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Analysis of Student Learning Outcomes in View of Mathematical Ability and Ability Chemistry Students at MAS Proyek Univa Medan on Buffer Solution Material

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Abstract: Analysis of Student Learning Outcomes in View of Mathematical Ability and Ability Chemistry Students at MAS Proyek Univa Medan on Buffer Solution Material. The aim of this research is to determine the mathematical abilities and analytical abilities of students in class XI IPA Madrasah Aliyah Swasta (MAS) Proyek Univa Medan on Buffer Solutions material. This type of research is cause and effect research. The data collected was in the form of mathematical ability test instruments, chemical analysis ability tests and student learning outcomes tests based on Low Order Thinking Skills (LOTS) and High Order Thinking Skills (HOTS). The results of this research are: (1) there is a linear and significant relationship relationship between mathematics ability and chemistry learning outcomes with Sig (1-tailed) value 0.001 <0.05; (2) there is a linear and significant relationship between chemical analysis abilities learning outcomes with a Sig(1-tailed) value of 0.004 <0.05; (3) there is a significant relationship between mathematical abilities and chemical analysis abilities on chemistry learning outcomes with a Sig(1-tailed) value 0.013 <0.05. Based on the research findings, it is concluded that there is a significant relationship between mathematical ability, analytical skills, and chemistry learning outcomes.

Keywords: Learning Outcomes, Mathematical Ability, Analytical Ability, Buffer Solution

Abstrak: Analisis Hasil Belajar Siswa Ditinjau dari Kemampuan Matematika dan Kemampuan Analisis Siswa MAS Proyek Univa Medan pada Materi Larutan Penyangga. *Tujuan dari penelitian ini adalah untuk mengetahui kemampuan matematika dan kemampuan analisis siswa dikelas XI IPA MAS Proyek Univa Medan materi Larutan Penyangga. Jenis penelitian ini adalah penelitian cause and effect. Data yang dikumpulkan berupa instrumen test kemampuan matematika, tes kemampuan analisis kimia dan tes hasil belajar siswa berbasis Low Order Thinking Skills (LOTS) dan High Order Thinking Skills (HOTS). Hasil penelitian adalah: (1) terdapat hubungan linier dan signifikan antara kemampuan matematika terhadap hasil belajar kimia dengan nilai Sig (1-tailed) 0,001<0,05; (2) terdapat hubungan linier dan signifikan antara hasil belajar kemampuan analisis kimia dengan nilai Sig(1-tailed) sebesar 0,004 < 0,05; (3) terdapat hubungan yang signifikan antara kemampuan matematika dan kemampuan analisis kimia terhadap hasil belajar kimia dengan nilai Sig(1-tailed) 0,013 < 0,05. Berdasarkan hasil penelitian disimpulkan bahwa terdapat hubungan yang signifikan antara kemampuan matematika, kemampuan analisis, dan hasil belajar kimia.*

Kata Kunci: *Hasil Belajar, Kemampuan Matematika, Kemampuan Analisis, Larutan Penyangga*

- **INTRODUCTION**

21st century science has developed according to the demands of the times. Era Global competition requires learning by providing facilities for students in developing abilities and skills as provision face challenges in global life. Skills needed in the 21st century 4C is a Higher Order Thinking Skill The low One of the abilities of students can be influenced by the learning process carried out so far only emphasizes memorization without linking it with benefits in everyday life (Rahayu et al., 2022). Students who study chemistry tend to bombarded with isolated facts and chemical formulas that have nothing to do with their life, so they tend to memorize, then easily throw it away without a trace. Scientific literacy is needed to seek and question, critical thinking, developing knowledge, problem solving and decision making decisions, being a person who always learns throughout his life, pays attention to aspects surrounding environment, and an understanding of the values of science (Priliyanti et al., 2021). Inside indicator scientific literacy skills, namely the role of science, thinking and working independently scientific (scientific thinking and doing), science and society (science and society), mathematics in science (mathematics and science), scientific media literacy (scientific media literacy) as well as motivation and belief in science (science motivation and biliefs) (Fitriyani & Yulianti, 2022).

Chemistry is a part of science (IPA) that studies about natural phenomena in everyday life. Some characteristics of chemistry subjects including: (1) most of the concepts are abstract, tiered, and structured; (2) is the science of solving problems and describing facts and events. However, sometimes students do not enter new concepts that taught into a network of concepts that are already in the minds of students. This is because low understanding of students' concepts. Understanding the concept is a major foundation that must be instilled in students, so as to avoid misunderstandings actual concept. The low interest of students in chemistry lessons is caused by many factors, including: the way of presenting chemistry in textbooks, the way chemistry lessons conducted by teachers, public information received by students, and Chemical material is abstract so it is difficult for students to understand. The low interest in student learning in chemistry lessons, because some students think that chemistry subject matter very difficult to understand and abstract in nature and is considered a relatively new material (Fauzannur et al., 2022). In reality, many students still encounter difficulties in learning chemistry. The challenge students face in understanding chemistry lessons arises from the abstract and complex nature of chemical concepts, requiring a deep level of understanding to grasp them (Sariati et al., 2020). Interest is one of the factors within a student that can influence their learning outcomes. Interest serves as the fuel for someone in doing something, where an individual with a strong interest in learning will enhance their willingness and high enthusiasm for learning (Ernawati et al., 2015). The essence of chemistry is actually divided into two aspects: chemistry as an end product and chemistry as a process involving research and experimentation (Ningsih & Hidayah, 2020). Every aspect in the field of chemistry always requires mathematical skills. Therefore, students' lack of understanding regarding chemical calculation formulas is often caused by their insufficient grasp of basic mathematics (Sudiana et al., 2019).

