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The Effect Of Learning Styles And Self-Confidence On Students' Understanding of The Concept of Relational Presentation

Huri Suhendri[1],Lasia Agustina, Dahroni[3], Almaida Garudea Putri[4], Yulianah[5]

[1,2,3,4,5] Universitas Indraprasta PGRI, Indonesia

E-mai: hurisuhendri1981@gmail.com, lasiaagustina@gmail.com, ronnyjuhut.orc@gmail.com, almaidagarudeaptr@gmail.com, yuli.alkhansa@gmail.com

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Abstract

This study aims to analyze the influence of students' learning styles and self-confidence on their conceptual understanding of relation representation in mathematics at SMP Negeri Satu Atap 01 Ciseeng. The preliminary data showed that 65% of students had not achieved mastery learning. A qualitative descriptive survey method was applied involving 48 eighth-grade students. Data were collected through interviews, classroom observations, and document analysis, and were analyzed using Miles and Huberman's interactive model with triangulation for data validation. The findings reveal that visual learning style is dominant (42%) and produces the highest average score (82). Most students' self-confidence is at the moderate level (60%), while those with high self-confidence achieve better performance (85). The combination of visual learning style and high self-confidence results in the highest conceptual understanding score (86). This study confirms the relevance of differentiated instruction and Deep Learning models in mathematics education. The findings imply the need for adaptive teaching strategies that accommodate students' diverse learning styles while fostering self-confidence.

Keywords *: learning style, self-confidence, conceptual understanding, relation representation.*

INTRODUCTION

Education plays a strategic role in developing high-quality, creative, and highly competitive human resources. Mathematics, as a fundamental discipline, is an essential tool for developing critical, logical, creative, and systematic thinking skills. However, various studies show that mathematics remains a difficult subject for many junior high school students. This is due to both internal and external factors that influence student learning outcomes (Lincoln & Guba, 1985).

One of the key topics in the eighth-grade mathematics curriculum is the presentation of relations. This material serves as the foundation for students to understand advanced concepts such as functions, graphs, and mathematical modeling. Initial observations at SMP Negeri Satu Atap 01 Ciseeng indicate that students' understanding of this topic remains low, as reflected in daily tests, which showed that 65% of students had not achieved the minimum mastery level.

Various factors can influence conceptual understanding, including learning style and self-confidence. Fleming & Mills (Creswell & Creswell, 2018) suggest that learning style is an individual's unique way of receiving and processing information. Meanwhile, Bandura (Moleong, 2021) explains that self-efficacy and self-confidence have a significant influence on motivation and academic success. In the context of the Independent Curriculum, differentiated learning is a crucial approach that emphasizes the importance of facilitating students' diverse learning styles (Bandura, 2020).

State of the Art

Extensive research has been conducted on the relationship between learning styles and mathematics achievement. Putri & Wibowo (2021) found that visual learning styles significantly contribute to conceptual understanding. Another study by Setiawan & Rahmah (2023) showed that learning styles and self-confidence jointly influence mathematics learning outcomes. However, research examining these two variables simultaneously in the context of presenting relations in junior high school is still limited (DePorter & Hernacki, 2020).

Research Gap

There is little research that specifically focuses on the combination of learning styles and self-confidence in understanding relational concepts. Furthermore, previous research has mostly used quantitative approaches, while qualitative approaches that provide in-depth insights have not been widely applied.

Research Novelty

This research offers novelties in the form of:

1. in-depth analysis of the relationship between learning styles and self-confidence in the context of relational material,
2. qualitative approach that provides a complete descriptive picture of student learning behavior,
3. mapping the learning style–self-confidence combination to see the most effective combination.

Thus, this research has a high urgency to provide theoretical and practical contributions in mathematics learning based on differentiation and deep learning.

Formulation Of The Problem

1. What are the characteristics of students' learning styles in understanding the material on presenting relations at SMP Negeri Satu Atap 01 Ciseeng?
2. What is the level of student self-confidence in learning mathematics on the material of presenting relations?
3. How is the relationship between students' learning styles and their understanding of the concept of relational presentation?
4. How is the relationship between students' self-confidence and their understanding of the concept of relational presentation?
5. How does the combination of learning styles and self-confidence influence students' understanding of the concept of relational presentation?

