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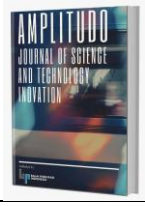

# Identification of Learning Independence Levels and Its Corelationship with Students Chemical Learning Outcomes at Covid-19 Era

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**Abstract:** The purpose of this research was to determine the level of independence learning, chemical learning outcomes and the correlation between independence learning and chemical learning outcomes during the Covid-19 period in class XI MIPA SMAN 6 Mataram in 2020/2021. This type of research is called correlational research. The population used was all students from class XI MIPA SMAN 6 Mataram in 2020/2021, which consisted of 4 classes totaling 126 students and the sample used was 56 students using the Slovin formula. The sampling technique is proportional random sampling. Data in the form of the level of independence learning were collected using a questionnaire distribution technique, while the learning outcomes data were collected using a documentation technique from the value of chemistry test result. The data analysis technique used is non-parametric statistics using contingency correlation coefficient test. The results showed that the level of independence learning and chemical learning outcomes were categorized as moderate. The results also show a contingency correlation coefficient (C) which is 0.612 and compared to a rtable of 0.266 which shows there is a positive and significant relationship between independence learning and chemical learning outcomes during the Covid-19 period in class XI MIPA SMAN 6 Mataram Years 2020/2021.

**Keywords:** Chemistry Learning Outcome; Covid-19 Era; Learning Independence levels

## Introduction

During the COVID-19 pandemic, the learning process was shifted from face-to-face (offline) instruction to an online learning system. This transition was in accordance with Circular Letter No. 36962/MPK.A/HK/2020 issued by the Minister of Education and Culture, which mandated the implementation of online learning and remote work as part of efforts to prevent the spread of the Coronavirus Disease (COVID-19). Consequently, online learning during the pandemic functioned as a substitute for conventional learning. The entire learning process was conducted online, encompassing all instructional materials, assignments, discussions, consultations, exercises, and examinations, which were fully administered via the internet (Ministry of Education and Culture, 2020).

The quality of students' learning processes can be influenced by learning conditions. Students' responses to the learning process depend on their learning independence. Learning independence refers to an active learning process built upon the students' prior knowledge or competencies, enabling them to regulate their study time, learning strategies, learning environment, and self-evaluation (Mujiman, 2005). Learning independence is particularly essential in chemistry education, as chemistry requires an integrated instructional approach that combines intellectual, emotional, and spiritual aspects to achieve optimal learning outcomes (Saifullah et al., 2013).

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One of the objectives of chemistry education, as outlined in Ministerial Regulation No. 59 of 2014, is to foster an understanding of chemical concepts, their interrelationships, and their applications in solving real-life and technological problems. Consequently, students must attain proficiency in chemistry (Ministry of Education and Culture, 2014). One indicator of students' proficiency in chemistry is their academic performance. Academic achievement is a measure of students' success in the learning process. The knowledge gained through learning determines a student's academic standing relative to their peers. A student's learning outcomes reflect whether they have undergone cognitive, skill-based, or attitudinal changes (Aliyyah et al., 2017).

One of the challenges in schools is the suboptimal academic performance in chemistry. Based on survey results and interviews, it was found that the average chemistry test scores of Grades XI MIPA students at SMAN 6 Mataram in the 2020/2021 academic year were 70.35, which was below the Minimum Mastery Criterion (KKM) of 74. An analysis of the odd semester examination scores revealed that the average scores for each class were as follows: MIPA 1 (69.1), MIPA 2 (70.5), MIPA 3 (71.3), and MIPA 4 (70.5). To improve learning outcomes, it is necessary to first identify the factors influencing students' academic performance. One such factor is students' attitudes toward the learning environment, which is closely related to their learning independence.

Interviews conducted with students at SMAN 6 Mataram during the COVID-19 pandemic revealed that their learning independence remained suboptimal. This finding was corroborated by interviews with chemistry teachers at the school, who reported that students exhibited low levels of learning independence. This was evident from their lack of discipline in submitting assignments and participating in learning evaluations. Additionally, survey data indicated that some students demonstrated low initiative, as confirmed by students' statements that they did not ask questions when they did not understand the material, did not plan their studies, and did not review previously delivered lessons.