HOTS are ways or techniques for students to use the ability to analyze, plan, design, implement and evaluate all existing problems. HOTS questions have four indicators, namely: (1) The process of finding problems and how to solve problems based on real information, so that conclusions can be drawn; (2) Decision making skills; (3) Critical thinking skills are efforts to find accurate/more reliable information that can be

used appropriately in a problem; and (4) Creative thinking skills (Umami et al., 2021). The process of developing HOTS (Higher Order Thinking Skills) for students takes a long time, in fact the empowerment process is continuous along with the development of students and their educational levels from kindergarten to college (Ayu et al., 2022). Low Order Thinking Skill (LOTS) is a student's thinking ability functional. many can be said to be low level thinking abilities. Ability Low level thinking involves skills such as memorization, recall of knowledge what already exists, and understanding what is known. LOTS is an ability remember, understand and apply (Kenedi, 2018).

Mathematical ability is one that plays a role in the development of modern technology today which is a universal science, has an important role in various scientific disciplines, and in developing human thinking power. Apart from that, the rapid development in the field of information and communication technology today cannot be separated from mathematics. Strong mastery of mathematics from an early age is very necessary for improving technology in the future. On this basis, mathematics lessons must be provided from an early age to improve mathematical thinking skills from a basic level, in creating logical, analytical, systematic, critical, creative thinking and abilities (Hilda, 2020). Mathematical thinking ability is an ability that must be developed in the learning process. The success of students who are less than optimal in class can be possible because they have learning difficulties. Difficulty learning mathematics is not always caused by low intelligence, but is also caused by other factors. This means that a high IQ does not necessarily guarantee learning success (Anugrahana, 2021).

Learning outcomes are the abilities possessed by students after receiving learning experiences. A number of experiences gained by students include the cognitive domain, affective domain and psychomotor domain. Learning outcomes have an important role in the learning process because they will provide information to teachers about students' progress in achieving their learning goals through the process of subsequent teaching and learning activities (Tasya Nabillah & Abadi, 2019). Successful mastery of a concept will be achieved when students are able to think at a higher level. So that students' HOTS can develop well, students need to be familiarized with activities that train HOTS itself where students can not only remember and understand a concept, but students can analyze and synthesize, evaluate and create a concept well, The concepts that have been understood can stick in their memories for a long time, so it is very important for students to have high-level thinking skills (Ndiung & Jediut, 2020).

Buffer solution is a chemical material that contains concepts complex. To be able to understand buffer solutions, students are required to understand.The underlying concepts are the concepts of acid-base and chemical equilibrium. If students experience misconceptions about the concepts of acids and bases and chemical equilibrium. So it is very likely that students also experience misconceptions about environmental concepts buffer. The misconception about the concept of buffer solutions is that students believe that solutions.Buffers can be made from acid base mixtures without the strength of the acid or base its shaper (Efendi & Latifah, 2021). In this educational content, students need to engage in a sequence of scientific procedures, including observing, identifying problems, making observations, formulating hypotheses, conducting experiments, and deriving conclusion (Ginting & Ginting, 2023).

Based on the results of interviews with subject teachers about student learning outcomes, where the KKM score in Chemistry and the KKM score respectively is 78. Many student learning outcomes do not pass the KKM score. Some of the factors that cause student learning outcomes are the lack of mathematical ability so that students

cannot apply it to chemical formulas and the lack of chemical analysis skills. The majority of students find mathematics challenging, which makes them less active when presented with math problems, and only a few are willing to step forward in the classroom. Interviews with class teachers indicate that students are beginning to encounter difficulties in learning mathematics. Some of the challenges they face include comprehending the meaning of math problems and confusion in determining which arithmetic operations to use. They often make mistakes in calculations, especially in multiplication and division using the long-form method. Additionally, students rarely take the opportunity to ask questions, and most of them do not complete assigned homework (Raharjo et al., 2021). One of the various difficulties students encounter in learning mathematics includes struggles with facts, concepts, skills, and principles. Other studies have also revealed that the level of difficulty among students in mathematics remains high, as evidenced by a number of mistakes made by students when solving problems (Utari et al., 2019).

Students' mathematical ability is one of the internal factors that can influence the results of learning chemistry Students face difficulties in learning chemistry due to various internal factors, such as lack of interest and motivation in learning chemistry, students' understanding of solubility concepts and low understanding of solubility product concepts, as well as inadequate comprehension of supporting concepts. Additionally, students' ability in performing calculations is also weak. External factors also play a role, including students' adaptation to insufficient teaching methods by teachers, chemistry learning management by teachers, influence from peers, and the lack of effectiveness in chemistry learning time (Muderawan et al., 2019). The value of learning outcomes obtained by students when carrying out tests can vary, there are those who get high, medium and low scores. This can happen because students' chemistry learning outcomes are still low, weak basic math skills make it difficult for students to apply formulas in working on problems, and teachers also have not used the right learning model in learning chemistry on buffer solution material. Given these problems, the researcher will conduct research on the Analysis of Student Learning Outcomes in View of the Mathematical Ability and Chemistry Ability of Class XI IPA Students at the Madrasah Aliyah Swasta (MAS) Proyek Univa Medan on Buffer Solution Material.

