difficulty listening and telling stories longer, difficulty understanding the intent and purpose of SLM. This study aims to: (1) describe planning, (2) describe implementation, (3) describe the evaluation of the implementation of the school literacy movement (SLM) policy oriented to computer-based national assessment in elementary school students in Bireuen Regency. This research is a field study using a qualitative approach conducted at SD 4 in Bireuen Regency. The data was collected through interviews, and observation. Data analysis techniques are carried out through data reduction and data presentation. The results showed that: (1) Computer-based National Assessment-oriented School Literacy Movement policy implementation planning: (a) goal and target planning, (b) problem identification, (c) stakeholder identification, (d) resources and budget, (e) strategy, (f) monitoring and evaluation, (g) improvement and learning, (h) problem formulation, (i) recommendations, (j) result monitoring, (k) performance evaluation, (l) Computer-based National Assessment-oriented School Literacy Movement policy implementation. (2) Implementation of Computer-based National Assessment-oriented School Literacy Movement policy: (a) allocating natural resources and human resources, (b) hardware and software, (c) technological infrastructure, (d) educational content, (e) training and professional development, (f) coaching and supervision, (g) administration and reporting, (h) communication and awareness, (i) research evaluation and budget, (j) awards and recognition, (l) ensuring data security and privacy, (k) Stakeholder involvement, (l) Achievement of targets in implementation, (m) Quality in implementation, (n) communication and coordination in implementation. (3) Evaluation of Computer-based National Assessment-oriented School Literacy Movement Implementation for Elementary School Students in Bireuen District, which are the effectiveness of policy implementation, efficient policy implementation, satisfactory policy implementation, equality and equity of implementation, student response to implementation and accuracy of policy implementation.

Keywords: Implementation, Policy, School Literacy Movement, Computer-Based National Assessment

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1. INTRODUCTION

Policy implementation refers to the process of converting policies that are formulated into concrete and implementative actions. It involves a series of steps and activities undertaken by a government, public institution, or other organization to implement an agreed policy. Policy analysis helps in understanding the problems faced and the challenges that need to be addressed. According to Dunn (1999) policy analysis is an applied social science discipline that uses *inquiry methods* and several arguments to generate and utilize appropriate policy information in the political decision-making process in order to solve policy problems.

Education has a very important role to ensure the development and survival of the nation. Education is essentially a conscious and planned effort to humanize man, in the hope that the process of transforming education, man can increase all his cognitive, affective and psychomotor potential. Moretti & Frandell (2013) affirm that the education in question is able to understand, read, write and count. These important life skills translate into broader terms of literacy.

The low literacy culture in Indonesia is a benchmark that education in Indonesia is still lagging behind other countries. The importance of literacy in order to determine the quality of human resources for capital to advance the nation. The government's focus is to encourage children to understand the material they read by making education policies that lead to 21st century skills (literacy, competence,

and character) and this is formulated in the Regulation of the Minister of Education and Culture Number 23 of 2015 concerning ethical growth.

Since 2016 the Ministry of Education and Culture initiated the birth of the Indonesian Reading Movement and the National Literacy Movement. The National Literacy and Reading Movement as part of the implementation of Ministerial Regulations of Education and Culture Number 23 of 2015 concerning ethical growth. Furthermore, the Ministry of Education and Culture formed a National Literacy Movement working group to coordinate various literacy activities managed by related work units. These literacy activities include the Community Literacy Movement, the Family Literacy Movement, and the School Literacy Movement (SLM).

The obstacle that occurs is that during the learning process experienced by students, students are required to be able to do questions on computers with various kinds of questions that require reasoning. Andriani (2020) stated that to obtain the right Computer-Based National Assessment design, several things are needed that can measure the success of the assessment well and comprehensively. These things are content that is in accordance with the learning process both at home and at school, cognitive processes that have been, are and will be passed, and contexts that can accommodate student abilities.

The problems mentioned above are expected to encourage education units and education offices to focus resources on improving the quality of learning, one of which is the implementation of the school literacy movement, so that if analyzed GLS actually greatly contributes to the results of student's Computer-Based National Assessment. However, the problem is that there is no benchmark for the effectiveness of SLM program implementation in schools that are able to utilize facilities and infrastructure, manage libraries well, inventory all infrastructure, create comfortable reading rooms, collaborate with other parties related to SLM, and build a literate school environment. The results of interviews and data searches in the Jeumpa Principal Working Group (K3S) area through the head of Jeumpa K3S, stated that 18 out of 44 schools had good literacy achievements on education report cards, the rest were underachieving or needed special interpretation.

Based on the results of initial observations made by researchers at SD Negeri 5 Bireuen, it can be seen that only some students want to read books during breaks in the school library room, while other students are only busy playing and snacking in the cafeteria. SD Negeri 5 Bireuen has a library of storybooks for students to read during recess and after school. The library of SD Negeri 5 Bireuen is equipped with a collection of books both fiction and nonfiction. But the problem is the lack of effectiveness of literacy carried out by students, and the lack of teacher concern for GLS.

The above observations are supported by the results of an interview with the Principal of SD Negeri 5 Bireuen who stated that efforts have been made to provide a library and various kinds of book needs available, but students are still reluctant to visit the library, only a few students regularly read books. Such students during activities in the library, are freed to read books that they like. Library employees will guide the next activity after reading the book. But in fact other students are less interested in entering the library room, besides that teachers are also less concerned with GLS, if reprimanded just to carry it out.

Based on the observations and interviews above, it can be understood that, schools have tried to implement SLM by providing library facilities equipped with various books, but the problem is that there is still a lack of awareness of students to enter the library room, and teacher concern is also minimal to direct students to be aware of literacy. Students must be able to take advantage of the facilities in the library to improve their knowledge in literacy, so that students have knowledge by trying to learn independently through literacy.

Based on the background and previous research that has been discussed by the researchers above, researchers are interested in researching further regarding the implementation of the computer-based national assessment-oriented school literacy movement in primary school with the research questions:

a. How are the planning to implement the school literacy movement policy oriented towards computer-based national assessment for primary school students in Bireuen District?
b. How are the implementation of the school literacy movement policy oriented towards computer-based national assessment for primary school students in Bireuen District?
c. How is the evaluation of implementation of the school literacy movement policy oriented towards computer-based national assessment for primary school students in Bireuen District carried out?

2. RESEARCH METHODS

A. Research Design

The approach in this research is a qualitative descriptive approach, which is a research procedure in producing descriptive data sources in the form of written words or words of people and observed behaviour. The use of a qualitative descriptive approach because this research has complex, dynamic and meaningful problems and needs an in-depth understanding of social situations, (Hadi, 2004).

Wray (2018) states that qualitative research is the collection of data in a natural setting, using natural methods, and conducted by people or researchers who are naturally interested. Descriptive research methods are research strategies and techniques that attempt to describe, record, analyse and interpret conditions or events that exist and are found in the field in the form of communities, problems or symptoms in society, by collecting in-depth facts, then the data is presented in verbal form, not in the form of numbers. In this case, the researcher seeks to describe in depth the implementation of the school literacy movement for students in primary schools in Bireuen Regency.

B. Research Location

The research location is the object of research where research activities are carried out. The purpose of determining the research site is to facilitate or clarify the location targeted in the research. The research site in this study is located at UPTD SD Negeri 4 Bireuen Bandar Bireuen Village, which is located at Jalan Laksamana Malahayati, Bandar Bireuen-Kec. Kota Juang, Bireuen Regency, Aceh.

C. Research Participants

According to Sedarmayanti (2011), qualitative research is descriptive, tends to use analysis with an inductive approach, process and meaning (subject perspective) are more emphasized. The characteristics of qualitative research colour the nature and form of the report, because it is compiled in the form of a narrative that is creative and in-depth, showing naturalistic characteristics full of authentic values. Qualitative research does not aim to make generalisations from its findings. Therefore, there is no known population or sample in qualitative research. The research subject is reflected in the research focus. The research subject becomes an informant who will provide various information needed during the research process. There are three types of informants in this research, namely

1. Key informants, i.e. those who know and have various basic information needed in the research.
2. Main informants, that is, those who are directly involved in the social interactions under study.
3. Supplementary informants, i.e. those who can provide information even though they are not directly involved in the social interactions under study.

Based on the above description, the researcher determines informants using purposive sampling technique, that is, the determination of informants not based on strata, guidelines or areas, but based on certain objectives that are still related to the research problems. Those who were used as informants in this study were based on the consideration that they had represented and adapted to their fields in the school where the researchers conducted the research. Thus, in this case, the researcher uses informants consisting of

1. Key informants, a total of 1 principal.
2. Key informants, a total of 3 teachers.
3. Additional informants, totalling 6 pupils.

D. Data Collection Technique

a. Interview

An interview is a meeting of two people to exchange information and ideas through questions and answers, so that meaning can be constructed about a particular topic. The interviews that researchers conduct are unstructured interviews, unstructured interviews are interviews that are free, and researchers do not use interview guides that have been systematically and completely prepared for data collection. The interview guide used is only an outline of the questions to be asked.

Unstructured or open-ended interviews are often used in preliminary research or even for more in-depth research on respondents. In preliminary research, researchers try to get preliminary information about various issues or problems that exist in the subject, so that researchers can determine exactly which issues or variables should be studied to get more complete problems.

b. Observation

By making direct observations of the subject or area under study, all the data from the observations were collected and clarified according to their type that could be the implementation of the school literacy movement for students in primary schools in Bireuen Regency. The researcher carried out two

stages of observation, the general nature of which was that observations were made of different elements in the educational unit of Bireuen Regency that could help this research.

While the specific nature is that the observer directly sees and records situations related to professional knowledge and knowledge or information directly obtained from the data needed to be carried out on the implementation of the school literacy movement for students in primary schools in Bireuen District, namely (1) Organisational structure, (2) Programme implementation, (3) Existence of the school, (4) Data/documentation on school structure, (5). Financial development efforts made, (6). The final results of the performance to be accounted for.

E. Data Analysis Technique

Data analysis was carried out by researchers as an attempt to systematically record the results of observations, interviews and documentation in order to improve the researchers' understanding of the issues they are investigating and to present them as findings for others. To make it easier for researchers to analyse data, researchers reduced data, presented data and drew conclusions.

a. Data Reduction

The data obtained by grouping the data, summarising which data are important and which are not, because it cannot be denied that the longer the researcher is in the field, the more, broader and more complicated the amount of data becomes.

b. Data Presentation

After the researcher has reduced the data, the researcher then presents the data, namely from the data/results obtained in the field and has been grouped or summarised more specifically and clearly. The researcher has presented the data according to the answer or results of what was obtained, such as the results of observations. The researcher has sorted the observations first in order to arrange them so that the observations made have more interrelated relationships.

3. RESULTS AND DISCUSSION

A. Planning the implementation of the school literacy movement (SLM) policy oriented towards computer-based national assessment for elementary school students in Bireuen District.

To determine the planning for the implementation of the school literacy movement (SLM) policy oriented to computer-based national assessment for elementary school students in Bireuen District, measured by 11 (eleven) question indicators, such as: (a) Planning goals and objectives, (b) Planning identifying problems, (c) Planning identifying *stakeholders*, (d) resource and budget planning, (e) Strategy planning, (f) Monitoring and evaluation planning, (g) Improvement and learning planning, (h) Problem formulation planning, (i) Policy recommendation planning, (j) Policy outcome monitoring planning, (k) Policy performance evaluation planning.

a. Planning the goals and objectives

To find out the aims and objectives of planning the implementation of the Computer-Based National Assessment School Literacy Movement policy for elementary school students in Bireuen Regency, the following are the results of an interview with the principle of SD Negeri 4 Bireueun.

> Planning the goals and objectives of the implementation of the School Literacy Movement policy oriented towards the Computer-Based National Assessment for SDN 4 Bireuen students is an important step in ensuring the success of policy implementation, this is done planning based on the School education report card, so that GLS is implemented to improve school quality. The steps we take to plan goals and objectives, namely identifying the main goals, determining the specific goals to be achieved, and identifying targets. (Interview, 02 October 2023).

It can be seen that the school determines the main objectives of the computer-based National Assessment oriented school literacy movement policy. For example, the main objective is to improve the reading and writing literacy of SDN 4 students through the use of Computer-Based National Assessment. (Observation, 06 October 2023).

The school literacy movement is oriented towards the National Assessment of Computer-Based Elementary School Students in Bireuen District. It can be understood that schools identify main goals, specific goals, targets, concrete actions, make budget plans, and determine the right time. The school conducts monitoring and evaluation, consultation and collaboration, effective communication with various interested parties, evaluation and adjustment.

b. Designing the identifying of problems

To find out the planning to identify problems in the implementation of the Computer-Based National Assessment-Oriented School Literacy Movement policy for elementary school students in Bireuen Regency, the following are the results of an interview with the head of SD Negeri 4 Bireueun.

> I think, as a principal here, it is very important to do, aiming to ensure this program runs effectively and efficiently, by introducing and guiding children to use personal laptops and some laptops at school. Then carefully study the Computer-Based National Assessment School Literacy Movement, as well as its implementation plan. Next understand the desired goals, objectives, methods and targets of the population. (Interview, 02 October 2023).

By this, it can be seen that schools evaluate the impact of actions taken to overcome problems, whether problems have been resolved, or whether policy implementation is getting better. Later, the school establishes a cycle of evaluation and improvement, revises action plans where necessary, and learns from experiences that have been done to improve future policy implementation. (Observation, 06 October 2023).

It is generally understood that schools review policies and implementation plans, identify relevant parties, collect preliminary data, consider challenges that may arise, identify key problems, prioritize Consult with relevant parties, create action plans, implement action plans, evaluate results, revise and review on an ongoing basis to improve future policy implementation.

c. Designing the identifying of stakeholders

To find out the design for stakeholder identification in the implementation of the school literacy movement policy oriented to the Computer-Based National Assessment for elementary school students in Bireuen Regency, the following are the results of an interview with the principle of SD Negeri 4 Bireueun.

> The first thing I have to do is, understand well the policy of the School Literacy Movement oriented towards the Computer-Based National Assessment and its goals, this will help me understand who I will involve in the implementation and who will be affected by the policy, then socialize the Computer-Based Literacy Movement to all teachers in the school. In addition, I also identified parties directly involved to support its implementation. (Interview, 02 October 2023).

It can be seen that the school makes a stakeholder engagement plan that includes communication strategies, how to involve them in planning and implementation, and how to address possible problems or concerns appear. The school evaluates stakeholder engagement and support throughout the implementation process, revising engagement plans where needed to ensure policies run smoothly. (Observation, 02 October 2023).

The results of the researcher's field observations of the planning to identify stakeholders in the implementation of the Computer Based National Assessment-oriented School Literacy Movement policy for primary school students in Bireuen District showed that the school has prepared a stakeholder engagement plan that includes communication strategies, how to involve them in planning and implementation, and how to address problems or concerns that may arise. The school evaluates stakeholder involvement and support during the implementation process and revises the engagement plan if necessary to ensure that the policy runs smoothly. (Observation, 02 October 2023).

d. Resource and budget planning

To find out the planning of resources and budgets in the implementation of school literacy movement policies oriented towards the Computer-Based National Assessment for Elementary School Students in Bireuen Regency, the following are the results of an interview with the head of SD Negeri 4 Bireueun.

> Regarding resource and budget planning in the implementation of ANBK-oriented GLS policies for Students, efforts have been made so far to identify what resources are required for policy implementation, such as computer hardware and software, teacher training, technical support, and learning materials. Next, determine the costs associated with each resource requirement, and make careful calculations, including hardware, software, training costs, etc., all sourced from BOS funds, and other untied funds. (Interview, 02 October 2023).

It can be seen that schools make budget planning as needed, and create a reporting system that allows to track and report budget use to interested parties, such as the Education Office, school committee, or government. (Observation, 06 October 2023).

Based on the results of the above interviews and observations about resource and budget planning in the implementation of the Computer Based National Assessment Oriented School Literacy Movement policy for primary school students in Bireuen District, it can be generally understood that the school identifies resource needs, estimates budget needs according to needs, makes a budget plan that is in accordance with needs, seeks sources of funds, prioritises targeted expenditures, makes long-term budget planning to adjust there is a possibility that resource needs will change, transparency and accountability for budget use, monitoring and evaluating budget use, making budget planning flexible, making systematic reporting. The school has a sound and structured resource and budget planning to ensure that the Computer Based National Assessment Oriented School Literacy Movement policy for students can be successfully implemented, supported by good budget management to maximise the return on investment of available resources.

e. Strategy Planning

To find out the strategic planning for the implementation of the school literacy movement policy oriented towards the Computer-Based National Assessment for elementary school students in Bireuen Regency, the following are the results of an interview with the head of SD Negeri 4 Bireueun.

> As a school principal, of course, ensure that all parties involved understand well the content and objectives of the School Literacy Movement policy oriented towards the Computer-Based National Assessment, including teachers, students, and parents. Then I formed an implementation team consisting of individuals responsible for various aspects of policy implementation, such as teachers, technology coordinators, training instructors, and others. Create a training plan for teachers and school staff regarding the use of hardware and software to be used in computer assessments. I make sure that they have the necessary capacity to carry out their duties. (Interview, 02 October 2023).

The planning strategies involve teachers, parents, and students in the decision-making process and policy implementation, and consider their input in improving the process. The school shares the positive outcomes and achievements associated with this policy with the rest of the Education community. Schools identify risks and develop strategies to mitigate them, for example, backup planning in case of technical problems or lack of resources. The school makes flexible strategy planning and is ready to adjust the strategy in case of unforeseen changes or challenges. (Observation, 06 October 2023).

Based on the results, it can generally be concluded that schools ensure that all parties involved understand well the content and objectives of the Computer Based National Assessment Oriented School Literacy Movement policy, including teachers, students, and parents, form implementation teams, create training and capacity, Conduct effective communication with stakeholders, procure tools and resources, pilot projects and trials, manage good data, develop learning materials, conduct monitoring and evaluation, provide technical support, conduct evaluations consistently, involve stakeholders, disseminate results, control risks, and create flexible strategies.

f. Planning, monitoring and evaluation

To find out the planning for monitoring and evaluating the implementation of the school literacy movement policy oriented towards the Computer-Based National Assessment for Elementary School Students in Bireuen Regency, the following are the results of an interview with the head of SD Negeri 4 Bireueun.

> Conducting meetings on how to monitor and evaluate the program. establish clear goals and objectives for the School Literacy Movement program, and ensure they can be measured and measured, such as improving student literacy levels through Computer-Based National Assessments. Next, the school identifies relevant and measurable performance indicators to monitor the progress of the program. Examples of performance indicators include student graduation rates, exam results, or participation rates in literacy. (Interview, 02 October 2023).

Based on the observations it can be seen that if the school finds problems or is not in accordance with the program objectives, the school makes the necessary corrective action plans and makes changes as needed. The school conducts periodic program evaluations to ensure sustainability and continuous improvement. In addition, schools ensure that evaluation results are used to inform policy and better decision-making regarding school literacy programs. It is generally understood that schools set clear goals and objectives for the GLS program in a measurable manner. (Observation, 06 October 2023).

g. Improvement and lesson planning.

To find out the improvement planning and learning implementation of the school literacy movement policy oriented towards the Computer-Based National Assessment for Elementary School Students in Bireuen Regency, the following are the results of an interview with the head of SD Negeri 4 Bireueun.

> Conducting an in-depth analysis of the implementation of school literacy policies oriented to the Computer-Based National Assessment, and identify problems, obstacles, or challenges that may arise, such as lack of resources, resistance from schools, or technical problems. Involving a variety of parties involved in literacy programs, including teachers, parents, students, school kimite and Education officials, they can provide valuable insight into the issues they face. Then renovate, improve and implement innovations so that students are motivated. (Interview, 02 October 2023).

It can be seen that schools are ready to face obstacles that may arise during the implementation of corrective actions and are willing to make changes if needed. Schools communicate and learn from the experience of implementing corrective actions, using evaluation results and learning for continuous improvement in the implementation of literacy programs. (Observation, 06 October 2023).

Based on the results of the interviews and observations, it can be concluded that schools identify problems, obstacles, or challenges that may arise, such as lack of resources, resistance from schools, or technical problems. The school involves various interested parties in the literacy program.

h. Planning of formulating problems

To find out the planning to formulate problems in implementing the school literacy movement policy oriented towards the Computer-Based National Assessment for Elementary School Students in Bireuen Regency, the following are the results of an interview with Zahriani, as the head of UPTD SD Negeri 4 Bireueun, who stated that:

> As a principal I need to be able to recognise all parties involved in the implementation of this policy, including teachers, parents, students, and Education officials, they have varying insights into issues that may arise. Identify trends or patterns that reflect problems in policy implementation, paying attention to statistics, developing literacy outcomes, participation rates, or technical issues. Then find the things that are obstacles in the computer-based literacy movement. (Interview, 02 October 2023).

By this, the school is reevaluating the existing policy and considering modifying it if necessary to overcome the problems that have been identified. Formulating problems well is a crucial first step in overcoming obstacles to the implementation of the Computer-Based National Assessment-oriented School Literacy Movement policy on students, to focus on necessary improvements and improve policy effectiveness. (Observation, 06 October 2023).

It is generally understood that schools understand all parties involved in policy implementation, including teachers, parents, students, and education officers, they have different insights into problems that may arise.

i. Policy Recommendation Planning

To find out the planning of policy recommendations for the implementation of the School Literacy Movement Computer-Based National Assessment for Elementary School Students in Bireuen Regency, the following are the results of an interview with the principle of SD Negeri 4 Bireueun.

> Planning policy recommendations is an important step in the process of improving and developing the implementation of School Literacy Movement Computer-Based National Assessment policies in students, recommendations can help address identified problems and improve policy effectiveness. The steps in planning policy recommendations: (a) ensure a deep understanding of the key issues to be faced in the implementation of school literacy policies, understand the root causes of problems and their impact on policy objectives, (b) evaluate the opinions and perspectives of various parties involved in the program, understand their needs, expectations, and constraints regarding implementation. (Interview, 02 October 2023).

The schools communicate policy recommendations to stakeholders, including government, educational institutions, and parents, identifying strong cases for recommendations that need to be adopted. Once the recommendations are adopted, then ensure there is a robust monitoring and evaluation system in place to monitor the progress and impact of implementing the recommendations. The school makes continuous improvement part of the process, open to changing recommendations if needed to achieve the desired results. (Observation, 06 October 2023).

It can be concluded that there are several steps in planning policy recommendations, including (a) schools understand the root of the problem and its impact on policy objectives, (b) evaluate the opinions and perspectives of various parties involved within the program, and understand their needs, expectations, and constraints related to implementation, (c) gather relevant data, empirical evidence, and research that can support policy recommendations, including research results, evaluation reports, *and best practices*, (d) make specific recommendations, (e) prioritize recommendations, and identify necessary resources, (f) develop action plans, (g) coordinate and consult with *stakeholders, (*h) reviewing policies that have been made, (i) conducting advocacy, supervision, evaluation, and continuous improvement.

j. Policy Results Monitoring Planning

To find out the planning of the results of the monitoring policy on the implementation of the National Assessment of the Computer-Based Elementary School Literacy Movement in Bireuen Regency, the following is the result of an interview with the head of SD Negeri 4 Bireueun.

> Planning to monitor the results of the ANBK-oriented GLS policy implementation policy for students, requires structured and careful planning, the steps we take at SDN 4, including determining the monitoring objectives to be achieved, for example increasing student literacy levels or the effectiveness of policy implementation, determining indicators to be used to measure successful implementation, Examples of indicators can include student literacy levels, teacher and student participation, access to computer devices, or national assessment results. (Interview, 02 October 2023).

By this, the school makes a monitoring plan which includes monitoring schedules, types of data to be collected, as well as data collection methods, and determines data sources, such as student literacy tests, teacher interviews, student surveys, and school administration data. Then, the school identifies the software or system that will be used to manage and analyze the data. In addition, schools determine who will be involved in data collection and analysis, involving teachers, school staff, authorities in education policy, and so on. (Observation, 06 October 2023).

k. Policy Performance Evaluation Planning.

Based on the interview and observation, it can be seen that the school makes recommendations for improvement or policy implementation, identifying concrete steps that can be taken to improve policy performance. Performance evaluation planning is carried out consistently and continuously, in addition to continuous monitoring to see the progress of policy implementation and ensure periodic evaluations to ensure policies continue to perform well. (Observation, 06 October 2023).

It can be seen that (a) schools determine the main objectives of evaluation, (b) select performance indicators, (c) design evaluation methodologies, (d) identify relevant and representative data sources collected, (e) planning data collection instruments, (f) conducting data collection in accordance with the methodology that has been designed, (g) ensuring data is collected objectively and accurately, (h) using appropriate statistical tools or analytical methods to evaluate policy performance and achieve evaluation objectives, (i) interpreting results, (j) making reporting results, and (k) conducting continuous monitoring and evaluation.