The research problem addressed in this study is as follows: What is the level of students' learning independence? What are their chemistry learning outcomes? Is there a correlation between learning independence and chemistry learning outcomes during the COVID-19 pandemic among Grade XI MIPA students at SMAN 6 Mataram in the 2020/2021 academic year? This study aims to determine the level of learning independence, chemistry learning outcomes, and the correlation between learning independence and chemistry learning outcomes during the COVID-19 pandemic among Grade XI MIPA students at SMAN 6 Mataram in the 2020/2021 academic year. One of the expected benefits of this research is to contribute positively to improving the quality of education at SMAN 6 Mataram and to provide valuable insights for the school in its efforts to enhance educational quality by offering additional information regarding the correlation between learning independence and chemistry learning outcomes. This study is expected to serve as a useful reference.

## Method

This study was conducted at SMAN 6 Mataram in Class XI MIPA for the 2020/2021 academic year, employing a quantitative approach with a correlational research method. The research involved two types of variables: the predictor (independent) variable, which was students' learning independence, and the criterion (dependent) variable, which was their chemistry learning outcomes. The population of this study comprised all students of Class XI MIPA in the 2020/2021 academic year, totaling 126 students. The sample was determined using proportional random sampling with Slovin's formula, resulting in a final sample size of 56 students, representing 44.44% of the total population from four classes.

The data collected in this study included students' chemistry learning outcomes and initial data on learning independence, obtained through documentation, interviews, and questionnaires. The documentation technique was used to gather students' chemistry scores, while interviews were conducted to obtain preliminary data on students' learning independence. Additionally, a questionnaire was used to measure students' learning independence. The questionnaire employed a Likert scale with four response options: strongly agree, agree, disagree, and strongly disagree. It consisted of both positive and negative statements, where positive statements were scored 4, 3, 2, and 1 for strongly agree, agree, disagree, and strongly disagree, respectively, while negative statements were scored in the opposite order.

To ensure the validity and reliability of the research instrument, expert validity testing, empirical validity testing, and reliability testing were conducted. The instrument was validated by two chemistry education lecturers from FKIP Universitas Mataram and one chemistry teacher from SMAN 6 Mataram. Empirical validity testing of the instrument items was carried out using the Product-Moment Correlation test, as formulated in Equation 1.

$$rxy = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{\{N\sum X^2 - (\sum X)^2\}\{N\sum Y^2 - (\sum Y)}} \quad (1)$$

$$r_i = \frac{2\,rb}{1 + rb} \quad (2)$$

$$Interval = \frac{The\ highest\ score - Lowest\ Value + 1}{Number\ of\ categories} \quad (3)$$

$$Interval = \frac{The\ highest\ score - Lowest\ Value + 1}{Number\ of\ categories} \quad (4)$$

Information:

$r_{xy}$ : Correlation Coefficient
N : Number of respondents
X : Item score per respondent
Y : Total score per respondent
$\sum X$ : Sum of item scores
$\sum Y$ : Total score (all items)
$\sum XY$ : Sum of scores multiplied by x score and y score
$r_i$ : Internal reliability of all instruments
$r_b$ : Product moment correlation between first and second halves

An instrument is considered valid if the calculated r value ($r_{hitung}$) is equal to or greater than the critical r value ($r_{tabelr}$ ) at a 5% significance level. Conversely, if rhitungr_{hitung}rhitung is less than rtabelr_{tabel}rtabel, the instrument is deemed invalid (Sugiyono, 2017). The reliability test in this study was conducted using the Spearman-Brown formula, as shown in Equation 2. Once the calculated reliability coefficient ($r_i$ ) was obtained, it was compared to the reference values in Table 1 to determine whether the instrument was reliable (Pasaribu, 2020).

The data analysis techniques in this study included three main stages: instrument testing, validity and reliability testing, and the analysis of students' learning independence levels. To a ssess students' learning independence, each questionnaire item was scored based on students' responses. The data were then classified into three categories—high, moderate, and low—using an interval formula, as presented in Equation 3 (Mutia, 2018). After determining the categorical norms, the frequency and percentage of each category were calculated.

The scale for learning independence consisted of six indicators: independence from others, self-confidence, disciplined behavior, a sense of responsibility, self-initiated behavior, and self-control. To assess learning independence across these indicators, each questionnaire item corresponding to an indicator was scored based on student responses. A statistical description of the data was then generated using Microsoft Excel. The data were subsequently classified into three categories—high, moderate, and low—using an interval formula, as presented in Equation 4 (Mutia, 2018). After determining the category norms, the next step was to calculate the frequency and percentage for each category.

