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The Correlation of Mathematics Ability and Chemistry Analysis Ability to Improve Student Learning Outcomes in Buffer Solution

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Abstract: This study aims to determine the linear and significant relationship between mathematical ability and chemistry learning results; chemical analytical abilities and learning result: association between students' chemistry learning outcomes and mathematical skills and chemical analysis abilities. This type of research is causal research with a quasi-experimental research design. Students in this study were given tests in the form of mathematical ability instruments, chemical analysis abilities, and buffer solution tests. This study found a linear and significant relationship between mathematical ability and students' learning outcomes, a linear and meaningful relationship between chemistry analysis ability and students' learning outcomes, and a significant relationship between mathematical knowledge and chemistry ability.

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

INTRODUCTION

Education is crucial in educating the nation's life; as a result, every individual involved in education is expected to improve educational quality (Wijanarko, 2017). Chemistry is a part of science usually taught in school (Yuliastusi, 2020). Chemistry is one of the materials that students consider difficult. The difficulties experienced by students are typically due to concepts that must be understood; there is a relationship between one concept and another, and there are also many mathematical calculations (Cholifah et al., 2019). For example, Habiddin et al. (2023) found a strong correlation between students understanding of Lewis structure and molecular geometry.

Teachers have not adequately considered the elements contributing to low learning accomplishment thus far. One of the elements to consider is the ability to count or perform maths (Maysaroh et al., 2021). Mathematical skills are also very much needed in solving various chemical problems. Students must first understand and master the stages of basic concepts and procedural methods in mathematics to answer chemistry problems. If students do not know or even cannot solve math problems, their ability to solve chemical problems will also be doubted. The study's results also show significant results if the math ability is high; the ability to analyze math problems is also elevated by as much as 80% (Panggabean et al., 2022; Vula, & Berisha, 2022).

It is not a new idea that basic math skills and the automaticity of these skills are related to chemistry scores. Some researchers have suggested ways to solve it. One study used a test of 84 problems; students were told not to use calculators. Students were informed of the results and could take an extra class that focused on a formal, in-depth explanation of the mathematical concepts used in the exam. Most students who take such additional courses graduate with a degree in chemistry.

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The chemistry lab uses peer learning. This was done by comparing how self-selecting students into groups impacted combining groups of students with different math abilities (Williamson et al., 2020).

Analytical ability is a fundamental ability that students must possess. Analytical ability concerns the capacity to (a) observe, hear, and retrieve relevant information; b) analyze data and reflect on implications for practice; c) look at issues from multiple perspectives and recognize different ways of thinking; and others (Suliman et al., 2017). Previous research stated that the higher the analytical ability, the higher the achievement of learning chemistry in chemical materials, including some materials in chemistry that contain a lot of chemical calculations (Cholifah et al., 2019; Bain, Rodriguez, & Towns, 2019) and buffer solution (Habiddin & Nagol, 2023). Analytic ability refers to pupils' capacity to organize various pieces, look for interrelationships between some of these parts, and integrate components relevant to occurrences in everyday life. Analytical thinking skills are frequently referred to as comprehensive (complex) skills since they include features such as the learner's information, comprehension of that knowledge, and application of that knowledge following comprehension. As a result, it is critical for pupils to develop analytical thinking skills (Fitriani et al., 2021).

One of the materials considered difficult by students when studying chemistry in class XI is a buffer solution. This is because students are expected to understand concepts and solve mathematical equations appropriately in the support material (Cholifah et al., 2019). When studying buffer solutions, students frequently struggle with chemical calculation difficulties, particularly finding the pH of solutions. Calculating the pH value in the buffer solution material requires mathematical concepts, especially regarding logarithms. Students must master the concept of logarithms well so that they can operate the numbers to get the pH value when they have to find a solution's pH value (Silitonga & Sitepu, 2022; Becker & Towns, 2012).

According to Cholifah et al.'s (2022) research, there was a substantial positive association between analytical skills and learning achievement, with a correlation value of 0.748 and a coefficient of determination of 55.95%. With a correlation coefficient of 0.426 and a coefficient of determination of 18.15%, mathematical ability has a substantial positive link. And there is a significant positive relationship between analytical ability and mathematical ability on student achievement, with a correlation coefficient of 0.762, the regression equation Y = 9.417 + 0.762 X1 + 0.236 X2, an effective contribution of 51.39% analytical ability and mathematical ability 6, 61%, and a relative contribution of 88.61% analytical ability and 11.39% mathematical ability (Cholifah et al., 2019).