B. Implementation of the school literacy movement (GLS) policy oriented towards computer-based national assessment (ANBK) for elementary school students in Bireuen District

To determine the implementation of the school literacy movement policy oriented to computer-based national assessment for elementary school students in Bireuen Regency, measured by 8 (eight) question indicators, such as: (a) Objectives in implementation, (b) Allocation of resources (funds and human resources) in its implementation, (c) *Stakeholder* involvement in implementation, (d) Achievement of targets in implementation, (e) Quality of service in implementation, (f) Stages of habituation in service, (g) Stages of development, (h) Stages of learning.

a. Purpose of implementation

To find out the objectives of implementing the policy of implementing the school literacy movement oriented towards the Computer-Based National Assessment for elementary school students in Bireuen Regency, the following are the results of an interview with a teacher at SD Negeri 4 Bireueun.

> SD Negeri 4 Bireueun Regency has objectives in implementing the implementation policy of the School Literacy Movement oriented towards Computer-Based National Assessment for students is to improve the quality of education and student literacy by using computer-based assessment technology, the objectives include: (a) providing opportunities for students to

> develop literacy skills, such as reading, writing, and critical thinking through National Assessment-oriented assessments Computer-based literacy, (b) ensuring that students and teachers have a better understanding of the national curriculum and the competencies to be achieved. (Interview, 02 October 2023).

Based on the results, it can be concluded that the objectives are to improve literacy, increase curriculum understanding, more accurate measurement, provide rapid feedback, improve education standards, prepare national assessments, reduce inequality, increase efficiency administration, improving the use of technology, evaluating the effectiveness of education, providing decision support data.

b. Resource of allocation in implementation

To determine the allocation of resources in the implementation of the policy implementation of the school literacy movement oriented to the Computer-Based National Assessment for elementary school students in Bireuen Regency, the following are the results of observations by researchers in the field on the allocation of resources in the implementation of the policy implementation. It can be seen that the provision of awards and recognition budgets to teachers, and students who achieve good results in policy implementation, and allocate funds to ensure the security and privacy of student data during computer-based assessments. (Observation, 06 October 2023).

It can generally be concluded that (a) allocate human resource budgets, (b) allocate hardware and software budgets, (c) allocate technology infrastructure budgets, (d) allocate an educational content budget, (e) allocate a training and professional development budget, (f) allocate a coaching and supervision budget, (g) allocate an administration and reporting budget, (h) allocate a communications and awareness budget, (i) allocate an evaluation and research budget, (j) allocate resources to teams or individuals responsible for program implementation and budget management, (k) provide a budget for Reward and recognition of teachers, and students who achieve good results in the implementation of the policy (l) allocate funds to ensure the security and privacy of student data during the implementation of computer-based assessments.

c. Stakeholder involvement in implementation

To determine the involvement of stakeholders in the implementation, it shows that *stakeholders* play an active role. The involvement of these stakeholders makes for very effective communication, coordination and cooperation. All parties have a clear understanding of the program's objectives and how they can contribute. In terms of computer-based assessment, the role of teachers and students in mastering technology becomes very important. With the right support, training, and resources provided to them so that they can succeed in the program. (Observation, 06 October 2023).

Based on the above observations it involved and played an active role, aiming to ensure the success and effectiveness of the program, including the Ministry of Education, Education Office, principals, teachers and educators, parents or guardians of students, school supervisors, school committees, local communities, and private institutions concerned with education.

d. Achievement of targets in implementation

To find out the achievement of the target in implementing the policy of implementing the school literacy movement oriented to the Computer-Based National Assessment for elementary school students in Bireuen Regency, the following are the results of an interview with the head of SD Negeri 4 Bireueun.

> Ensure that the goals and objectives of the program are clearly defined. Our goals are specific, measurable, achievable, relevant, and time-limiting (SMART). Kemi creates an implementation plan that covers all stages of the program, including the selection of appropriate tools and technology, teacher training, student preparation, and assessment schedules. (Interview, 02 October 2023).

In general it can be concluded that the planning of program goals and objectives is clearly formulated, specifically, measurable, achievable, relevant, and has a time limit (SMART). Plan an implementation that covers all stages of the program. Teachers and other education personnel receive adequate training on the use of computer-based technology and the implementation of assessments. Schools have adequate infrastructure, such as computers and internet access, to conduct computer-based assessments and have an effective monitoring and evaluation system to measure program progress and results.

e. Quality of service in implementation

To determine the quality in the implementation of the policy implementation of the Computer-Based National Assessment Oriented School Deliberation policy for elementary school students in Bireuen Regency, the following are the results of an interview with the head of SD Negeri 4 Bireueun.

> Quality in the implementation of the School Literacy Movement policy oriented towards Computer-Based National Assessment of students is a key factor that will affect the success of the program. The steps we take are that the programme objectives and expected outcomes have been clearly formulated and measurable. Plan a comprehensive implementation that covers all aspects of the program, such as tool and technology selection, teacher training, student preparation, and assessment schedules. (Interview, 02 October 2023).

It can generally be concluded that the school carries out the formulation of clear goals, comprehensive planning, effective training, selection and preparation of resources, continuous monitoring and evaluation, involvement of students and parents, open communication and collaboration, leadership commitment, rewards and recognition, adaptation and continuous improvement, use of data for decision making, involvement of local communities.

f. Communication and coordination in implementation

To find out communication and coordination in the implementation of the National Movement for Computer-Based School Literacy for Elementary School Students in Bireuen Regency, the following are the observations of researchers in the field on communication and coordination in the implementation of the policy implementation The school literacy movement is oriented towards the National Assessment of Computer-Based Elementary School Students in Bireuen Regency, it can be seen that if there are conflicts or problems in the implementation of the program, immediately identify the problem and find a wise solution, Open and constructive communication can help resolve conflicts well. After the program is completed, a joint evaluation meeting is held with all parties involved, to help identify what is going well and what needs to be improved in the next implementation. (Observation, 06 October 2023).

In general it can be concluded that, schools build clear communication channels, conduct regular coordination meetings, Build partnerships with external parties, communicate with parents, make collaborative training, Monitor the implementation process, use communication technology, if there are conflicts or problems in the implementation of the program, immediately identify problems and find the best solutions, communicate openly and constructively to help resolve conflicts well, and conduct joint evaluations.

g. Bottlenecks in execution

To find out the obstacles in implementing the policy of implementing the school literacy movement oriented to the Computer-Based National Assessment for elementary school students in Bireuen Regency, the following are the results of an interview with the head of SD Negeri 4 Bireueun.

> Kamai in implementing the School Literacy Movement policy oriented towards Computer-Based National Assessment for students, faces various obstacles, including limited access to computers and the internet, this can hinder the implementation of computer-based assessments. Teachers need a long time for more intensive training to understand and manage computer-based assessments well, because if the lack of training can affect the quality of implementation. (Interview, 02 October 2023).

It appears that students from lower socioeconomic backgrounds may face difficulties in accessing technology or obtaining needed support. School curricula may not align with computer-based assessment requirements, and this can lead to mismatches between what is taught and what is tested in assessments. (Observation, 06 October 2023).

In general it can be concluded that lack of access to technology, lack of teacher training, lack of resources, technical problems, student anxiety, lack of parental support, tight time limits, lack of coordination between *stakeholders*, lack of assessment data, importance of digital literacy, socioeconomic disparities, and lack of curriculum readiness.

C. Evaluation of the implementation of the School Literacy Movement (GLS) policy oriented to the Computer-Based National Study (ANBK) for elementary school students in Bireuen Regency.

To determine the evaluation of the implementation of the school literacy movement policy oriented towards computer-based national assessment for elementary school students in Bireuen Regency, measured by 6 (six) question indicators, such as: (a) Effectiveness of implementation, (b)

Efficiency of implementation, (c) Satisfaction of implementation, (d) Similarity and equity of implementation, (e) Implementation of student responses, (f) Accuracy of implementation, (g) running according to predictable stages of development its implementation, (h) balanced policy implementation, (i) integrated with the policy implementation curriculum, (j) developing awareness of the diversity of policy implementation.

a. Implementation effectiveness

To find out whether the implementation of the Computer-Based National Assessment oriented school literacy movement policy has been effective for elementary school students in Bireuen Regency, the following are the observations of researchers in the field about the effectiveness of the implementation of the Computer-Based School Literacy Movement policy The Computer-Based National Assessment for elementary school students in Bireuen Regency shows that its implementation has been very effective because the GLS policy is implemented based on quality report cards school. In addition, there is support from various parties, including teachers, staff, school committees, parents, and the government. In addition, it is supported by the availability of adequate resources, providing training to teachers, making effective curriculum planning, and developing learning materials that suit student needs. It can generally be concluded that the implementation has been very effective, because the GLS policy is implemented based on school quality report card scores. (Observation, 06 October 2023).

b. Implementation Efficiency

To determine the efficiency of the implementation of the school literacy movement policy oriented towards the Computer-Based National Assessment for elementary school students in Bireuen Regency, the following are the results of an interview with the head of SD Negeri 4 Bireueun.

> To efficiently implement the implementation of the School Literacy Movement policy oriented towards the Computer-Based National Assessment for elementary school students, our step is to identify clear goals and objectives of each policy implemented. Create a work plan that includes the necessary steps, resources, time schedules, and responsibilities, and consider a realistic time frame for the implementation of this policy. In addition, it involves a variety of relevant parties, including teachers, school commitments, parents, and students, in policy planning and implementation, and communicates program goals, benefits, and expectations to all *stakeholders*. (Interview, 02 October 2023).

In general it can be concluded that it has been very efficient, can be measured by school indicators making very careful planning, schools involve all stakeholders, the school provides training to teachers, the availability of supporting infrastructure and technology in the school, the school provides consistent coaching and supervision, conducts periodic measurements and evaluations, the school is very flexible and ready to adjust policies if obstacles or problems are found in the implementation process, the school evaluates the impact, involves parents, develops materials and content, monitors security and privacy, Provides rewards and recognition for achievement of good results in policy implementation.

c. Implementation satisfaction

To find out the satisfactory implementation of the school literacy movement policy oriented towards the Computer-Based National Assessment for elementary school students in Bireuen Regency, the following are the results of an interview with the head of SD Negeri 4 Bireueun.

> Alhamdulillah, (it) is very satisfying, because we make careful and structured planning, identify clear goals and determine measurable success indicators. We have the full support of all *stakeholders* involved, including teachers, principals, parents, assessment bodies, and students by ensuring they understand the importance of the programme and their role in its implementation. (Interview, 02 October 2023).

In general it can be concluded very satisfactory, because it is measured by several indicators including: having careful planning, stakeholders engagement, adequate training, regular monitoring, use of assessment data, consistency of implementation, improvement of digital literacy, parental support, evaluation and continuous improvement, leadership commitment, community involvement around the school, building open communication, and preparing good infrastructure.

d. Equitable distribution of implementations

To determine the similarity and equitable implementation of the policy, it can be seen that school equity can include policies to provide support Additional to schools or districts that may require

more attention to address inequalities in literacy outcomes. The school ensures that all students have equal opportunities to participate in computer-based literacy and assessment programs, regardless of their social, economic, or geographic background. (Observation, 06 October 2023).

It can generally be concluded that there is national program approval, consistent standards and guidelines, equitable access to technology, use of assessment data, uniform teacher education, fair parental involvement, equitable curriculum readiness, support policies, and fair opportunities.

e. Implementation of student response

Based on the interview and observation, it seems that students are very excited, students who see computer-based assessment as an opportunity. To learn and measure his abilities may be more responsive to the program. It can be concluded that the students' response is very positive, meaning that students are very excited, the level of enthusiasm is also high, but there are some students who are anxious or uncomfortable because they do not know how to use it. On the other hand, students are motivated and want to be involved, then parental involvement is very full, there is digital literacy readiness, *positive feedback* and recognition, and opportunities to learn. (Observation, 06 October 2023).

f. Accuracy of implementation.

The good time management ensures that the implementation of the program is in accordance with the schedule that has been determined without being late or rushed, assessment results should be put to good use to make decisions and improvements in learning. Effective use of data is an important indicator of implementation accuracy. (Observation, 06 October 2023).

Based on the results, it can be concluded that it is appropriate, measured by indicators, such as compliance with guidelines and standards, quality of training, periodic monitoring and evaluation, infrastructure readiness, student readiness, parental readiness and family support, effective communication, coordination between schools and districts, good time management, and use of assessment data.

4. CONCLUSION

In planning for the implementation of the school literacy movement's policy of computer-based national assessment, schools play a role in setting goals and objectives, planning in identifying problems, identifying stakeholders, planning resources and budgets, strategies, monitoring and evaluation, planning for improvement and learning, formulating problems, making policy recommendations, monitoring policy results and evaluating policy performance.

The implementation of the School Literacy Movement policy is oriented towards the Computer-Based National Assessment for elementary school students in Bireuen District. This is measured by eight question indicators, including (a) objectives in implementation, (b) resource allocation (financial and human) in implementation, (c) stakeholder involvement in implementation, (d) achievement of objectives in implementation, (e) quality of service in implementation, (f) familiarisation phase of service, (g) development phase, and (h) learning phase. Based on the evaluation, the policy implemented in SD Negeri 4 Bireuen is effective, efficient, satisfactory and equitable. Moreover, the students' response is also positive and the policy is appropriate as measured by guidelines and standards, quality of education, regular monitoring and evaluation, infrastructure readiness, student readiness, parent readiness and family support, effective communication, coordination between schools and regions, good time management and use of assessment data. As the policy is properly implemented and receives positive response from students, the policy of implementing the school literacy movement based on the computer-based national assessment for elementary school is a good decision to improve the quality of students' literacy. The improvement of students' literacy can enhance students' thinking ability according to stages and literacy components. It is suggested that more research should be done on the improvement of the literacy movement that will be appropriate for other levels of education.

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Methods of Finding All Factors of a Natural Number

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ABSTRACT

This study focused on "Methods of finding all factors of a natural number". The study was designed to show the simplest and precise methods of finding all factors of a natural number, and to point out the advantages of the simplest and precise methods of finding all factors of a natural number. The study found that the SPAM method and the method of using REM formulas are simple and precise methods to find all factors of a given natural number. By applying the preliminary concepts for the simplest and precise methods of finding all factors of a natural number, methods of finding all factors of a natural number, i.e. the SPAM method and method of using REM formulas, were developed in this study.

Keywords: Natural number, Prime factorization, REM, SPAM

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1. INTRODUCTION

When we deal with a set of natural numbers, the concept of factors of a certain natural number is remembered (Tomas, 2022). We frequently apply the concept of factors of a certain natural number for our day – to – day activities (MOE, 2010).

A natural number x is said to be a factor or divisor of a natural number y if and only if x divides y. It is simple to find all factors of a small natural number using thinking skill (Nagell, 2021). But it is difficult to find all factors of a large natural number using thinking skill (Tizazu, 2022). For instance; to list out all factors of 1,000,000, we need to test 1,000,000 is divisible or not divisible by a number from 1 to 1,000,000. This wastes our time and resources (Raji, 2019).

Since there is no simple and precise method to find all factors of a certain natural number, students and teachers add a number which is not a factor of that number, and miss a number that is a factor of that number during the time of finding all factors of a certain natural number (Rosen, 2020). To eliminate these two problems, this study was conducted.

This study is used to show the simple and precise methods of finding all factors of a given natural number, to point out the advantages of the simple and precise methods of finding all factors of a given natural number, as a reference for teachers/students when they teach/learn factors of a natural number.

This study is based on a core concept of number theory "a factor of any composite natural number is not out of the multiples of a prime factors of the number "(Sefinew, 2020). "No simple and premise method to find all factors of a given natural number" was taken as the gap of the previously conducted researches.

2. RESEARCH METHODS

This study used classroom observation and document analysis data gathering instruments to gather available data that were important to conduct the study. Class observations in classes 7-12 were used to understand the problem of this study. The following concepts were taken from different materials as the preliminary concepts of the study using document analysis.

Definition 2.1: A set of natural numbers, denoted by $\mathbb{N}$, is a set of numbers which is described by
$\mathbb{N} = \{1, 2, 3, 4, \ldots\}$ (Cameron, 2019).

Definition 2.2: Let x and y be two natural numbers. Then x is said to be a factor of y if and only if there exists a natural number t such that $y = tx$. This means that x is a factor of y if and only if x divides y (Fine, et al., 2017).

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Example 2.1: 7 is a factor of 105 since there exists a natural number 15 such that 105 = 15 × 7.
Definition 2.3: A natural number is said to be

a. Prime number if it has exactly two distinct factors, namely 1 and itself.
b. Composite number if it has more than two distinct factors (Bordelles, 2022).

Remark 2.1: 1 is neither a prime nor a composite number (Zhao, 2017).
Example 2.2

1. Consider a natural number 13. Since 13 is divisible only by 1 and itself, it is a prime number.
2. Consider the natural number 16. The factors of 16 are 1, 2, 4, 8 and 16. Since 16 has five distinct factors, it is a composite number.

Definition 2.4: When a number is expressed as a product of its prime factors, the expression is called the prime factorization of a number (Fine, et al., 2017).
There are two methods to find the prime factorization of a number. These are

a. Tree Diagram Method
b. Tabular method (William, 2020).

Let us see these methods in the following examples.
Example 2.3

1. From Table 2.4.1, the prime factorization of 4500 is $2^2 \times 3^2 \times 5^3$.
2. a. From Figure 2.4.1, the prime factorization of 64 is 2^6.
   b. From Figure 2.4.2, the prime factorization of 1000 is $2^3 \times 5^3$.

Table 1

2	4500
2	2250
3	1125
3	375
5	125
5	25
5	5
	1

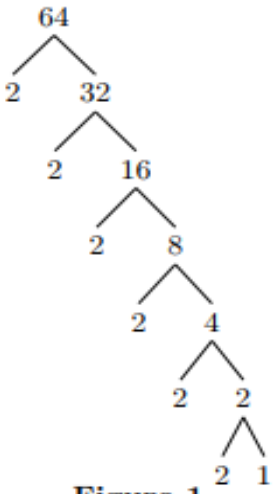

Figure 1

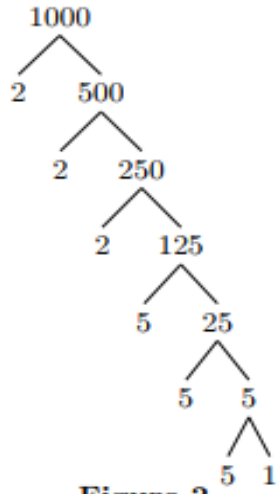

Figure 2

Definition 2.5: If a prime factorization of a natural number m is $p_1{}^{a_1} x\, p_2{}^{a_2} x \cdots x\, p_n{}^{a_n}$, then the total **number of factors** of m, denoted by T(m), is calculated by

$T(m) = (a_1 + 1)x(a_2 + 1)x \cdots x(a_n + 1)$ [3] [13].

Example 2.4 From Example 2.3, the prime factorization of

- 4500 is $2^2 \times 3^2 \times 5^3$
- 64 is 2^6
- 1000 is $2^3 \times 5^3$.

Then the

1. $T(4500) = (2 + 1)(2 + 1)(3 + 1) = 36$
2. T (64) = (6 + 1) = 7
3. $T(1000) = (3 + 1)(3 + 1) = 16$

Definition 2.6: Let F and G be the finite sets of natural numbers. Then the **SPAM** of F and G, denoted by F [S] G, is given by

$F\,[S]\,G = \{y: y = a \times b \text{ for all } a \in F \,\&\, \text{all } b \in G, \text{and } \times \text{ is an ordinary multiplication}\}$.

Example 2.5: Let $F = \{1, 2, 5\}$ and $G = \{3, 4\}$, then the SPAM of F and G is given by

F [S] G = {1x3, 1x4, 2x3, 2x4, 5x3, 5x4}
$\Rightarrow F\,[S]\,G = \{3, 4, 6, 8, 15, 20\}$

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Remark 2.2: Let F, G and H be the finite sets of natural numbers, then

- F $\boxed{s}$ G = G $\boxed{s}$ F. This is known as the commutative property.
- [F $\boxed{s}$ G] $\boxed{s}$ H = F $\boxed{s}$ [G $\boxed{s}$ H]. This is known as the associative property.
- The number of elements of F $\boxed{s}$ G is less than or equal to the product of the number of elements of F & the number of elements of G.

Theorem 2.1. If p is a prime factor of a natural number N, then the multiples of $P \leq N$ can be the factors of N. This idea is very important to develop the third steps in REM and SPAM methods (Tadesse, 2021).

3. RESULTS AND DISCUSSION

This study developed two methods which are important to find all factors of a given natural number using the stated preliminary concepts. These methods are

a. SPAM method and
b. Method of using REM formulas.

These methods minimize anxiety and fatigue when students and teachers find all factors of a given natural number.

A. SPAM method

To find all factors of a given natural number using the SPAM method, we must apply the following steps.

Step 1: Express the given natural number in prime factorization.
Step 2: Find the total number of factors of a given natural number.
Step 3: List all factors of a given natural number using the concept of SPAM. In this step, we have the following three cases.

Case – one

Suppose that the prime factorization of a natural number m is ${p_1}^{a_1}$. Then the set of all factors of m is given by

$$B(m) = F \boxed{s} \{1\}$$

where $F = \{{p_1}^i : i = 0, 1, 2, \cdots, a_1\}$.

Case – two

Suppose the prime factorization of a natural number n is ${p_1}^{a_1} x\, {p_2}^{a_2}$. Then the set of all factors of n is given by

$$B(n) = F \boxed{s} G$$

where $F = \{{p_1}^i : i = 0, 1, 2, \cdots, a_1\}$ and
$G = \{{p_2}^j : j = 0, 1, 2, \cdots, a_2\}$.

Case – three

Suppose the prime factorization of a natural number w is ${p_1}^{a_1} x\, {p_2}^{a_2} x\, {p_3}^{a_3}$. Then the set of all factors of w is given by

$$B(w) = [F \boxed{s} G] \boxed{s} H$$

where $F = \{{p_1}^i : i = 0, 1, 2, \cdots, a_1\}$,
$G = \{{p_2}^j : j = 0, 1, 2, \cdots, a_2\}$ and
$H = \{{p_3}^k : k = 0, 1, 2, \cdots, a_3\}$

Remark 3.1.1

- $B(m), B(n)$ and $B(w)$ denote the set of all factors of natural numbers m, n and w respectively.
- In general, if the prime factorization of a natural number z is ${p_1}^{a_1} x\, {p_2}^{a_2} x \cdots x\, {p_n}^{a_n}$, then the set of all factors of z is given by

$$B(z) = F_1 \boxed{s} F_2 \boxed{s} \cdots \boxed{s} F_n$$

where $F_k = \{{p_k}^i : i = 0, 1, \cdots, a_k\}$ and $k = 1, 2, \cdots, n$.

Example 3.1.1: Using SPAM method, let us find all factors of 64, 1000 and 4500.

a. From examples 2.3 and 2.4,
   i. The prime factorization of 64 is 2^6.
   ii. The total number of factors of 64 is 7.

Let $F = \{2^i : i = 0, 1, 2, 3, 4, 5. 6\}$
$\Longrightarrow F = \{1, 2, 4, 8, 16, 32, 64\}$
Using case one (i.e. multiplying every element of F by 1),

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$B(64) = F\ \boxed{s}\ \{1\} = \{1,\ 2,\ 4,\ 8,\ 16,\ 32,\ 64\}$
Hence, all factors of 64 are 1, 2, 4, 8, 16, 32 and 64.

b. From examples 2.3 and 2.4,

i. The prime factorization of 1000 is $2^3 \times 5^3$.

ii. The total number of factors of 1000 is 16.

Let $F = \{2^i : i = 0, 1, 2, 3\} = \{1, 2, 4, 8\}$
$G = \{5^j : j = 0, 1, 2, 3\} = \{1, 5, 25, 125\}$
Using case two (i.e. multiplying every element of F by every element of G),
$B(1000) = F\ \boxed{s}\ G = \{1, 2, 4, 5, 8, 10, 20, 25, 40,\ 50, 100, 125, 200, 250, 500, 1000\}$
Hence, all factors of 1000 are 1, 2, 4, 5, 8, 10, 20, 25, 40, 50, 100, 125, 200, 250, 500 and 1000.

c. From examples 2.3 and 2.4,

i. The prime factorization of 4500 is $2^2 \times 3^2 \times 5^3$.

ii. The total number of factors of 4500 is 36.