**Tabel 1.** Instrument Reliability Coefficient

| Coefficient Interval | Relationship Level |
|---|---|
| 0.80-1.00 | Very high |
| 0.60-0.80 | High |
| 0.40-0.60 | Medium |
| 0.20-0.40 | Low |
| 0.00-0.20 | Very low |

*Learning Outcome Data Analysis Techniques*

The steps taken to assess students' chemistry learning outcomes involved collecting their chemistry scores through documentation techniques. Subsequently, a statistical description of the data was generated using Microsoft Excel. The data were then classified into three categories—high, moderate, and low—using an interval formula, as presented in the equation 5 (Mutia, 2018). After the category norms were established, the next step was to determine the frequency and percentage for each category..

$$Interval = \frac{The\ highest\ score - Lowest\ Value + 1}{Number\ of\ categories} \quad (5)$$

$$x^2 = \sum \frac{\sum (f_0 - f_h)^2}{f_h} \quad (6)$$

$$C = \sqrt{\frac{x^2}{N + x^2}} \quad (7)$$

$$\Phi = \frac{C}{\sqrt{1 - C^2}} \quad (8)$$

Information:

$x^2$ : Chi Square
$f_0$ : Observed frequency
$f_h$ : Expected frequency
C : Contingency coefficient
N : Number of respondents

*Correlation test*

The test used in this study was the contingency coefficient correlation test, which is a non-parametric inferential statistical test. This test was chosen because the data did not follow a normal distribution, as shown by the normality test. This technique is closely related to the Chi-square test, which is used to test comparative hypotheses for k independent samples. Therefore, the formula used incorporates the Chi-square value (Sugiyono, 2017), as shown in Equation 6.

The contingency coefficient correlation formula is shown in Equation 7. The interpretation of the contingency coefficient index (C or KK) involves first converting the C value into Phi, using Equation 7. Once the Phi value is obtained, it is then compared with the "r" product-moment table value with degrees of freedom (df) equal to N-nr. If the calculated index (in this case, C converted to Phi and treated as $r_y$ is equal to or greater than the table value of r, the null hypothesis is rejected; if it is smaller than the table value, the null hypothesis is accepted or approved (Imron et al., 2020).

This analysis technique is used to determine the strength of the relationship. A higher contingency value indicates a stronger relationship between the two categorical variables under study (Siswanto & Suyanto, 2018). The relationship strength categories between the two variables are provided in Table 2.

**Table 2.** Interval of Correlation Coefficient (C) Values and Strength of Relationship

| Value interval | Relationship Strength |
|---|---|
| C = 0 | None |
| 0.00 < C ≤ 0.20 | Very low or very weak |
| 0.20 < C ≤ 0.40 | Low or weak but definite |
| 0.40 < C ≤ 0.70 | Quite significant or moderate |
| 0.70 < C ≤ 0.90 | High or strong |
| 0.90 < C < 1.00 | Very high or very strong |
| C = 1 | Excellent |

(Siswanto dan Suyanto, 2018)

## Result and Discussion

*Expert Validity Test Results*

Before being tested, the instrument was validated by subject matter experts, including an XI-grade chemistry teacher and the thesis supervisor, using Aiken's V formula to calculate the content-validity coefficient. The result obtained using Aiken's V formula was 0.9, which falls under the "highly valid" category.

*Empirical Validity Test Results*

Before the questionnaire was used, an empirical validity test was conducted by administering it to respondents who were not part of the research sample. The respondents used for this test were 15 students from XI Science 3, a class that was not included in the study sample. The validity was assessed using the Pearson Product-Moment formula, and the results indicated that all items were categorized as valid.

*Reliability Test Results*

Before being used to collect data, the questionnaire underwent a reliability test by being administered to respondents who were not part of the study sample. The test was conducted on 15 students from XI Science 3, and the reliability was calculated using the Spearman formula. The result obtained was 0.778, which places the instrument in the "high reliability" category.

*Analysis of Students' Learning Independence*

After scoring each item for all indicators in the questionnaire completed by 56 respondents, the required values were determined using Microsoft Excel. A comprehensive summary of the results can be found in Table 3.

**Table 3.** Description of Learning Independence Statistics

| Description | Score |
|---|---|
| Average | 61.91 |
| Minimum | 52 |
| Maximum | 74 |

**Table 4.** Student Learning Independence Category Guidelines

| Interval Scale | Category |
|---|---|
| 52-59.7 | Less |
| 59.8-67.4 | Enough |
| 67.5-75.2 | Good |

After the interval value is obtained, the learning independence category guidelines are determined in Table 4. Based on the average learning independence score of 61.91, it falls into the moderate category according to the classification guidelines. There is a variation in students' learning independence categories based on the questionnaire results, as presented in Table 5.