Research Purposes

1. Describes students' learning styles in the presentation of relations material at SMP Negeri Satu Atap 01 Ciseeng.
2. Analyzing the level of student self-confidence in learning mathematics.

3. Analyzing the relationship between students' learning styles and understanding the concept of relational presentation.
4. Analyzing the relationship between students' self-confidence and understanding of the concept of relational presentation.
5. Identifying the influence of the combination of learning styles and self-confidence on students' conceptual understanding.
6. Providing theoretical contributions to the development of educational psychology studies, particularly regarding the relationship between learning styles, self-confidence, and understanding of mathematical concepts.
7. Provides practical recommendations for teachers and schools regarding differentiated learning strategies and Deep Learning approaches to improving students' conceptual understanding.

RESEARCH METHODOLOGY

Research Approach and Design

This study used **a qualitative approach** with **a descriptive survey method.** The qualitative approach was chosen because this study seeks to understand student learning phenomena in depth, related to learning styles, self-confidence, and understanding of the concept of relational representation. According to Creswell (Putri & Wibowo, 2021) a qualitative approach allows researchers to obtain a comprehensive picture of the subjects' behavior, perceptions, and experiences through non-numerical data.

A descriptive survey method was used to collect data from students regarding learning style characteristics, self-confidence levels, and understanding of relational concepts without manipulating variables. Thus, this study aims to provide an in-depth description of student learning phenomena based on real-world conditions (Rahman & Lestari, 2021).

Research Setting

The research was conducted at **SMP Negeri Satu Atap 01 Ciseeng,** Bogor Regency, West Java. This school was chosen because, based on observations and interviews with mathematics teachers, it was found that many students had difficulty understanding the material on presenting relations. Furthermore, the diversity of students' learning styles and differing levels of self-confidence were important reasons for conducting this research at this school (Sari & Purnomo, 2022).

The research period began in **October 2025,** including classroom observation activities, interviews, collection of value documents, and data triangulation.

The research subjects were **48 eighth-grade students,** consisting of 26 boys and 22 girls. Subjects were selected using a **purposive sampling technique,** which selects subjects based on certain characteristics (Y. Siregar, 2023), namely:

1. have received the presentation material on relations;
2. have a variety of learning styles;
3. shows differences in levels of self-confidence in the learning process;
4. willing to participate in interviews and observations.

In addition to students, supporting subjects in this study were mathematics teachers and class VIII homeroom teachers who provided additional information regarding learning behavior and class dynamics.

Data Analysis Techniques

Data analysis using the **Miles & Huberman model** (Creswell, 2018) which includes:

1. Data Reduction

Sorting important data from observation notes, interview results, and student documents. Irrelevant data was eliminated.

2. Data Presentation

Data is presented in the form:

1. learning style distribution table,
2. confidence level table,
3. conceptual understanding value,
4. supporting graphs and diagrams.

3. Drawing Conclusions

Conclusions were obtained through in-depth interpretation of the relationship between students' learning styles, self-confidence, and conceptual understanding (Y. Siregar, 2024).

Data Validity

The validity of the data was tested using the four criteria of **Lincoln & Guba (1985)** :

1. Credibility

Achieved through:

1. triangulation of sources and techniques,
2. member check,
3. repeated observations.

2. Transferability (Transferability)

This is achieved by providing a detailed description of the research setting so that the research can be replicated in similar schools.

3. Dependability (Dependency)

Maintained by documenting the research process in full, including field notes and interview recordings.

4. Confirmability (Confirmability)

Ensuring that research results are objective and free from researcher bias. This is achieved by preserving the original data and matching it with the analysis results (Wulandari & Nugroho, 2023).

RESULTS AND DISCUSSION

This section presents the research results based on data collected through observation, interviews, and documentation. The results are divided into four main sections (Bandura, 2020):

1. student learning styles,
2. level of self-confidence,
3. conceptual understanding value,
4. relationships between variables based on data interpretation.

