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An Analysis of Eighth-Grade Students of Mathematical Reasoning Ability in Statistics Based on Independent Learning Methods

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ABSTRACT

This study investigates students' mathematical reasoning ability in statistics in relation to Student level of learning individuality. Employing a qualitative descriptive design, the study involved 22 eighth-grade students from a junior secondary school in Banda Aceh, Indonesia. Data were collected through questionnaires, written tests, and semi-structured interviews to capture both cognitive performance and learning behaviour. The findings reveal distinct variations in reasoning ability across levels of learning independence. Students with high learning independence consistently demonstrated strong reasoning skills by fulfilling all five indicators of mathematical reasoning. Those with moderate independence showed partial task completion, yet were able to meet key reasoning indicators in solved tasks. In contrast, students with low learning independence exhibited limited reasoning performance, fulfilling only basic indicators. This study offers a novel contribution by integrating learning independence as a critical lens for analysing mathematical reasoning in statistics at the junior secondary level, an area that remains underexplored in existing literature. The results emphasize that higher learning independence is positively associated with stronger reasoning ability. These findings suggest that fostering independent learning strategies is essential for enhancing students' mathematical reasoning in statistics education.

1. Introduction

Mathematical reasoning is one of the basic competencies of mathematics in addition to understanding, communication, connections and problem solving(Marasabessy, 2021). Reasoning is a mental process in developing thoughts from several facts and principles(Khoeriyah et al., 2024). Reasoning is also an activity or process of thinking to draw conclusions or make new statements based on previous statements and the truth of which has been proven. "Mathematical material and mathematical reasoning are two things that cannot be separated, namely mathematical material is understood through reasoning, while reasoning is understood and practiced through learning mathematics"(Kusumawardani et al., 2018). Thus, reasoning ability is one of the thinking processes carried out by drawing a conclusion where the conclusion is a conclusion that is valid or can be

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accounted for. As a thinking activity, reasoning ability activities are also a logical thinking process, where logical thinking is defined as the activity of thinking according to a certain pattern. Based on the Ministry of National Education in Elementary and Secondary Education Regulation No. (506/C/PP/2004) explains that indicators of students possessing mathematical reasoning abilities include: (1) proposing conjectures, (2) performing mathematical manipulations, (3) drawing conclusions, compiling evidence, and providing reasons or proof for the validity of solutions, (4) drawing conclusions from statements, (5) verifying the validity of an argument, and (6) discovering patterns or properties of mathematical phenomena to make generalizations(Sari et al., 2020).

In mathematics education, students necessitate certain dispositions to nurture strong mathematical reasoning skills, one of which is independence in learning. The cultivation of independence is crucial in enhancing kids' reasoning abilities(Lukmanul et al., 2022). Prior study indicates that the proficiency in mathematical reasoning within statistics fluctuates based on students' degree of learning autonomy(Maslihah et al., 2021). Students exhibiting elevated degrees of learning independence typically display both high and, in certain instances, moderate levels of mathematical reasoning proficiency(Dewi et al., 2025). Students with moderate learning independence typically demonstrate diminished reasoning skills(Mukuka et al., 2023). Likewise, students exhibiting minimal learning autonomy frequently demonstrate poor mathematical thinking abilities(Mulyono et al., 2018). The findings suggest that learning independence significantly affects students' capacity for mathematical reasoning, especially in the field of statistics education(Agustini et al., 2023).

Students who exhibit a high degree of learning independence tend to exhibit more robust mathematical reasoning abilities(Widana, 2022). In general, they are more adept at interpreting problems, selecting appropriate strategies, and justifying their solutions through logical arguments(Nurlinda et al., 2024). exhibit moderate levels of reasoning in certain instances, despite the fact that their performance is not consistently high, due to their willingness to engage with challenges and attempt multiple solution pathways(Gultom et al., 2022). Independent learners are more adaptable and resilient when confronted with intricate statistical problems, as this suggests(Septian et al., 2022).

