# Unveiling the Relationship of Zoomer Generation Learning Preferences and Mathematical Conceptual Understanding

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**Abstract**

This correlational study investigates the relationship between mathematics learning preferences and conceptual understanding ability among 34 eighth-grade Gen Z students at MTs in Rejang Lebong Regency, Curup, selected through simple random sampling. Data were collected via questionnaires and tests, then analyzed using the product-moment correlation test. Findings reveal three key results: (i) Gen Z students strongly prefer interactive methods—learning in pairs (70.52%) and direct questioning (69.99%)—over passive approaches such as rewriting (51.17%) and listening to recordings (52.64%); (ii) students demonstrate relatively competent procedural execution (69.11%) but limited conceptual comprehension (60.29%), indicating procedural fluency outpaces conceptual understanding; (iii) a significant and strong relationship exists between learning preferences and conceptual understanding ($r$=0.629>0.339=$r$-table; α=0.05), with a coefficient of determination of 39.43%, suggesting that alignment between instructional approaches and students' learning preferences moderately yet meaningfully contributes to deeper conceptual understanding. These findings underscore that recognizing and accommodating Gen Z's learning preferences is fundamental to fostering genuine mathematical understanding beyond mere procedural mastery.



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## INTRODUCTION

The National Education System faces complex challenges in preparing human resources capable of competing in the era of globalization, positioning education as a strategic means for developing quality human capital. In response, the government has implemented various efforts, including continuous curriculum reforms aimed at improving educational quality (Saputra, 2020). However, these efforts have not fully addressed the need to align learning approaches with the characteristics and preferences of Generation Z learners, particularly in mathematics education. This gap indicates the importance of examining how students' learning preferences relate to their conceptual understanding in mathematics. Each curriculum change requires teachers to actively create enjoyable, effective, and meaningful learning, actively involving students as they play the primary role in the learning process, while teachers act as facilitators.

A differentiated learning approach is crucial in this regard, where teachers need to adapt learning strategies based on students' interests, learning preferences, and readiness to improve learning outcomes. This approach avoids individualizing learning, but rather responds to students' strengths and needs (Oktavia et al., 2025). Differentiation involves assessment results consisting of three components, one of which is student learning preferences. These three components of differentiation are readiness, interest, and learning preferences (Noviyanti et al., 2025). This study examines students’ learning preferences as tendencies in choosing and engaging with learning activities, which are contextual and dynamic rather than fixed individual traits. By understanding their learning preferences, teachers can adapt teaching methods that are more effective and appropriate to the needs of students. According to the Big Indonesian Dictionary, preference is a choice, tendency, liking, or something that is prioritized and prioritized over others. Preference is the tendency to choose something that is most liked and becomes an important part of a person's decision-making. In the context of learning, preference refers to students' tendencies or choices in determining the learning method they consider most appropriate and enjoyable (Ningrum, 2023). The learning preferences of Gen Z students are an important factor to understand because their unique characteristics influence the best way to learn mathematics.. Each curriculum change requires teachers to actively create enjoyable, effective, and meaningful learning, actively involving students as they play the primary role in the learning process, while teachers act as facilitators.

Gen Z is a group of individuals born between 1995 and 2012 who grew up in an environment heavily influenced by technological advancements. They are known to enjoy challenges, enjoy group discussions, and enjoy interactive learning environments. For Gen Z, learning is not limited by space and time because they are accustomed to accessing information anytime and anywhere via the internet. They tend to prefer the use of digital tools and online forums because they provide the freedom to directly engage in the learning process. The availability of digital tools and smooth internet access are their primary expectations, as Gen Z desires a fast, practical, and seamless learning process (Saputra, 2020). However, in this study, these expectations are operationalized through measurable indicators, including engagement with video-based learning. This alignment ensures consistency between the theoretical assumptions and the instruments used to capture students’ learning preferences. Based on the definition above, Gen Z prefers to be involved in technology-based, online learning processes, the goal of which is to facilitate their understanding of learning materials.