Let $F = \{2^i : i = 0, 1, 2\} = \{1, 2, 4\}$
$G = \{3^j : j = 0, 1, 2\} = \{1, 3, 9\}$
$H = \{5^k : k = 0, 1, 2, 3\} = \{1, 5, 25, 125\}$
Using case two (i.e. multiplying every element of F by every element of G) and case three (i.e. multiplying every element of F $\boxed{s}$ G by every element of H),
$B(4500) = [F\ \boxed{s}\ G]\ \boxed{s}\ H$
$\Longrightarrow B(4500) = \{1, 2, 3, 4, 6, 9, 12, 18, 36\}\ \boxed{s}\ H$
$\Longrightarrow B(4500) = \{1, 2, 3, 4, 5, 6, 9, 10, 12, 15, 18, 20, 25, 30, 36, 45, 50, 60, 75, 90, 100, 125, 150, 180, 225, 250, 300, 375, 450, 500, 750, 900, 1125, 1500, 2250, 4500\}$
Hence, all factors of 4500 are 1, 2, 3, 4, 5, 6, 9, 10, 12, 15, 18, 20, 25, 30, 36, 45, 50, 60, 75, 90, 100, 125, 150, 180, 225, 250, 300, 375, 450, 500, 750, 900, 1125, 1500, 2250 and 4500.

B. Method of using REM formulas

To find all factors of a given natural number using REM formulas, we must apply the following steps.
Step 1: Express the given natural number in prime factorization.
Step 2: Find the total number of factors of a given natural number.
Step 3: List all factors of a given natural number using REM formulas. In this step, we have the following three formulas.

R – formula

Let the prime factorization of a natural number x is $p_1{}^{a_1}$, then we can find all factors of x by using the following formula.

$$R_i = p_1{}^{i-1}$$

where $i = 1,\ 2,\ 3,\ \cdots,\ (a_1 + 1)$. This formula is said to be the **R – formula.**

E – formula

Let the prime factorization of a natural number y is $p_1{}^{a_1} x\ p_2{}^{a_2}$, then we can find all factors of y by using the following formula.

$$E_j = R_i\ x\ p_2{}^{j-1}$$

where R_i are the factors of $p_1{}^{a_1}$; which are calculated using R – formula & $j = 1,\ 2,\ 3,\ \cdots,\ (a_2 + 1)$. This formula is said to be **E – formula.**

M – formula

Let the prime factorization of a natural number z is $p_1{}^{a_1} x\ p_2{}^{a_2} x\ p_3{}^{a_3}$, then we can find all factors of z by using the following formula.

$$M_k = E_j\ x\ p_3{}^{k-1}$$

where E_j are the factors of $p_1{}^{a_1} x\ p_2{}^{a_2}$; which are calculated using E – formula & $k = 1,\ 2,\ 3,\ \cdots,\ (a_3 + 1)$. This formula is said to be the **M – formula.**

Remark 3.2.1

1. The three formulas are said to be REM formulas.

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2. We apply REM formulas when a natural number has at most three distinct prime factors. But, by applying the pattern of REM formulas repeatedly, we can find all factors of a given natural number that has more than three distinct prime factors.

Example 3.2.1: Using REM formulas, let us find all factors of natural numbers 32, 36 and 84.

a. Step 1: The prime factorization of 32 is 2^5.
Step – 2: $\mathrm{T}(32) = 6$.
Step -3: Let us find all factors of 32 using the R – formula.
$\mathrm{R_i} = 2^{\mathrm{i}-1}$; where $\mathrm{i} = 1,\ 2,\ 3, \cdots, 6$
$\Rightarrow \mathrm{R_1} = 2^{1-1} = 1$
$\mathrm{R_2} = 2^{2-1} = 2$
$\mathrm{R_3} = 2^{3-1} = 4$
$\mathrm{R_4} = 2^{4-1} = 8$
$\mathrm{R_5} = 2^{5-1} = 16$
$\mathrm{R_6} = 2^{6-1} = 32$
Hence, all factors of 32 are 1, 2, 4, 8, 16 and 32.

b. Step – 1: The prime factorization of 36 is 2^2x3^2.
Step – 2: $\mathrm{T}(36) = 9$.
Step -3: Let us find all factors of 36 using the E – formula.
Firstly, let us find the factors of 2^2 using the R – formula.
$\mathrm{R_i} = 2^{\mathrm{i}-1}$; where $\mathrm{i} = 1,\ 2,\ 3$
$\Rightarrow \mathrm{R_1} = 1, \mathrm{R_2} = 2$ and $\mathrm{R_3} = 4$
Secondly, let us find the factors of 2^2 x 3^2 using the E – formula.
$\mathrm{E_j} = \mathrm{R_i}$ x $3^{\mathrm{j}-1}$; where $\mathrm{j} = 1, 2, 3$

- $\mathrm{E_1} = \mathrm{R_i}$ x $3^{1-1} = \mathrm{R_i}$

Since the values of i are 1, 2 and 3, then

$$\mathrm{E_1} = \begin{cases} \mathrm{R_1} = 1 \text{ if } \mathrm{i} = 1 \\ \mathrm{R_2} = 2 \text{ if } \mathrm{i} = 2 \\ \mathrm{R_3} = 4 \text{ if } \mathrm{i} = 3 \end{cases}$$
$$\Rightarrow \mathrm{E_1} = 1, 2 \text{ and } 4$$

- $\mathrm{E_2} = \mathrm{R_i}$ x $3^{2-1} = 3\mathrm{R_i}$

Since the values of i are 1, 2 and 3, then

$$\mathrm{E_2} = \begin{cases} 3\mathrm{R_1} = 3\mathrm{x}1 = 3 \text{ if } \mathrm{i} = 1 \\ 3\mathrm{R_2} = 3\mathrm{x}2 = 6 \text{ if } \mathrm{i} = 2 \\ 3\mathrm{R_3} = 3\mathrm{x}4 = 12 \text{ if } \mathrm{i} = 3 \end{cases}$$
$$\Rightarrow \mathrm{E_2} = 3, 6 \text{ and } 12$$

- $\mathrm{E_3} = \mathrm{R_i}$ x $3^{3-1} = 9\mathrm{R_i}$

Since the values of i are 1, 2 and 3, then

$$\mathrm{E_3} = \begin{cases} 9\mathrm{R_1} = 9\mathrm{x}1 = 9 \text{ if } \mathrm{i} = 1 \\ 9\mathrm{R_2} = 9\mathrm{x}2 = 18 \text{ if } \mathrm{i} = 2 \\ 9\mathrm{R_3} = 9\mathrm{x}4 = 36 \text{ if } \mathrm{i} = 3 \end{cases}$$
$$\Rightarrow \mathrm{E_3} = 9, 18 \text{ and } 36$$

Hence, the values of $\mathrm{E_1}$, $\mathrm{E_2}$ and $\mathrm{E_3}$ are all factors of 36. That means, the factors of 36 are 1, 2, 3, 4, 6, 9, 12, 18 and 36.

c. Step – 1: The prime factorization of 84 is 2^2x3x7.
Step – 2: $\tau(84) = 12$.
Step -3: Let us find all factors of 84 using the M – formula.
Firstly, let us find the factors of 2^2 using the R – formula.
$\mathrm{R_i} = 2^{\mathrm{i}-1}$; where $\mathrm{i} = 1, 2, 3$
$\Rightarrow \mathrm{R_1} = 1, \mathrm{R_2} = 2$ and $\mathrm{R_3} = 4$
Secondly, let us find the factors of 2^2x3 using E – formula.
$\mathrm{E_j} = \mathrm{R_i}$ x $3^{\mathrm{j}-1}$; where $\mathrm{j} = 1, 2$

- $\mathrm{E_1} = \mathrm{R_i}$ x $3^{1-1} = \mathrm{R_i}$

Since the values of i are 1, 2 and 3, then

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$$E_1 = \begin{cases} R_1 = 1 \text{ if } i = 1 \\ R_2 = 2 \text{ if } i = 2 \\ R_3 = 4 \text{ if } i = 3 \end{cases}$$
$$\Rightarrow E_1 = 1, 2 \text{ and } 4$$

- $E_2 = R_i \text{ x } 3^{2-1} = 3R_i$

Since the values of i are 1, 2 and 3, then

$$E_2 = \begin{cases} 3R_1 = 3x1 = 3 \text{ if } i = 1 \\ 3R_2 = 3x2 = 6 \text{ if } i = 2 \\ 3R_3 = 3x4 = 12 \text{ if } i = 3 \end{cases}$$
$$\Rightarrow E_2 = 3, 6 \text{ and } 12$$

Thirdly, let us apply the M – formula to find the factors of 2^2 x 3 x 7.

$M_k = E_j \text{ x } 7^{k-1}$; where $k = 1, 2$

- $M_1 = E_j \text{ x } 7^{1-1} = E_j$

Since the values of j are 1 and 2, then

$$M_1 = \begin{cases} E_1 = 1, 2 \text{ and } 4 \text{ if } j = 1 \\ E_2 = 3, 6 \text{ and } 12 \text{ if } j = 2 \end{cases}$$
$$\Rightarrow M_1 = 1, 2, 3, 4, 6 \text{ and } 12$$

- $M_2 = E_j \text{ x } 7^{2-1} = 7E_j$

Since the values of j are 1 and 2, then

$$M_2 = \begin{cases} 7E_1 = 7, 14, 28 \text{ if } j = 1 \\ 7E_2 = 21, 42, 84 \text{ if } j = 2 \end{cases}$$
$$\Rightarrow M_2 = 7, 14, 21, 28, 42 \text{ and } 84$$

Hence, the values of M_1 and M_2 are all factors of 84. That means that the factors of 84 are 1, 2, 3, 4, 6, 7, 12, 14, 21, 28, 42 and 84.

4. CONCLUSION

This study focused on methods of finding all factors of a given natural number. These methods are the SPAM method and method of using REM formulas. The main advantage of these methods is minimizing anxiety and fatigue when students and teachers list out all factors of a given natural number.

Before we deal with methods of finding all factors of a natural number, we must have the concepts of a set of natural numbers, factor or divisor of a natural number, prime and composite numbers, prime factorization of a natural number, formula for finding total number of factors of a natural number, and SPAM of two finite sets of natural number.

Abbreviations

SPAM denotes 'Sertsepetros Aschale Moges', who is a child of this researcher. He was born on November 24, 2007 E.C.

REM denotes 'Remembering Etenesh Moges (1982 – 2000 E.C.)", who is a sister of this researcher. She died in November 24/2000 E.C. She studied her education until grade seven with good rank. Sertsepetros Aschale and Etenesh Moges have great historical relationships with this researcher. This work was done to memorize the historical relation of Sertsepetros Aschale and Etenesh Moges.

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Optimization of Increasing Teacher Engagement through Strengthening Self-Efficacy, Interpersonal Communication, Organizational Culture and Job Satisfaction

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ABSTRACT

The unity of teachers with the organization where they work, where the teacher feels that he has an organization and enjoys the conditions of the organization and his work, not only physically but also rationally, emotionally and normatively, so that the teacher feels satisfied and loyal to work in his organization is called teacher engagement. Optimal teacher engagement behavior will have a positive impact on the performance of their work and the madrasah institution. With a sense of love for their work and institution, teachers in carrying out their work work without knowing the time and fully invest themselves and their energy because they are no longer carrying out obligations, but the teaching profession has become a service. in his life. The aim of this research is to find strategies and ways to increase teacher engagement by conducting research on the influence of the variables of self-efficacy, interpersonal communication, organizational support and job satisfaction. This research uses the path analysis method to determine the influence between the variables studied and the SITOREM method for indicator analysis to obtain optimal solutions to increase teacher engagement.

Keywords: Teacher Engagement, Self-Efficacy, Interpersonal Communication, Organizational Culture, Job Satisfaction, SITOREM Analysis

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1. INTRODUCTION

Fulfilling professionalism in the 21st century requires educational transformation, especially the development of quality teachers who are able to advance knowledge, training, equity and student achievement. Teaching is a profession that requires interconnection and interdependence between abilities, competencies and various roles as a complete and synergistic unit which is usually known as engagement. This description is the basis for efforts to complement the programs and instruments that have been carried out by the government so far in capturing teacher performance with a new concept, namely teacher engagement.

The rapid development and progress currently spurring schools to be able to compete and be innovative in order to maintain school continuity and achieve school goals. Achieving success requires human resources who are professional and have good performance. To realize the goal of a reliable, professional and competent human resources organization. Human resources are assets that play a very important role in running an organization. The human resources in question are all educators and educational staff who are directly related to implementing the mission and achieving the organization's vision. To achieve these organizational goals, teachers and education staff should have good performance through competence, reliability, innovation and competitiveness.

Optimal teacher engagement behavior will have a positive impact on the performance of their work and the madrasah institution. With a sense of love for their work and institution, teachers in carrying out their work work without knowing the time and fully invest themselves and their energy because they are no longer carrying out obligations, but the teaching profession has become a service. in his life.

The description of teacher engagement is to strengthen the background of this research, so the researcher distributed a preliminary survey questionnaire to 30 respondents in 7 PGRI Vocational Schools in Bogor Regency using a "Likert" scale with a value of 5 as the highest and 1 as the lowest,

with categories (5) Strongly Agree, (4) Agree, (3) Doubtful, (2) Disagree, (1) Strongly Disagree, then the following conclusions can be drawn:

1) There are 42% of teachers who have problems with career development, this can be seen from the number of teachers who do not believe that schools have clarity in improving career paths and self-development in activities and training.
2) There are 43% of teachers who have problems with concerns for productivity, this can be seen from the large number of teachers who have not tried their best to complete their work according to the targets set and have not tried to maintain the quality of their work as best as possible.
3) There are 45% of teachers who have problems with ownership, it can be seen that teachers feel that they do not have a place of work that can increase work engagement.
4) There are 41% of teachers who have problems with loyalty, this can be seen from the number of teachers who feel that their desire to work at this school is not in accordance with the school's needs and feel that the school is not sufficient for life's needs so they are not comfortable working.
5) There are 35% of teachers who have problems with vigor, this can be seen from the number of teachers who have not tried to survive the problems they face at work and have not tried to check and improve the results of their work.
6) There are 36% of teachers who have problems with dedication, this can be seen from the number of teachers who have not been able to collaborate with other people to complete tasks and feel less enthusiastic about any work they are given.
7) There are 45% of teachers who have problems with absorption, this can be seen from the number of teachers who are not happy and enjoy their work and are immersed in work which causes time to pass quickly when doing work.

The survey results above show that teacher engagement needs to be strengthened, so it is necessary to find strategies and ways to strengthen teacher engagement. Considering that teacher engagement is the key to achieving educational goals, teacher engagement is interesting to research.

The aim of the research is to produce strategies and methods for strengthening teacher engagement, namely by strengthening independent variables that have a positive effect on teacher engagement. These variables are self-efficacy, interpersonal communication, organizational culture, and job satisfaction. The optimal solution found is then used as a recommendation to related parties, namely teachers, school principals, school supervisors, school organizing institutions and education offices.

2. RESEARCH METHOD

As explained above, this research aims to find strategies and ways to increase teacher engagement through research on the strength of influence between teacher engagement as the dependent variable and self-efficacy, interpersonal communication, organizational culture and job satisfaction as independent variables. The research method used is a survey method with a path analysis test approach to test statistical hypotheses and the SITOREM method for indicator analysis to determine optimal solutions for increasing teacher engagement.

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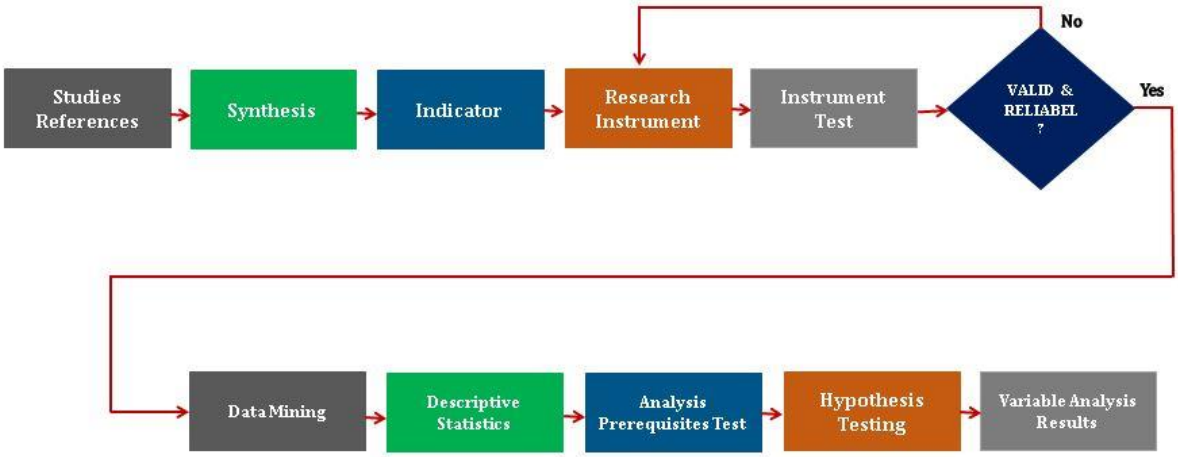

Fig 1. The Average Value of Concept Understanding Ability

The research was carried out on foundation permanent teachers (GTY) of PGRI Vocational High Schools (SMK) in Bogor Regency with a teacher population of 289 people, with a sample of 168 teachers calculated using the Slovin formula taken from Umar.

Data collection in this research used research instruments in the form of questionnaires which were distributed to teachers as research respondents. The research instrument items are derived from the research indicators whose conditions will be explored. Before being distributed to respondents, the research instrument was first tested to determine its validity and reliability. The validity test was carried out using the Pearson Product Moment technique, while for the reliability test a calculation was used using the Cronbach's Alpha formula. After the data is collected, homogeneity tests, normality tests, linearity tests, simple correlation analysis, coefficient of determination analysis, partial correlation analysis, and statistical hypothesis testing are then carried out.

Next, indicator analysis was carried out using the SITOREM method from Hardhienata to determine the priority order for improving indicators as a recommendation to related parties as a result of this research. In determining the priority order for handling indicators, SITOREM uses three criteria, namely (1) the strength of the relationship between variables obtained from hypothesis testing, (2) the priority order for handling indicators resulting from expert assessments, and (3) the indicator value obtained from data calculations obtained from the answers of research respondents.

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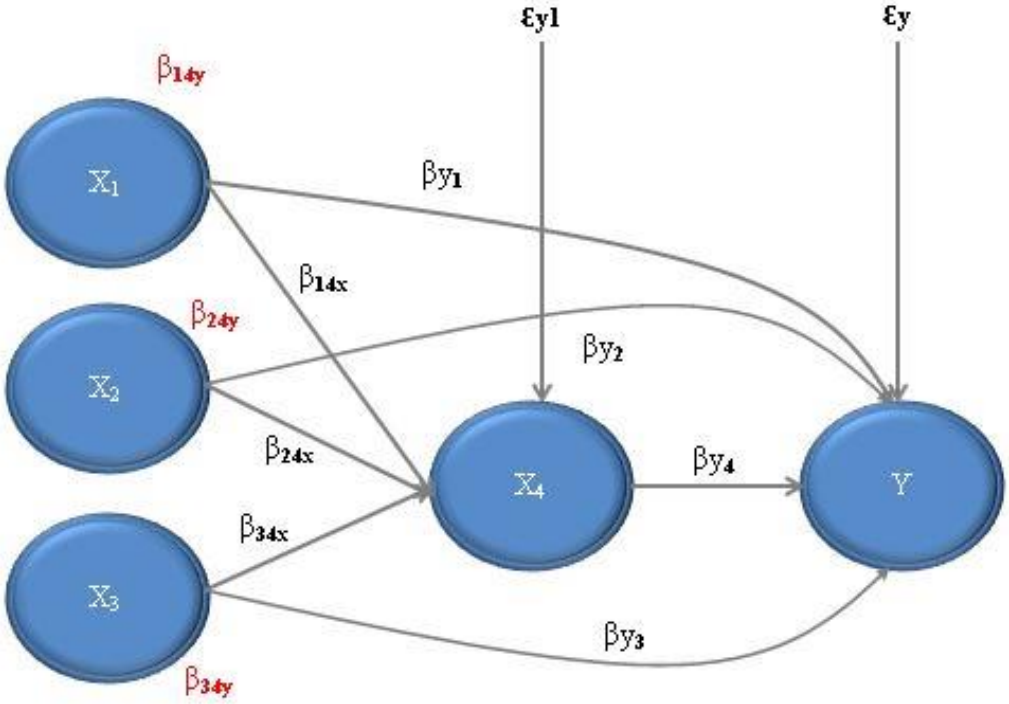

Fig. 2 Research Constellation

X_1	:	Self Efficacy	X_4	:	Job Satisfaction
X_2	:	Interpersonal Communication	Y	:	Teacher Engagement
X_3	:	Organization Culture			

βy1 : Direct influence of Self-Efficacy (X1) on Teacher Engagement (Y).
βy2 : Direct influence of Interpersonal Communication (X2) on Teacher Engagement (Y).
βy3 : Direct influence of Organizational Culture (X3) on Teacher Engagement (Y).
βy4 : Direct influence of Job Satisfaction (X4) on Teacher Engagement (Y).
β14x : Direct influence of Self-Efficacy (X1) on Job Satisfaction (X4).
β24x : Direct influence of Interpersonal Communication (X2) Job Satisfaction (X4).
β34x : Direct influence of organizational culture (X3) on job satisfaction (X4)
β14y : Indirect influence of Self-Efficacy (X1) on Teacher Engagement (Y) through Job Satisfaction (X4).
β24y : Indirect influence of Interpersonal Communication (X2) on Teacher Engagement (Y) through Job Satisfaction (X4).
β34y : Indirect influence of Organizational Culture (X3) on Teacher Engagement (Y) through Job Satisfaction (X4).