In contrast, students who demonstrate moderate levels of learning independence frequently demonstrate restricted reasoning abilities(Negara et al., 2022). Although they may comprehend fundamental concepts, they frequently depend on procedural methods and may encounter difficulty in establishing connections between concepts or providing obvious justifications for their responses(Fitriyah et al., 2022). Their reasoning is frequently inadequate, indicating a partial comprehension of the fundamental concepts(Jamil et al., 2024).

Students who exhibit low levels of learning independence encounter even more formidable obstacles(Somuncu & Aslan, 2021). They frequently rely on direct instruction and exhibit minimal initiative in problem-solving. Consequently, their mathematical reasoning is typically insufficient, as evidenced by their inability to analyse problems, construct logical arguments, and verify the accuracy of their solutions.

Previous research has shown that learning independence considerably enhances students' mathematical reasoning skills. (Wulandari & Wutsqa, 2019)The results indicate that students possess proficient reasoning skills for analysis, generalisation, synthesis, justification, and the resolution of non-routine problems, with percentages of 62.69%, 66.67%, 48.15%, 24.07%, and 3.70, respectively. Several aspects affect the varying levels of pupils' reasoning skills, including their capacity to discern information inside the question, employ mathematical arguments to elucidate the answer, and recognise strategies for problem-solving. To improve students' mathematical reasoning, they should be motivated to transcend dependence on teacher-supplied information and actively pursue

knowledge from many sources, including textbooks and additional educational resources. Autonomous learning empowers students to investigate concepts thoroughly, assess information critically, and formulate sound conclusions in problem-solving. Furthermore, it fosters internal drive, enhances accountability for learning, and eventually leads to better academic results.

This study examines the function of learning independence as a framework for comprehending students' mathematical reasoning in statistics at the junior secondary level. To accomplish this goal, data were gathered by distributing a learning independence questionnaire in conjunction with a mathematical reasoning ability assessment to all participating pupils. The questionnaire aimed to evaluate students' levels of autonomy, responsibility, and initiative in the learning process, whereas the test assessed their capacity to employ reasoning abilities in resolving statistical issues. This study aims to create a detailed profile of students' mathematical reasoning skills concerning different degrees of learning independence by integrating these two instruments, thus enhancing the understanding of how independent learning traits manifest in students' reasoning performance.

2. Methodology

This study applied a qualitative descriptive methodology(Stanley, 2023). The sample comprised 22 eighth-grade students from SMP Negeri 6 Banda Aceh, chosen via purposive sampling in accordance with the research goals. The first selection process included the administration of a learning independence questionnaire and a mathematical reasoning assessment to all children. Six kids were selected for additional examination, consisting of two pupils from each group of learning independence: high, medium, and poor. The selected people subsequently participated in comprehensive interviews.

This study employed a learning independence questionnaire, a mathematical reasoning ability assessment, and a semi-structured interview protocol. Data were gathered by questionnaires, written evaluations, and interviews. To assure data validity, triangulation was employed by contrasting findings from assessments and interviews regarding students' mathematical reasoning capabilities. Subsequently, the validated data were analysed to yield a thorough knowledge of students' mathematical reasoning across various levels of learning autonomy. The analysis adhered to the Miles and Huberman framework, which includes data reduction, data display, and conclusion formulation.

The research procedure began with the administration of the learning independence questionnaire and the mathematical reasoning test to all 22 pupils. The questionnaire consisted of 30 items formulated based on characteristics of learning autonomy, whereas the reasoning exam featured four open-ended questions pertaining to statistics, corresponding with mathematical reasoning indicators. Subsequent to this phase, interview participants were chosen based on their levels of learning autonomy. The concluding step encompassed data analysis, interpretation of results, and development of conclusions.