With Gen Z's tendency to prefer technology-based learning, it is important to understand how they build understanding of concepts, particularly in mathematics. Understanding, according to the Big Indonesian Dictionary, is the process of how, doing, understanding, and comprehending. Understanding comes from the word understand which means to understand properly, while understanding can be interpreted as the ability to understand and comprehend the intended thing at a higher level than just knowledge. Conceptual understanding is a fundamental component of mathematical proficiency, referring not only to the ability to recall and apply procedures, but also to grasp the underlying meaning and relationships among mathematical ideas. Within the framework of Kilpatrick et al. (2021), conceptual understanding is distinguished from procedural fluency, emphasizing comprehension of concepts, operations, and relations. Similarly, differentiates between relational understanding (knowing both what to do and why) and instrumental understanding (knowing rules without underlying meaning) (Skemp, 2012). In this study, conceptual understanding is operationalized as students' ability to explain mathematical concepts, identify connections between them, and apply them flexibly and meaningfully, allowing for interpretation of whether students' understanding tends to be relational or merely instrumental. Gen Z's understanding of mathematical concepts needs to be improved because they grew up in the digital era where access to technology, digital and information is easily obtained.

Observations indicate that students' understanding of mathematical concepts at MTs in Curup still needs improvement, as evidenced by the students' low level of understanding. In initial observations of the learning process at MTs in Curup, students were often unable to re-explain what they had learned from the teacher's explanation, even though one indicator of conceptual understanding is restating the concept. Furthermore, interviews with eighth-grade mathematics teachers also indicated that many students still had difficulty identifying and distinguishing symbols and formulas, transforming problems into mathematical models, and formulating ideas from problem information. Understanding mathematical concepts is a crucial foundation in the mathematics learning process, including problem-solving using symbols and formulas. Failure to do so will negatively impact problem-solving. Although teachers have implemented a group learning model, student participation remains low because they tend to be passive, shy about asking questions, and simply memorize formulas without understanding their use. Consequently, when problems are presented in different formats, students have difficulty identifying relevant concepts and are unable to develop appropriate problem-solving strategies. As stated by Nurhangesti and Seruni (2024), conceptual understanding allows students to grasp material in depth, enabling them to apply it in a variety of situations. In other words, conceptual understanding isn't just about memorizing formulas or algorithms; it also involves the ability to connect concepts, apply them in various situations, and solve problems.

The difficulties experienced by some students in understanding mathematical concepts in eighth grade demonstrate the importance of examining the relationship between their learning preferences and their ability to understand mathematical concepts. Research on the relationship between Gen Z's mathematics learning preferences and their ability to understand mathematical concepts highlights the importance of understanding how Gen Z learns and how their learning preferences influence learning outcomes. To improve Gen Z's mathematical conceptual understanding, it is crucial to understand their learning preferences.

This study aims to determine Gen Z's mathematics learning preferences and students' mathematical conceptual understanding, and to determine whether there is a relationship between Gen Z's mathematics learning preferences and their ability to understand mathematical concepts. Thus, it is hoped that this research can contribute to the development of mathematics learning strategies that are more contextual and responsive to students' abilities, especially at MTs in Curup.

## RESEARCH METHODS

This study uses a quantitative research type, a research method that conducts research data in the form of numbers and analysis using statistics (Sugiyono, 2019a). This study uses a correlation method to determine and measure the relationship between variables by looking at the magnitude of the correlation coefficient that describes the relationship between events or research objects (Syahrizal & Jailani, 2023). The sample in this study consisted of students from one class (*n*=34), determined through cluster random sampling from six available classes (VIII A–VIII F), in which intact classes rather than individual students served as the sampling units. One class (VIIIA) was randomly selected by writing each class name on a separate piece of paper, placing all papers into a container, mixing them thoroughly, and drawing one at random—a procedure that ensures every class had an equal probability of selection, thereby upholding the principles of randomness and sampling fairness.

The design of this research as shown in Figure 1, is a correlational study that aims to find out whether there is a relationship between Gen Z's mathematics learning preferences and students' mathematical concept understanding abilities in class VIII students of MTs in Curup.

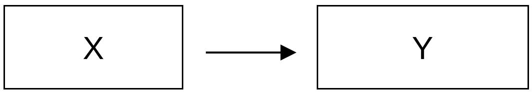


Figure 1. Research Model

To determine the magnitude of the relationship between variable X (Generation Z's learning preferences in mathematics learning) and variable Y (the ability to understand mathematical concepts), a bivariate correlation was used. The instrument for variable X was a learning preference questionnaire compiled based on several key indicators, such as preference for Study with partners (study in pairs), using internet, gamification, contextual learning, and other interactive learning strategies relevant to Generation Z's characteristics. The questionnaire consisted of 30 statements (15 positive and 15 negative) measured using a Likert scale. The learning preference score in this study was calculated as a total score, the sum of all items after reverse-scoring negative statements. Whereas, the instrument for variable Y consisted of a seven-item essay test structured based on indicators of mathematical conceptual understanding, including the ability to restate concepts, classify objects, provide examples and non-examples, represent concepts in various forms, and apply concepts in problem-solving. Test scores were obtained based on a previously validated assessment rubric.