3. RESULTS AND DISCUSSION

A. Descriptive Statistics

Based on the results of the analysis of statistical descriptions for research variables, symptoms of central data can be revealed as listed in the following table:

Table 1. Summary of Statistical Description of Research Variables

Description	Self Efficacy **(X_1)**	Interpersonal Communication **(X_2)**	Organization Culture **(X_3)**	Job Satisfaction **(X_4)**	Teacher Engagement **(Y)**
Mean	126.75	126.28	122.91	122.80	121.05

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Description	Self Efficacy **(X_1)**	Interpersonal Communication **(X_2)**	Organization Culture **(X_3)**	Job Satisfaction **(X_4)**	Teacher Engagement **(Y)**
Standard Error	1.75046	1.25326	1.19771	1.77186	1.21728
Median	134	130	126.5	130	124
Mode	150	136	130	149	121
Stand Deviation	24.001	17.1838	16.4221	24.2945	16.6906
Sample Variance	576.049	295.284	269.687	590.223	278.575
Kurtosis	1.64903	0.85695	1.64832	0.5498	0.58266
Skewness	-1.4904	-1.0468	-1.3927	-0.7772	-0.9844
Range	101	77	81	101	70
Minimum Score	52	75	64	59	74
Maximum Score	153	152	145	160	144

B. Normality Test

Based on the overall calculation results of the error normality test in this study, it can be seen in the summary in the following table:

Table 2. Estimated Standard Error Normality Test

Estimate Error	**n**	**L_{count}**	**L_{table}**		**Decision**
			$\alpha = 0,05$	**$\alpha = 0,01$**	
$y - \hat{Y}_1$	168	0.015	0.065	0.075	Normality
$y - \hat{Y}_2$	168	0.014	0.065	0.075	Normality
$y - \hat{Y}_3$	168	0.010	0.065	0.075	Normality
$y - \hat{Y}_4$	168	0.015	0.065	0.075	Normality
$X_4 - X_1$	168	0.013	0.065	0.075	Normality
$X_4 - X_2$	168	0.016	0.065	0.075	Normality
$X_4 - X_3$	168	0.014	0.065	0.075	Normality
Normal distribution requirements : $L_{count} < L_{table}$					

C. Homogeneity Test

Based on the overall calculation results of the error normality test in this study, it can be seen in the summary in the following table:

Table 3. Summary of Data Variance Homogeneity Test

Grouping	**X^2_{count}**	**X^2_{table}** **$\alpha = 0,05$**	**Decision**
y on the basis of X_1	4912.17	6132.59	Homogeneity
y on the basis of X_2	3787.16	7288.01	Homogeneity
y on the basis of X_3	3823.33	7288.01	Homogeneity
y on the basis of X_4	4592.84	6132.59	Homogeneity
X_4 on the basis of X_1	4469.28	7288.01	Homogeneity
X_4 on the basis of X_2	4613.17	8451.28	Homogeneity
X_4 on the basis of X_3	3710.50	6313.26	Homogeneity
Homogeneous population requirement $\chi^2_{count} < \chi^2_{table}$			

D. Regression Model Test

The overall calculation results of the regression model in this research can be seen in the summary in the following table:

Table 4. Regression Model

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Relationship Model Between Variables	Regression Models	Significance Test Results
y over x1	$\hat{y} = 62{,}423 + 0{,}447X_2$	Significant
y over x2	$\hat{y} = 72{,}122 + 0{,}382X_3$	Significant
y over x3	$\hat{y} = 48{,}717 + 0{,}581X_4$	Significant
y over x4	$\hat{y} = 58{,}693 + 0{,}533X_3$	Significant
x4 over x1	$\hat{y} = 39{,}508 + 0{,}645X_1$	Significant
x4 over x2	$\hat{y} = 39{,}508 + 0{,}645X_1$	Significant
x4 over x3	$\hat{y} = 54{,}744 + 0{,}523X_2$	Significant
y over x1 through x4	$\hat{y} = 51{,}45 + 0{,}34X_2 + 0{,}20X_4$	Significant
y over x2 through x4	$\hat{y} = 46{,}77 + 0{,}30X_2 + 0{,}26X_5$	Significant
y over x3 through x4	$\hat{y} = 34{,}12 + 0{,}37X_1 + 0{,}33X_4$	Significant

E. Regression Model Significance Test

The overall calculation results of the linearity test of the regression model in this study can be seen in the summary in the following table:

Table 5. Summary of Regression Model Significance Test Results (F Test)

Relationship Model Between Variables	Sig	α	Significance Test Results
y over x1	0,000[b]	0,005	Significant
y over x2	0,000[b]	0,005	Significant
y over x3	0,000[b]	0,005	Significant
y over x4	0,000[b]	0,005	Significant
x4 over x1	0,000[b]	0,005	Significant
x4 over x2	0,000[b]	0,005	Significant
x4 over x3	0,000[b]	0,005	Significant
y over x1 through x4	0,000[b]	0,005	Significant
y over x2 through x4	0,000[b]	0,005	Significant
y over x3 through x4	0,000[b]	0,005	Significant
Significant Terms : Sig < α			

F. Linearity Test

The overall calculation results of the linearity test of the regression model in this study can be seen in the summary in the following table:

Table 6. Summary of Regression Model Linearity Test Results (t Test)

Relationship Model Between Variables	Sig	α	Significance Test Results
y over x1	0,000	0,005	Linear
y over x2	0,000	0,005	Linear
y over x3	0,000	0,005	Linear
y over x4	0,000	0,005	Linear
x4 over x1	0,000	0,005	Linear
x4 over x2	0,000	0,005	Linear
x4 over x3	0,000	0,005	Linear
y over x1 through x4	0,000	0,005	Linear
y over x2 through x4	0,000	0,005	Linear
y over x3 through x4	0,000	0,005	Linear
Linear Terms : Sig < α			

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G. Multicollinearity Test

Multicollinearity testing aims to determine whether the regression model found any correlation between independent variables or independent variables. Testing uses the Spearman Test. The effect of this multicollinearity is that it causes high variability in the sample. This means that the standard error is large, as a result, when the coefficient is tested, tcount will be a smaller value than ttable. The overall calculation results of the multicollinearity test are as follows:

Table 7. Summary of Multicollinearity Test

Independent Variable	Tolerance	VIF	Precondition	Conclusion
Self Efficacy (X_1)	0.505	4.408	H_0 : VIF < 10, there is no multicollinearity H_1 : VIF > 10, there is multicollinearity	Ho accepted There is no multicollinearity
Interpersonal Communication (X_2)	0.612	5.803	H_0 : VIF < 10, there is no multicollinearity H_1 : VIF > 10, there is multicollinearity	Ho accepted There is no multicollinearity
Organization Culture (X_3)	0.542	4.449	H_0 : VIF < 10, there is no multicollinearity H_1 : VIF > 10, there is multicollinearity	Ho accepted There is no multicollinearity
Job Satisfaction (X_4)	0.603	4.934	H_0 : VIF < 10, there is no multicollinearity H_1 : VIF > 10, there is multicollinearity	Ho accepted There is no multicollinearity

H. Heteroscedasticity Test

In this research, to test whether there is heteroscedasticity using the Glejser test where if the significant value is <0.05 then heteroscedasticity occurs, if on the contrary the significance value is ≥ 0.05 then homoscedasticity occurs. The overall calculation results of the heteroscedasticity test in this study can be seen in the summary in the following table:

Table 8. Summary of Heteroscedacity Test

Independent Variable	Sig.	α	Prasyarat	Kesimpulan
Self Efficacy (X_1)	0,001	0,05	H_0 : sig < 0,05 then there is no heteroscedasticity. H_1 : sig ≥ 0,05 then there is heteroscedasticity.	Ho accepted There is no heteroscedasticity
Interpersonal Communication (X_2)	0,002	0,05	H_0 : sig < 0,05 then there is no heteroscedasticity. H_1 : sig ≥ 0,05 then there is heteroscedasticity.	Ho accepted There is no heteroscedasticity
Organization Culture (X_3)	0,001	0,05	H_0 : sig < 0,05 then there is no heteroscedasticity. H_1 : sig ≥ 0,05 then there is heteroscedasticity.	Ho accepted There is no heteroscedasticity

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Independent Variable	Sig.	α	Prasyarat	Kesimpulan
Job Satisfaction (X_4)	0,001	0,05	H_0 : sig < 0,05 then there is no heteroscedasticity. H_1 : sig ≥ 0,05 then there is heteroscedasticity.	Ho accepted There is no heteroscedasticity

Path Analysis Test

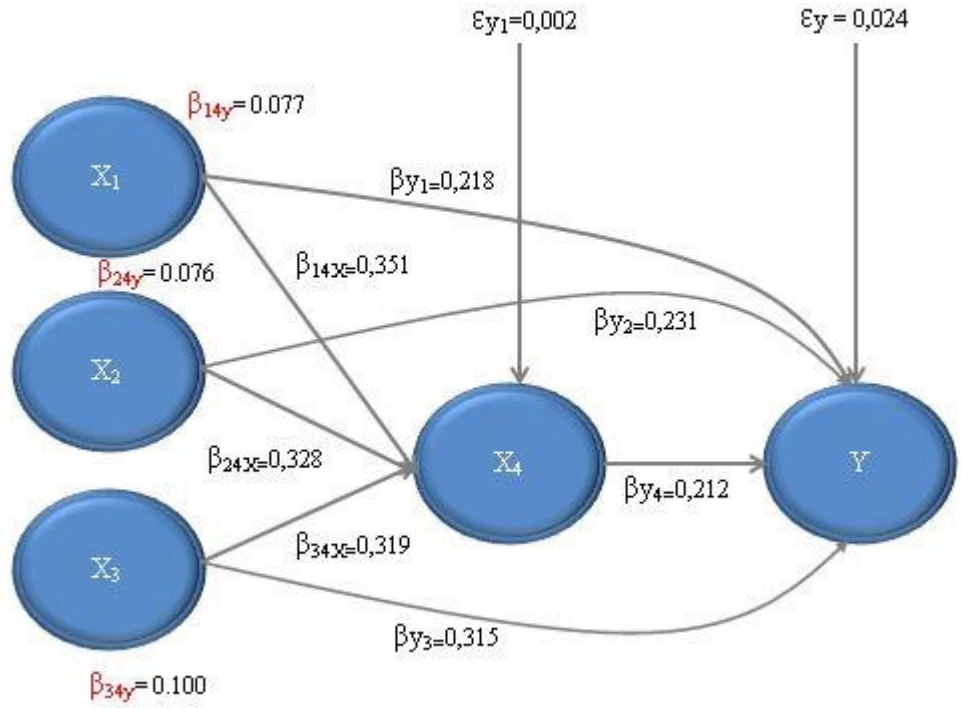

Fig. 3 Research Constellation

X_1 : Self Efficacy
X_2 : Interpersonal Communication
X_3 : Organization Culture
X_4 : Job Satisfaction
Y : Teacher Engagement

The influence between the independent variable and the dependent variable when viewed from path analysis, then this relationship is a functional relationship where Professional Commitment (Y) is formed as a result of the functioning of Adversity Intelligence (X1), Interpersonal Communication (X2), Task Interdependence (X3) and Job Satisfaction (X4). Discussion of research results can be described as follows:

Table 9. Research Hypothesis

Hypothesis	Path	Statistic Test	Decision	Conclusion
Self-Efficacy (X1) on Teacher Engagement (Y)	0.302	$H_0 : \beta_{y1} \leq 0$ $H_1 : \beta_{y1} > 0$	H_0 is rejected H_1 is accepted	Direct Positive Influence
Interpersonal Communication (X2) on Teacher Engagement (Y)	0.281	$H_0 : \beta_{y2} \leq 0$ $H_1 : \beta_{y2} > 0$	H_0 is rejected H_1 is accepted	Direct Positive Influence

Hypothesis	Path	Statistic Test	Decision	Conclusion
Organizational Culture (X3) on Teacher Engagement (Y)	0.205	$H_0 : \beta_{y3} \leq 0$ $H_1 : \beta_{y3} > 0$	H_0 is rejected H_1 is accepted	Direct Positive Influence
Job Satisfaction (X4) on Teacher Engagement (Y)	0.210	$H_0 : \beta_{y4} \leq 0$ $H_1 : \beta_{y4} > 0$	H_0 is rejected H_1 is accepted	Direct Positive Influence
Self-Efficacy (X1) on Job Satisfaction (X4)	0.344	$H_0 : \beta_{14y} \leq 0$ $H_1 : \beta_{14y} > 0$	H_0 is rejected H_1 is accepted	Direct Positive Influence
Interpersonal Communication (X2) on Job Satisfaction (X4)	0.328	$H_0 : \beta_{24y} \leq 0$ $H_1 : \beta_{24y} > 0$	H_0 is rejected H_1 is accepted	Direct Positive Influence
Organizational Culture (X3) on Job Satisfaction (X4)	0.327	$H_0 : \beta_{34y} \leq 0$ $H_1 : \beta_{34y} > 0$	H_0 is rejected H_1 is accepted	Direct Positive Influence
Self-Efficacy (X1) on Teacher Engagement (Y) through Job Satisfaction (X4)	0.104	$H_0 : \beta_{14y} \leq 0$ $H_1 : \beta_{14y} > 0$	H_0 is rejected H_1 is accepted	Indirect Positive Influence
Interpersonal Communication (X2) on Teacher Engagement (Y) through Job Satisfaction (X4)	0.092	$H_0 : \beta_{24y} \leq 0$ $H_1 : \beta_{24y} > 0$	H_0 is rejected H_1 is accepted	Indirect Positive Influence
Organizational Culture (X3) on Teacher Engagement (Y) through Job Satisfaction (X4)	0.067	$H_0 : \beta_{34y} \leq 0$ $H_1 : \beta_{34y} > 0$	H_0 is rejected H_1 is accepted	Indirect Positive Influence

I. Indirect Effect Test

The indirect effect test is used to test the effectiveness of the intervening variable which mediates the independent variable and the dependent variable. The results of the indirect influence test are as follows:

Table 10. Research Hypothesis

Indirect Influence	Z_{Count}	Z_{table}	Decision	Conclusion
Self-Efficacy (X1) on Teacher Engagement (Y) through Job Satisfaction (X4)	3.560	1,966	H_0 is rejected H_1 is accepted	proven to mediate
Interpersonal Communication (X2) on Teacher Engagement (Y) through Job Satisfaction (X4)	4,512	1,966	H_0 is rejected H_1 is accepted	proven to mediate
Organizational Culture (X3) on Teacher Engagement (Y) through Job Satisfaction (X4)	3,628	1,966	H_0 is rejected H_1 is accepted	proven to mediate

J. Optimal Solution for Reducing Teacher Work Stress

Based on the results of statistical hypothesis testing, determining indicator priorities, and calculating indicator values as described above, a recapitulation of research results can be made which is the optimal solution for reducing teacher work stress as follows:

Table 11. SITOREM Analysis

Self-efficacy(βy1 = 0,218) (rangk.III)			
Indicator in Initial State		Indicator after Weighting by Expert	Indicator Value
1 Emotional Cues	1st	Magnitude (26.67%)	4.12
2 Generality	2nd	Generality (25.07%)	4.10

3	Magnitude	3rd	Strength (24.88%)	4.00
4	Past Performance	4th	Past Performance (23.38%)	3.88
5	Strength	5th	Vicarious Experience (21.38%)	3.90
6	Verbal Persuasion	6th	Verbal Persuasion (16.25%)	3.87
7	Vicarious Experience	7th	Emotional Cues (16.21%)	4.02

Interpersonal Communication (βy2 = 0,231) (rangk.II)

	Indicator in Initial State		Indicator after Weighting by Expert	Indicator Value
1	Be positive towards yourself and others	1st	Openness to receiving input from others (26.67%)	4.14
2	The ability to understand other people	2nd	Ability to understand other people (25.07%)	4.02
3	Ability to interpret every word, sentence, information and behavior of other people.	3rd	Providing support to others (24.88%)	4.02
4	Openness to receiving input from others,	4th	Be positive towards yourself and others (23.38%)	3.94
5	Provide support to others	5th	Providing views, thoughts and ideas for organizational progress (21.38%)	3.96
6	Providing views, thoughts and ideas for the progress of the organization	6th	Ability to interpret every word, sentence, information and behavior of other people. (18.28%)	3.87

Organization Culture (βy3 = 0,315) (rangk.I)

	Indicator in Initial State		Indicator after Weighting by Expert	Indicator Value
1	Adaptation to changes.	1st	Innovation at work (21.45%)	4.05
2	Oriented to work results	2nd	Oriented to work results (20.24%)	4.07
3	Team oriented	3rd	Team oriented (19.78%)	4.11
4	Innovation at work	4th	Empowerment of human resources in the organization (19.64%)	3.93
5	Consistent with the rules that have been set	5th	Consistent with established rules (16.45%)	3.97
6	Empowerment of human resources in organizations	6th	Adaptation to changes. (15.67%)	3.93

Job Satisfaction (βy4 = 0,212) (rank.IV)

	Indicator in Initial State		Indicator after Weighting by Expert	Indicator Value
1	Work relationships with friends and leaders,	1st	Income earned (16.95%)	3.96
2	Security in carrying out tasks,	2nd	Career advancement opportunities at work (16.36%)	4.11
3	Career advancement opportunities at work,	3rd	Work relationships with friends and leaders (14.31%)	3.97
4	Opportunity for creativity at work.	4th	Quality control of work by leadership (13.78%)	4.03
5	Quality control of work by the leadership,	5th	Security in carrying out tasks (13.73%)	3.92
6	Earned income,	6th	Opportunities for creativity at work (13.72%)	4.02

Teacher Engagement

	Indicator in Initial State		Indicator after Weighting by Expert	Indicator Value
1	Strong affection for the profession and the organization	1st	Strong affection for the profession and organization (18.48%)	4.12
2	Teachers' moral obligation to remain in their organization	2nd	Have strong motivation to stay in their job (17.93%)	4.05
3	Lack of alternative professions	3rd	Selfless and devoted in carrying out their duties (16.77%)	3.85
4	Has obligations in his work	4th	Individual assessment of the cost of living if they leave their job (16.77%)	3.96
5	Has a strong motivation to stay in his job	5th	Lack of alternative professions (15.59%)	3.94
6	Maintaining stability/togetherness between the morals of society and the profession as well as a sense of responsibility to uphold the values of the profession	6th	Have obligations in their work (14.78%)	3.95

7	An individual's assessment of the cost of living if he leaves his job	7th	Maintaining stability/togetherness between the morals of society and the profession as well as a sense of responsibility to uphold the values of the profession (14. 62%)	4.02
8	Selfless and devoted in carrying out his duties	8th	Teachers' moral obligation to remain in their organization (14.60%)	4.01

SITOREM ANALYSIS RESULT

Priority order of indicator to be Strengthened		Indicator remain to be maintained	
1st	Empowerment of human resources in organizations	1.	Innovation at work
2nd	Consistent with the rules that have been set	2.	Oriented to work results
3rd	Adaptation to changes.	3.	Team oriented
4th	Be positive towards yourself and others	4.	Openness to receiving input from other people
5th	Providing views, thoughts and ideas for the progress of the organization	5.	Ability to understand other people
6th	Ability to interpret every word, sentence, information and behavior of other people.	6.	Provide support to others
7th	Past Performance	7.	Magnitude
8th	Vicarious Experience	8.	Generality
9th	Verbal Persuasion	9.	Strength
10th	Earned income	10.	Emotional Cues
11th	Work relationships with friends and leaders	11.	Opportunities for career advancement at work
12th	Security in carrying out tasks	12.	Control of the quality of work by the leadership
13th	Selfless and devoted in carrying out his duties	13.	Opportunity for creativity at work
14th	An individual's assessment of the cost of living if he leaves his job	14.	Strong affection for the profession and the organization
15th	Lack of alternative professions	15.	Have strong motivation to stay in his job
16th	Has obligations in his work	16.	Maintain stability/togetherness between the morals of society and the profession as well as a sense of responsibility to uphold the values of the profession
		17.	Teachers' moral obligation to remain in their organization

4. CONCLUSION

Based on the results of the analysis, discussion of research results and hypotheses that have been tested, it can be concluded as follows:

a. Increasing Teacher Engagement can be done by using variable development strategies that have a positive effect on Teacher Engagement.
b. Variables that have a positive influence on Teacher Engagement are Self-Efficacy, Interpersonal Communication, Organizational Culture and Job Satisfaction. This was proven from the results of variable analysis using the Path Analysis method.
c. The way to increase teacher engagement is to improve indicators that are still weak and maintain good indicators for each research variable.

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Increasing Lecturer Innovation through Strengthening Personality, Transformational Leadership, Organizational Culture and Work Motivation Using Path Analysis and SITOREM Analysis Techniques at Politeknik Negeri Jakarta

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ABSTRACT

This study aims to find out empirical data and find strategies and ways to increase lecturer innovation through efforts to strengthen personality, transformational leadership, organizational culture and work motivation. This study uses the path analysis method that is used to determine the direct and indirect effect between variables, then followed by SITOREM analysis to analyze the indicators of research variables so that efforts will be made to increase lecturer innovation through strengthening personality, leadership transformational, organizational culture and work motivation. The population of this study was a lecturer at the Jakarta State Polytechnic, totaling 398 lecturers with a number of research samples of 200 lecturers taken with random sampling techniques using the Slovin formula. The results of the path analysis shows that there is a significant positive direct effect of personality (X1) on lecturer innovation (Y) with βy1 = 0.205, there is a significant positive direct effect of transformational leadership (X2) on lecturer innovation (Y) with βy2 = 0.245, there is a significant positive direct of organizational culture (X3) on lecturer innovation (Y) with βy3 = 0.211, there is a significant positive direct effect of work motivation (X4) on lecturer innovation (Y) with βy4 = 0.344. There is a significant positive direct of personality (X1) on work motivation (X4) with βy41 = 0.239, there is a significant positive direct of transformational leadership (X2) on work motivation (X4) with βy42 = 0.301, there is a significant positive direct effect of organizational culture (X3) on work motivation (X4) with βy43 = 0.394. There is a significant positive indirect effect of personality (X1) on lecturer innovation (Y) through work motivation (X4) with βxy1 = 0.049, there is a significant positive indirect effect of transformational leadership (X2) on lecturer innovation (Y) through work motivation (X4) With βxy2 = 0.074, there is a significant positive indirect effect of organizational culture (X3) on lecturer innovation (Y) through work motivation (X4) with βxy3 = 0.083. And based on the SITOREM analysis, several efforts were made to increase lecturer innovation by improving indicators, are: 1) product development; 2) use of new models; 3) product improvement; 4) products produced; 5) communication with customers; 6) model improvement and 7) relationships with customers. Efforts to strengthen personality by improving indicators, are: 1) openness; 2) awareness; and 3) neuroticism, and maintaining or developing good indicators, are: 1) agreeableness and 2) extraversion. Efforts to strengthen transformational leadership by improving indicators, are: 1) exemplary; 2) inspiration; and 3) innovative behavior; and maintaining or developing good indicators, are: 1) creation; 2) trusted behavior; and 3) loyalty. Efforts to strengthen organizational culture by maintaining or developing good indicators, are: 1) the atmosphere felt by members in the life of the organization, 2) the most important (dominant) values that members, 4) patterns of organizational behavior, and 5) norms and standards of behavior at work; And efforts to strengthen work motivation by improving indicators, are: 1) achievement; 2) meeting affiliate needs; 3) work completion; and 4) participation, and maintaining or developing good indicators, namely; 1) morale; 2) opportunities and 3) utilization of expertise.

Keywords: lecturer innovation, personality, transformational leadership, cultural organization and work motivation.

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1. INTRODUCTION

Indonesia's Vision 2045 is an important guideline regarding the direction of Indonesia's development towards a Golden Indonesia, namely 100 years of Independent Indonesia, carried out with four main pillars, one of which is human resource development. In the era of globalization, labor market conditions are characterized by the integration of labor between countries and also accompanied by the emergence of various new types of work in line with innovation in the field of science and technology and increased creativity to provide answers to increasingly fierce competition.

McKinsey Global Institute (MGI) shows that in the global labor market in 2030 Indonesia is expected to experience a shortage of educated and skilled labor, but an excess of unskilled labor(Handayani, 2015). Referring to data released by the Asian Development Bank in 2015, it was

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recorded that Indonesia had 55 million skilled workers, but based on estimates in the Master Plan for the Acceleration and Improvement of Economic Growth in Indonesia (MP3EI), of this number, 113 million skilled workers will still be needed by 2030 with an average addition of 3.2 million per year. Changes in worker skills in Indonesia in the 2017-2030 period. Figure 1 Job Skills Goals in Indonesia 2017-2030 (Ministry of Manpower, 2017)

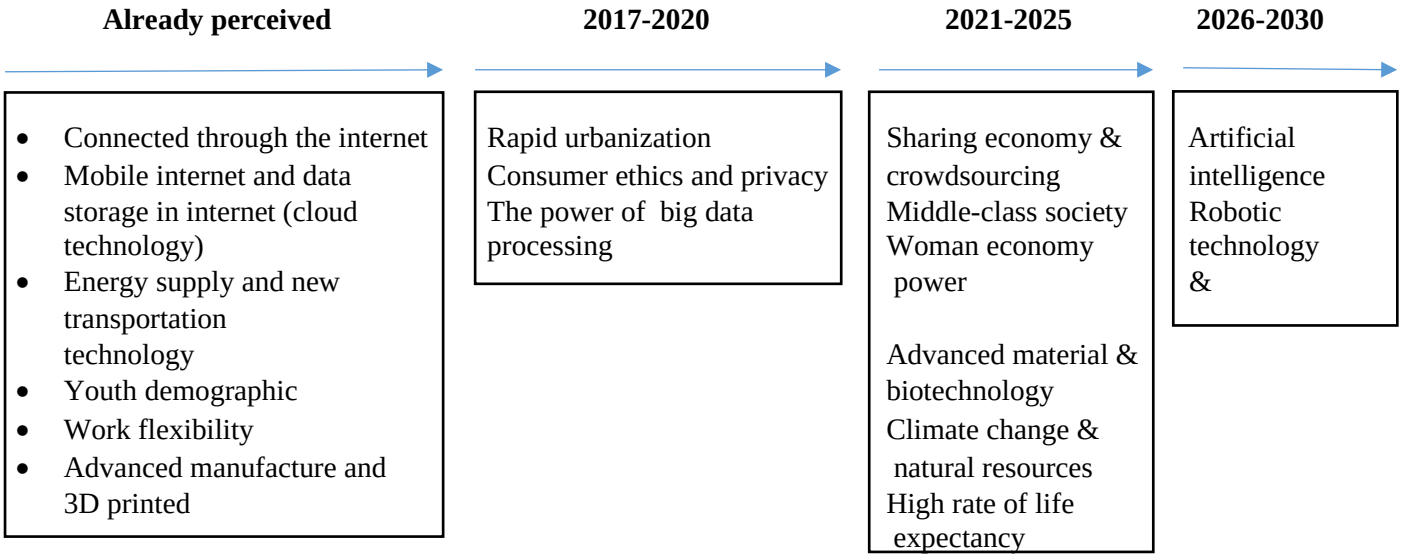

Fig 1. Global Human Capital Index by the World Economic Forum

Based on Global Human Capital Index by the World Economic Forum (WEF) 2017, Indonesia's HR ranking is in 65th position out of 130 countries, lagging behind Malaysia (33rd), Thailand (40th) and Vietnam (64th)(World Bank, 2017). Even though Indonesia's labor productivity has increased, namely from 81.9 million rupiah/person in 2017 to 84.07 million rupiah/person in 2018, Indonesian labor productivity is still lagging behind compared to Singapore and Malaysia. Apart from that, Indonesia's GDP growth was 4.9 percent in 2017, only 0.6 percent of which came from Total Factor Productivity (TFP). The remaining 2.8 percent of economic growth comes from capital and 1.5 percent from human capital. A review of these facts shows that Indonesian workers have very low work competency, which can provide an indication of how weak the human resource preparation system is in Indonesia.