▪ METHOD

This research will be carried out at the Univa Medan Private Madrasah Aliyah (MAS) school on Jalan Sisingamangaraja Km 5.5 No.10, Medan Amplas District, Medan City, North Sumatra. This research will be carried out in the even semester of the 2022/2023 school year. The subjects of this study were students of class XI IPA at the Madrasah Aliyah Swasta (MAS) Proyek Univa Medan for the 2022/2023 academic year. Product trials were carried out on 25 students of XI IPA 1. The type of research used is cause and effect research. Cause and effect research is a causal or causal relationship between two variables and measures how close the relationship between the two variables is called Regression Analysis (Panggabean et al., 2022). Sampling used a purposive sampling technique, namely directly selecting one class, namely XI IPA 1 with a total of 25 students. Data collection techniques used are quantitative and qualitative data. Data collection techniques are methods that can be used by researchers to collect data needed in research.

The test instrument is a tool for measuring student learning outcomes. Before the questions are tested on students, the questions are tested first instrument to determine the

extent to which the instrument has met the requirements of terms of difficulty level, discriminating power, validity, reliability, and distractor.

Research Design

The design of this study is a correlation research design with simple linear regression and multiple regression.

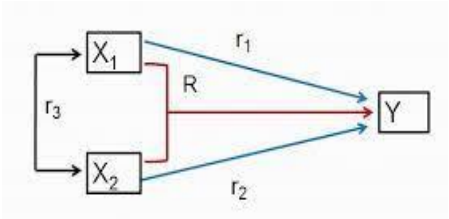

Figure 1.1 . Multiple paradigmas, showing the relationship between 2 variables independent and 1 independent.

Research Instruments

The research instrument used by researchers is an ability test mathematics, chemical analysis ability tests and student learning outcomes tests based on Low Order Thinking Skills (LOTS) and High Order Thinking Skills (HOTS) on Solution material Buffer. The learning result test is validated in advance by an expert validator (lecturer) 9 before being given by students. The learning outcomes test is carried out once, namely post- test

▪ RESULT AND DISCUSSION

RESULT

Research Instrument Analysis

There are three types of instruments that are tested on students, namely mathematical ability instruments, chemical analysis instruments, and chemistry learning outcomes instruments. The mathematical ability instrument consists of 12 multiple choice questions, the analytical instrument consists of 10 essay questions and the results of the chemistry instrument consist of 40 multiple choice questions. After being validated, the third instrument was tried out on class XI IPA students at the Univa Medan Private Madrasah Aliyah (MAS). The purpose of the trial was to determine validity, reliability, discriminatory power, level of difficulty and deception.

Test Validity

The validity coefficient obtained (rxy) is compared with the moment product r table value at α=0.05, if the calculated r value obtained is greater than r table then the item is said to be valid. For the validity of the test instrument with respondents (N) as many as 25 people, the r table was 0.396. The results of the validity test of the mathematical ability test instrument tested on class XI IPA students showed that out of 12 questions there were 9 valid questions and 3 invalid questions. The results of the validity test of the chemical analysis ability test instrument showed that as many as 7 questions were valid and 3 questions were invalid. Meanwhile, to test the validity of the chemistry learning outcomes test, the results obtained were 9 valid questions and 11 invalid category questions.

Test Reliability

After testing the validity of the question items, valid question items are then tested again with a confidence test. For the mathematical ability test r_{11} = 0.0692 while r_{table} = 0.396 it can be concluded that the mathematical ability test instrument is reliable and in the high category. Chemical analysis ability test r_{11} = 0.647 While r_{table} = 0.396 so it can be concluded that the chemical analysis ability test instrument is reliable and in the high category. Chemistry learning outcomes test r_{11} = 0.745 While r_{table} = 0.396 so it can be concluded that the chemical analysis ability test instrument is reliable and in the high category.

Difficulty Level

The results of the test for the difficulty level of the mathematics ability test showed that there were 6 questions in the easy category, namely questions numbered 1, 4, 7, 8, 9, and 10. There were 4 questions in the medium category, namely questions numbered 2, 3, 5 and 6. There are 2 questions in the difficult category, namely questions numbered 11 and 12. The results of the test for the level of difficulty of the chemical analysis ability test show that there are 4 questions in the easy category, namely questions numbered 1, 4, 8, and 9. Questions in the medium category are 6 questions, namely questions numbered 2, 3,5, 6, 7, and 10. The results of the test for the difficulty level of chemistry learning outcomes showed that there were 2 easy category questions, namely questions number 9 and 19. There were 35 questions in the medium category, namely question number 1 , 2, 3, 4, 5, 6, 7, 8, 11, 12, 13, 14, 15, 17, and 18. There are 4 questions in the difficult category, namely questions numbered 10, 11, 16 and 20.

Discrimination Power

An item is said to meet the requirements if the Difference Power Index (D) ranges from 0.2-1.0. The results of the different power test of the mathematical ability test showed that there were 12 questions that met the requirements, meaning that all the items met the requirements. The results of the different power test of the chemical analysis ability test showed that there were 3 questions that met the requirements, namely questions numbered 1, 5 and 7, while questions numbered 2, 3, 4, 6, 8, 9, and 10 were declared not eligible. The results of the different power test of the learning outcomes test show that there are 38 questions that meet the requirements, namely questions numbered 1, 2, 3, 4, 5, 6, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18 , 19, and 20. While questions numbered 7 and 10 were declared not eligible.