The validity of the questionnaire and test instruments was tested using construct validity and content validity, with two lecturers and one mathematics teacher as validators. Validation criteria included the items' suitability to the indicators, level of understandability, and level of difficulty. Instrument reliability was calculated using Cronbach's Alpha formula. The trial results showed a questionnaire reliability coefficient of 0.89, and a test of 0.86, which indicates high reliability based on Guilford's interpretation.

This research was conducted through three main stages: preparation, implementation, and data analysis, systematically designed to achieve the research objectives. In the preparation stage, the researcher first developed a research instrument that included measuring tools to assess Gen Z's mathematics learning preferences and students' mathematical conceptual understanding. Next, the researcher determined the research sample through random sampling.

In the implementation stage, the distribution of test questions was conducted prior to the administration of questionnaires on the following day. This sequence was intentionally designed to minimize potential bias, such as the testing effect or mood effect, by preventing students' responses on the questionnaire from being influenced by prior reflection on their learning preferences. The final stage was data analysis, where the questionnaire and test results were analyzed using statistical tests (descriptive and inferential) to determine the relationship between Gen Z's mathematics learning preferences and their mathematical conceptual understanding, comparing the scores of the two groups. Descriptive statistical data analysis is used to describe the data, namely to fully describe the contents of a step (Sugiyono, 2019a). Inferential statistics is a statistical technique used to analyze sample data and apply the results to the population (Sugiyono, 2019a). Inferential statistical analysis techniques are used to test hypotheses, but prior prerequisite tests are necessary. In this study, normality and linearity tests were used. After conducting normality and linearity tests on the research data, a correlation test was then conducted. To interpret the correlation coefficient, as cited from Sugiyono (2013) that the information in Table 1 as the guidelines.

Table 1. Guidelines for Interpreting Correlation Coefficients

| Coefficient Interval | Level of Relationship |
|---|---|
| 0.00 – 0.199 | Very Weak |
| 0.20 – 0.399 | Weak |
| 0.40 – 0.599 | Medium |
| 0.60 – 0.799 | Strong |
| 0.80 – 1.000 | Very Strong |

This relationship was analyzed, a *t*-test was conducted, provided the sample was considered representative of the population and of adequate size (Sugiyono, 2019) with a confident interval 95%. Furthermore, the coefficient of determination ($R^2$) was calculated to estimate the proportion of shared variance between the variables. In the context of correlational research, the coefficient of determination does not indicate causal influence, but rather reflects the extent to which variability in one variable is associated with variability in the other.

The interpretation of the coefficient of determination is divided into three groups: strong (0.50%–100%), moderate (0.25%–0.50%), and weak (0–25%) (Aprilyani & Syah, 2023). Therefore, the higher the coefficient of determination, the stronger the model's ability to explain the relationship between variables. This interpretation helps assess the extent to which the regression model or the relationship between variables can reliably explain the phenomenon under study.

Thus, this study provides a clear picture of Gen Z's mathematics learning preferences and their mathematical conceptual understanding.

## RESULTS AND DISCUSSION

Descriptive statistics of Gen Z's mathematics learning preferences and conceptual understanding are shown in Table 2, that the preferences of Gen Z students are high in learning with partners, while the lowest is in writing paragraphs.

Table 2 Individual Learning Preferences

| Indicators | Achieved (%) | Not Achieved (%) |
|---|---|---|
| a. Listening to the teacher | 55.29 | 44.71 |
| b. Independent and flexible learning | 53.32 | 46.68 |
| c. Study with partners (study in pairs) | 70.52 | 29.48 |
| d. Study in groups | 68.52 | 31.48 |
| e. Asking questions to the teacher | 69.99 | 30.01 |
| f. Listen to the recording and do the exercises | 52.64 | 47.36 |
| g. Read | 59.99 | 40.01 |
| h. Writing a paragraph (rewriting) | 51.17 | 48.83 |
| i. Using the internet | 56.17 | 43.83 |
| j. Gamification | 59.93 | 40.07 |
| k. Interactive visuals | 59.26 | 40.74 |
| l. Contextual learning | 62.49 | 37.51 |

Table 3 shows the highest percentage of students' mathematical conceptual understanding were found in classifying objects according to specific properties according to their concepts, presenting concepts in various mathematical representations, using, utilizing, and selecting specific procedures or operations, and applying concepts or algorithms to problem-solving. The lowest percentages were found in developing necessary or sufficient conditions for a concept.