3. Results

Based on the results of the learning independence questionnaire and reasoning ability test questions, the researcher selected 6 students to be subjects with categories of mathematical reasoning ability levels reviewed from the students' learning independence and in-depth interviews will be conducted by the researcher as can be seen in Table 1 as follows:

Table 1. the category of mathematical reasoning ability

No	Code	Learning Independence Score	Category of Learning Independence Level	Mathematical Reasoning Ability Score	Category of Mathematical Reasoning Ability Level
1	NS	99	High	95	High
2	AT	65	Low	20	Low
3	NM	98	High	92.5	High
4	FL	71	Low	20	Low
5	ZN	78	Medium	25	Low
6	PN	81	Medium	65	Low

The statistics reveal a constant correlation between students' learning independence and their mathematical reasoning skills. Students classified as having high learning independence (NS and NM) attained elevated mathematical reasoning scores (95 and 92.5), signifying robust reasoning abilities. This indicates that pupils exhibiting increased autonomy in learning are often more proficient in comprehending and resolving statistical problems successfully. Conversely, students exhibiting little learning independence (AT and FL) achieved exceedingly low reasoning scores (both 20), indicating a constrained capacity for mathematical thinking. This pattern suggests that an absence of autonomous learning behaviour may impede pupils' ability to develop and utilise mathematical reasoning. Students exhibiting moderate learning independence (ZN and PN) demonstrate comparatively low reasoning performance, scoring 25 and 65, respectively. Despite PN attaining a superior score relative to ZN, both are classified at a low level, signifying that moderate independence has not yet evolved into robust reasoning capability.

The findings indicate a positive correlation between learning independence and mathematical reasoning ability, with more independence linked to enhanced reasoning performance. This underscores the significance of cultivating students' autonomous learning abilities to enhance their mathematical reasoning, especially in statistics.

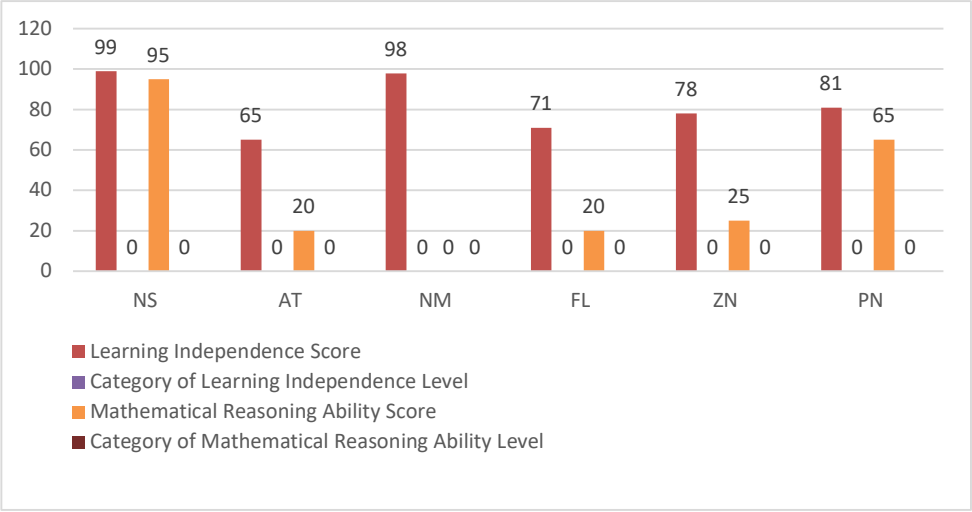

Fig.1. Relationship between Learning Independence and Mathematical Reasoning Ability among Students

A comparative distribution of students' results in learning independence and mathematical reasoning ability, demonstrating a distinct and regular pattern among participants. A clear correlation exists, indicating that pupils exhibiting greater learning independence typically show enhanced mathematical thinking abilities. Students NS and NM demonstrate the greatest independence scores (99 and 98), which align with consistently elevated reasoning scores (95 and 92.5), signifying advanced reasoning abilities in statistical problem-solving.

In contrast, students AT and FL, with lower independence scores of 65 and 71, have significantly restricted reasoning performance, maintaining scores at 20. This indicates that a lack of autonomy in learning may limit students' capacity to participate in higher-order mathematical reasoning. Moreover, students ZN and PN, exhibiting intermediate degrees of learning autonomy (78 and 81), display comparatively low reasoning results (25 and 65), suggesting that moderate independence does not inherently correlate with robust reasoning capabilities.