The future challenge for higher education institutions in Indonesia in facing competition is the ability of their educational institutions to position themselves at par with leading universities in the world. The development of a number of universities into world-class universities has been carried out in many countries. At the Asian level, Japan is ranked first, followed by Singapore, Hong Kong, China, Korea, while universities in Indonesia have still not reached the hundredth rank as world-class universities at the Asian level. (The Times Higher Education, Download, as of August, 2014). The Times Higher Education's world-class university ranking data is based on considerations of a university's mission, teaching methods, research, knowledge transfer and international insight. The development of higher education cannot be separated from the role of lecturers. Lecturers are university human resources who have a very central and strategic role in all activities at the university. The performance of lecturers will greatly determine the high or low quality of a higher education institution that can be realized if lecturers carry out their duties with full creativity through lecturer innovation.

The world of education is currently experiencing significant changes, especially in terms of technology. Technology experiences changes and developments in every era (Desy Irsalina Savitri, 2019). This development has an impact on the role of lecturers as educators in the learning process. In this case, lecturers must be able to create a pleasant learning atmosphere and produce student graduates in accordance with educational goals. Student learning outcomes will of course also increase along with the innovations carried out by lecturers. Therefore, lecturers must have high innovation power and be

able to create tools that are able to achieve learning goals. Lecturer innovation is very necessary in today's very rapid technological era. Lecturers as innovators must have the qualities of a true leader, namely the ability to influence and the ability to create sustainable changes in a situational manner adapted to the character of the students in the class they teach. With their ability to innovate, lecturers who are innovators always become reliable lecturers, always make students have hope and are able to make students motivated in learning, besides that, lecturers must also be able to provide solutions to achieve educational goals.

The importance of superior lecturers is that they are expected to be able to solve educational problems. As stated by the Minister of Education and Culture, the complexity of the future, if human resources are good, then educational problems will be overcome. The presence of platform 4.0 has an impact on innovation that needs to be implemented by lecturers. The presence of platform 4.0 which relies on cyber-physical systems, supported by rapid technological advances, information bases, knowledge, innovation and networking, heralds the emergence of a creative century.(Sirait, 2022). Apart from that, the weak mentality of students is also one of the challenges in creating quality education. Following up on these conditions, the Ministry of Education and Culture issued a policy, one of which was called the independent learning program. The independent learning program can provide opportunities for students to be able to master various soft skill competencies that can keep up with the needs of the times and can become moral and ethical individuals.(Simatupang & Yuhertiana, 2021). This is expected to improve the quality of human resources, and freedom of learning which can create a learning environment that is free for expression and free from psychological pressure. Therefore, lecturers are expected to be able to become people who are motivated in creating comfortable and enjoyable learning for their students in order to achieve learning goals in accordance with expectations.

Lecturers as people who have the task of providing facilities and motivation in changing student behavior from not knowing to knowing more, changing student behavior for the better. Lecturers can be said to be leaders of sections/units of several individuals who respect and are committed to the changes that will be made. The lecturer is a leader in a class. A successful leader is a leader who is an innovator and an indicator. The success of an innovator is being able to create team success by being a reliable team player, being able to work together, being able to make a big contribution to the team, being able to create sustainable change situationally according to the character of the team personnel and being able to motivate the team to innovate(Enadarlita, 2019). An innovator's innovation is highly demanded to be a creative individual in developing various things in the world of education. Lecturer innovation is the ability of an innovator to introduce new ideas, methods, tools or other things, as well as being able to realize creative, useful new ideas that can provide added value. However, in reality in higher education, innovation carried out by lecturers is still said to be low. Lecturers' understanding of innovating or creating learning processes that activate students is still not clearly visible. Lecturers still do not understand the meaning and importance of innovation in learning. Apart from this, lecturers' courage in changing the rules set by university leaders is also a trigger for the problem of low lecturer innovation. Facilities in the form of campus infrastructure that are lacking can result in the innovation power of lecturers also being low. This condition results in the weakness or lack of lecturers in carrying out innovation.

Weak system for preparing the Nation's Human Resources (HR).Indonesia is influenced by various factors, one of which is the education system. The education system should not only be the basis for every human resource development process, but should also be able to make discoveries towards education that is more aligned with the needs of society and industry. This is a challenge for the education sector, for this reason universities as places where the educational process takes place and producing graduates in meeting workforce needs in the global era are increasingly being required to be able to respond to the needs of a world of work that continues to move dynamically and complexly. The challenges and demands mentioned above are trying to be answered by the education sector by presenting an educational concept where practical elements in the lecture process are carried out more than theoretical elements, which has become known as vocational education.

Referring to Law no. 20 of 2003 concerning the National Education System, the framework of the education system must be directed at national interests(National, nd). The Indonesian government, through the National Medium Term Development Plan (RPJMN) 2020-2024, launched five main directions as strategies in implementing the Nawacita mission and achieving the targets of the Indonesian Vision 2045 through economic transformation supported by industrial downstreaming by utilizing human resources (HR), infrastructure, simplification of regulations, and bureaucratic reform.

This development planning is then directed at Indonesia's achievement target of getting out of the middle-income trap so that it can become a developed country (top 5 in the world) by 2045. In connection with this, national laws and regulations mandate the importance of strengthening vocational education. Vocational education is in principle intended to provide mastery of certain applied skills and adapt to technological advances to create job opportunities. In practice, vocational education combines concepts/theories in the classroom, practice and internships in an integrated manner for students to be able and ready (directly) to meet the needs of the industrial world. Thus, vocational education should be one of the pillars of human resource development to achieve the targets set by the government.

Seeing the huge challenge of the need for an educated and skilled workforce in the future, and the condition of the existing educational system and institutions, the government finally focused on growing the components of the education sector, especially on vocational education, where vocational education is an educational model that carries excellence in the form of 70% practice and 30% % theory, with the hope that it can be one of the answers to the problem of preparing college graduates with the applied skills needed by the labor market. One form of the Government's commitment to supporting Vocational Education is by issuing a policy in the form of Presidential Instruction number 9 of 2016 concerning the Revitalization of Vocational Schools in the Context of Improving the Quality and Competitiveness of Indonesian Human Resources, where the Presidential Instruction is used as a strategic legal momentum for the development of vocational education in Indonesia (Khurniawan et al., 2021). However, the need for skilled workers in the industrial world is not only at the level of vocational school graduates, but also at the level of polytechnic graduates, both D3 and D4 graduates. For this reason, the revitalization of vocational education does not stop at vocational schools, but must also be continued with the revitalization of polytechnics.

Polytechnics are higher education institutions that only provide vocational-based education, so polytechnics do not provide academic education. Polytechnic with its vision and mission is to prepare students to become graduates with professional skills who are able to apply, develop and disseminate science and technology, so they can compete in the world of work. To produce vocational graduates with professional abilities, a lecturer profile with superior abilities is needed. Based on Law no. 14 of 2005, Lecturers are professional educators and scientists with the main task of transforming, developing and disseminating science, technology and art through education, research and community service (Pratama et al., 2022). And lecturers are required to have academic qualifications, competencies, and educational certificates, be physically and mentally healthy, and meet other qualifications required by the higher education unit where they are assigned, and have the ability to realize national education goals. Where the achievement of national education goals is greatly influenced by lecturer innovation.

Based on the Ministry of Research, Technology and Higher Education's Press Release Number: 147/SP/HM/BKKP/VIII/2019 concerning Higher Education Clusterization from around 4,670 HEIs which include: Universities, Institutes, Polytechnics, Colleges and Academies, the contribution to research and science and technology is still worrying. The Ministry of Research and Technology/National Research and Innovation Agency (Ristek/BRIN) recently announced the results of the assessment of higher education research performance for the 2016-2018 period (Simlitabmas data), namely: only 47 universities were included in the Independent group, 146 universities in the Main group, 479 universities in the Intermediate group, and 1,305 universities in the Assisted group. The number of new contributors reached 1,977 universities or only 42% of the total 4,670 universities in Indonesia, although the number of contributors in the above period showed an increase from the previous 2013-2015 period which only involved 1,447 universities.

Of the number above, only 10 (ten) universities have the highest research performance. All ten are state universities. Where are the private universities, when compared with the number of large, medium, small and micro scale business entities which amount to 56,539 560 (BPS, 2012), then there are still many opportunities for academics from Indonesian universities, the number of which is still relatively small, 89.5 per one million people contributing to research and innovation(National Research and Innovation Agency, nd)

Based on this data, it can be seen that the research level of lecturers is still low, this can show the activeness of lecturers in innovating because research is a form of proof of innovation carried out by lecturers. Where higher education is the basis for the development of science and technology, not only achieving professional graduates in the engineering field who are able to compete with foreign workers, in this era of globalization, but also being able to become a hub for research, technology, smart networks, and creating world civilization. .

Fajar & Hartanto, (2019) revealed thatThere are still things that can be improved, such as increasing the competency of vocational lecturers, strengthening pentahelix synergy and collaboration, revitalizing vocational education by adding a teaching factory, rebranding through direct studies to industry and comparative studies to more advanced educational institutions both inside and outside country, as well as adding and improving the character of students. Thus, it is hoped that vocational education can play a real role in efforts to achieve government programs to make Indonesia developed by preparing superior human resources.

In order to fulfill the needs of vocational graduates in the world of work in the industrial era 4.0 along with technological developments, of course innovation is needed by Polytechnic lecturers in preparing vocational graduates. To improve the quality of vocational education, especially in facing technological advances in the era of industry 4.0 and society 5.0. So the need for quality teaching staff must be answered by increasing innovation, competence, personality, motivation, polytechnic conditions, communication, and others which are carried out on an ongoing basis.

Lecturer innovation can be measured, one of the ways, by the amount of research conducted, because innovation itself is essentially research that produces new findings. To see the new findings produced, one source is published journal data.

The research location taken was the Jakarta State Polytechnic, where the Politeknik Negeri Jakarta is a vocational education institution established to meet the needs of professional human resources in industry, both the service industry and the manufacturing industry. Based on clustering data released by the Ministry of Research, Technology and Higher Education through Press Release Number: 147/SP/ HM/BKKP/VIII/2019 concerning Higher Education Clustering, the Jakarta State Polytechnic is included in cluster 3.

The following is a table of the number of lecturers who support lectures with various educational qualifications and functional positions with the following data composition:

Table 1. Lecturer Composition Based on Functional Positions

No.	Functional	Lecturer Status	
		Still	**Not fixed**
1.	Without Position	58	28
2.	Expert Assistant	85	1
3.	Lector	110	-
4.	Associate Professor	115	-
5.	Professor	1	-
	Amount	369	29

Source: Higher Education Database, Ministry of Education, Culture, Research, and Technology

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Table 2. Lecturer Composition based on Education Level

No.	Educational level	Lecturer Status	
		Still	**Not fixed**
1.	S3	40	1
2.	Applied PhD	-	-
3.	S2	324	19
4.	Applied Masters	1	-
5.	Sp-1	-	-
6.	Profession	-	-
7.	S1	4	9
	Amount	**369**	**29**

Source: Higher Education Database, Ministry of Education, Culture, Research, and Technology

Based on the conditions above, research related to lecturer innovation is needed to reveal and analyze what factors influence and dominate, so that efforts can be made to increase lecturer innovation.

2. RESEARCH METHOD

The research was conducted on lecturers at the Jakarta State Polytechnic (PNJ) which was carried out for 6 months from February to August 2022.

This research uses a combination research method between Quantitative Research and SITOREM Analysis. This combined research methodology flow uses a quantitative research flow which is analyzed using SITOREM analysis. As stated by S. Hardhienata (2017: 166), For the purposes of operations research in education management, we need to add the scientific identification theory mentioned above with statistical model and steps to obtain an optimal solution (For the purposes of Educational Management research, we need to add the scientific identification theory mentioned above with a model statistics and steps to obtain optimal solutions).

In summary, this research design consists of two major stages, namely

a. This research consists of quantitative research to prove the research hypothesis
b. Verify quantitative research results through SITOREM analysis, as in the research steps in the image below.

The research population was 398 lecturers at Politeknik Negeri Jakarta. The total research sample was 200 lecturers determined using the Slovin Formula (Umar, 2014).

Research data was obtained using instruments in the form of questionnaires consisting of instruments to measure: 1. Lecturer Innovation, 2. Personality, 3. Transformational Leadership, 4. Organizational Culture and 5. Work Motivation. Respondents who filled out the five instruments were lecturers at Politeknik Negeri Jakarta. The instruments for each variable were developed successively from conceptual definitions, operational definitions and instrument grids. Testing the validity of the test items and the reliability of the instrument is based on the results of testing the instrument on 30 test respondents. The results of the validity test and reliability test of the research instruments are as described in table 2 below:

Table 3. Validity and Reliability Test Results of Research Instruments

Variable Name	Number of Question Items	Valid statement	Reliability value	Conclusion
Lecturer Innovation	40	36	0.944	*valid*and reliable
Personality	40	38	0.945	*valid*and reliable
Transformational leadership	40	36	0.942	*valid*and reliable

Organizational culture	40	36	0.937	*valid*and reliable
Work motivation	40	36	0.926	*valid*and reliable

The data then was analysed through quantitative data analysis and SITOREM analysis. The quantitative data analysis was done through some stages such as:

a. The research data were analyzed using descriptive statistics, analysis prerequisite tests which included the Estimated Standard Error Normality Test (Liliefors), the Homogeneity of Variations Test (Barlet),
b. Linearity Test (if Fcount < Ftable with a significance level of 0.05)
c. Hypothesis testing using Linear Regression (calculations are entered into the ANOVA list to obtain Fcount), Multiple Regression (Model Summary, namely r value) (F Test) and Path Analysis Test using the SPSS Ver 26 tool

The SITOREM analysis was carried out to derive recommendations from the results of quantitative research and to determine the priority order for improvements that need to be carried out. The basic considerations used to derive recommendations and priority order for handling improvements include 3 (three) criteria, such as:

a. Strength of influence between independent and dependent variables
b. Priority order of indicators of the variables studied
c. Indicator values obtained from research results in the field

The research hypothesis is as follows:

a) Direct influence positive between personality (X1) and lecturer innovation (Y)
H0: $\beta y1 \leq 0$ There is no effect direct positive between personality (X1) and lecturer innovation (Y)
H1: $\beta y1 > 0$ There is influence direct positive between personality (X1) and lecturer innovation (Y)

b) Direct influence positive between personality (X1) and lecturer innovation (Y)
H0: $\beta y1 \leq 0$ There is no effect direct positive between personality (X1) and lecturer innovation (Y)
H1: $\beta y1 > 0$ There is influence direct positive between personality (X1) and lecturer innovation (Y)

c) Direct influence positive between organizational culture (X3) and lecturer innovation (Y)
H0: $\beta y3 \leq 0$ There is no influence direct positive between organizational culture (X3) and lecturer innovation (Y)
H1: $\beta y3 > 0$ There is influence direct positive between organizational culture (X3) and lecturer innovation (Y)

d) Direct influence positive between organizational culture (X3) and lecturer innovation (Y)
H0: $\beta y3 \leq 0$ There is no influence direct positive between organizational culture (X3) and lecturer innovation (Y)
H1: $\beta y3 > 0$ There is influence direct positive between organizational culture (X3) and lecturer innovation (Y)

e) Direct influence positive between organizational culture (X3) and lecturer innovation (Y)
H0: $\beta y3 \leq 0$ There is no influence direct positive between organizational culture (X3) and lecturer innovation (Y)
H1: $\beta y3 > 0$ There is influence direct positive between organizational culture (X3) and lecturer innovation (Y)

f) Direct influence positive between organizational culture (X3) and lecturer innovation (Y)
H0: $\beta y3 \leq 0$ There is no influence direct positive between organizational culture (X3) and lecturer innovation (Y)
H1: $\beta y3 > 0$ There is influence direct positive between organizational culture (X3) and lecturer innovation (Y)

g) Direct influence positive between organizational culture (X3) and lecturer innovation (Y)
H0: $\beta y3 \leq 0$ There is no influence direct positive between organizational culture (X3) and lecturer innovation (Y)
H1: $\beta y3 > 0$ There is influence direct positive between organizational culture (X3) and lecturer innovation (Y)

h) Direct influence positive between organizational culture (X3) and lecturer innovation (Y)

H0: βy3 ≤ 0 There is no influence direct positive between organizational culture (X3) and lecturer innovation (Y)
H1: βy3 > 0 There is influence direct positive between organizational culture (X3) and lecturer innovation (Y)

i) Direct influence positive between organizational culture (X3) and lecturer innovation (Y)

H0: βy3 ≤ 0 There is no influence direct positive between organizational culture (X3) and lecturer innovation (Y)
H1: βy3 > 0 There is influence direct positive between organizational culture (X3) and lecturer innovation (Y)

j) Indirect influence positive between organizational culture (X3) and lecturer innovation (Y) through work motivation (X4)

H0: β34y ≤ 0 There is no influence whatsoever direct positive between organizational culture (X3) and lecturer innovation (Y) through work motivation (X4)
H1: β34y > 0 There is no influence direct positive between organizational culture (X3) and lecturer innovation (Y) through work motivation (X4)

Based on the constellation of research variables above, a statistical mathematical model can then be prepared as follows:

a. Substructural Equation 1

$\hat{y} = y1 + y2 + y3 + y4 + y$

b. Substructural Equation 2

$\hat{y} = x1 + x2 + x3 + y$

3. RESULTS AND DISCUSSION

A. Descriptive Statistics

Based on the results of the analysis of statistical descriptions for research variables, symptoms of data concentration can be revealed as listed in table 3 below:

Table 4. Summary of Statistical Description of Research Variables

No.	Description	Personality (X1)	Transformational leadership (X2)	Organizational culture (X3)	Work motivation (X4)	Lecturer Innovation (Y)
1.	Average (Mean)	142,815	136.27	134,295	141.51	138,095
2.	Standard Error	1.94	1.57	1.66	1.43	1.52
3.	Middle Value (Median)	144.5	136.5	135	138.5	140
4.	Mode (Mode)	143	148	136	174	142
5.	Standard Deviation (Stand. Deviation)	27.40	22.16	23.49	20.27	21.45
6.	Sample Variance (Sample Variance)	750.99	490,922	551.78	410.94	459.91

7.	Kurtosis	-0.076	-0.269	-0.430	-0.165	-0.568
8.	Curve Slope	-0.541	-0.042	-0.221	-0.067	-0.060
9.	Range	129	110	125	111	105
10.	Smallest Score (Minimum)	61	70	55	69	75
11.	Biggest Score (Maximum)	190	180	180	180	180
12.	Amount (Sum)	28563	27254	26859	28302	27619
13.	Number of Respondents (Count)	200	200	200	200	200

Data Source: Processed

B. Normality Test

Based on the overall calculation results of the error normality test in this study, it can be seen in the summary in table 4 below:

Table 5. Estimated Standard Error Normality Test

No	**Estimate Error**	**N**	**Lcount**	**Table**		**Decision**
				α = 0.05	α = 0.01	
1	Y–X1	200	0.004	0.063	0.073	Normal
2	Y–X2	200	0.004	0.063	0.073	Normal
3	Y–X3	200	0.006	0.063	0.073	Normal
4	Y–X4	200	0.009	0.063	0.073	Normal
5	X4–X1	200	0.004	0.063	0.073	Normal
6	X4–X2	200	0.004	0.063	0.073	Normal
7	X4–X3	200	0.006	0.063	0.073	Normal

Normal distribution requirements: Lcount < Ltable

Data Source: Processed

C. Homogeneity Test

Based on the overall calculation results of the error normality test in this study, it can be seen in the summary in table 5 below:

Table 6. Summary of Data Variance Homogeneity Test

No	Grouping	X2count	X2 table	Conclusion
			α = 0.05	
1.	Y on the basis of X1	5794.38	9668.15	Homogeneous
2.	Y on the basis of X2	4526.26	7346.81	Homogeneous
3.	Y on the basis of X3	4919.64	8098.77	Homogeneous

4.	Y on the basis of X4	4062.72	6373.13	Homogeneous
5.	X4 on the basis of X1	5687.55	9668.15	Homogeneous
6.	X4 on the basis of X2	4463.92	7346.81	Homogeneous
7.	X4 on the basis of X3	4864.84	8098.77	Homogeneous

Requirements for a homogeneous population $\chi 2$ count < $\chi 2$ table

D. Linearity Test

The overall calculation results of the linearity test of the regression model in this study can be seen in the summary in table 6 below:

Table 7. Summary of Regression Model Linearity Test Results (t Test)

No	Linearity Test	Fcount	Ftable	Sig	Conclusion
1	Lecturer Innovation (Y) → Personality (X1)	0.841	0.193	0.009	Linear
2	Lecturer Innovation (Y) → Transformational Leadership (X2)	2,316	1,390	0,000	Linear
3	Lecturer Innovation (Y) → Organizational Culture (X3)	2,233	1,819	0,000	Linear
4	Lecturer Innovation (Y) → Work Motivation (X4)	1,084	0.052	0.007	Linear
5	Work Motivation (X4) → Personality (X1)	1,011	0.824	0.004	Linear
6	Work Motivation (X4) → Transformational Leadership (X2)	1,908	0.937	0.001	Linear
7	Work Motivation (X4) → Organizational Culture (X3)	1,959	0.593	0,000	Linear

Data source: Data processed

E. Multicollinearity Test

Multicollinearity testing aims to determine whether the regression model found any correlation between independent variables or independent variables. Testing uses the Spearman Test. The effect of this multicollinearity is that it causes high variability in the sample. This means that the standard error is large, as a result, when the coefficient is tested, tcount will be a smaller value than ttable. The overall calculation results of the multicollinearity test are as follows:

Table 8. Summary of Multicollinearity Test

Variable Free	**Tolerance**	**VIF**	**Precondition**	**Conclusion**
Personality (X1)	0.485	2,064	H0: VIF < 10, there is no multicollinearity H1: VIF > 10, there is multicollinearity	Ho is accepted. There is no multicollinearity

Transformational Leadership (X2)	0.353	2,831	H0: VIF < 10, there is no multicollinearity H1: VIF > 10, there is multicollinearity	Ho is accepted. There is no multicollinearity
Organizational culture (X3)	0.368	2,718	H0: VIF < 10, there is no multicollinearity H1: VIF > 10, there is multicollinearity	Ho is accepted. There is no multicollinearity
Work Motivation (X4)	0.317	3,159	H0: VIF < 10, there is no multicollinearity H1: VIF > 10, there is multicollinearity	Ho is accepted. There is no multicollinearity

Source: Processed Data

F. Heteroscedascity Test

In this research, to test whether there is heteroscedascticity using testGlejser where if the significant value is <0.05 then heteroscedasticity occurs, if on the contrary the significance value is ≥ 0.05 then homoscedasticity occurs. The overall calculation results of the heteroscedasticity test in this study can be seen in the summary in table 8 below:

Table 9. Summary of Heteroscedasticity

Variable	Sig.	α	Precondition	Conclusion
Personality (X1)	0,000	0.05	H0: significant value < 0.05 means there is no heteroscedasticity. H1: mark significant ≥ 0.05 then there is heteroscedasticity.	Ho accepted None heteroscedasticity
			H0: significant value < 0.05 means there is	Ho accepted

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Transformational Leadership (X2)	0,000	0.05		no heteroscedasticity.	None heteroscedasticity
			H1:	mark significant ≥ 0.05 then there is heteroscedasticity.	
Organizational culture (X3)	0,000	0.05	H0:	significant value < 0.05 means there is no heteroscedasticity.	Ho accepted None heteroscedasticity
			H1:	mark significant ≥ 0.05 then there is heteroscedasticity.	
Work Motivation (X4)	0,000	0.05	H0:	significant value < 0.05 means there is no heteroscedasticity.	Ho accepted None heteroscedasticity
			H1:	mark significant ≥ 0.05 then there is heteroscedasticity.	