1. Results of Identification of Student Learning Styles

Table 1. Distribution of Student Learning Styles

No	Learning Styles	Number of Students	Percentage
1	Visual	20 students	41.7%
2	Auditory	16 students	33.3%
3	Kinesthetic	12 students	25.0%
Total	**–**	**48 students**	**100%**

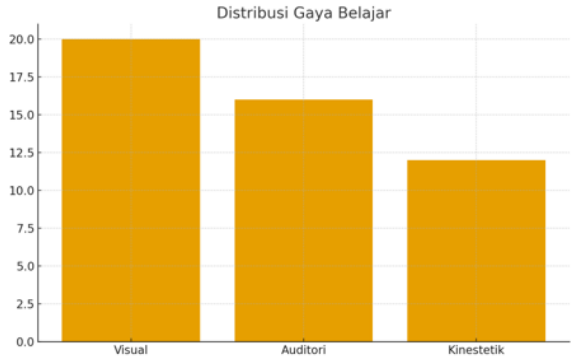

Figure 1. Learning Style Distribution Diagram

Interpretation:

Data shows that **visual learning styles dominate** at 41.7%. This aligns with the characteristics of mathematics learning, which often utilizes:

1. arrow diagram,
2. chart,
3. symbol,
4. other visual representations.

Auditory learning styles ranked second, while kinesthetic learning styles were the least popular, indicating that abstract mathematics learning is more difficult for students who require physical activity (Sitio & Roswiyani, 2022).

This finding is consistent with research by Putri & Wibowo (2021) which states that visual learning styles are more common at the junior high school level, especially in representational materials such as relations and functions (Clary & Ferrari, 2015).

2. Student Self-Confidence Level

Table 2. Student Self-Confidence Categories

No	Category	Number of Students	Percentage
1	Tall	7 students	14.6%
2	Currently	29 students	60.4%
3	Low	12 students	25.0%
Total	**–**	**48 students**	**100%**

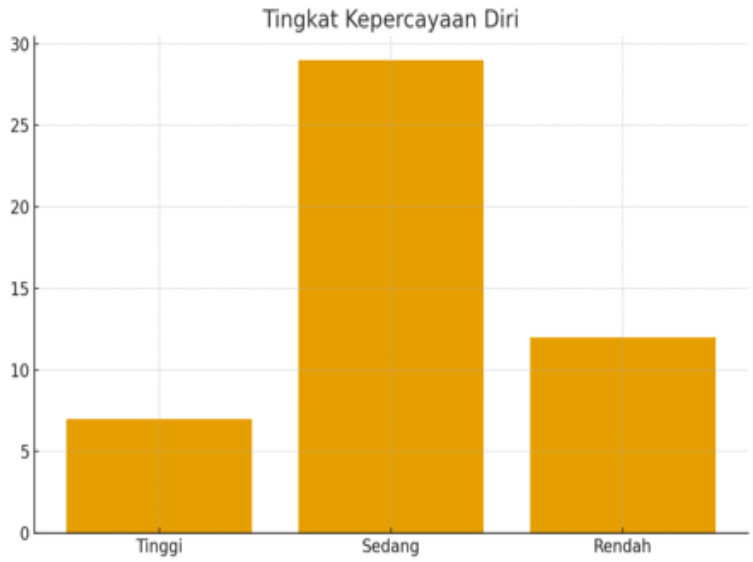

Figure 2. Student Self-Confidence Level

Interpretation:

The majority of students fell into the **moderate self-confidence category,** at 60.4%. This indicates that most students have sufficient confidence in facing math assignments, but it is not yet stable. Students in the low self-confidence category (25%) generally demonstrated (Rafiola et al., 2020):

1. hesitate to answer questions,
2. afraid of being wrong,
3. lack of confidence when asked to come forward,
4. inconsistent in working on challenging questions.

Meanwhile, students in the high category (14.6%) demonstrated high persistence and tended to be proactive in learning. This finding supports Bandura's (2020) theory that self-confidence influences persistence and academic achievement (Namaziandost & Çakmak, 2020).