Distructors

Distructors or distractors are all alternative answers (0ption) outside of the "answer key". The purpose of using the constructor is to distract the correct answer and trick test takers who are less able and do not know so that they can be distinguished from test takers who are able to answer the question. Among the answer options, only one is correct and the other options are called distractors. A constructor is said to function well if it has great appeal for test takers who lack mastery of the material. Distructor not selected at all (empty) means it does not work (not good). From the results of the analysis a decision can be made, namely the constructor is accepted, rejected, revised.

From this study, the distractor test was used, namely questions from the math ability test and the chemistry ability test. A good distractor is a distractor that has been selected by at least 5% of all test takers.

Data Analysis and Research Results

Before the results of chemistry learning from Buffer Solution are obtained, a math ability test is first given and analytical skills are assessed during the learning process. From the results of the acquisition of student scores, it can be seen that the average value of mathematical ability is 64. If it is related between mathematical ability and learning outcomes, the relationship between these two variables is classified into simple linear regression and multiple regression between mathematical ability and chemical analysis ability with chemistry learning outcomes is classified as enough with the calculations that have been done.

Hypothesis Test

After getting the data from the research results, a hypothesis test was carried out using Microsoft Excel and SPSS 20 For Windows which aims to find out whether the hypothesis in this study is accepted or rejected and to obtain more relevant data.

Hypothesis Test 1

Hypothesis 1 test that has been tested is in the form of a simple linear regression test which is carried out to test whether there is a significant linear relationship (cause and effect relationship) between the variables of mathematical ability (X) and chemistry learning outcomes (Y). By using Microsoft Excel and SPSS 20 For Windows, the output and calculations are obtained as attached to the linearity results data presented in the table below.

Table 1. Correlation between Mathematical Ability and Learning Outcomes

Descriptive Statistics

	Mean	Std. Deviation	N
Chemistry Learning Outcomes	78.80	6.813	25
Mathematical Ability	64.00	21.313	25

The first part is Descriptive Statistics, which contains information on the average students' Chemistry Learning Outcomes of 78.80 (Mean) with a standard deviation of 6.813 (Std. Deviation). While the results of chemical analysis averaged 64 with a standard deviation of 21.313 with the number of each sample (N) of 25.

Table 2 of Correlations

		Chemistry Learning Outcomes	Mathematical Ability
Pearson Correlation	Chemistry Learning Outcomes	1.000	.623
	Mathematical Ability	.623	1.000
Sig. (1-tailed)	Chemistry Learning Outcomes	.	.000
	Mathematical Ability	.000	.
N	Chemistry Learning Outcomes	25	25
	Mathematical Ability	25	25

The second part of Correlations (correlation) in the form of information on the relationship between the variables results of mathematics ability with Chemistry Learning Outcomes is 0.623. This result means that the relationship between the two variables is strong. The positive correlation coefficient shows a unidirectional relationship, meaning

that if there is an increase in the results of math skills it will increase the value of Chemistry learning outcomes. The relationship between the two variables can be seen from the significance level (sig.) of 0.000 <0.05, meaning that the relationship is significant.

Table 3 Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.623[a]	.388	.361	5.446	.388	14.565	1	23	.001

a. Predictors: (Constant), Mathematical Ability
b. Dependent Variable: Chemistry Learning Outcomes

The R value shows the correlation or relationship value, namely 0.623 or 62.3% and explains the magnitude of the influence of the independent variable on the dependent variable, which is called the coefficient of determination which is the square of the R value.

The R Square (R squared) value is called the coefficient of determination, which is 0.388, meaning that 38.8% of Chemistry Learning Results can be explained using the Mathematics Ability Result Variable.

Using R Square often causes problems, the value will always increase with the addition of independent variables which will cause bias. The Adjusted R Square value can increase or decrease with the addition of a new variable. This depends on the correlation between the additional independent variable and the dependent variable. The Adjusted R Square value can be negative, this value is considered 0, or the independent variable is completely unable to explain variance and other variables.

Std. Error of the Estimate (SEE) of 5.446 is used to assess the suitability of the independent variable (predictor) for the dependent/dependent variable. Conditions if the SEE value < Std. Deviation (see first section – Descriptive Statistics) then the predictor used to predict the dependent variable is feasible. The SEE results were 5.446 < 6.582 so it was concluded that the independent variable (chemistry learning outcomes) was suitable to be used as a predictor of the dependent variable (chemistry learning outcomes).

Table 4 ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	431.930	1	431.930	14.565	.001[b]
	Residual	682.070	23	29.655		
	Total	1114.000	24			

a. Dependent Variable: Chemistry Learning Outcomes
b. Predictors: (Constant), Mathematical Ability

In the fifth part of ANOVA, the calculated F value is 14.565 with a probability or significance (sig) of 0.000. Based on probability, 0.000 <0.005 so that the regression model is feasible to use to predict Chemistry learning outcomes.

Table 5 Coefficients[a] Matematika

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	66.061	3.511		18.815	.000
	Kemampuan Matematika	.199	.052	.623	3.816	.001

a. Dependent Variable: Chemistry Learning Outcomes

Table 1.5. Coefficients, this section explains the regression equation Y = a + bX with the following explanation:

Y = Chemistry Learning Outcomes

a = constant number of Unstandardized coefficients, in this case 59.75 which means the current sales transaction X (Mathematical Ability Results) = 0

b = regression coefficient number of 0.297, which means that each additional chemical analysis value increases the value of chemistry learning outcomes by 0.297. Conversely, if the number is negative (-) then a decrease in Chemistry Learning Results applies.