Table 3 Conceptual Understanding Ability

| Indicator | Achieved (%) | Not Achieved (%) |
|---|---|---|
| a. Restating a concept | 68.38 | 31.62 |
| b. Classifying objects according to certain properties according to their concept | 69.11 | 30.89 |
| c. Giving examples and non-examples of a concept | 65.44 | 34.56 |
| d. Presenting concepts in various forms of mathematical representation | 69.11 | 30.89 |
| e. Developing necessary or sufficient conditions of a concept | 60.29 | 39.71 |
| f. Using and utilizing, and selecting certain procedures or operations | 69.11 | 30.89 |
| g. Applying concepts or algorithms to problem-solving | 69.11 | 30.89 |

Before testing the relationship between Gen Z's mathematics learning preferences and conceptual understanding skills, a prerequisite test was first conducted to ensure that the data met the assumptions required for statistical analysis, namely the normality test. The normality test using Shapiro-Wilk and SPSS 26 yielded the following values.

Table 4. Normality and Correlation Test

| Aspect | Normality | | | Correlation | | |
|---|---|---|---|---|---|---|
| | Shapiro Wilk | Sig. | Distribution | $r$ | Sig. | $R^2$ |
| Preference | 0.948 | 0.109 | Normal | 0.629 | 0.936 | 39.43% |
| Understanding | 0.966 | 0.370 | Normal | | | |

Based on Table 4, $r$=0.692>0.339=$r$-table and $t$=4.56 (Sig.=0.936>0.05). This means there is a significant correlation or relationship between Gen Z's mathematics learning preferences and their mathematical concept understanding ability. It can be concluded that a significant linear relationship between the independent variable (mathematics learning preferences) and the dependent variable (mathematical conceptual understanding ability). The results of the calculation of the coefficient of determination of Gen Z's mathematics learning preferences with the ability to understand concepts are 39.43%. Based on these results, the level of relationship between mathematics learning preferences (X) and the ability to understand concepts (Y) is in a moderate interpretation.

## Learning Preferences and Conceptual Understanding

The results of the study indicate that the pair-based learning method is the most preferred form of learning by students in the context of mathematics learning, with a percentage of 70.52%, because it allows them to discuss, exchange understanding, and solve problems together directly in line with the characteristics of Gen Z who are collaborative and like two-way communication. This preference supports the implementation of the Think Pair Share (TPS) cooperative learning model in research conducted by (Rukmini, 2020), which has been proven to be more effective than the lecture method in improving understanding of mathematical concepts and student learning outcomes. The learning indicator with the lowest level of preference in this study was writing paragraphs (rewriting), with a percentage of 51.17%, which reflects Gen Z students' dislike of monotonous and passive activities such as copying text, because they are considered boring and do not support active mathematical understanding. The characteristics of Gen Z learning emphasizes the need for direct interaction, rapid feedback, and active involvement in the learning process. This finding is in line with research by Azizah and Purwanti (2023), which shows that students tend to be passive and easily bored when learning only focuses on listening and taking notes, so a more meaningful writing method is needed and is integrated with thinking activities and active communication. This preference for pair-based learning is relevant to research stating that Generation Z, the cohort born roughly between 1995 and 2010, exhibits unique traits that distinctly influence their learning preferences and work attitudes. Their upbringing in an era dominated by digital technology has shaped their cognitive processes, social interactions, and value systems. One prominent characteristic is their fluency with digital tools, which facilitate quick information access but also predispose them to shortened attention spans and a preference for immediate feedback. This digital immersion impacts their motivation, often favoring experiential and collaborative learning over traditional lecture-based methods (Mariah et al., 2025).

The indicators of understanding mathematical concepts with the highest achievement were classifying objects according to their nature, presenting concepts in various representations, using certain procedures, and applying algorithms in problem solving, each with a percentage of 69.11%, while the indicator of restating concepts was also quite high, namely 68.38%. This finding indicates that students are quite capable of re-explaining concepts that have been learned and using mathematical strategies, procedures, and representations appropriately, in line with the results of research by Mufidah et al. (2019) which stated that students are classified as quite capable in the indicators of restating concepts, representing concepts, using procedures, and applying them in problem solving, especially in elementary linear algebra learning. However, the lowest achievement was in the indicators of developing necessary or sufficient conditions for a concept (60.29%) and providing examples and non-examples of a concept (65.44%), which was also a major weakness in the research by Mufidah et al. (2019), where students only achieved 8.5% in these indicators. These findings indicate that students' understanding is still procedural and not yet relational, necessitating a learning approach that strengthens connections between concepts, trains logical thinking, and encourages in-depth understanding.