3. The Value of Understanding the Concept of Presenting Relations

Table 3. Average Value of Concept Understanding Based on Learning Style

No	Learning Styles	Average Value
1	Visual	82
2	Auditory	77
3	Kinesthetic	74

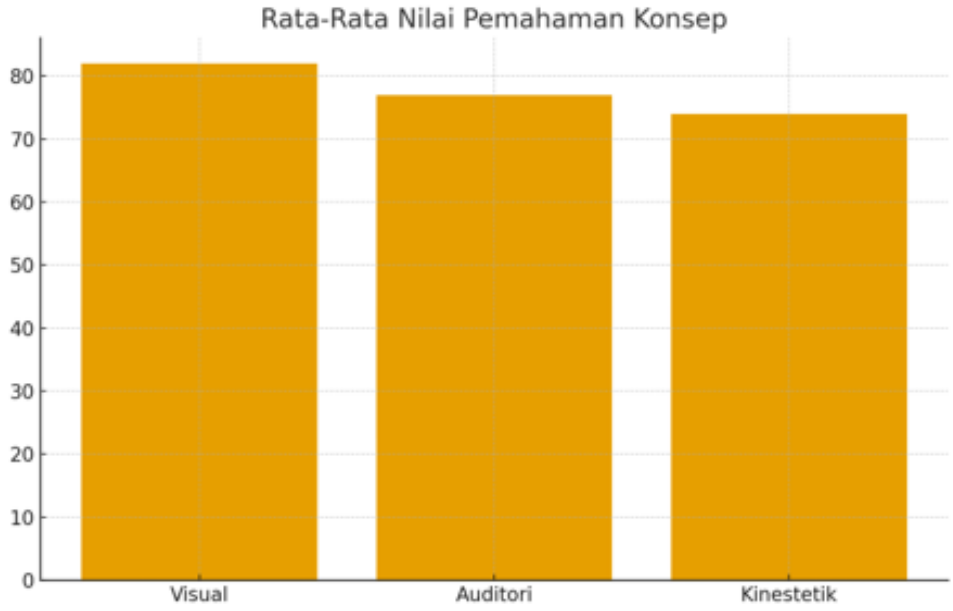

Figure 3. Average Concept Understanding Score

Interpretation:

Students with a **visual learning style obtained the highest score,** namely an average of 82. This shows that the graphical presentation of relations really supports visual students' understanding of concepts.

Auditory students scored medium (77). They were able to understand concepts after receiving clear verbal explanations.

Meanwhile, kinesthetic students obtained the lowest score (74), indicating that mathematics learning which involves many abstract symbols is less suited to their needs which rely on physical activity and object manipulation.

This finding is in line with Kolb (A. D. P. Siregar et al., 2024) who stated that the match between learning experiences and learning preferences affects academic performance.

4. Analysis of Relationships Between Variables

Table 4. Relationship between Learning Styles, Self-Confidence, and Learning Outcomes (Qualitative Findings)

Variables	Impact on Conceptual Understanding	Field Findings
Visual Learning Style	Tall	Students can easily understand arrow diagrams & graphs
Auditory Learning Style	Currently	Understanding increased after discussion and teacher explanation

Kinesthetic Learning Style	Low	Students have difficulty understanding symbolic representations
High Self-Confidence	Very influential	Students actively ask questions & try challenging questions
Moderate Self-Confidence	Moderately influential	Students follow the learning but are less stable
Low Self-Confidence	Low	Passive students, afraid of making mistakes, rarely express their opinions

Main Interpretation (Synthesis of Results)

1. Learning style and understanding concepts are interrelated
    1. Students with **a visual learning style** show the best understanding.
    2. Learning styles influence how students identify relationships, domains–codomains, and graphical diagrams.
2. Self-confidence is positively correlated with learning outcomes
    1. Students with high self-confidence are more daring to try questions and are not afraid of making mistakes.
    2. Students with low self-confidence tend to avoid tasks that are considered difficult.
3. The interaction between learning styles and self-confidence clarifies differences in learning outcomes (Guo & Xu, 2024).
    1. Visual learners + high self-confidence = best understanding of concepts.
    2. Kinesthetic students + low self-confidence = lowest understanding.
4. The results support the theories of Bandura, Kolb, and Deep Learning
    1. Conceptual understanding increases when learning experiences align with learning styles.
    2. Self-confidence strengthens motivation, self-confidence, and academic success.

1. Student Learning Styles

Table 5. Distribution of Learning Styles

Learning Styles	Amount	Percentage
Visual	20	42%
Auditory	16	33%
Kinesthetic	12	25%

Description: Visual learning style is dominant. This aligns with the nature of relational material that requires graphic representation (Setyaningsih & Sunaryo, 2021).