Source: Processed Data

G. Correlation Test

The complete correlation between variables tested using SPSS is shown in table 9 below:

Table 10. Correlation Test between Variables

		Lecturer Innovation_Y	Personality_X1	Transformational Leadership_X2	Organizational Culture_X3	Work Motivation_X4
Lecturer	Pearson	1	,720**	,783**	,765**	,815**

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	Correlation					
Innovation_Y	Sig. (2-tailed)		,000	,000	,000	,000
	N	200	200	200	200	200
	Pearson Correlation	,720**	1	,663**	,599**	,675**
Personality_X1	Sig. (2-tailed)	,000		,000	,000	,000
	N	200	200	200	200	200
	Pearson Correlation	,783**	,663**	1	,725**	,745**
Transformational Leadership_X2	Sig. (2-tailed)	,000	,000		,000	,000
	N	200	200	200	200	200
	Pearson Correlation	,765**	,599**	,725**	1	,756**
Organizational Culture_X3	Sig. (2-tailed)	,000	,000	,000		,000
	N	200	200	200	200	200
	Pearson Correlation	,815**	,675**	,745**	,756**	1
Work Motivation_X4	Sig. (2-tailed)	,000	,000	,000	,000	
	N	200	200	200	200	200

**.Correlation is significant at the 0.01 level (2-tailed).

H. Path Analysis

The influence of the path as a whole by combining the results of the analysis on each substructure can be described as follows:

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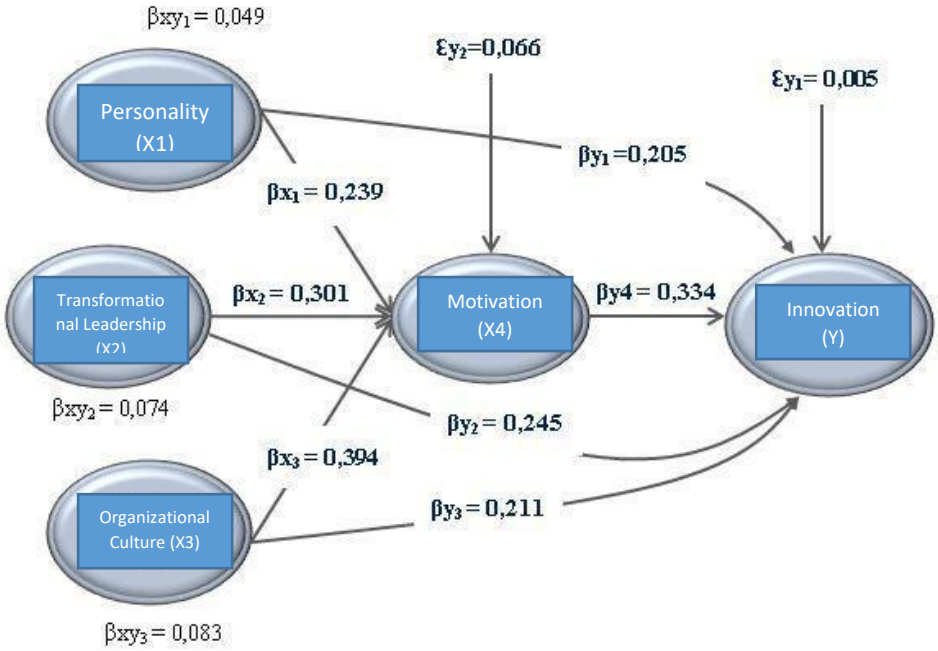

Fig 2. Path Analysis Results

The influence between the independent variable and the dependent variable when viewed from path analysis, then this relationship is a functional relationship where Lecturer Innovation (Y) is formed as a result of the functioning of the functions of National Personality (X1), Transformational Leadership (X2), Organizational Culture (X3) and Motivation Work (X4). Discussion of research results can be described as follows:

Table 11. Research Hypothesis

No	Hypothesis	Path Coefficient	Statistic Test	Decision	Conclusion
1	Personality (X1) on Lecturer Innovation (Y)	0.205	H0: βy1 ≤ 0 H1: βy1 > 0	H0 is rejected H1 is accepted	Influential direct positive
2	Transformational Leadership (X2) on Lecturer Innovation (Y)	0.245	H0: βy2 ≤ 0 H1: βy2 > 0	H0 is rejected H1 is accepted	Influential direct positive
3	Organizational Culture (X3) on Lecturer Innovation (Y)	0.211	H0: βy3 ≤ 0 H1: βy3 > 0	H0 is rejected H1 is accepted	Influential direct positive
4	Work Motivation (X4) on Lecturer Innovation (Y)	0.334	H0: βy4 ≤ 0 H1: βy4 > 0	H0 is rejected H1 is accepted	Influential direct positive
5	Personality (X1) on Work Motivation (X4)	0.239	H0: xy1 ≤ 0 H1: xy1 > 0	H0 is rejected H1 is accepted	Influential direct positive
6	Transformational Leadership (X2) on Work Motivation (X4)	0.301	H0: xy2 ≤ 0 H1: xy2 > 0	H0 is rejected H1 is accepted	Influential direct positive
7	Organizational Culture (X3) on Work Motivation (X4)	0.394	H0: xy3 ≤ 0 H1: xy3 > 0	H0 is rejected H1 is accepted	Influential direct positive
8	Personality (X1) on Lecturer Innovation (Y) through Work Motivation (X4)	0.049	H0: xy1 ≤ 0 H1: xy1 > 0	H0 is rejected H1 is accepted	Influential direct positive
9	Transformational Leadership	0.074	H0: βxy2 ≤ 0 H1: βxy2 > 0	H0 is rejected H1 is accepted	Influential direct positive

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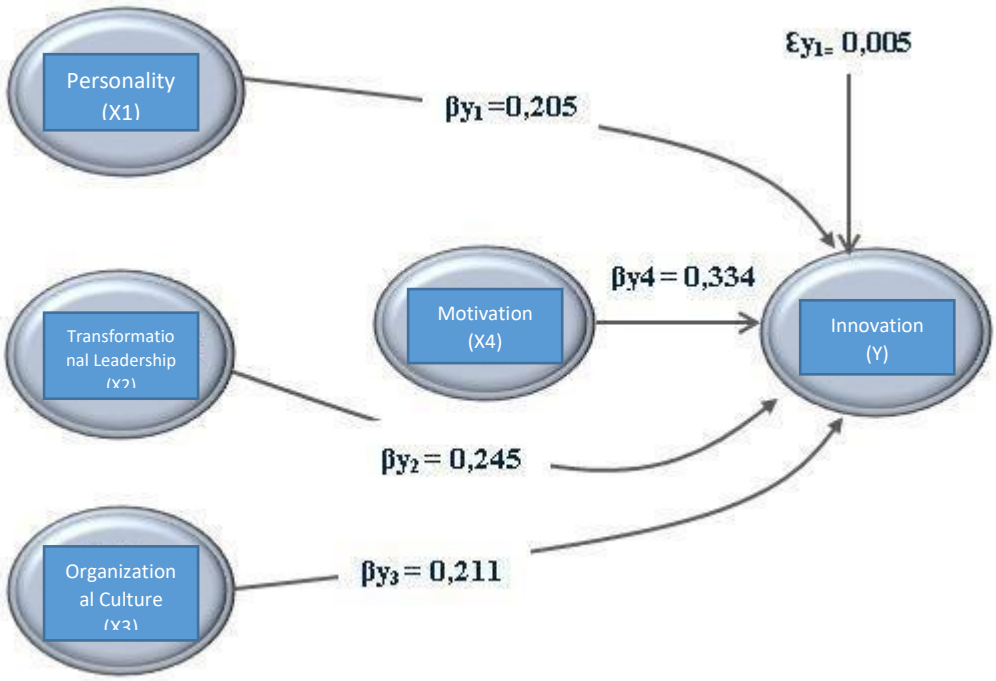
	(X2) towards Lecturer Innovation (Y) through Work Motivation (X4)				
10	Organizational Culture (X3) on Lecturer Innovation (Y) through Work Motivation (X4)	0.083	H0: βxy3 ≤ 0 H1: βxy3 > 0	H0 is rejected H1 is accepted	Influential direct positive

Data source: processed

I. Statistical Mathematical Models

Based on the constellation of influences between variables, a statistical mathematical model is produced as follows:

1) Substructural Equation 1



Based on the results of path analysis, the path model in substructure-1 is as follows$\hat{y}$ = 0.205x1 + 0.245x2 + 0.211x3 + 0.334 x4 + y1

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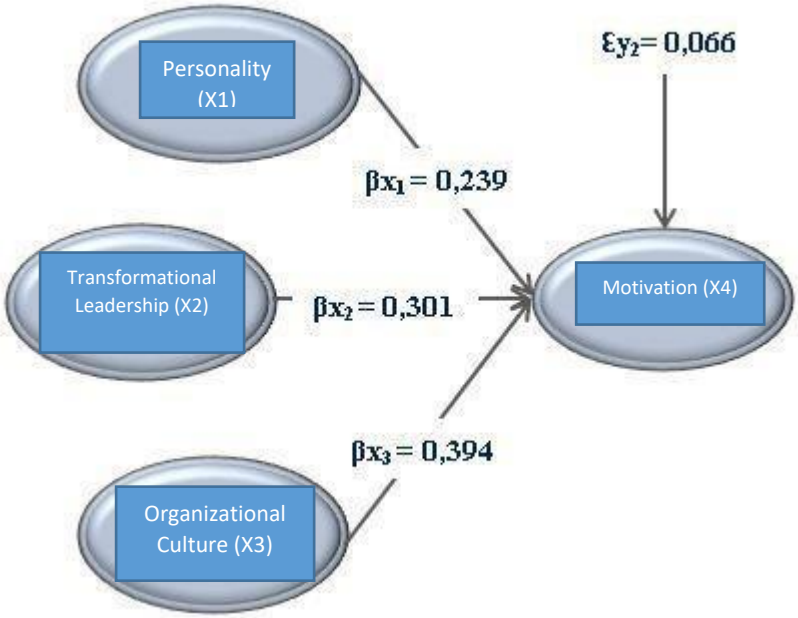
2) Substructural Equation 2



Based on the results of path analysis, the path model in substructure-2 is as follows ŷ=0.239x1+0.301x2+0.394x3+ y2

J. Indirect Effect Test

The indirect effect test is used to test the effectiveness of the intervening variable which mediates the independent variable and the dependent variable. The results of the indirect influence test can be seen in the following table:

Table 12. Research Hypothesis

No	Influence indirect	Zcount	Ztable	Decision	Conclusion
1	Personality (X1) on Lecturer Innovation (Y) through Work Motivation (X4)	5.619	1.966	H0 is rejected H1 is accepted	There is a significant indirect effect of personality (X1) on lecturer innovation (Y) through work motivation (X4)
2	Transformational Leadership (X2) towards Lecturer Innovation (Y) through Work Motivation (X4)	6.686	1.966	H0 is rejected H1 is accepted	There is a significant indirect effect of transformational leadership (X2) on lecturer innovation (Y) through work motivation (X4)
3	Organizational Culture (X3) towards Lecturer Innovation (Y) through Motivation Work (X4)	5.612	1.966	H0 is rejected H1 is accepted	There is a significant indirect effect of organizational culture (X1) on lecturer innovation (Y) through work motivation (X4)

K. Optimal Solution for Increasing Lecturer Innovation

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Based on the results of statistical hypothesis testing, determining indicator priorities, and calculating indicator values as described above, a recapitulation of research results can be made which is the optimal solution for improving lecturer innovation such as the following:

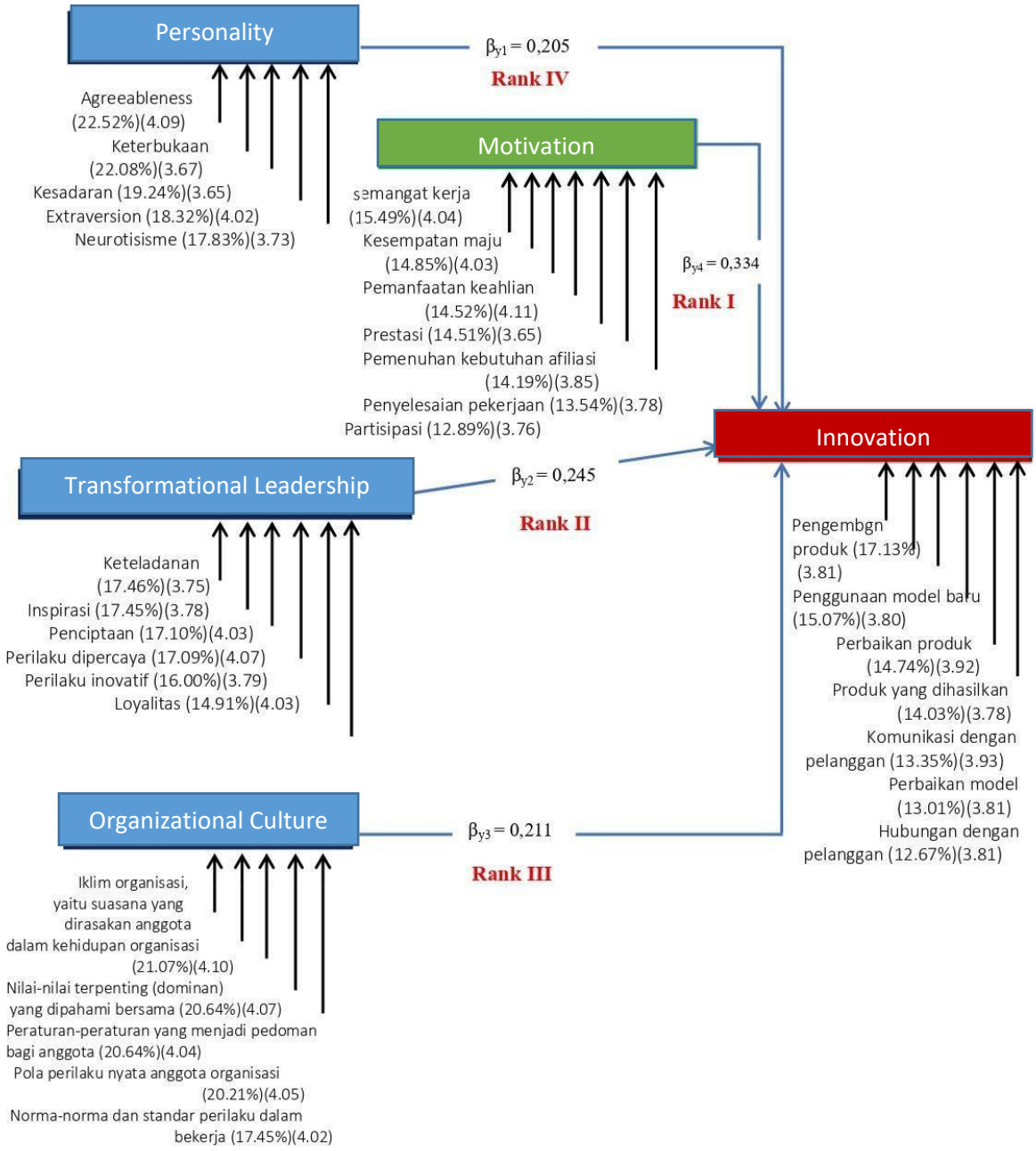

Fig. 3 Constellation of Research Variables and Indicators

Based on the results of the SITOREM analysis, we can know the value for each variable and the final results of the variables that are a priority for improvement and the variables that are a priority for improvement, as follows:

Table 13. SITOREM Analysis

Lecturer Innovation			
Indicators in Initial State		Indicator after Weighting by Expert	Indicator Value
Products produced	1st	Product development (17.13%)	3.81

Product improvements	2nd	Use of new models (15.07%)	3.8
Product development	3rd	Product improvement (14.74%)	3.92
Use of new models	4th	Products produced (14.03%)	3.78
Model improvements	5th	Communication with customers (13.35%)	3.93
Communication with customers	6th	Model improvements (13.01%)	3.81
Relationship with customers	7th	Relationship with customers (12.67%)	3.81

Personality (βY1 = 0.205)(IV)			
Indicators in Initial State		Indicator after Weighting by Expert	Indicator Value
Awareness	1st	Agreeableness (22.52%)	4.09
Agreeableness	2nd	Openness (22.08%)	3.67
Neuroticism	3rd	Awareness (19.24%)	3.65
Openness	4th	Extraversion (18.32%)	4.02
Extraversion	5th	Neuroticism (17.83%)	3.73

Transformational Leadership (βy2 = 0.245)(II)			
Indicators in Initial State		Indicator after Weighting by Expert	Indicator Value
Exemplary	1st	Exemplary (17.46%)	3.75
Trustworthy behavior	2nd	Inspiration (17.45%)	3.78
Inspiration	3rd	Creation (17.10%)	4.03
Creation	4th	Trustworthy behavior (17.09%)	4.07
Innovative behavior	5th	Innovative behavior (16.00%)	3.79
Loyalty	6th	Loyalty (14.91%)	4.03

Organizational Culture (βy3 = 0.211)(III)			
Indicators in Initial State		Indicator after Weighting by Expert	Indicator Value
Real behavior patterns of organizational members	1st	Organizational climate is the atmosphere felt by members in organizational life (21.07%)	4.10
Norms and standards of behavior at work	2nd	The most important (dominant) values that are mutually understood (20.64%)	4.07
The most important (dominant) values that are mutually understood	3rd	Regulations that serve as guidelines for members (20.64%)	4.04
Rules that serve as guidelines for members	4th	Real behavioral patterns of organizational members (20.21%)	4.05
Organizational climate is the atmosphere felt by members in organizational life	5th	Norms and standards of behavior at work (17.45%)	4.02

Organizational Culture (βy3 = 0.211)(III)			
Indicators in Initial State		Indicator after Weighting by Expert	Indicator Value
Real behavior patterns of organizational members	1st	Organizational climate is the atmosphere felt by members in organizational life (21.07%)	4.10
Norms and standards of behavior at work	2nd	The most important (dominant) values that are mutually understood (20.64%)	4.07
The most important (dominant) values that are mutually understood	3rd	Regulations that serve as guidelines for members (20.64%)	4.04
Rules that serve as guidelines for members	4th	Real behavioral patterns of organizational members (20.21%)	4.05

Organizational climate is the atmosphere felt by members in organizational life	5th	Norms and standards of behavior at work (17.45%)	4.02

Work Motivation (βy4 = 0.334)(I)			
Indicators in Initial State		Indicator after Weighting by Expert	Indicator Value
Performance	1st	Work morale (15.49%)	4.04
Utilization of expertise	2nd	Opportunity to advance (14.85%)	4.03
Spirit at work	3rd	Skills utilization (14.52%)	4.11
Completion of work	4th	Achievement (14.51%)	3.65
Fulfillment of affiliate needs	5th	Fulfillment of affiliate needs (14.19%)	3.85
Opportunity to advance	6th	Job completion (13.54%)	3.78
Participation	7th	Participation (12.89%)	3.76

SITOREM Analysis Results			
Priority order of indicators to be strengthened		**Indicator remains to be maintained**	
Work Motivation (βy4 = 0.334)(I)			
1st	Achievement (14.51%)(3.65)	1	Work morale (15.49%)(4.04)
2nd	Fulfillment of affiliate needs (14.19%)(3.85)	2	Opportunity to advance (14.85%)(4.03)
3rd	Job completion (13.54%)(3.78)	3	Skills utilization (14.52%)(4.11)
4th	Participation (12.89%)(3.76)		
Transformational Leadership (βy2 = 0.245)(II)			
5th	Exemplary (17.46%)(3.75)	4	Creation (17.10%)(4.03)
6th	Inspiration (17.45%)(3.78)	5	Trustworthy behavior (17.09%)(4.07)
7th	Innovative behavior (16.00%)(3.79)	6	Loyalty (14.91%)(4.03)
Organizational Culture **(βy3 = 0.211) (III)**			
		7	Organizational climate, namely the atmosphere felt by members in organizational life (21.07%) (4.10)
		8	The most important (dominant) values that are mutually understood (20.64%) (4.07)
		9	Regulations that serve as guidelines for members (20.64%) (4.04)
		10	Real behavior patterns of organizational members (20.21%) (4.05)
		11	Norms and standards of behavior at work (17.45%) (4.02)
Personality (**βY1 = 0.205**) (IV)			
8th	Openness (22.08%) (3.67)	12	Agreeableness (22.52%)(4.09)
9th	Awareness (19.24%) (3.65)	13	Extraversion (18.32%)(4.02)
10th	Neuroticism (17.83%) (3.73)		
Lecturer Innovation (Y)			
11th	Product development (17.13%) (3.81)		
12th	Use of new models (15.07%) (3.80)		
13th	Product improvement (14.74%) (3.92)		
14th	Products produced (14.03%) (3.78)		
15th	Communication with customers (13.35%) (3.93)		
16th	Model improvements (13.01%) (3.81)		

17th	Relationships with customers (12.67%) (3.816)

Source: Data processed

4. CONCLUSION

This research has succeeded in finding ways and strategies to increase lecturer innovation through identifying strengths influence between research variables. Furthermore, this research has produced findings regarding research variable indicators that need to be improved and maintained. Based on the results of the analysis, discussion of research results and hypotheses that have been tested, it can be concluded as follows:

a. There is an immediate positive influence personality (X1) towards lecturer innovation (Y), with path coefficient (y1) = 0.205, so personality strengthening (X1) can improve lecturer innovation (Y).
b. There is influence positive direct transformational leadership (X2) towards lecturer innovation (Y), with the path coefficient value (y2) = 0.245, so that transformational leadership is strengthened (X2) can improve lecturer innovation (Y).
c. There is Influence positive direct organizational culture (X3)towards lecturer innovation (Y),with path coefficient (y3) = 0.211, thus strengthening organizational culture (X3) can improve lecturer innovation(Y).
d. There is influence positive direct motivation Work(X4) towards lecturer innovation (Y), with the path coefficient value (y4) = 0.334, so it is strengthening motivation Work(X4) can improve lecturer innovation (Y).
e. There is influence positive direct personality (X1) on motivation Work(X4), with a path coefficient value (βy41) = 0.239, so it is strengthening personality (X1) can improve motivation Work(X4).
f. There is influence positive direct transformational leadership (X2) on motivation Work(X4), with the path coefficient value (y42) = 0.301, so it is strengthening transformational leadership (X2) can improve motivation Work(X4).
g. There is influence positive directly organizational culture (X3) on motivation Work(X4),with the path coefficient value (y43) = 0.394, so it is strengthening organizational culture (X3) can improve motivation Work(X4).
h. There is influence positive indirect personality (X1) towards lecturer innovation (Y) through motivation Work(X4), with the path coefficient value (xy1) = 0.049, so it is strengthening personality (X1) can increase lecturer innovation (Y) through motivation Work(X4).
i. There is influence positive indirect transformational leadership (X2) towards lecturer innovation (Y) through motivation Work (X4), with the path coefficient value (xy2) = 0.074, so it is strengthening transformational leadership (X2) can increase lecturer innovation (Y) through motivation Work (X4).
j. There is influence positive indirectly organizational culture (X3) on lecturer innovation (Y) through motivation Work (X4), with the path coefficient value (xy3) = 0.083, so it is strengthening organizational culture (X3) can increasing lecturer innovation (Y) through motivation Work(X4).
k. Based on the SITOREM analysis, the optimal solution is obtained as follows:
    1) Priority order for handling indicators that will be strengthened
        - 1st Achievement (14.51%) (3.65)
        - 2nd Fulfillment of affiliate needs (14.19%) (3.85)
        - 3rd Job completion (13.54%) (3.78)
        - 4th Participation (12.89%) (3.76)
        - 5th Exemplary (17.46%) (3.75)
        - 6th Inspiration (17.45%) (3.78)
        - 7th Innovative behavior (16.00%) (3.79)
        - 8th Openness (22.08%) (3.67)
        - 9th Awareness (19.24%) (3.65)
        - 10th Neuroticism (17.83%) (3.73)
        - 11th Product development (17.13%) (3.81)
        - 12th Use of new models (15.07%) (3.80)
        - 13th Product improvement (14.74%) (3.92)

- 14th Products produced (14.03%) (3.78)
- 15th Communication with customers (13.35%) (3.93)
- 16th Model improvements (13.01%) (3.81)

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Implications of Digital Library Transformation on the Learning Process of Accounting Education Students

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ABSTRACT

The purpose of this study was to determine the impact of digital Digital transformation in the library on the learning process of accounting education students, Faculty of Teacher Training and Education, Universitas Muhammadiyah Sumatera Utara, Indonesia. This research uses a quantitative approach because the observed phenomena are converted into numbers that are analysed using statistics. The sample in this study consisted of 79 students of accounting education programme. The results showed that there was an effect of digital transformation in the library on the students' learning process. This can be shown by the Fcount score of 97.639 with a significance level of 0.000 <0.05, in other words, there is an influence of the library digital transformation variable (X) on the students' learning process (Y). In addition, the coefficient of determination (R2) of 0.559 or 55.9% is influenced by the digital transformation in the library and is significant for the learning process of the students of the accounting education programme, while the remaining 44.1% is influenced by other variables not studied.
Keywords: Digital Transformation, Digital Library, Students' Learning Process.