**Table.** 5 Jumlah Siswa Sesuai Kategori Kemandirian Belajar

| Number of Students | Percentage (%) | Category |
|---|---|---|
| 18 | 32.14% | Less |
| 26 | 46.43% | Enough |
| 12 | 21.43% | Good |

After the categorization norms were set as above, there were variations in the learning independence category, namely 18 students (32.14%) received the less category and 26 students (46.43%) received the moderate category and 12 students (21.43%) received the good category. From these data, it can be seen that students' learning independence is classified as sufficient. The results of data processing for the independence category of each indicator are according to Table 6.

**Table 6.** Learning Independence Categories Based on Indicators

| Indicators Independence on others | Category Interval Not enough | Enough | Good | Average Value of Indicator | Category based on indicators |
|---|---|---|---|---|---|
| Having self-confidence | 5-7.3 | 7.4-9.7 | 9.8-12 | 8.5 | Enough |
| Behaving disciplined | 9-11.3 | 11.4-13.7 | 13.8-16.1 | 12.6 | Enough |
| Having a sense of responsibility | 07-Sep | 9.1-11.1 | 11.2-12.3 | 9.5 | Enough |
| Behaving based on one's own initiative | 07-Sep | 9.1-11.1 | 11.2-12.3 | 10.1 | Enough |
| Exercising self-control | 9-11.7 | 11.8-14.5 | 14.6-17.3 | 12 | Enough |
| Indicators | 6-8.2 | 8.3-10.5 | 10.6-12.8 | 9.6 | Enough |

Based on the data analysis presented in Table 6, the indicators of learning independence were evaluated as follows: the self-reliance indicator had an average score of 8.5, categorized as moderate; the self-confidence indicator had an average score of 12.6, categorized as moderate; the discipline indicator had an average score of 9.5, categorized as moderate; the responsibility indicator had an average score of 10.1, categorized as moderate; the initiative-driven behavior indicator had an average score of 12, categorized as moderate; and the self-regulation indicator had an average score of 9.6, categorized as moderate.

The distribution of students across each indicator category is as follows: Self-reliance: 12 students (21.43%) were in the low category, 32 students (57.14%) in the moderate category, and 12 students (21.43%) in the high category. Self-confidence: 9 students (16.07%) were in the low category, 32 students (57.14%) in the moderate category, and 15 students (26.79%) in the high category. Discipline: 12 students (21.43%) were in the low category, 31 students (55.36%) in the moderate category, and 13 students (23.21%) in the high category. Responsibility: 8 students (14.43%) were in the low category, 23 students (41.07%) in the moderate category, and 25 students (44.64%) in the high category. Initiative-driven behavior: 22 students (39.29%) were in the low category, 32 students (57.14%) in the moderate category, and 2 students (3.57%) in the high category. Self-regulation: 10 students (17.86%) were in the low category, 42 students (75%) in the moderate category, and 4 students (7.14%) in the high category.

These findings indicate that the majority of students exhibit a moderate level of learning independence across all indicators, with a notable portion still falling into the low category, particularly in initiative-driven behavior and self-reliance. This suggests the need for targeted interventions to enhance students' self-initiated learning behaviors and independence in academic settings.

*Chemistry Learning Outcome Analysis Results*

From the documentation used in collecting chemistry learning outcomes for 56 students, a more detailed presentation can be found in Table 7. After determining the score intervals, a guideline for categorizing students' chemistry learning outcomes was established, as shown in Table 7.

The categorization of students' learning outcomes varies, as presented in Table 8. Based on Table 8, after classification, the distribution of chemistry learning outcomes is as follows: 21 students (37.5%) were categorized as having low learning outcomes. 15 students (26.79%) were categorized as having moderate learning outcomes. 14 students (25%) were categorized as having high learning outcomes.

These results indicate a significant proportion of students fall into the low and moderate categories, suggesting the need for improvements in instructional strategies to enhance students' chemistry learning outcomes.

**Tabel 6.** Description of Learning Outcome Statistics

| Description | Score |
|---|---|
| N | 56 |
| Average | 72.17 |
| Minimum | 67 |
| Maximum | 80 |

**Table 7.** Chemistry Learning Outcome Category Guidelines

| Interval Scale | Category |
|---|---|
| 67-71.7 | Less |
| 71.8-76.5 | Enough |
| 76.6-81.2 | Good |

**Table 8.** Number of Students According to Chemistry Learning Outcome Category

| Number of Students | Category | Percentage (%) |
|---|---|---|
| 21 | Less | 37.5 |
| 21 | Enough | 37.5 |
| 14 | Good | 25 |

*Correlation Test Results*

In the hypothesis testing, the collected data were used to categorize both research variables based on frequency distributions for each category. The Chi-square test was then performed, yielding a result of