3.1 Mathematical Reasoning Characteristics of Students with High Learning Independence

The exam and interview results demonstrate that students exhibiting high degrees of learning independence can effectively fulfil all five characteristics of mathematical thinking. This is seen in the performance of subjects NS and NM, who exhibited robust reasoning capabilities. Both students accurately resolved all four problems and met every criterion of mathematical reasoning, including articulating mathematical statements, executing precise mathematical operations, providing valid supporting evidence, deriving logical conclusions, and validating the correctness of their arguments.

Their research indicates that pupils exhibiting high learning freedom has more proficiency in comprehending problem settings, recognising suitable solution options, and implementing systematic reasoning processes. They exhibit greater confidence and adaptability in problem-solving, enabling them to execute tasks with enhanced accuracy and efficiency. Moreover, they exhibit the capacity to express their thoughts coherently, both in written formats and during interviews.

These findings corroborate the notion that robust learning autonomy fosters the advancement of higher-order cognitive skills, especially in mathematical reasoning. Self-directed students typically engage more profoundly with the content, investigate various solution options, and contemplate the validity of their responses. Consequently, students attain a more profound comprehension of statistical ideas. The study elucidates a distinct correlation between learning autonomy and mathematical reasoning proficiency. kids exhibiting greater freedom frequently have enhanced reasoning abilities, suggesting that cultivating independent learning practices is crucial for advancing kids' mathematical proficiency.

3.2 Mathematical Reasoning Characteristics of Students with Moderate Learning Independence in Statistics

The results of the written assessments and interviews regarding mathematical reasoning skills demonstrate that students exhibiting a moderate degree of learning independence can only fulfil one criterion of mathematical reasoning, specifically the capacity to accurately articulate mathematical statements from the four given questions. Their performance is not as good as that of pupils with great learning independence, especially when it comes to answering problems that demand more in-depth reasoning. The subjects with moderate learning independence show this clearly.

The subject PN could only try to answer questions one and two. But even with these two problems, PN couldn't meet all the requirements for mathematical thinking. The subject ZN was also only able to work on questions one and four. Based on these answers, ZN was only able to meet the requirement of presenting mathematical assertions. They did not do well in other areas, such as doing right mathematical operations, making good supporting evidence, and coming to correct conclusions. To put it another way, the answers given were not full and had a number of mistakes in both the concepts and the steps.

These results indicate that kids with moderate learning independence typically display underdeveloped reasoning skills, frequently categorising them as low performers. While they exhibit preliminary comprehension by reformulating problems numerically, they encounter difficulties in advancing systematic reasoning and justification. The interview results show that the poor level of mathematical reasoning in both PN and ZN is mostly due to a lack of knowledge of statistical notions. Moreover, extrinsic influences, including students' evaluations of the teacher's instructional methodology, seem to influence their involvement and overall success in solving mathematical problems.

3.3 Mathematical Reasoning Characteristics of Students with Low Learning Independence in Statistics.

The exam and interview results reveal that students exhibiting low learning independence also display deficient mathematical reasoning skills, as they fail to satisfy the five evaluated indications of reasoning. Their result on the four test items clearly demonstrates that both FL and AT could only attempt one question, specifically question number one. Even in this inquiry, their responses did not adequately fulfil the criteria of mathematical thinking. They successfully articulated a mathematical proposition and executed fundamental mathematical operations; nonetheless, they erred in formulating suitable evidence to substantiate their solutions and did not arrive at accurate conclusions.

Additional insights from the interviews indicate that while both students were able to articulate the problems mathematically for all four questions, they had considerable challenges in the ensuing reasoning processes. They could not perform accurate mathematical operations, generate supporting evidence, construct logical conclusions, or validate the soundness of their arguments. The challenges were especially evident in questions two, three, and four, where the students demonstrated a poor comprehension of the enquiries posed. In certain instances, they submitted blank response sheets, signifying a deficiency in conceptual understanding of the statistical content.

The findings indicate that diminished learning freedom is strongly correlated with restricted problem-solving initiative and inadequate conceptual comprehension. Students in this category often have difficulties in employing systematic methods for problem-solving, which subsequently impairs their capacity to develop logical reasoning and reach valid conclusions. Thus, inadequate learning independence adversely affects mathematical reasoning abilities. This study categorises both FL and AT into the low reasoning tier, with interview findings corroborating that their challenges mostly stem from a deficient comprehension of statistical concepts.