Based on the results of data processing, the regression equation Y = 66.061 + 0.199X is obtained. Next, to find out whether the regression coefficient is significant or not, the t test is used to test the significance of the constant variable Mathematics Ability as a predictor of the outcome variable Learn Chemistry by first making a hypothesis as follows:

H_0 : the regression coefficient is not significant

H_a : significant regression coefficient

Looking at the t table value with the condition $\alpha/2 = 0.05/2 = 0.025$, a two-sided test because you want to know the significance of the regression coefficient, not looking for bigger or smaller. Degrees of freedom (df – degrees of freedom) are calculated using the formula = amount of data. a- 2 = 25 - 2 = 23. So the t table value is 2.042.

Determine the criteria as a basis for decision making. If the calculated t value < table t value then H0 is accepted. If the calculated t value > t table value then H0 is rejected.

Decision: because the calculated t value is 3.816 > 2.042 (t table value), then H0 is rejected or Ha is accepted, which means the regression coefficient is accepted. Meanwhile, decision making based on probability or significance (sig.) as a basis is as follows:

If the probability (sig.) > 0.025 (two-sided test), then H0 is accepted

If the probability (sig.) < 0.025 (two-sided test) then Ha is accepted

Decision: because the probability value (sig.) is 0.000 < 0.025, then H0 is rejected or Ha is accepted, which means the regression coefficient is significant or the Mathematical Ability Results really have a significant effect on chemistry learning outcomes. So the higher a student's mathematical ability, the higher the student's learning outcomes.

Hypothesis Test 2

Hypothesis II testing was carried out by applying a simple linear regression test to evaluate the significance of the linear relationship (cause and effect relationship) between the variable chemical analysis ability (X) and chemistry learning outcomes (Y). The output and calculations related to this test were obtained through the Microsoft Excel and SPSS 22 for Windows programs, and information on the linearity results is presented in the table below.

Table 6 Descriptive Statistics

	Mean	Std. Deviation	N
Learning outcomes	47.00	15.069	25

Chemical analysis	63.24	9.248	25

The first section of Descriptive Statistics contains information regarding Student Chemistry Learning Outcomes, which has an average of 47.00 (Mean) and a standard deviation of 15.069 (Std. Deviation). Meanwhile, the Chemical Analysis Results have an average of 63.24 with a standard deviation of 9.248, and each sample consists of 25 data (N).

Table 7 Correlations

		Learning outcomes	Chemical analysis
Pearson Correlation	Learning outcomes	1.000	.559
	Chemical analysis	.559	1.000
Sig. (1-tailed)	Learning outcomes	.	.002
	Chemical analysis	.002	.
N	Learning outcomes	25	25
	Chemical analysis	25	25

The second section regarding Correlations presents information about the relationship between the variables Chemical Analysis Results and Chemistry Learning Results of 0.559, indicating that the relationship between these two variables is very strong. This positive correlation coefficient indicates a unidirectional relationship, which means that an increase in Chemical Analysis Results has a positive impact on the value of Chemistry Learning Results. The relationship between the two variables can be considered significant, as indicated by a significance value (sig.) of 0.000 < 0.05.

Table 8 Variables Entered/Removed

Model	Variables Entered	Variables Removed	Method
1	Chemical Analysis	.	Enter

a. Dependent Variable: Learning Outcomes
b. All requested variables entered.

The third section explains the method used, namely the Enter (single step) method for variable analysis, where no variables are removed. Other method options include Stepwise, Backward, Forward, and Remove.

Table 9 Model Summary [b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.559 [a]	.312	.282	12.769	.312	10.427	1	23	.004

a. Predictors: (Constant), Chemical Analysis
b. Dependent Variable: Learning Outcomes

From the table above, the R value shows a correlation or relationship, namely 0.559 or 55.9%. This indicates the extent to which the independent variable influences

the dependent variable and is known as the coefficient of determination which is the result of squaring the R value.

The R Square value, which is the coefficient of determination, is 0.312 (the square of the R value). This means that 31.2% of Chemistry Learning Results can be explained by the Chemical Analysis Results variable. The remaining 69.8% (1 – 69.8%) is influenced by other factors. The influence of these other factors is referred to as error (e), which is calculated by the formula e = 1 - r2. The R Square value ranges from 0 to 1, the smaller the number, the weaker the relationship between the two variables or vice versa.

Using R Square often causes problems because the value will always increase with the addition of independent variables, which can result in bias. A researcher can add arbitrary variables to obtain high values. Therefore, many researchers recommend using the Adjusted R Square value with the same interpretation as R Square.

The Adjusted R Square value can increase or decrease with the addition of a new variable, depending on the correlation between the additional independent variable and the dependent variable. The Adjusted R Square value can even be negative, and if so, the value is considered 0, which means the independent variable is completely unable to explain the variance of the dependent variable.

Std value. Error of the Estimate (SEE) of 12.769 is used to assess the validity of the independent variable (predictor) in relation to the dependent variable. The rule that applies is if the SEE value < Std. Deviation (see the first section Descriptive Statistics), then the predictor used to predict the dependent variable is considered suitable. In this case, the SEE value is 12.769 < 15.069 (as stated in the Descriptive Statistics section), so it can be concluded that the independent variable (Chemical Analysis Results) is an appropriate predictor for the dependent variable (Chemical Learning Results).