20.226. Subsequently, the contingency correlation coefficient (C) was calculated, resulting in a value of 0.52. To interpret the coefficient, the value of C was converted into Phi (Φ), which was found to be 0.612. This Phi value was then compared with the critical r-table value. For a sample size (N) of 55, the r-table value at a 5% significance level with degrees of freedom (df = N - nr = 54) was 0.266. However, since an exact df value of 54 was not available in the product-moment correlation table, the df of 55 was used, yielding an r-table value of 0.345 at a 1% significance level. Since the obtained Phi value (0.612) was greater than the critical r-table value at the 1% significance level (0.345), the alternative hypothesis was accepted. This indicates a positive and significant correlation between learning independence and chemistry learning outcomes during the COVID-19 pandemic among Grade XI MIPA students at SMAN 6 Mataram in the 2020/2021 academic year.

To determine the strength of the relationship between the variables, the obtained C value was compared with Table 3.14, which classifies a C value of 0.52 as moderate. This suggests that learning independence is moderately related to chemistry learning outcomes.

Online learning during the COVID-19 pandemic has the potential to enhance students' learning independence. This aligns with Firman and Rahman (2020), who stated that online learning fosters learning independence as it requires greater student engagement in observational learning through reading, interpreting discussion posts, and analyzing educational videos or content.

The tendency of learning independence across all indicators was categorized as moderate. Students with a high level of learning independence exhibit characteristics such as self-reliance, problem-solving abilities, and goal-setting skills. This aligns with Listyani (2010), who identified the characteristics of learning independence as follows: (1) self-reliance, (2) self-confidence, (3) disciplined behavior, (4) a sense of responsibility, (5) initiative-driven behavior, and (6) self-regulation.

In this study, the average chemistry learning outcome of Grade XI MIPA students at SMAN 6 Mataram during the COVID-19 pandemic was 72.17, categorized as moderate. Student learning outcomes are influenced by various factors. According to Susanto (2014), learning outcomes are generally affected by two main factors: (1) internal factors, including intelligence, interest, talent, effort, motivation, attention, weaknesses, health, and study habits; and (2) external factors, such as classroom conditions, environment, and teacher influences. Students with higher motivation and learning independence are more likely to adapt to the online learning environment during the COVID-19 pandemic and achieve optimal learning outcomes, while those with lower motivation and independence tend to attain suboptimal results.

This study confirms the existence of a positive and significant relationship between learning independence and chemistry learning outcomes. This implies that an increase in students' learning independence leads to improved academic performance. Learning independence is an internal factor influencing academic achievement, as emphasized by Rahmawati (2016). To achieve optimal learning outcomes, particularly in chemistry, students' learning independence must be strengthened by fostering self-reliance, self-confidence, disciplined behavior, responsibility, initiative-driven behavior, and self-regulation. Efforts to enhance learning independence should not be solely the responsibility of students but also require support from teachers and parents, especially during the COVID-19 pandemic, when learning was conducted online.

The findings of this study are supported by Purwanto (2014), who stated that learning independence is a key internal factor influencing academic achievement. Furthermore, Astuti (2018) investigated the correlation between learning independence and chemistry learning outcomes, particularly in fundamental chemical laws and stoichiometry, and found a positive and significant relationship between the two variables. This suggests that fostering learning independence can enhance students' chemistry learning outcomes. Similarly, research conducted by Aliyyah et al. (2017) on the impact of learning independence on science learning outcomes demonstrated a significant effect, further reinforcing the findings of this study

## Conclusion

Based on the research findings and discussion, it can be concluded that the level of learning independence among Class XI MIPA students at SMAN 6 Mataram during the 2020/2021 academic year in chemistry during the COVID-19 pandemic was categorized as moderate, with an average score of 61.91. Similarly, students' chemistry learning outcomes, based on the average score of 72.17, were also classified as moderate. Furthermore, there was a positive and significant relationship between learning independence and chemistry learning outcomes among Class XI MIPA students at SMAN 6 Mataram during the COVID-19 pandemic in the 2020/2021 academic year. Based on the conducted research, the researcher proposes several recommendations. First, teachers are encouraged to continuously support and foster students' learning independence by implementing engaging teaching methods to enhance learning outcomes. Second, future researchers are advised to explore other variables that

may influence students' chemistry learning outcomes. Lastly, researchers should consider students' characteristics and other factors that may affect both learning independence and academic performance.

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The research was conceptualized by Authors 1, 2, and 3. The methodology, data analysis, and manuscript writing were conducted by Author 1, while Authors 2, 3 and 4 contributed to the review and supervision of the study.

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**Conflicts of Interest**
The authors declare no conflict of interest.

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