Another study found that the product-moment correlation test measured the correlation between students' math ability and their understanding of buffer solutions. The value of r-count (0.803) > r-table (0.268), or a significant value of 0.000 < 0.050, indicates that students' ability in basic math operations is positively correlated with their understanding of buffer solutions (Simanjuntak & Silitonga, 2020; Habiddin & Nagol, 2023). Based on this, teachers must pay attention to their students' mathematical and chemical analysis abilities. Teachers are expected to be able to provide direction and design appropriate learning so that learning outcomes are more optimal.

METHOD

This is a causal study using a quasi-experimental research approach. Correlation with simple linear regression and multiple regression is the research design used in this study. In this study, students were given tests in the form of mathematical ability instruments, chemistry analysis ability instruments, and buffer solution test results to determine the correlation of the two independent variables (mathematical ability and chemistry analysis ability) with the dependent variable (learning outcomes) in the buffer solution material.

This study's population comprised all students in class XI who studied chemistry at SMA Negeri 1 Perbaungan, which had six classes. The sampling approach utilized in this study was purposive sampling. Purposive sampling is a sampling approach that chooses one class from among multiple options. Class XI 2 SMA Negeri 1 Perbaungan was chosen as the research sample.

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

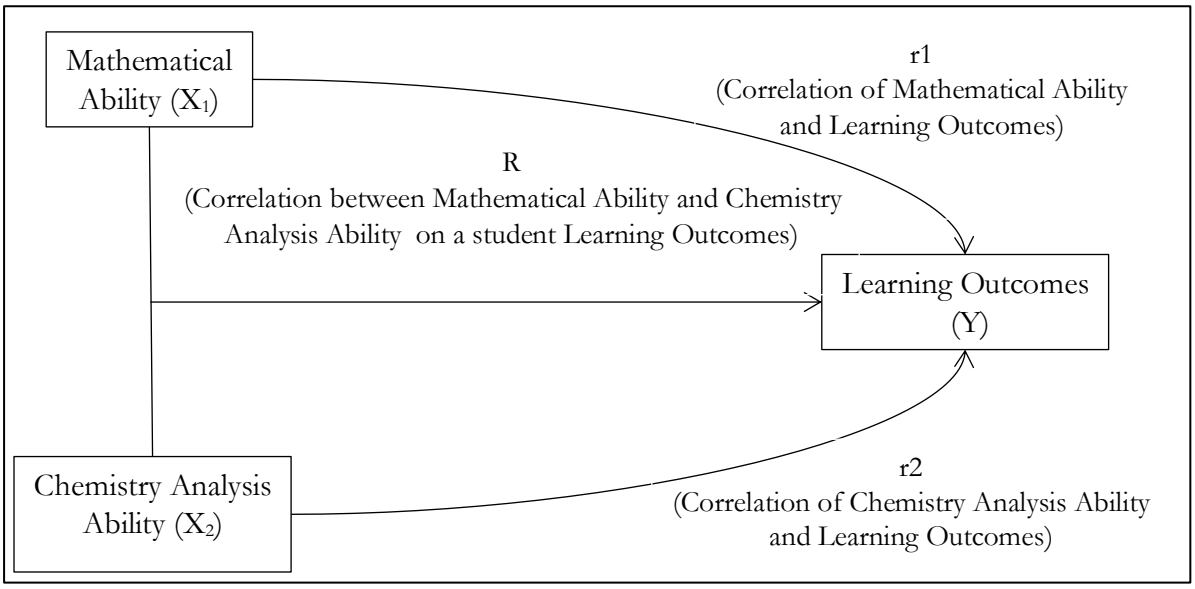

Figure 1. Double Paradigm

A test of mathematical ability in the form of an essay in the C2-C5 cognitive domain was used, as was a test of chemical analysis abilities in the form of an essay in the C4 cognitive domain and a test of students' chemistry learning outcomes on buffer solutions in the form of multiple choice in the cognitive domain. C3-C5. Multiple linear regression tests were utilized in this quantitative study to assess two independent variables, namely mathematical ability (X1) and chemical analysis ability (X2), and one dependent variable, namely student learning outcomes in the reaction level material (Y). The number of student scores was used to conduct data analysis with instrument testing.