Table 10 ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	1700.035	1	1700.035	10.427	.004[b]
	Residual	3749.965	23	163.042		
	Total	5450.000	24			

a. Dependent Variable: Learning Outcomes
b. Predictors: (Constant), Chemical Analysis

In the fifth part of the ANOVA, the degree of freedom (DF) value was 10,427 with a probability or significance level (sig.) of 0.004. Because the probability is 0.000 < 0.005, it can be concluded that this regression model is suitable for use in predicting Chemistry Learning Outcomes.

Table 11 Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-10.554	18.006		-.586	.563
	Chemical analysis	.910	.282	.559	3.229	.004

In Table 1.16, which is referred to as Coefficients, an explanation of the regression equation Y = a + bX is given, with the following information:
Y = Chemistry Learning Outcomes

a = Constant of Unstandardized Coefficients, in this case it is -10.554, which indicates a sales transaction when the value of X (Chemical Analysis Results) = 0.

b = Regression coefficient number, has a value of 0.910, which indicates that every one unit increase in the chemical analysis variable will result in an increase of 0.910 in chemistry learning outcomes. On the other hand, if this number is negative (-), it will indicate a decrease in Chemistry Learning Results.

Based on data analysis, the regression equation is: Y = -10.554 + 0.910X. Next, to determine whether the regression coefficient is significant or not, the t test is used to test the significance of the constant Chemical Analysis variable as a predictor for the Chemistry Learning Outcome variable by first making a hypothesis as follows:

H_0 : The regression coefficient is not significant.

H_a : Significant regression coefficient.

Looking at the t table value with a significance level of $\alpha/2 = 0.05/2 = 0.025$, remember that this is a two-sided test because what you want to determine is the significance of the regression coefficient, not whether it is bigger or smaller. The degrees of freedom (df - degree of freedom) are calculated using the formula for the amount of data - 2 = 25 - 2 = 23. Thus, the t table value is 2.069.

Determining the decision: If the calculated t value > t table value, then H0 is rejected and Ha is accepted, which means the regression coefficient is significant. If the calculated t value < table t value, then H0 is accepted. In this case, the calculated t value is 3.229 > 2.069. Therefore, H0 is rejected, and Ha is accepted, indicating that the regression coefficient is significant. Furthermore, decisions can also be based on probability or level of significance (sig.) with the following conditions:

If sig > 0.025 (two-tailed test), then Ho is accepted.

If sig < 0.025 (two-tailed test), then Ha is accepted

In this case, because the sig value. equal to 0.004 < 0.025, H0 is rejected, and Ha is accepted, which means that the regression coefficient is significant. Chemical analysis results significantly influence chemistry learning outcomes, and the higher a student's chemical analysis skills, the higher the student's learning outcomes.

Hypothesis Test 3

The third hypothesis test that has been tested is whether there is a linear and significant relationship between mathematics ability (X1) and analytical ability (X2) on chemistry learning outcomes (Y). The significant test was carried out using the Multiple Linear Regression Test using Microsoft Excel and SPSS 20 For Windows programs and data was obtained according to the following table:

Table 12 The relationship between mathematics ability and analytical ability on chemistry learning outcomes

Descriptive Statistics

	Mean	Std. Deviation	N
Learning outcomes	47.00	15.069	25
Mathematical Ability	64.00	21.313	25
Chemical analysis	63.24	9.248	25

Table 1.17 Descriptive Statistics contains information regarding Student Chemistry Learning Outcomes, which has an average of 47.00 (Mean) and a standard

deviation of 15.069 (Std. Deviation). Then, the Mathematics Ability Results have an average of 64.00 with a standard deviation of 21.313 and the Chemical Analysis Results have an average of 63.24 with a standard deviation of 9.248, and each sample consists of 25 data (N).

Table 13 Relationship between chemistry learning outcome variables, chemical analysis results and mathematics learning outcomes

Correlations

		Learning outcomes	Mathematical Ability	Chemical analysis
Pearson Correlation	Learning outcomes	1.000	-.217	.559
	Mathematical Ability	-.217	1.000	-.560
	Chemical analysis	.559	-.560	1.000
Sig. (1-tailed)	Learning outcomes	.	.149	.002
	Mathematical Ability	.149	.	.002
	Chemical analysis	.002	.002	.
N	Learning outcomes	25	25	25
	Mathematical Ability	25	25	25
	Chemical analysis	25	25	25

The second section Correlations contains information on the relationship between the variables Chemistry Learning Outcomes, Chemical Analysis Results and Mathematics Learning Outcomes. The relationship between the Chemical Analysis Results variable and Chemistry Learning Results is 0.559, which means the relationship between the two variables is very strong. A positive correlation coefficient indicates a unidirectional relationship, meaning that if there is an increase in the Chemical Analysis Results, the value of the Chemistry Learning Results will increase. The relationship between the two variables can be seen from the significance number (sig.) of 0.000 < 0.05, meaning the relationship is significant.

Meanwhile, the relationship between Chemistry Learning Results and Mathematics Learning Results is 0.217, which means the relationship between the two variables is in the high category. The positive correlation coefficient indicates a unidirectional relationship, meaning that increasing Mathematics Ability can increase students' Chemistry Learning Outcomes scores. The relationship between the two variables can be seen from the significance level (sig.) of 0.000 <0.05, meaning the relationship is significant.