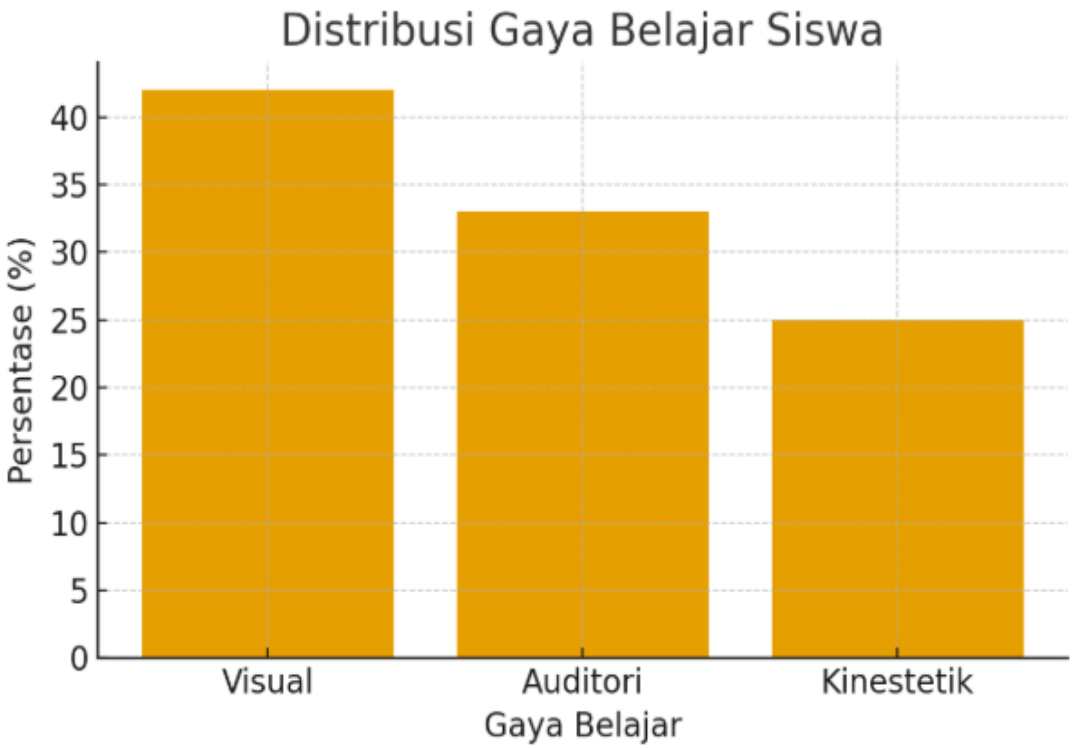

Figure 4. Distribution of Student Learning Styles

2. Self-Confidence Level

Table 6. Self-Confidence Level

Category	Amount	Percentage
Tall	7	15%
Currently	29	60%
Low	12	25%

The majority of students were in the average category. Students with high self-confidence showed greater courage in reading answers and attempting difficult problems.

DISCUSSION

The results of the study indicate that visual learning styles dominate and correlate with the highest average conceptual understanding scores. This finding aligns with Kolb's Experiential Learning framework, which emphasizes the importance of concrete experiences and visual representations in the abstract conceptualization process (Rasidi & Susana, 2020). In the context of relational presentation materials—which require an understanding of arrow diagrams, ordered pairs, and graphs—visual instruments provide a cognitive bridge that facilitates the internalization of concepts. In other words, when students gain observational experience through images and

graphs, they more easily reflect and construct the abstract concepts needed to solve relational problems (Kustanto et al., 2021).

In addition to learning styles, self-confidence has been shown to significantly influence students' academic performance, consistent with Bandura's self-efficacy theory. Students with high self-confidence tend to be more willing to take cognitive risks—for example, attempting challenging problems or presenting solutions in front of the class—thus increasing their opportunities to receive feedback and make improvements (Ardiansyah, 2021).. This finding corroborates the results of Hasanah's (2023) study, which reported a positive contribution of self-confidence to mathematical problem-solving abilities. Thus, building self-confidence is not merely an affective aspect but also a crucial driver for improving the quality of conceptual understanding (Abdillah et al., 2022)

The interaction between learning styles and self-confidence yields an interesting pattern: the combination of a visual style and high self-confidence results in the best comprehension, while the combination of a kinesthetic style and low self-confidence results in the lowest performance. This pattern indicates that a match between the material delivery method and individual learning preferences needs to be combined with self-confidence-boosting interventions for maximum learning effectiveness. This finding is consistent with a report by Wulandari & Nugroho (2023), which emphasized that the successful implementation of the Independent Curriculum depends on adapting learning strategies to student profiles, including affective aspects such as self-confidence.