RESULTS AND DISCUSSION

Correlation Between Mathematical Ability and Chemistry Learning Results

The first hypothesis uses a basic linear regression test to determine the relationship between the independent variable (mathematical ability) and the dependent variable (Students Learning Outcomes). Based on observations of students' mathematical skills, the following graph of students' mathematical ability scores is produced:

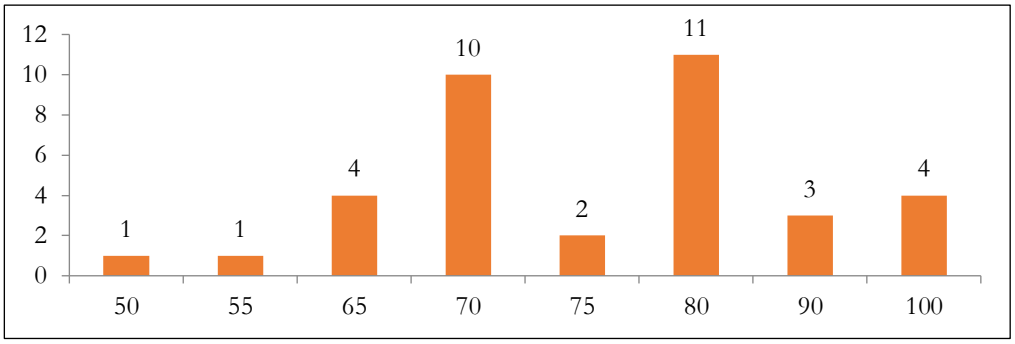

Figure 2. Students' math ability scores

As seen in the image, the results of the student's mathematical ability exam are given as a bar chart. The pupils' mathematical talents may be demonstrated in their mathematical ability test scores, which average 76.81. The best possible score is 100. To put the hypothesis to the test, use simple regression analysis. The regression direction b of 0.258 and the constant or an of 57.304 are produced by the variables of mathematical ability and learning outcomes. Therefore, the regression equation Y = 57.304 + 0.258 can be used to describe the relationship between the two variables.

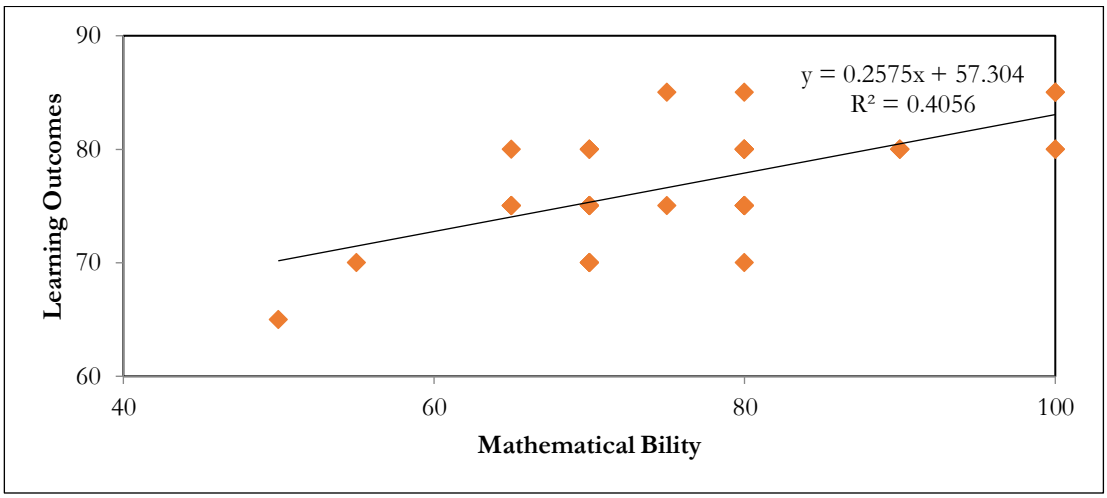

Figure 3. The relationship between mathematical ability and chemistry learning outcomes

A linearity test is next performed to determine what the terms of the regression equation will mean if F-count > F-table. Based on the significance test calculation data, F-count = 23.202 whereas F-table = 4.13; because F-count > F-table, reject Ho (Ha is accepted). The Significance value (Sig.) can also be used to do the significance test; if the Sig. is 0.05, Ha is accepted, and H0 is refused. The significance value derived in hypothesis I is 0.000 0.05, indicating a linear and significant association between students' chemical learning outcomes and mathematical competence.