Table 14 Model Summary of mathematical ability results and chemical analysis ability results

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.570[a]	.325	.264	12.928	.325	5.304	2	22	.013

a. Predictors: (Constant), Chemical Analysis, Mathematical Ability

b. Dependent Variable: Learning outcomes

From table 1.19, the R value shows the correlation or relationship value, which is 0.570 or 57% and explains the magnitude of the influence of the independent variable on the dependent variable which is called the coefficient of determination which is the result of squaring the R value

The R Square value (R squared) is referred to as the coefficient of determination with the number 0.325 (squaring the R value) meaning that 32.5% of Chemistry Learning Results can be explained using the variables Chemical Analysis Results and Mathematical Ability Results. The remaining 67.5% (1-32.5%) is caused by other variables or other factors. The influence of other factors is called error (e) which is calculated using the formula e = 1- r. The R Square value ranges from 0 to 1, the smaller this number, the weaker the relationship between the two variables or vice versa.

Using R Square often causes problems, the value will always increase with the addition of independent variables which will cause bias. A researcher can add any variable to get a high value, so many researchers recommend using the Adjusted R Square value with the same interpretation as R Square. The Adjusted R Square value can increase or decrease with the addition of one new variable; depending on the correlation between the additional independent variable and the dependent variable. The Adjusted R Square value can be negative so that if the value is negative, the value is considered 0, or the independent variable is completely unable to explain the variance of the dependent variable.

Std value. Error of the Estimate (SEE) of 12.928 is used to assess the appropriateness of the independent variable (predictor) in relation to the dependent/dependent variable. The condition is that if the SEE value < Std. Deviation (see the first section of Descriptive Statistics) then the predictor used to predict the dependent variable is appropriate. The SEE results were 12.928, so it was concluded that the independent variables, Chemical Analysis Results and Mathematical Ability Results, were worthy of being used as predictors for the dependent variable, Chemistry Learning Results.

Table 15 Anova test of student learning outcomes with results of mathematical abilities and chemical analysis abilities

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1772.962	2	886.481	5.304	.013[b]
	Residual	3677.038	22	167.138		
	Total	5450.000	24			

a. Dependent Variable: Learning outcomes

b. Predictors: (Constant), Chemical Analysis, Mathematical Ability

From table 1.20, the calculated F value is 5.304 with a probability or significance (sig.) of 0.013. Based on probability, 0.013 < 0.005 so the regression model is suitable to be used to predict Chemistry Learning Outcomes.

Tabel 16 Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-24.918	28.376		-.878	.389
	Kemampuan Matematika	.099	.149	.140	.661	.516
	Analisis Kimia	1.037	.344	.637	3.013	.006

a. Dependent Variable: Learning outcomes

This section describes the regression equation $Y = a + b_1x_1 + b_2x_2$ with the following explanation:

Y = Chemistry Learning Outcomes

a = Constant number from Unstandardized Coefficients, in this case -24.918 which means sales transactions when the value of X (Chemical Analysis Results) = 0

b = the first regression coefficient number is 0.099, which means that every additional chemical analysis value increases the value of chemistry learning outcomes by 0.099. Conversely, if the number is negative (-), a decrease in Chemistry Learning Results applies. b_2- the second regression coefficient number is 1.037, which means that every additional mathematics ability value increases the chemistry learning outcome value by 1.037. Conversely, if the number is negative (-), a decrease in Chemistry Learning Results applies.

Based on the results of data processing, the regression equation $Y = 24.918 + 1.037X_1 + 0.099X_2$ Next, to find out whether the regression coefficient is significant or not, the t test is used to test the significance of the constant Mathematics Ability and Chemical Analysis variables as predictors for the Chemistry Learning Outcomes variable by first making the following hypothesis:

H_0 : the regression coefficient is not significant

H_a : significant regression coefficient

Looking at the t table value with the condition $\alpha / 2 = 0.05 / 2 = 0.025$, the test is two-sided because you want to know the significance of the regression coefficient, not look for bigger or smaller. Degrees of freedom (df - degree of freedom) are calculated using the formula = amount of data. a-2 = 25-2-23. So the t table value is 2.069. Next, determine the criteria as a basis for decision making :

If the calculated t value < table t value, Ho is accepted

If the calculated t value > table t value, Ho is rejected

Decision: the first variable is Chemical Analysis Ability, calculated t value 3.816 > 2.069 (t table value), Ho is rejected or H, accepted which means the regression coefficient is accepted. The second variable is Mathematics Ability, the calculated t value is 3.816 > 2.069 (t table value), Ho is rejected or Ha is accepted which means the regression coefficient is accepted. Meanwhile, decision making based on probability or significance (sig.) as a basis is as follows:

If probability (sig.) > 0.025 (two-party test), H0 is accepted

If probability (sig.) < 0.025 (two-tailed test), Ha is accepted

Decision: (1) Mathematical ability probability value (sig.) is 0.001 < 0.025, so that Ho is rejected or H is accepted, which means the regression coefficient is significant or the chemical analysis results really have a significant effect on chemistry learning outcomes. (2) Chemical Analysis Ability probability value (sig) is 0.004 < 0.025, so that H0 is rejected or Ha is accepted, which means the regression coefficient is significant or the Chemical Analysis Results really have a significant effect on chemistry learning outcomes. (3) mathematics ability and chemical analysis ability on chemistry learning outcomes Sig (1-tailed) 0.013 < 0.025 so that Ho is rejected or Ha is accepted, which means there is a significant relationship between mathematics ability and chemical analysis ability on chemistry learning outcomes.