4. Conclusions

The analysis and discussion of the mathematical reasoning abilities of eighth-grade students at SMP Negeri 6 Banda Aceh, as viewed from their level of learning independence, have led to the conclusion that learning independence significantly influences students' mathematical reasoning. According to the results, there is a consistent and evident correlation between increased levels of learning independence and enhanced mathematical reasoning capabilities.

Students who are classified as having high learning independence exhibit well-developed reasoning skills. They are capable of presenting mathematical statements in a clear and concise manner, conducting appropriate and systematic mathematical manipulations, constructing coherent and pertinent evidence, drawing logical and accurate conclusions, and critically evaluating the validity of their arguments. These students also tend to demonstrate a more profound conceptual understanding, as evidenced by their increased confidence and persistence in resolving statistical problems. Conversely, students who demonstrate moderate and low levels of learning independence tend to demonstrate inferior mathematical reasoning abilities. Their performance is distinguished by their inability to execute mathematical procedures, their limited capacity to organise and justify evidence, and their difficulties in drawing logical conclusions. Additionally, they frequently exhibit difficulty in assessing the validity of their reasoning or verifying the accuracy of their solutions, which suggests a more superficial comprehension of the concepts. In general, the research serves to

substantiate the idea that the capacity to reason mathematically is significantly influenced by the acquisition of independence. Students who exhibit greater autonomy in their learning are better prepared to participate in intricate reasoning processes, while those who exhibit less independence necessitate more structured guidance. Therefore, in order to improve students' mathematical reasoning, it is crucial to prioritise the development of learning independence in instructional practices, particularly in the context of statistics education.

References

Agustini, P., Nurimani, N., & Warti, E. (2023). The Relationship between Middle School Students' Learning Independence and Mathematical Reasoning Ability. *Proceeding of International Conference on Education*, *2*, 123–129. https://doi.org/10.37640/ICE.02.686

Dewi, A. M., Turmuzi, M., Kurniawan, E., & Arjudin, A. (2025). Analysis of Mathematical Reasoning Abilities Based on Student's Independent Learning on Straight Line Equation Material. *Sigma&Mu: Journal of Mathematics Education, Mathematics, Statistics and Data Science*, *3*(1), 9–16. https://doi.org/10.56566/SIGMAMU.V3I1.214

Fitriyah, I. M., Putro, N. H. P. S., Apino, E., Fitriyah, I. M., Putro, N. H. P. S., & Apino, E. (2022). Meta analysis study: Effectiveness of problem based learning on Indonesian students' mathematical reasoning ability. *Jurnal Riset Pendidikan Matematika*, *9*(1), 36–45. https://doi.org/10.21831/jrpm.v9i1.46447

Gultom, C. I., Triyanto, & Saputro, D. R. S. (2022). Students' Mathematical Reasoning Skills in Solving Mathematical Problems. *JPI (Jurnal Pendidikan Indonesia)*, *11*(3), 542–551. https://doi.org/10.23887/JPIUNDIKSHA.V11I3.42073

Jamil, M., Bokhari, T. B., & Iqbal, J. (2024). Incorporation of Critical Thinking Skills Development: A Case of Mathematics Curriculum for Grades I-XII. *Journal of Asian Development Studies*, *13*(1), 375–382. https://doi.org/10.62345/JADS.2024.13.1.32

Khoeriyah, N., Nurimani, & Erlis. (2024). Student Learning Independence and Mathematical Problem-Solving Skills. *Proceeding of International Conference on Education*, *3*, 42–47. https://doi.org/10.37640/ice.862

Kusumawardani, D. R., Wardono, W., & Kartono, K. (2018). Pentingnya Penalaran Matematika dalam Meningkatkan Kemampuan Literasi Matematika. *PRISMA, Prosiding Seminar Nasional Matematika*, *1*, 588–595. https://journal.unnes.ac.id/sju/prisma/article/view/20201