From a practical perspective, these results lead to two main recommendations (Amin et al., 2020). first, mathematics teachers need to integrate visual materials and activities that support graphical representations for relational learning, and provide alternative approaches for kinesthetic learners through manipulatives or physical simulations; second, teachers should implement reinforcement techniques that increase self-confidence, such as scaffolding, constructive feedback, and opportunities for staged presentations (Prasetyo et al., 2021). These two approaches not only strengthen the theoretical foundations of Kolb and Bandura, but also reflect the practices recommended in the Deep Learning model that encourage meaningful understanding, not just procedural mastery (Sulistiyono et al., 2021).

Overall, this discussion suggests that improving understanding of relational representation concepts requires a holistic intervention—combining appropriate teaching strategies with learning styles and affective reinforcement to build student confidence. This research complements previous empirical evidence (Hasanah, 2023; Wulandari & Nugroho, 2023) and opens up opportunities for further research exploring differentiation-based learning intervention designs whose effectiveness can be measured through quantitative experimental designs.

Research Implications

1. Theoretical Implications

The results of this study provide theoretical contributions to the development of mathematics education studies, particularly regarding the relationship between learning styles, self-confidence, and conceptual understanding. First, the finding that visual learning styles produce the highest conceptual understanding strengthens Kolb's Experiential Learning theory, which states that learning becomes more effective when learning experiences match students' cognitive

tendencies. Second, the findings regarding the influence of self-confidence on learning success support Bandura's Self-Efficacy theory that individual beliefs can increase motivation, effort, and persistence in academic activities. Thus, this study enriches the understanding that cognitive (learning styles) and affective (self-confidence) variables work simultaneously in influencing learning success, especially in mathematical materials that require visual representation and high levels of abstraction (Yunaeti et al., 2021)

Furthermore, this study strengthens the literature on Deep Learning in mathematics learning by demonstrating that understanding of relational concepts can be enhanced through an approach that emphasizes knowledge construction, rather than simply memorizing procedures (Widiastuti & Imami, 2022). These findings provide additional empirical evidence that differentiated, student-centered learning has a significant impact on the quality of mathematical concept learning.

2. Practical Implications

1). Implications for Teachers

This research emphasizes the importance of teachers implementing **differentiated learning** based on students' learning style profiles. Teachers can provide a variety of learning media, such as arrow diagrams, graphs, relationship cards, and structured verbal explanations to accommodate visual, auditory, and kinesthetic learning styles. Furthermore, teachers need to increase student self-confidence through strategies such as providing positive feedback, incremental assignments, and presentation opportunities (Wulan, 2017). Teachers are also advised to implement a Deep Learning approach to help students develop a more meaningful understanding of concepts (Nuryana & Chaidar, n.d.).

2). Implications for Schools

Schools need to provide support by providing visual and digital learning resources that foster understanding of mathematical concepts, such as LCDs, interactive boards, and technology-based learning devices. Furthermore, schools can conduct internal training on differentiated learning, strengthening student self-confidence, and implementing the Independent Curriculum to improve teacher competency (Pangestu et al., 2021)..

3). Implications for Students

For students, this research emphasizes the importance of recognizing their individual learning styles in order to choose appropriate learning strategies. Students are also encouraged to build self-confidence through consistent practice, asking questions, and actively participating in class discussions. Awareness of their learning styles and self-confidence can help students achieve more optimal results, particularly in materials requiring an understanding of mathematical representations and relationships (Fitriyah et al., 2019)

Research Limitations

This study has several limitations that need to be considered when interpreting the results and designing further research. These limitations include subject limitations, methodological limitations, and research instrument limitations.

1. Limitations of Research Subjects

This study involved only **48 eighth-grade students from a single school,** SMP Negeri Satu Atap 01 Ciseeng. The relatively small number of subjects and the specific school context mean that the results cannot be generalized to the entire population of junior high school students. Student characteristics, learning environments, and specific school cultures can influence students' learning styles, self-confidence, and conceptual understanding. Therefore, further research is needed to involve more schools and more diverse samples to obtain a more representative picture.