The calculation results show a correlation value of 0.629 with a significance level (*p*-value) of 0.000. A significance level less than 0.05 means that $H_0$ is rejected and $H_a$ is accepted. This means there is a significant relationship between mathematics learning preferences and the ability to understand mathematical concepts. A correlation value of 0.629 indicates a strong relationship. This means that the stronger the mathematics learning preferences that align with the characteristics of Gen Z students, the higher their ability to understand mathematical concepts. This strong correlation indicates the importance of designing learning based on students' learning preferences so they can construct knowledge more meaningfully and deeply.

The calculation of the coefficient of determination shows that learning preferences contribute 39.43% to students' mathematical concept understanding ability, which means that almost 40% of the variation in conceptual understanding can be explained by the suitability of teaching strategies with students' learning styles, especially Gen Z's preference for paired learning that supports abstract concept understanding. This shows that learning preferences have a sufficient influence, which is interpreted as moderate, on student learning outcomes, especially in understanding abstract concepts in mathematics. Gen Z's preference, which tends more towards paired learning, will find it easier to understand concepts if learning is tailored to their learning preferences. In other words, the ability to understand mathematical concepts increases along with the suitability of teaching strategies with students' learning styles.

The results of this study align with research conducted by Nursyabani et al., (2022), which showed that appropriate learning methods can improve students' mathematical understanding. This research emphasizes the importance for educators to understand students' learning preferences, as learning tailored to students' preferences has been shown to increase learning enthusiasm and conceptual understanding, as evidenced by a strong correlation of 0.629 between Gen Z mathematics learning preferences and mathematical conceptual understanding. Students who learn according to their preferences tend to have more systematic and reflective thinking processes and can connect concepts logically and comprehensively. Furthermore, research by Darma et al. (2024) also emphasized that learning style-based instruction can improve students' absorption of mathematics material. This is because students feel more comfortable and emotionally engaged when the material is presented through media or approaches that suit their preferences. Ultimately, these conducive learning conditions strengthen the conceptual understanding necessary for mathematics learning.

Thus, the results of this study have shown that there is a relationship between learning preferences and the ability to understand mathematical concepts in Gen Z students, which is influenced by learning methods that suit their characteristics, such as collaboration, flexibility, the use of technology, and interactive approaches involving discussion, visualization, and real-world contexts. Active student involvement in the learning process, such as asking questions, discussing, and solving problems, has been shown to increase conceptual understanding in a deeper and more meaningful way. However, challenges such as gaps in technology access, limited teacher capabilities, and limited research contexts are obstacles to the implementation of preference-based learning strategies. Given the dynamic nature of learning preferences, regular evaluation of student learning tendencies and outcomes is crucial to ensure teaching methods remain relevant, adaptive, and able to maintain the continuity of effective learning.

## CONCLUSION

This study concludes that Gen Z students fundamentally gravitate toward interactive and collaborative learning—particularly pair-based learning (70.52%) and direct teacher interaction (69.99%)—reflecting their digitally-shaped cognitive disposition that demands immediacy, engagement, and active participation over passive reception. While students demonstrate adequate procedural competence in mathematical steps and representation (69.11%), their conceptual comprehension remains the deeper challenge to overcome. Critically, a significant and strong relationship exists between learning preferences and mathematical conceptual understanding ($r$=0.629; $\alpha$=0.05), with learning preferences accounting for 39.43% of the variation in conceptual understanding—affirming that how Gen Z learns is not merely a stylistic inclination, but a substantive determinant of how deeply they comprehend mathematics. Consequently, aligning instructional design with Gen Z's learning preferences is not peripheral but central to cultivating genuine mathematical understanding.

These findings implicate that educators must fundamentally reconceptualize instructional design by prioritizing interactive and preference-aligned pedagogies, as learning preferences are proven determinants—not mere accessories—of mathematical conceptual depth. Most critically, the consistently low preference for rewriting (51.17%) alongside weak conceptual explanation indicators signals that mathematical literacy and written articulation of concepts must be deliberately cultivated, given that the ability to reorganize and express ideas in writing is epistemologically foundational to genuine conceptual understanding. Future research is therefore recommended to systematically explore learning strategies that stimulate students' mathematical writing and numeracy skills, while employing larger samples, mixed-methods approaches, or experimental designs—so that the complex interplay between Gen Z's learning characteristics and mathematical conceptual understanding can be mapped more comprehensively and actionably.

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