This is consistent with previous research (Wahyuni & Kurniawan, 2018), where the Signifikansi nilai yang diperoleh pada penelitian yang mereka lakukan adalah 0,140 > 0,05, implying that Ha is tolak and H0 is not tolak. Finally, (Cahyono *et al.*, 2016) Conducted research using a significance level of 0,008 0.050 and a coefficient of variation of 0.550. This indicates that there are significant connections in the study.

Correlation Between Chemical Analytical Abilities and Learning Results

The Two Hypothesis test is a simple linear regression test used to determine the relationship between the independent variable (Chemistry Analysis abilities) and the dependent variable (Students Learning Outcomes). The following graph of students' mathematical ability scores is produced based on observations of students' mathematical abilities.

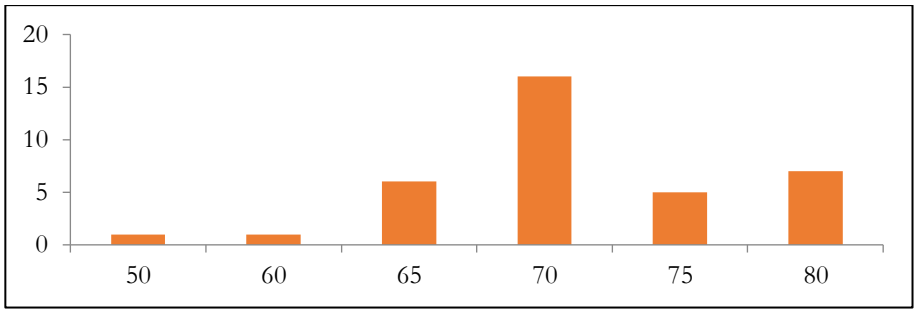

Figure 4. Chemistry analysis ability

According to the data, the average value of students' analytical ability was 70.97. Figure 4 shows that the lowest analytical ability score is 50, with one student. With seven pupils, the highest analytical ability score was reached at 80. To put the hypothesis to the test, use simple regression analysis. Analytical ability and learning outcomes result in a regression direction b of 0.539 and a constant of 38.810. Therefore, the regression equation Y = 0.539X + 38.810 can be used to describe the relationship between the two variables.

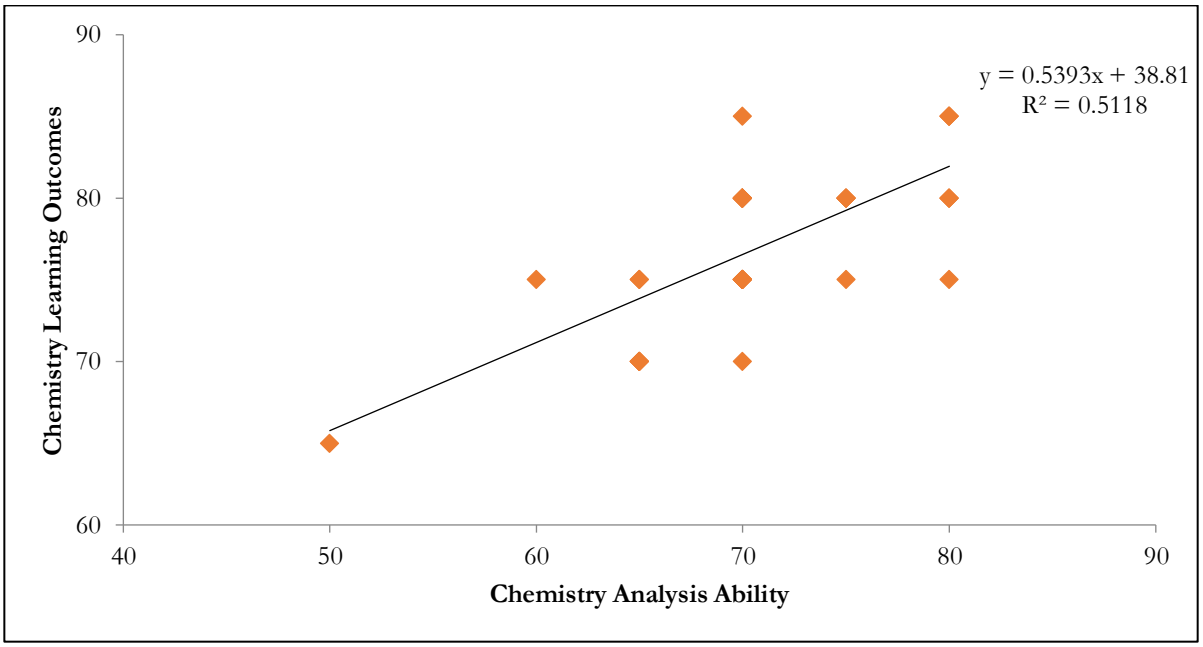

Figure 5. The correlation between analytical skills and chemistry learning outcomes