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1. INTRODUCTION

The role of education cannot be separated in the effort to achieve a quality Indonesian society. Education is a conscious and planned attempt to create a learning atmosphere and learning process in order for students to be able to actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character and skills needed by themselves, society, nation and state (Ahsanul Husna et al., 2014). The learning process is one of the things that determine the achievement of educational goals. It is a designed activity to strengthen students' understanding of the material as a result of learning activities.

According to (Abdul Istiqlal, 2018) the learning process is something that is conducted through both formal and non-formal education. In organising formal education, educators and students are required to be more creative in order to achieve the expected educational goals. According to Sani and Abdullah (2016) states that in social constructivism learning theory, the success of students or learners is measured based on their learning process, where students need facilities that assist students during the learning process.

The success of the learning process cannot be separated from the various factors that influence it. According to Amna Emda (2014), the development of the learning process is divided into two factors, which are internal factors and external factors. Internal factors include health, intelligence, talent, interest, motivation and learning methods. Whereas external factors include family, quality of lecturers, teaching methods, available facilities/equipment, room conditions, community, environment and so forth.

According to Yani Riyani (2018), one of the factors that affect the quality of the learning process is the facilities and infrastructure factor, which is all those things that greatly affect the smooth running of the learning process, such as classrooms, libraries, toilets and so on. Some of these factors can promote passion in the learning process. One of the facilities that support the learning and teaching process in the school is the library (Sani, Abdullah, 2016). In this case, it can be seen that infrastructural facilities are one of the factors that greatly affect the learning outcomes of the students

Jose Antonio Gomes JHernandez (2010) in his research revealed that the library has made great commitment to achieve several objectives such as developing digital repositories for research and learning, implementing a resource centre model for learning and research, carrying out general and specific user training, publishing tutorials and guidelines for information management, organising thematic digital resources, providing OpenCourseWare, promoting reference services, using social networks, supporting lecturers in preparing new teaching materials and so on. Thus, it can be seen that the library plays a very important role in supporting the learning process or academic activities in an educational institution, especially in a university.

Based on previous studies conducted by (Rivaldo, 2017) and (Cynthia et al., 2015) on the effect of learning infrastructure facilities on the learning process, this study found significant results that learning facilities affect the process and learning outcomes. Therefore, it can be concluded that the learning process of students is not only influenced by intelligence factors, but there are various factors that influence both external and internal.

Alifah (2016) asserted that the role of the library is very important in supporting the educational process, because the library provides various sources of information that we need. In this case, the library can be a means of providing information and reference sources both offline and online provided by universities, a factor that can affect the learning process of students. The provision of library facilities in every university aims to provide information and various sources of knowledge that can help broaden horizons through collections of library materials, scientific journals and scientific works. The existence of a library will help students to find, select and read reference books in order to obtain the desired information (Dongoran & Febriyana, 2020).

The role of the library is aligned with previous research proposed by Kasus et al., (2015), in which his research states that users who dominate access to the digital library information system of UIN Sunan Kalijaga Yogyakarta are students whose need for digital information content is higher to support the theory in the learning process and completion of their final assignments.

The library of Universitas Muhammadiyah Sumatera Utara has been accredited Excellent for the national scale in Indonesia, which means that the higher the rank of the library, the better the standard and service of the library. Library digital transformation is one of the manifestations of library digitalisation. Digitalisation in a library is actually a manifestation of various interests. According to Vivanco (2015), new technologies contribute to the increased flow of knowledge and information. This interest encourages libraries to modernise their services and implement IT in their daily activities. The application of IT in library services can be seen in different ways such as: Circulation services, reference services and research results, journal/magazine/periodical services, internet and computer station services, bibliography and so on (Amhar, 2019). Currently, the library of Universitas Muhammadiyah Sumatera Utara has a digital library service where students can do online resources available in the UMSU library.

The digital library application can be downloaded from the Playstore by searching for UMSU Digital Library. The digital library application can provide benefits or advantages that manual libraries do not have, because digital libraries can break the limitations of space and time for users who want to take advantage of digital library systems (Alifah, 2016). In other words, the digitalisation of libraries is aimed at facilitating students to engage in learning activities anywhere and anytime. The development of digital libraries has been utilised by students, but not to the maximum extent, especially by students of the Accounting Education programme at Universitas Muhammadiyah Sumatera Utara.

The following is data obtained from the Library Technical Implementing System of the Universitas Muhammadiyah Sumatera Utara, which shows the number of visitors to the digital library application in 2020 - 2022 as a whole can be seen in the data below:

Table 1. Number of visitors to the UMSU library application in the years 2020 - 2022

Visitor	2020	2021	2022
University Student	4266	1524	2148

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Student	57	5	40
Lecturer	76	3	38

Source : UMSU Library Technical Implementing System

From the above data, it can be seen that the visits to the library application of Universitas Muhammadiyah Sumatera Utara are dominated by students, lecturers and undergraduates, although it is also provided for the general public. Based on the description of the research background above, it is considered necessary to conduct research to find out whether there is an influence of a library that has been accredited as superior, especially the development of digital library services of Universitas Muhammadiyah Sumatera Utara on the learning process of students, especially the students of Accounting Education programme, Faculty of Teacher Training and Education, Universitas Muhammadiyah Sumatera Utara.

2. RESEARCH METHOD

This research was conducted at Universitas Muhammadiyah Sumatera Utara, Indonesia. The population or research subjects were students of the Accounting Education Study Programme, Faculty of Teacher Training and Education, Universitas Muhammadiyah Sumatera Utara.

Table 2. Population Table

No	Academic Year	Class	Total of Students
1	2019-2020	Morning class of accounting 8th Semester	31
2	2020-2021	Morning class of accounting 6th Semester	14
3	2020-2021	Morning class of accounting 6th Semester	4
4	2021-2022	Morning class of accounting 4th Semester	13
5	2021-2022	Morning class of accounting 2nd Semester	13
6	2022-2023	Afternoon class of accounting 2nd Semester	4
		Total	**79**

The number of samples is determined using the census technique, where the sample is determined by taking all members of the population as a sample, thus the sample for this study is 79 students.

The approach and type of data used in the research is quantitative data, which includes information on the number of samples to be used. This research does not change or treat these variables, so this research design is ex post facto. Ex post facto research examines cause and effect relationships that are not manipulated or treated by the researchers. Cause and effect research is conducted on programmes, activities or events that have taken place or are taking place. The existence of a causal relationship is based on theoretical studies that a variable is caused or motivated by certain variables or causes certain variables (Sappaile & Makassar, 2020).

Research instruments are the means used to collect data in a study. This data collection instrument is used to obtain maximum results so that the validity of the research can be realised. The instrument prepared is a questionnaire instrument using the Likert scale. According to Bahrun et al., (2017), the Likert Scale is a scale used to measure the perceptions, attitudes or opinions of a person or group about an event or social phenomenon by presenting questions accompanied by choices.

The data analysis technique used in this research is inferential statistics. According to Mustafa (2022), inferential statistics are statistics used to test hypotheses as well as the existence of differential relationships and estimation or prediction functions among the data obtained in different variables that have been tested. Inferential statistics play a role in data collection methods, data presentation and drawing conclusions.

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3. RESULTS AND DISCUSSION

A. Results Description

Validity Test

The validity results obtained on variable X using SPSS 20 software are presented in the following table:

Table 3. Results of the validity of digital library services (X)

Number of Question	r_{count}	r_{table} (α = 5%, N=79)	Description
1	0,654	0,285	Valid
2	0,830	0,285	Valid
3	0,672	0,285	Valid
4	0,782	0,285	Valid
5	0,814	0,285	Valid

Based on the table above, it can be understood that the validity of the data at the α = 5% level with 79 respondents is obtained r_{table} = 0,285. The above validity test results for variable X show that out of the 5 questionnaire items or questions, 5 items are declared valid with a value of $r_{count} > r_{table}$.

The validity results obtained for variable Y using SPSS 20 software are shown in the following table:

Table 4. Validity results of the student learning process (Y)

Number of Question	r_{count}	r_{table} (α = 5%, N=79)	Description
1	0,644	0,285	Valid
2	0,753	0,285	Valid
3	0,558	0,285	Valid
4	0,785	0,285	Valid
5	0,802	0,285	Valid
6	0,860	0,285	Valid

From the table above it can be seen that the validity of the data at the α = 5% level with 79 respondents is obtained with r_{table} = 0,285. The results of the above validity test for up to 6 items are declared valid with a value of $r_{count} > r_{table}$.

B. Data Analysis Technique

Partial Test (t-test)

Partial test or t-test is used to determine whether there is an effect of the independent variable on the dependent variable individually.

Table 5. Partial hypothesis testing results (t)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5,459	1,262		4,325	,000

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Layanan Perpustakaan Digital	,803	,081	,748	9,881	,000

a. Dependent Variable: Proses Belajar

Source : SPSS 20 Processing Results (2023)

From Table 4.9 above, there are the results of computing the t-test at the significance level of 5%, obtained a tcount of 9.881 which is greater than the ttable of 1.991 and the significance value of tcount = 0.00 <0.05, so the hypothesis is stated that there is an effect of digital library services on the learning process of students of Accounting Education programme, Faculty of Teacher Training and Education, Universitas Muhammadiyah Sumatera Utara.

Simultaneous test (F-test)

The F-test was carried out to determine whether the independent variables, specifically the digital library services, together had a significant effect on the dependent variable, particularly the students' learning process, using the following hypothesis:

1. If the sig score is <0.05 or Fcount > Ftable, then there is a simultaneous effect of the X variables on the Y variable.
2. If the sig value is > 0.05 or Fcount < Ftable, then there is no simultaneous influence of the X variables on the Y variable.

Simultaneous tests (F) are performed by comparing Fcount with the Ftable score. The Fcount score can be obtained from the SPSS test results, and the Ftable value used is the F value with degrees of freedom (df) at df1 = k-1 and df2 = n-k at α = 0.05, namely by using

Df1 = 2-1 = 1

Df2 = 79-1 = 78 (3,96)

Table 6. Simultaneous Hypothesis Testing Results (F) ANOVA [b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	558,015	1	558,015	97,639	,000[b]
	Residual	440,061	77	5,715		
	Total	998,076	78			

a. Dependent Variable: Proses Belajar

b. Predictors: (Constant), Layanan Perpustakaan Digital

Source : SPSS 20 Processing Results (2023)

Determination Coefficient Test

The coefficient of determination used in this study measures the proximity of the relationship between the independent variable and the dependent variable. The higher the value of the correlation coefficient, the closer the relationship and vice versa. The coefficient of determination table is shown below:

Table 7. Determination Coefficient

Model Summary[b]

Model	R	R Square	Adjusted Square	RStd. Error of the Estimate
1	,748[a]	,559	,553	2,391

a. Predictors: (Constant), Layanan Perpustakaan Digital
b. Dependent Variable: Proses Belajar
Source : SPSS 20 Processing Results (2023)

From the results of the data processing, it can be seen that the coefficient value (R Square) is 0.559, which means that Digital Library Services has an effect about 55.9%, while the remaining 44.1% is influenced by other variables that are not examined in this study.

This study aims to examine the effect of digital-based library services (X) on the learning process (Y) of students of Accounting Education programme, Faculty of Teacher Training and Education, Universitas Muhammadiyah Sumatera Utara. Based on the research data analysed using SPSS 20, the following results were obtained:

From the results of simple linear regression test conducted, the Fcouunt value of 97.639 was obtained with a significance level of 0.000 <0.05. In other words, there is an influence of digital library service variable (X) on student learning process (Y). Meanwhile, from the results of the coefficient of determination test, which aims to measure the proximity of the relationship between the independent variable and the dependent variable obtained from data processing, that the coefficient value (R Square) is 0.559, which means that Digital Library Services has an effect of 55.9%, while the remaining 44.1% is influenced by other variables not examined in this study.

4. CONCLUSION

Based on the results of data analysis in the research conducted, the authors can conclude that there is a significant influence of digital-based library services on the learning process of students of Accounting Education Study Programme, Faculty of Teacher Training and Education, Universitas Muhammadiyah Sumatera Utara, Indonesia.

From the results of the simple linear regression test conducted, the Fcount value is 97.639 with a significance level of 0.000 <0.05, in other words, there is an influence of digital library service variable (X) on student learning process (Y).

The results of the determination test show that the coefficient value (R Square) is 0.559, which means that Digital Library Services has an effect of 55.9%, while the remaining 44.1% is influenced by other variables not examined in this study.

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Initial Study: The Effect of Digital Literacy on Students' Argumentation Skills in Junior High School on the Materials of Motion, Waves and Light

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ABSTRACT

The purpose of this study was to determine the effect of digital literacy on students' argumentation skills in junior high school on vibration, wave and light materials. The method used in this research is a qualitative method, with the type of research using an initial study obtained by interview, the subjects and samples of this study were science teachers at Muaro Jambi State 1 Junior High School and Muaro Jambi State 33 Junior High School, the sampling technique in this study was purposive sampling technique, the instrument used was an interview with 20 questions, the data analysis used was Mile and Huberman analysis. Based on the research that has been done, the results show that digital literacy can improve students' argumentation skills. So the conclusion of this study is that digital literacy has an influence on students' argumentation skills.

Keywords: Argumentation Skills, Digital Literacy, Science

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1. INTRODUCTION

Education in Indonesia is an important foundation for the development and future of the nation. (Haliza & Dewi, 2021; Aldila et al., 2023). Despite various reforms, challenges remain in terms of accessibility, quality and equity of education. Government programs to improve the quality of teachers, school infrastructure and curricula have been implemented, but further efforts are needed to reach remote areas and provide equitable education for all (Farhas, 2021; Lega, 2023). Improving the quality of education also needs to go hand in hand with developing skills that are relevant to the demands of the times, so that students can compete globally and contribute positively in realizing the nation's progress. One of the efforts to improve quality is to implement the Kurikulum Merdeka.

Kurikulum Merdeka is a recent initiative in Indonesian education that aims to give schools more freedom to design curricula that suit local needs, student potential and the times. Through this approach, education is expected to be more responsive to the individual needs of students and to explore the unique potential of each region. The Merdeka Curriculum provides opportunities for schools to develop learning programs that are more diverse, inclusive and relevant to today's global challenges, while still maintaining high educational standards (Rohmah et al., 2023). Although it is still in the implementation and evaluation stages, the Merdeka Curriculum promises a more dynamic and adaptive approach in welcoming a more diverse and inclusive educational future (Lubis et al., 2023). One of the skills used is Digital Literacy.

Digital literacy is the ability to use, understand and participate in the digital world effectively (Nahdi & Jatisunda, 2020). In today's information age, this ability is crucial for individuals to access, evaluate and use various sources of information wisely and safely. Digital literacy includes not only technical skills, but also an understanding of internet etiquette, digital safety, and the ability to sort valid information from invalid ones (Nahdi & Jatisunda, 2020). The importance of digital literacy is growing as it affects how we interact, learn and contribute in an increasingly digitally connected society (Setianingsih et al., 2023). With strong digital literacy, individuals can become more independent, critical and skilled in dealing with rapid changes in the realm of technology and information. Students' digital literacy skills are related to argumentation skills.

Argumentation ability is an important skill that involves one's ability to organize and present opinions or views in a logical, cohesive, and persuasive manner (Ariyanto et al., 2020). It involves the ability to frame arguments with relevant evidence, reliable data, and strong logic to support the position

or opinion expressed. In addition, argumentation skills also involve good listening skills, accepting other people's points of view, and presenting substantial counter-arguments. These skills not only enrich discussions, but also enable individuals to contribute effectively in a variety of contexts, whether in academic, professional or social settings.

Natural Science subjects at the Junior High School level have an important role in shaping students' understanding of natural phenomena and scientific principles. Science in junior high school explores basic concepts in physics, chemistry, biology, and the environment, and involves students in experimentation, observation, and analysis to understand how nature works and the scientific process (Diniya, 2019). Through a curriculum based on real-life experiences, science in junior high school aims to shape critical thinking, scientific thinking skills, and a deep understanding of the relationship between humans and the environment (Pratiwi et al., 2019; Vercaruz et al., 2023). Thus, this subject is an important foundation for the development of students' science literacy before entering higher education.

Vibrations, waves, and light are closely related concepts in physics (Wulandari & Prihandono, 2019). Vibrations are alternating movements that occur in a medium, while waves are the propagation of vibrations through the medium, either in the form of mechanical waves in a medium such as water or electromagnetic waves in a vacuum. Light, as one form of electromagnetic wave, has the dual nature of being both a wave and a particle called a photon. Through an understanding of vibrations and waves, we can understand various phenomena such as the formation of sound, the propagation of earthquakes, or even the phenomenon of light that forms a spectrum of colors and transforms into various forms of energy that we use daily, such as electricity and heat. By learning these concepts, we can explore the complexity of the universe and apply this knowledge in various fields of science and technology.

Research conducted by Chen et al., (2020) found that the use of digital media can improve student learning outcomes and can also improve students' argumentation skills. With this, teachers can explore the use of digital media in the teaching and learning process so that it can attract interest in learning and will have an impact on student learning outcomes and student abilities. In previous research conducted by Darmaji et al. (2022), where the effect of science process skills on argumentation skills was sought and this study aims to determine the effect of digital literacy on students' argumentation skills. So the difference between this research and previous research is different in the research variables.

Based on the opinions above, the researchers conducted this research with the formulation of the problem, namely how the results of the analysis of the effect of digital literacy on science process skills and argumentation skills. With the purpose of the study, namely to determine the results of the analysis of the effect of digital literacy on science process skills and argumentation skills. So that researchers are interested in conducting research with the title **"Initial Study: The Influence of Digital Literacy on the Argumentation Ability of Students in Junior High School on the Material of Geometry, Waves and Light."**

2. RESEARCH METHOD

This research uses qualitative methods and this type of research uses an initial study obtained through interviews. The subjects and samples in this study were physics teachers at SMP Negeri 1 Muaro Jambi and SMP Negeri 33 Muaro Jambi. The sampling technique used in this study was purposive sampling technique. Purposive sampling is a sampling method in research in which the researcher deliberately selects certain participants or sample units based on certain characteristics or criteria relevant to the research objectives (Astalini et al., 2023; Oktavia et al., 2023). The instrument used in this study was an interview with 20 questions. The data analysis used in this research is Mile and Huberman. This data analysis is commonly used in qualitative research and is a systematic method for analyzing qualitative data that has been collected.

3. RESULTS AND DISCUSSION

A. Results

The results of the interviews can be seen in the explanation below.

1. In your teaching experience, some students may have difficulty in answering questions on exercises or exams in Physics. Some students may face difficulties especially in understanding more abstract concepts or applying theories to real situations. Difficulties can also arise in understanding

formulas, applying math in a physics context, or solving physics problems that require creative thinking.

2. In my teaching experience, some students are able to provide claims supported by relevant data or evidence when answering questions in Physics lessons. These students may be able to relate physics concepts to concrete examples, experimental results, or data they obtain from both literature and practicum. However, there are also students who need further assistance to hone their skills in constructing arguments based on relevant data.
3. The learning behavior of students when participating in learning activities tends to vary. Some students show active involvement, focus, and high enthusiasm in learning, they actively ask questions, engage in discussions, and try to understand the concepts taught. However, there are also students who may need additional encouragement to be actively involved in learning, they may be more passive or need extra help in understanding the material.
4. Teachers use a variety of digital media to support learning, including slide-based presentations such as PowerPoint or to present the material with interesting and easy-to-understand visuals. In addition, teachers utilize learning videos from online platforms such as YouTube to provide applicative examples or more in-depth explanations of material concepts.
5. Learners' behavior when participating in learning by utilizing digital media tends to vary. Some learners show high engagement, actively utilizing various features of digital media such as asking questions through chat platforms, participating in online discussions, and actively using the resources provided. However, there are also students who may need additional assistance in operating or utilizing digital media well.
6. There are some obstacles that may arise in learning by using digital media. Some of them are technical issues such as unstable internet connection, disruption in the online learning platform, or hardware constraints used by students.

B. Discussion

Based on the results of the interviews, it was found that practicum activities in science subjects are an important element in providing students with direct experience related to scientific concepts. Through practicum, students can experience for themselves how theoretical concepts are applied in real situations, such as the use of microscopes in studying cells or experiments on vibrations, waves and light in physics. These activities not only improve students' understanding of the material, but also develop their practical skills and science process skills. However, sometimes there are constraints such as limited time in class hours or a tight curriculum that can be an obstacle in organizing practicums that require more extensive time. In addition, the evolution in lesson plans every year and the development of science triggers the adjustment of materials or the addition of new experiments to stay relevant to the latest developments.

Practical activities in science subjects have a vital role in student education (Daniah, 2020; Casquilho et al., 2023). The interview results show that the hands-on experience students gain through practicum is valuable because they can apply the concepts of scientific theories to real situations. For example, experiments using microscopes help students understand the structure of cells in more depth, while physics-related experiments such as vibrations, waves and light provide practical images that are difficult to obtain through theoretical learning alone. However, there are challenges faced, such as limited time in class hours or a tight curriculum. This constraint often becomes an obstacle in organizing practicum that requires longer time.

Adjustment to the evolution in learning design and scientific developments is also an important factor in the sustainability of practicum activities (Meliani et al., 2021). Continuous developments in science trigger the need for material adjustments or the addition of new experiments (Adisaputro, 2020). With these developments, it is important for teachers to stay relevant with the latest information so that the practicum organized remains in accordance with the latest advances in the field of science. Although challenges and adjustments continue to exist, it is important to recognize that practicum activities have an irreplaceable role in students' scientific learning.

Digital literacy has a significant impact on argumentation skills in various contexts (Wigati et al., 2023). The ability to access extensive information from various online sources allows individuals to gather diverse perspectives and evidence to support their arguments. With strong digital literacy, one can construct more robust arguments by referring to reliable data, scientific research and relevant

information. In addition, the ability to use various online platforms to participate in open discussions or forums allows individuals to practice argumentation skills effectively (Solihin & Muhlis, 2023; Astalini et al., 2023). This enables them to understand other points of view, respond appropriately and enrich their arguments through productive online interactions. Digital literacy also facilitates individuals in understanding the ethics of online argumentation, including how to communicate honestly, politely, and respect the opinions of others in the digital realm.

4. CONCLUSION

From the interview with the subject teacher, it was found that digital literacy can affect argumentation skills. With wider access to diverse information from online platforms, individuals are equipped with the ability to evaluate, select and use reliable sources in crafting stronger arguments. The critical ability to assess the reliability of online information allows them to produce arguments that are supported by valid facts. In addition, digital literacy also enriches the way individuals convey arguments effectively through digital media and enables active engagement in relevant online discussions. Thus, digital literacy not only expands knowledge but also enriches argumentation skills in a digital environment. Argumentation skills also prove to be an integral part of digital literacy, enabling individuals to construct solid arguments by referring to various online sources and participating in discussions that enrich perspectives and uphold the ethics of communicating online. In conclusion, digital literacy can make an important contribution to the development of students' understanding, skills and abilities in the context of science.

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The Development of Augmented Reality Based Geometry Module (AR-Geo) to Improve Spatial Ability in Learning 3D Geometry Material in SMA Negeri 3 Medan

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ABSTRACT

This research aims to develop an augmented reality-based teaching material, namely the AR-Geo module on 3D Geometry material at SMA Negeri 3 Medan. These teaching materials are able to determine the level of validity, practicality, and effectiveness of the AR-Geo module and student responses to learning. This research method used research and development (R&D) through the ADDIE model. The subjects of the study involved students of class XII IPS 1 SMAN 3 Medan in the academic year 2023/2024 totaling 36 students. The research instruments employed AR-Geo module assessment sheets by media and material expert lecturers, mathematics teachers, peers, student ability tests and student response questionnaires, as well as student spatial ability tests. The results indicate that the material expert score is 91,53% and the design expert score is 90,53%, classified as very valid. The practicality of the module can be identified from the teacher response questionnaire score of 80,00% classified as practical, and the questionnaire score in the small group trial of 84,26%, field test 84,38% classified as very practical. The effectiveness is shown by 83,33% of students completing the learning outcomes test, and the results of the N-Gain calculation are 17 students experiencing an increase in medium spatial ability and 19 students experiencing an increase in high spatial ability. As a result, the development of augmented reality-based modules for 3D geometry material that has been developed is feasible to use.