Lukmanul, H. ∗, Sukestiyarno, Y. L., & Zaenuri, Z. (2022). Mathematical Reasoning Ability from Student Learning Independence Side in Problem Based Learning Assisted Ethnomathematical Comics Module. *Unnes Journal of Mathematics Education Research*, *11*(1), 26–33. https://journal.unnes.ac.id/sju/ujmer/article/view/50792

Marasabessy, R. (2021). Study of Mathematical Reasoning Ability for Mathematics Learning in Schools: A Literature Review. *Indonesian Journal of Teaching in Science*, *1*(2), 79–90. https://doi.org/10.17509/IJOTIS.V1I2.37950

Maslihah, S., Waluya, S. B., Rochmad, Kartono, Karomah, N., & Iqbal, K. (2021). Increasing mathematical literacy ability and learning independence through problem-based learning model with realistic mathematic education approach. *Journal of Physics: Conference Series*, *1918*(4), 042123. https://doi.org/10.1088/1742-6596/1918/4/042123

Mukuka, A., Balimuttajjo, S., & Mutarutinya, V. (2023). Teacher efforts towards the development of students' mathematical reasoning skills. *Heliyon*, *9*(4), e14789. https://doi.org/10.1016/j.heliyon.2023.e14789

Mulyono, D., Asmawi, M., & Nuriah, T. (2018). The Effect of Reciprocal Teaching, Student Facilitator and Explaining and Learning Independence on Mathematical Learning Results by Controlling the Initial Ability of Students. *International Electronic Journal of Mathematics Education*, *13*(3), 199–205. https://doi.org/10.12973/IEJME/3838

Negara, H., Negara, H., Wahyudin, Nurlaelah, E., & Herman, T. (2022). Improving Students' Mathematical Reasoning Abilities Through Social Cognitive... *International Journal of Emerging Technologies in Learning (IJET)*, *17*(18), 118–135. https://doi.org/10.3991/ijet.v17i18.32151

Nurlinda, E., Azis, Z., & Nasution, M. D. (2024). Students' Mathematical Reasoning Ability and Self-Efficacy Viewed from the Application of Problem Based Learning and Contextual Teaching and Learning Models Assisted. *JMEA : Journal of Mathematics Education and Application*, *3*(2), 54–61. https://doi.org/10.30596/JMEA.V3I2.20329

Sari, M. P., Susanto, Yuliati, N., Imamah, E. N., & Laily, N. I. (2020). The students' mathematical reasoning ability based on problem based learning model. *Journal of Physics: Conference Series*, *1538*(1), 012078. https://doi.org/10.1088/1742-6596/1538/1/012078

Septian, A., Widodo, S. A., Afifah, I. N., Nisa, D. Z., Putri, N. P. K., Tyas, M. D., Nisa, R. H., & Andriani, A. (2022). Mathematical Problem Solving Ability in Indonesia. *Journal of Instructional Mathematics*, *3*(1), 16–25. https://doi.org/10.37640/JIM.V3I1.1223

Somuncu, B., & Aslan, D. (2021). Effect of coding activities on preschool children's mathematical reasoning skills. *Education and Information Technologies 2021 27:1*, *27*(1), 877–890. https://doi.org/10.1007/S10639-021-10618-9

Stanley, M. (2023). Qualitative Descriptive: A Very Good Place to Start. *Qualitative Research Methodologies for Occupational Science and Occupational Therapy: Second Edition*, 52–67. https://doi.org/10.4324/9781003456216-4/QUALITATIVE-DESCRIPTIVE-MANDY-STANLEY

Widana, I. W. (2022). META-ANALYSIS: THE RELATIONSHIP BETWEEN SELF-REGULATED LEARNING AND MATHEMATICAL CRITICAL REASONING. *Education. Innovation. Diversity*, *1*(4), 64–75. https://doi.org/10.17770/EID2022.1.6739

Wulandari, S. Y., & Wutsqa, D. U. (2019). A study of junior high school students reasoning skill in mathematics. *Journal of Physics: Conference Series*, *1320*(1), 012059. https://doi.org/10.1088/1742-6596/1320/1/012059