A linearity test is next performed to determine what the terms of the regression equation will mean if F-count > F-table. Based on the significance test calculation data, F-count = 35.648 whereas F-table = 4.13; because F-count > F-table, reject Ho (Ha is accepted). The Significance value (Sig.) can also be used to do the significance test; if the Sig. is 0.05, Ha is accepted, and H0 is refused. The significance value derived in hypothesis II is 0.000 0.05, indicating a linear and significant association between chemical analysis ability and chemistry learning results in pupils.

This is consistent with the findings of Wibowo et al. (2019), who discovered a significant positive relationship between analytical skills and cognitive learning outcomes of buffer solution material, which is classified as very strong, as indicated by the obtained value of r-count = 0.814 > r-table = 0.442 with a magnitude of 66.2%. This demonstrates that the study found a substantial association.

Correlations Between Students' Chemistry Learning Results and Mathematical Abilities and Chemical Analysis Abilities

The three hypotheses are tested using a basic linear regression test to see if there is a correlation between the independent variables (mathematical ability and chemistry analysis ability) and the dependent variable (Student learning outcomes). Based on observations of students' mathematical abilities, the following graph of students' mathematical ability scores is produced.

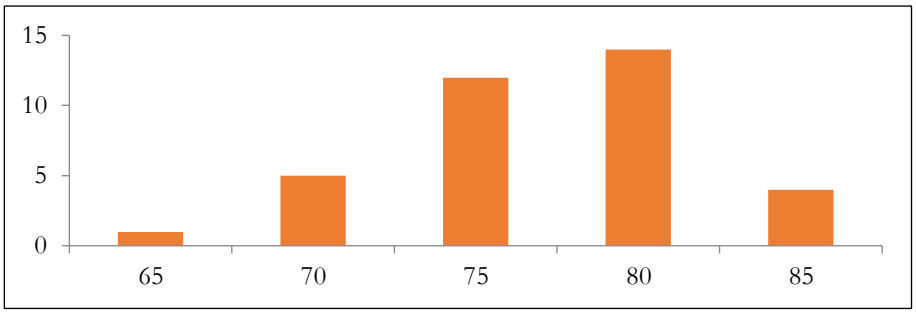

Figure 4. Students learning outcomes

According to the research data, the average student chemistry learning outcome was 77.08. and the most significant value of chemical learning outcomes acquired by pupils is 85, as obtained by four students. Multiple linear regression analysis will be used to evaluate the hypothesis. Mathematical Ability and Learning Outcomes produce regression directions b of 0.139X1 and 0.394X2, respectively, and a constant of 38.485. Therefore, the regression equation Y = 38.485 + 0.139X1 + 0.394X2 can be used to define the form of the relationship between the two variables. The terms of the regression equation are then tested for multiple linearity if F-count > F-table. Fcount is 23.955 based on the significance test calculation data, while Ftable at 0.05 (N = 36) is 4.13. Ho is refused because of F-count > F-table (Ha is approved).

This is consistent with prior research conducted by (Malahayati *et al.*, 2015), where the significant value attained in their study was 0.000 0.050, after which Ha was accepted and H0 was rejected. Furthermore, in the study conducted by (Daniyati & Sugiman, 2015), the probability value in the sig column is 0.000, implying that p 0.05 indicates a significant link between these studies. The significance value for hypothesis III is 0.00 0.05, meaning there is a linear and practical link between mathematical ability and chemical analysis ability and students' chemistry learning outcomes.

CONCLUSIONS

Based on the findings of the research, it is possible to conclude that (1) there is a linear and significant relationship between mathematical ability and students' learning outcomes with a Sig(1-tailed) value of 0.0000.05; (2) there is a linear and significant relationship between chemistry analysis ability and students' learning outcomes with a Sig(1-tailed) value of 0.0000.05; and (3) there is a significant relationship between mathematical ability and chemistrative ability.

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