Keyword : ***ADDIE model, Augmented Reality, 3D geometry, Module, Student's Spatial Ability.***

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1. INTRODUCTION

Math lesson, particularly geometry, is often considered as the difficult and boring lesson by most students. Math lessons are filled with formulas and calculations, making it a challenge for many students. However, geometry is more than a set of formulas. From a psychological point of view, geometry represents an abstraction derived from visual and spatial experiences, such as planes, patterns, measurements, and mapping. Meanwhile, from a mathematical point of view, geometry provides approaches to problem solving, such as drawings, diagrams, coordinate systems, vectors, and transformations. Geometry is also an environment for studying mathematical structures (Nopriana, Tri, 2013).

At the higher educational (SMA/MA) levels in the Merdeka Curriculum, the Geometry study field discusses various forms of flat and spatial shapes in both Euclides and Non-Euclides studies and their characteristics in flat geometry and space geometry subelements. Spatial geometry is the study of spatial objects, relations, and transformations that have been formed (made into mathematics) and systems of mathematical axioms that have been constructed to make them (Imamuddin, 2018).

Although the importance of geometry is recognized in the education curriculum, the reality shows that there are still numerous students and teachers who face difficulties in understanding and teaching geometry materials, especially spatial geometry. Spatial ability, which is key to understanding geometry, often shows low ability in students. Based on the observations by the researcher, the difficulty of learning geometry dimension 3 is in imagining the representation of flat/space shapes that represent the problems posed. As in the research conducted by (Budiarto, M. T., & Artiono, R, 2019), they mentioned that the characteristics of the form of student errors in solving a geometry problem include visual skills, verbal skills, and applied skills. Visual skills include insufficient understanding of geometric elements

needed to describe geometric correlation and unsatisfactory perception of space. Errors related to verbal skills include misconceptions in understanding geometry concepts; weak ability to analyze problems; ambiguous use of terms such as rib and side; cube and square; quadrilateral and quadrilateral pyramid of disorderly use in conventions, such as notation for line, line segment, line ray, angle and angle magnitude; not understanding what is known and what will be proven from the given problem; unable to use what is known or use what will be proven as what is known; unable to relate one knowledge with other knowledge in geometry; and less resilient and easily discouraged if facing challenging geometry problems. Errors related to applied skills include: not being able to use axioms, definitions, theorems to solve proof problems; failing to learn the basic concepts of geometry; not understanding that two perpendicular lines intersect; not understanding that the plane can be expanded; not being able to make the intersection of a plane with a space due to low spatial vision; and not being able to use the acquisition of geometry in high school or flat geometry to solve space geometry problems.

In order to overcome these challenges in learning geometry in the classroom, teachers usually present real objects as props related to the material being studied. The props presented are not only based on real objects that can be seen, held, or touched, but can also be computer simulations that combine the sophistication of various information and communication technology devices. One technology that is currently starting to be considered at is augmented reality (AR). Hosch (2021) in Encyclopaedia Britannica states that augmented reality is the process of combining video or photo displays by overlaying images with related computer data. Meanwhile, Azuma (1997) also states that augmented reality (AR) is a form of virtual reality (VR) that allows users to see the real world through virtual objects that are combined with the real world.

In the context of math learning, AR offers an innovative way to present geometry concepts visually and interactively, increasing students' interest and understanding, as well as spatial abilities. As in various studies in the field of geometry, they mention that augmented reality can be a solution to make it easier for students to understand various complex spatial problems compared to traditional methods (Kaufmann, 2009).

Based on this explanation above, the researcher is interested in developing an interactive learning module that combines geometry with AR technology, called AR-Geo. Therefore, the researcher can develop new products of augmented reality in SMA Negeri 3 Medan as a result of the development of existing research based on geometry module (AR - Geo) to improve spatial abilities in 3-D geometry learning at SMA Negeri 3 Medan.

2. RESEARCH METHOD

This study used the Research and Development (R&D) using the ADDIE model development method (Analysis, Design, Development, Implementation, Evaluation), which aims to develop Learning Media in the form of augmented reality-based AR-Geo module with the help of smartphone devices and certain applications on 3D geometry material in class XII SMA Negeri 3 Medan. Products produced in the research in the form of learning media in the form of AR-Geo module based on augmented reality with the help of smartphone devices and certain applications on 3D geometry material in class XII SMA Negeri 3 Medan is to follow all the stages in the ADDIE model. The stages in the ADDIE model describe the feed back process at the research stage, which is shown in the following figure:

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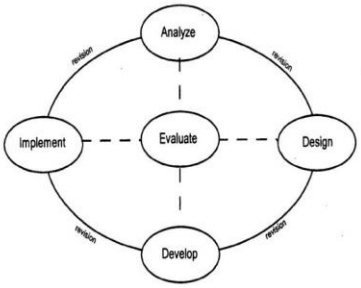

Fig 1: Stages of ADDIE Model Development

The analysis stage was carried out with two stages, namely problem analysis and material analysis. Problem analysis was carried out to find out the problems and obstacles occurred in the learning process by interviewing math teachers and initial tests regarding students' spatial abilities.

In the design stage, the researcher designed an augmented reality-based AR-Geo module developed by systematically detailing and compiling the principles of 3D geometry was implemented to be taught for the research subjects to improve maximum students' spatial abilities

The development stage of the AR-Geo teaching module development product testing process involved the implementation and concrete creation of all the elements that have been planned during the design stage.

At the Implementation stage, the researcher conducted classroom trials with the AR - Geo module, and learning to students in class XII IPS 1 SMA Negeri 3 Medan in the next small group according to the results of responses worthy of use. Furthermore, the researcher implemented the product in class XII students in a large group involving all students of class XII IPS 1 SMA Negeri 3 Medan.

Last, at the evaluation stage, assessment was carried out in two forms, namely formative evaluation in the form of feedback so that it is in accordance with the objectives of developing teaching modules.

Data collection techniques used observation sheets, interviews, questionnaires, evaluation test sheets. Testing was carried out based on testing the level of validity, practicality, and effectiveness of the AR-Geo module, and student responses to learning.

In order to calculate the percentage validity of the data obtained from the assessment item scores using the following formula:

$$Validity\ Level = \frac{Total\ of\ score\ obtained}{Total\ of\ maximum\ score} x\ 100\%$$

The validity results percentage obtained was then classified in percentages as described in Table 1 below.

Table 1. Product Validation Criteria

No.	Percentage (%)	Criteria
1	0 – 20	Invalid
2	21 – 40	Less Valid
3	41 – 60	Valid Enough
4	61 – 80	Valid
5	81 - 100	Very Valid

(Akbar, 2013)

The data that has been obtained was then analyzed descriptively quantitatively to calculate the percentage of practicality, then it was described using data frequency analysis techniques using the formula:

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$$Practicality\ Level\ (p) = \frac{Total\ of\ score\ obtained}{Total\ of\ maximum\ score} x\ 100\%$$

The results of the percentage of data obtained was classified in percentages as described in Table 2 as follows:

Table 2. Product Practicality Criteria

No.	Percentage (%)	Criteria
1	0 – 20	Not practical
2	21 – 40	Less Practical
3	41 – 60	Practical enough
4	61 – 80	Practical
5	81 - 100	Very Practical

(Akbar, 2013)

The difference between the *pre-test* and *post-test* was calculated to calculate the improvement of students' spatial abilities. The difference in the two tests is called Gain. The formula for calculating N - Gain is presented as follows:

$$N - Gain = \frac{posttest\ score - pretest\ score}{max\ score - \ pretest\ score}$$

Furthermore, the results of the N Gain calculation were percented using the criteria in Table 3.

Table 3. N-Gain Interpretation

N - Gain	**Criteria**
N – gain	High
0,3 N-gain < 0,7	Medium
N-gain < 0,3	Low

Table 4. aims to examine the effectiveness interpretation category based on the N-Gain value.

Table 4. Categories of Effectiveness Gain Interpretation

Persentase	Kriteria
< 40	Ineffective
40 – 55	Less effective
56 – 75	Effective enough
>76	Effective

3. RESULTS AND DISCUSSION

This research aims to develop an augmented reality-based teaching material called the AR-Geo module on 3D Geometry material at SMA Negeri 3 Medan to determine the level of validity, practicality, and effectiveness of the AR-Geo module, as well as the student responses to learning. The development process was carried out with the ADDIE model. The ADDIE development model consists of 5 (five) phases, namely analysis, design, development, implementation and evaluation.

At the stage of result analysis of interviews obtained, the students are more interested in using the media when learning space geometry because of the difficulties experienced by students when learning flat-sided space that is imagining and visualizing the shape of space geometry. The results of preliminary observations show that the spatial abilities of students on the material space geometry is low.

At the Design stage, the results obtained to improve students' spatial abilities are designed on each material that requires visualization of space geometry on the augmented reality markers. The use of augmented reality markers can bring up the real form if scanned using the space geometry application.

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At the development stage, this augmented reality-based module was printed using HVS paper using a purple cover with a combination of pink and black. The researcher reproduced augmented reality-based modules to be used in the testing phase.

In the implementation stage, the first step taken by researcher was to validate research instruments, material validation, and design validation.

A. Instrument Validation

Table 5. Results of validation by instrument experts

No.	Instrument	Total Score obtained	Total Ideal Score	P %	Criteria
1	**2**	**3**	**4**	**5**	**6**
1	Material Validation Questionnaire	42	45	93,33%	Very Valid
2	Design Validation Questionnaire	43	45	95,56%	Very Valid
3	Practicality Questionnaire (teacher)	41	45	91,11%	Very Valid
4	Practicality Questionnaire (students)	39	45	86,67%	Very Valid
5	Individual and Small Group Trial Observation Sheet Questionnaire	37	40	92,50%	Very Valid
6	Questionnaire Observation Sheet Teacher Activity	55	60	91,67%	Very Valid
7	Observation Sheet Questionnaire Student Activity	55	60	91,67%	Very Valid
8	Interview Guidelines Questionnaire, Individual Trial and Small Group Trial	38	40	95,00%	Very Valid
9	Small Group Trial Learning Outcome Test	45	50	90,00%	Very Valid
10	Special Ability Test	45	50	90,00%	Very Valid

Based on Table 5, the assessment results of all research instrument validations obtained a percentage of 87% with a "very valid" category.

B. Material Validation

The validation of augmented reality-based module material was reviewed from the aspects of content feasibility, language, and component feasibility aspects. The results of the validation of augmented reality-based module material by material expert validators used the Material Validation Questionnaire. The results of validation by material experts amounted to 91,43%. Thus, based on the criteria for the level of validation of material experts obtained Augmented Reality-based modules are on very valid criteria.

C. Design Validation

The results of the validation of augmented reality-based module design by the design expert validators used the design validation questionnaire. Meanwhile, the results of validation by the design

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experts amounted to 90,53%. Therefore, based on the criteria for the validation level of design experts, the Augmented Reality-based module is obtained in very valid criteria.

The second step was carried out field trial activities, the researcher conducted research to see the practicality and effectiveness of the augmented reality-based module designed during the learning process, namely four meetings where in one week two meetings were held. The results of the field trial obtained the following results.

Table 6. Observation Results of Teacher and Student Activities

Activities	Observation Results		
	Meeting 2	Meeting 3	Meeting 4
Teacher	88,54 %	89,58 %	89, 29 %
Students	75 %	79,19 %	79, 29 %

Based on the results of the student response questionnaire, the practicality level of the augmented reality-based module is 84,38% with a very practical category.

At the Evaluation stage, the learning outcomes test consisted of 5 (five) items in the form of essays and a test of students' spatial abilities consisting of 10 (ten) items in the form of multiple choice questions accompanied by the reason students chose the option. The results obtained the percentage of completeness reached 83,33%, it can be concluded that the augmented reality-based module is included in the criteria very effective.

The following is the data from the normality test results on the pre-test and post-test.

Table 7. Normality Test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
pre-test	.161	24	.111	.901	24	.023
post-test	.223	24	.003	.914	24	.044

Table 8. Wilcoxon Test Rating Results pre-test and post-test

	N	Mean Rank	Sum of Ranks
Negative Ranks	0[a]	.00	.00
Positive Ranks	36[b]	12,50	300,00
Ties	0[c]		
Total	36		

Table 9. Wilcoxon Test Significance Results

	post-test - pre-test
Z	-4.294[b]
Asymp. Sig. (2-tailed)	.000

Table 10. N-Gain Calculation Results

No.	Name	*PreTest*	*PostTest*	Post – Pre	NM – Pre	*N –Gain*	Criteria
1	AN	7	31	24	33	0,73	High
2	AP	4	28	24	36	0,67	Medium
3	AFR	6	29	23	34	0,68	Medium
4	AW	3	39	36	37	0,97	High
5	AZ	6	31	25	34	0,74	High
6	BA	11	31	20	29	0,69	Medium

7	CA	8	36	28	32	0,88	High
8	DA	2	36	34	38	0,89	High
9	FL	2	30	28	38	0,74	High
10	FG	15	31	16	25	0,64	Medium
11	J	6	34	28	34	0,82	High
12	KAN	3	36	33	37	0,89	High
13	MAA	5	29	24	35	0,69	Medium
14	MRS	5	28	23	35	0,66	Medium
15	MA	7	34	27	33	0,82	High
16	MFAA	7	30	23	33	0,70	High
17	NRS	3	28	25	37	0,68	Medium
18	NZE	3	30	27	37	0,73	High
19	NFS	11	29	18	29	0,62	Medium
20	NZ	7	34	27	33	0,82	High
21	PNL	4	28	24	36	0,67	Medium
22	RAS	5	26	21	35	0,60	Medium
23	RK	8	31	23	32	0,72	High
24	RFTS	5	28	23	35	0,66	Medium
25	RMS	2	36	34	38	0,89	High
26	RSS	5	29	24	35	0,69	Medium
27	SS	7	28	21	33	0,64	High
28	SP	2	34	32	38	0,84	Medium
29	SD	25	39	14	15	0,93	Medium
30	SHA	2	28	26	38	0,68	High
31	SJH	6	30	24	34	0,71	High
32	SS	11	36	25	29	0,86	High
33	TPS	8	34	26	32	0,81	High
34	TAF	2	28	26	38	0,68	High
35	VFS	3	28	25	37	0,68	Medium
36	YVL	7	29	22	33	0,67	Medium
Average						0,74	High
Percentage						75%	Effective Enough

As for the category of the effectiveness interpretation of gain is based on the percentage obtained N-Gain of 75%, with the interpretation category is quite effective. Thus, based on the analysis of N-Gain data, the augmented reality-based module on space geometry material is effective for use in learning.

Based on the above data, it can be known about the validity, practicality, and effectiveness of the augmented reality-based module. The module is stated to be effective if students succeed in the learning process and there is consistency between the learning experience and the achievement of learning outcomes. As a result, it can be concluded that the augmented reality-based module for space geometry material is effectively to be used in learning activities and can be known that augmented reality-based modules have met the criteria of good teaching materials.

4. CONCLUSION

Based on the results of the research described above, it is concluded that the development of learning media, specifically in the form of augmented reality-based AR-Geo modules using smartphone devices and certain applications on 3D geometry material in class XII SMA Negeri 3 Medan, has a significant influence on enhancing students' spatial abilities. This conclusion is supported by test evaluating the AR-Geo module's validity, practicality, and effectiveness as well as by the student responses to learning. Comparison made before and after using the augmented reality-based module indicates its influence on improving students' spatial skills. Therefore, Augmented Reality-based modules for space geometry materials are stated to be feasible and can be used to improve students' spatial abilities by fulfilling valid, practical, and effective criteria.

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Increasing Knowledge about First Aid for Falls in Primary School Children

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ABSTRACT

Elementary school children are those who are in their growth period. During their growth period, it is not uncommon for them to be very active and explore new things. While exploring, some of them may fall, slip, get scratched and get wounds on their hands, foreheads or feet. The wounds they get are certainly a valuable experience for them, but do children know how to handle them properly when a child gets injured? Education needs to be given to children so that children at least know what steps or methods to take when they get injured. Based on the results of observations made by the author at SD Negeri 013, Suko Mulyo Village, Sepaku. Education regarding handling open wounds has not been provided optimally. Therefore, the author conducted outreach at the elementary school regarding handling open wounds in children so that children and teachers at the school would pay more attention to how to handle open wounds when children experience falls or other things that cause injuries. The method used is observation and an approach through Role Playing Models. Respondents consisted of 18 grade 4 children at SD Negeri 013. The results achieved showed that children knew what tools were and how to handle open wounds as evidenced by recalling that children were able to mention first aid steps for open wounds in the correct order.

Keywords: Elementary School, First Aid, Open Wounds

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1. INTRODUCTION

Education is a place of growth for children, because this is where children will grow and develop, students at school are at high risk of experiencing simple accidents such as scratches and injuries from falls. The high incidence of injuries at school is 5.4%. First aid for open wounds in children is not the direct responsibility of the child, but children must be aware and understand how to properly handle open wounds that have just been obtained so that germs do not spread (Ulum & Gunungpati, 2023).

School life is the most important part of children's lives which has a direct effect on a child's mental and physical health because more than 660,000 children aged 0-14 years died due to injuries in 2012 (Oktaviani et al., 2020).

Injury is generally defined as a state of physical immobility caused by damage to certain parts of the body. In particular, injury is described as damage to the structure of bones, muscles and other soft tissue due to impact, excessive activity (overload), environmental conditions and technical errors. (Indri Harta & Nur Fata, n.d.,2022) Injuries also result in disabilities that can be caused by accidental injury or intentional injury. Burns are one of the unintentional injuries that often occur in children and are the eleventh cause of death in children aged 1 to 9 years (Made Krisna Dewi Widya Permata Adi et al., 2021).

A more effective way to deal with injuries is to understand several types of injuries and recognize how our body responds to these injuries. So you can know what to do to prevent injuries from becoming serious, and how to treat them (Kemala & Mamesah, 2020). When experiencing an acute accident, a person often experiences trauma which results in physical and physiological conditions that require treatment of the injury through several stages (Maldi et al., n.d.,2020).

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First aid for accidents (P3K) is an action that is taken when an incident first occurs, before receiving medical assistance. This is important because with proper treatment it will minimize the risk of severity of the patient's condition. However, what was found in the field were several cases resulting from accidents at home. Stairs can become worse as a result of mishandling. For example, a client who suffered burns due to an accident while cooking was treated by applying toothpaste to treat the burns. This actually makes the wound worse because the location around the wound is due to the presence of mint, bleach, and dye which can slow down wound healing, trigger infection, and can result in the burnt skin becoming even more blistered (Kattan et al., 2016). First aid can be done in a very easy way, including cleaning and closing the wound. If the victim has a wound inside the body, first aid can be done by bandaging the wound and ensuring that no debris enters the body (Siregar et al., 2024). Providing appropriate first aid to people who have experienced burns is an important step to reduce the severity of injuries, pain and post-burn complications (Lam et al., 2017).

A first aid kit or first aid box is a place or container containing first aid tools that can be used when an emergency or injury occurs to someone and to prevent a higher level of injury severity. These relief efforts are aimed at reducing pain, preventing possibilities and conditions that can make the victim worse (Budi et al., 2024).

The existence of first aid training in improving skills is very influential, where training is a short-term educational process that combines theoretical and practical learning, so that training is a factor that can increase a person's knowledge (MUHAMMAD+SOFHIAN+NUR+6+TERBIT+1+sd+7, n.d., 2022). According to Kalaiyasaran, having knowledge about first aid in the school environment is very important so that they can help other people or themselves in the school environment. Wirakhmi emphasized that improper first aid measures, for example if a wound is not treated properly, has the potential for the wound to get worse. In fact, it is feared that it could become a nest for germs that spread throughout the body.(Setianingsih et al., n.d.)

Elementary school children also experience quite rapid changes compared to their previous age. From a physical perspective, children experience changes, elementary school age children tend to like to move and be active. The tendency of elementary school age children to be active and move a lot can cause unexpected things such as falls and accidents. (Mirwanti & Nuraeni, 2017)

A layperson is the first person who is able to provide assistance to someone with an injury with the aim of reducing the negative impacts that arise because of it. Providing first aid is an important thing to do in the school environment considering that school is a place with a fairly high risk of injury and students are ideal laypersons..(Nastiti, 2020)

The success of providing first aid can be seen from the quality of individual behavior which is influenced by the understanding they have regarding aiding wounds. The higher the knowledge, the more positive an individual's behavior towards a problem will be. The better a person's knowledge and experience, the better they will be at providing first aid (Christianingsih et al., 2021). So, in carrying out the first treatment for open wounds, proper education must be carried out in order to get maximum results and not get acute infections in the wounds. If it is handled incorrectly, infection of the wound can cause possible consequences, such as delays in the healing process of the wound, the appearance of green fluid with an unpleasant odor, and causing fever.

Based on the results of observations and approaches through Role Playing Models at SD Negeri 013, Suko Mulyo Village, Sepaku. It was found that the institution did not have complete first aid facilities for open wounds in children. Apart from that, there is a lack of in-depth knowledge regarding the effects of open wounds and how to properly handle children's wounds. After observing open wounds on students at SD Negeri 013, Suko Mulyo Village, these were caused by falls and scratches. The treatment carried out by this institution is still not optimal, where the wound is only wrapped with plaster without cleaning it first,

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this can cause infection in the child's wound which can cause the wound to become more serious. Treatment that should be carried out for open wounds in early childhood is to clean the wound with running water, clean the edges of the wound with sterile tissue, then clean the wound with antiseptic and cover with sterile gauze or gauze plaster. This is done to prevent germs from entering the wound which will cause excessive infection and helps wounds dry quickly. Based on the results of these observations and background, outreach activities regarding first aid for open wounds and burns in children are needed from as early as possible. Therefore, socialization was carried out regarding first aid for open wounds at the school.

2. RESEARCH METHOD

The activity was in the form of counseling for children which was packaged under the activity name "Socialization about First Aid When Falls in Elementary School Children" using the Role Playing Models approach method. The role play method is a learning model that assigns students to act as a character in material or an event expressed in the form of a simple story. As well as providing education through fun delivery so that children are enthusiastic about learning and understanding what is being socialized. This socialization activity for students was held on Tuesday, February 6, and took place at SD Negeri 013 which is located at Suko Mulyo Village, Sepaku District, North Penajam Paser. The objects or targets for this community service activity are the children of SD Negeri 013 in Suko Mulyo Village who are in the age range of 6 to 12 years. The method of activity carried out in this activity is by providing counseling and delivering material offline or face to face.

3. RESULTS AND DISCUSSION

This community service activity was attended by 25 class VI students of SDN 013 SEPAKU. The preparations made for this community service activity include visiting the location that will be used as a venue for the activity. In choosing a location, members consider everything, such as the class teaching schedule. Carrying out debriefing by group members who help with socialization regarding what is done during the activity. Coordinating with the staff of the agency where the activity is related regarding the mechanism of the activity that will be carried out. Preparing games along with prizes that we have prepared to enliven the activities that will be carried out.

Then this socialization was led by students by providing material about First Aid when fall in Elementary School Children. The implementation of this community service activity is as follows:

Fig 1. Explanation of Material

At this stage, the presenter explains material regarding socialization about first aid when falling. The aim of this activity is to provide understanding and knowledge about what is in a first aid kit and its functions.

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Fig 2. Questions and Answers and Practice

Questions and answers and sharing about the activity material. At this stage of the activity, I as the presenter asked questions regarding the discussion of the material for this activity. The questions such as, "who here has ever fallen at school? Who has ever treated his own wounds when he fell?" and so on, were given and then the presenters provide responses to answers and questions from activity participants. This stage also included a sharing session where the children participating in the activity could convey their experiences of falling and treating wounds. The learning was using Role Models. At this stage, the speaker appointed a female student named Raisa to play the role of a victim who fell at school. The use of role models as intermediaries in conveying information was intended to make learning activities more interesting and realistic, which could create enthusiasm for learning by making one of the female students as a role model. Direct interaction between students and presenters provides a new and enjoyable experience in learning activities. It is hoped that providing knowledge about First Aid in a fun way will be easier for elementary school children to understand.

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Fig 3. Giving Gifts and Taking Photos Together

At this stage the presenter gives prizes to students who have the courage to ask the presenter and have interesting questions and give prizes as a memento to the students. Students of field study and community service badge XV for the 2024 academic year hope that this socialization can help elementary school age children in first treating injuries and providing education and understanding about how to treat injuries when they fall.

4. CONCLUSION

This socialization illustrates the importance of providing safety education and first aid to children from an early age to increase their awareness and readiness to face emergency situations. In this way, children can respond quickly and effectively when a minor accident occurs. Suggestions from this socialization activity are: to carry out safety education programs as early as possible, use interactive and fun learning methods, involve parents and teachers in supporting children's learning and encourage children's participation in simulation exercises to strengthen their skills.

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