2. Limitations of Qualitative Methods

The method used in this study is **a descriptive qualitative method,** which relies on the researcher's interpretation of data from interviews, observations, and documentation. The presence of the researcher as the primary instrument has the potential to introduce subjectivity in data processing and interpretation. Although triangulation and member checks have been conducted, researcher bias cannot be completely eliminated. Furthermore, the qualitative approach does not allow for stronger statistical relationship tests, such as regression or correlation, so the nature of the relationship between variables is only a tendency, not a quantitative certainty.

3. Limitations of Research Instruments

Research instruments such as interview guides, observation sheets, and documentation have limitations because they depend on student honesty, researcher thoroughness, and classroom conditions during observation. Interviews can be influenced by students' emotional states, while observations are significantly influenced by the researcher's presence, which may alter students' natural behavior (observer effect). Furthermore, there is no standard psychological measurement instrument (e.g., a standardized self-confidence scale), so data related to self-confidence remains subjective and dependent on student and teacher perceptions.

Research Recommendations

Based on the research results and limitations that have been described, there are several recommendations that can be used as considerations for further research and the development of learning practices in schools.

1. Recommendations for Further Research

Future research is recommended to include **a larger sample size** and schools from various regions to obtain more representative and generalizable findings. Furthermore, using **a mixed methods approach** can provide both qualitative analytical depth and quantitative statistical power, allowing for more robust testing of relationships between variables such as learning styles, self-confidence, and conceptual understanding. Further research could also include other variables such as learning motivation, learning strategies, or the learning environment to examine dynamics more comprehensively.

2. Instrument Development Recommendations

Instruments used in future research should utilize **standardized psychological measurement tools,** particularly for measuring student self-confidence, to ensure more accurate and comparable data across studies. Developing a more objective observation rubric and learning behavior checklist could also improve data reliability.

3. Recommendations for the Development of Learning Models

Further research could develop and test **Deep Learning-based differentiated learning models** that specifically tailor instruction to students' learning styles. Furthermore, self-confidence-boosting interventions, such as mentoring programs, group tutoring, or project-based learning

(PjBL), could be researched to determine their effectiveness in improving understanding of mathematical concepts.

4. Recommendations for School Policy Development

Schools can consider developing more student-centered learning policies, such as providing interactive visual aids, math laboratories, and teacher training on differentiated learning. Future research can evaluate the effectiveness of these policies in improving mathematics learning outcomes.

5. Recommendations for the Application of Technology in Relationship Learning

Further research is also recommended exploring the use of **educational technology,** such as GeoGebra, interactive digital modules, or augmented reality (AR) to help students understand relationships and their representations more intuitively. Technology can be a bridge for students with visual and kinesthetic learning styles.

CONCLUSION

Based on the results of research on learning styles, self-confidence, and understanding of the concept of presenting relations of students at SMP Negeri Satu Atap 01 Ciseeng, the following conclusions can be drawn:

1. Student learning styles fall into three main categories: visual, auditory, and kinesthetic, with the visual learning style dominating at 41.7%. This indicates that most students find it easier to understand material when presented through diagrams, graphs, and other visual representations.
2. Student self-confidence was in the moderate category, at 60.4% of the total study subjects. This finding indicates that most students have sufficient confidence to participate in the learning process, but still need reinforcement to actively participate and confidently face challenging math tasks.
3. There is a relationship between students' learning styles and their understanding of the concept of relational presentation. Students with a visual learning style obtained the highest average score (82), followed by auditory (77), and kinesthetic (74). This indicates that the suitability between the method of material presentation and learning preferences influences the quality of students' conceptual understanding.
4. Self-confidence is related to students' conceptual understanding. Students with high self-confidence demonstrate active participation, courage to attempt difficult problems, and perseverance in completing assignments. Conversely, students with low self-confidence tend to be passive and give up easily, resulting in poor learning outcomes.
5. The interaction between learning style and self-confidence simultaneously influences conceptual understanding. The combination of a visual learning style and high self-confidence produces the most optimal conceptual understanding, while the combination of a kinesthetic learning style and low self-confidence shows the lowest results.
6. In general, relational presentation learning will be more effective if it considers students' learning profiles and affective reinforcement. The results of this study emphasize the importance of differentiated learning and a deep learning approach to improving students' understanding of mathematical concepts.

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