- **DISCUSSION**

This research was carried out in MAS Project Univa Medan, to be precise, in class XI MIPA with 25 students. In This research results are analyzed in hypothesis testing is (1) relationship in the form of simple linear regression, namely relationship between mathematical abilities (X1) with chemistry learning outcomes (Y), (2) analytical ability (X2) with results study chemistry (Y), and (3) analysis using multiple linear regression, namely relationship between mathematical ability (X1) and chemical analysis capabilities (X2) with results study chemistry (Y).

Mathematical Ability

The mathematics ability test is carried out to see the mathematics abilities possessed by each student using 12 mathematics questions. This question instrument will then be tested on a mathematics research sample, namely class XI MIPA MAS Project Univa Medan. The graph of students' mathematical abilities is shown in the following picture.

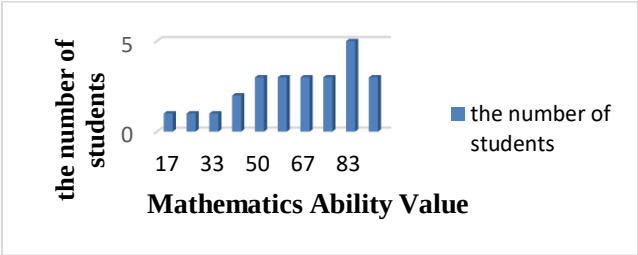

Figure 1. Graph of students' mathematical ability scores

Evaluation data on students' mathematical abilities is presented via a bar chart as attached. The evaluation results of students' mathematical abilities are based on an average test score of 64.00, which indicates a level of ability that is still below the student's Minimum Completeness Criteria (KKM) value of 75. From figure (4.1), it can be seen that the lowest score obtained by students was 17, while the highest score was 92.

Analytical Capabilities

From observations made on the chemical analysis skills of 25 students in class XI MAS Project Univa Medan, a graph was obtained showing the students' analytical ability scores as follows:

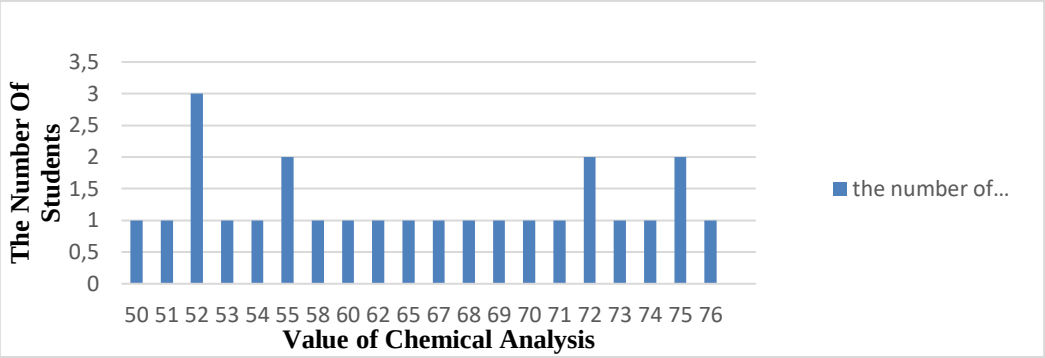

Figure 2. Graph of students' analytical ability scores

Based on the data obtained, the average value of students' analytical skills is 63.24. From Figure 4.3, it can be seen that the lowest score for students' analytical skills is 50, with the number of students being 1 person. Meanwhile, the highest score for analytical ability was 76, with the number of students being 1 person.

Learning Outcomes

From the results of observations, chemistry learning results tests on 25 students in class XI MAS Project Univa Medan, a graph was obtained showing the students' analytical ability scores as follows:

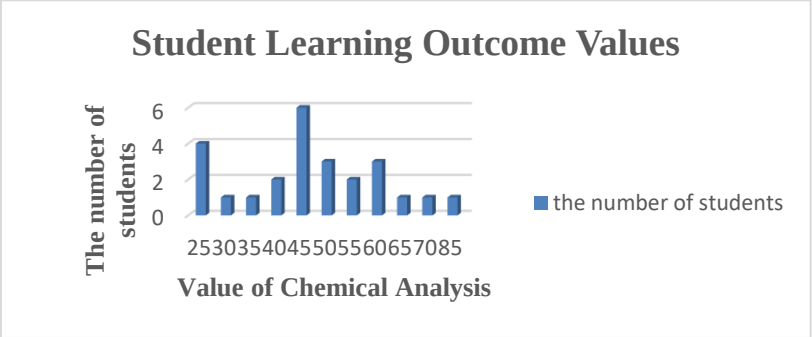

Figure 3. Graph of student learning outcomes

From the research results, the average student chemistry learning outcome was 47.00. This average shows a lower achievement than the KKM score for chemistry subjects which is 75. According to (Figure 4.5), there are 4 students who achieved the lowest score of 25, while 1 student achieved the highest score in chemistry learning outcomes of 85 .

▪ CONCLUSION

Based on the results of the research that has been carried out, it is concluded that (1) There is a significant correlation between mathematics ability and chemistry learning outcomes with a Sig(1-tailed) value of 0.000 < 0.025. (2) There is a linear and significant relationship between analytical skills and chemistry learning outcomes with a Sig (1-tailed) value of 0.000 < 0.025. (3) There is a significant relationship between mathematical ability and chemical analysis ability on chemistry learning outcomes with a Sig (1-tailed) value of 0.000 < 0.025.

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