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CRITICAL REVIEW OF 'IDENTIFICATION OF STUDENT MISCONCEPTIONS BASED ON FIELD-DEPENDENT AND FIELD-INDEPENDENT COGNITIVE STYLES THROUGH THE JIGSAW LEARNING MODEL': INSIGHTS AND RECOMMENDATIONS FOR IMPROVEMENT

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Abstract

This study aims to identify students' misconceptions based on field-dependent (FD) and field-independent (FI) cognitive styles through the application of the Jigsaw learning model, particularly in mathematics learning. The research subjects consisted of 4 seventh-grade students at SMPN 1 Bolo, divided into FD and FI groups based on the results of the Group Embedded Figures Test (GEFT). The findings show that FD students had a higher misconception rate than FI students. A total of 35% of FD students experienced misconceptions. On the other hand, FI students had a lower percentage of misconceptions, at 15%. Applying the Jigsaw learning model successfully reduced misconceptions in both groups, especially among FI students, who are naturally more independent in processing information. However, FD students require additional intervention in the form of guidance and peer support to enhance their understanding. The Jigsaw learning model is effective in identification of misconceptions, particularly for FI students, but it still requires adaptations for FD students to achieve optimal results. Besides, the integration of the CRI that provides a nuanced insight into students' misconceptions. The CRI allows educators to pinpoint not only incorrect answers but also the confidence levels associated with these errors, which helps in diagnosing misconceptions more effectively. Future research could investigate the impact of intrinsic motivation and prior knowledge on misconceptions, particularly across different cognitive styles. Understanding how these factors interact could offer insights into improving learning outcomes.

Keywords: misconceptions; cognitive styles; field-dependent; field-independent; jigsaw learning

Abstrak

Penelitian ini bertujuan untuk mengidentifikasi miskonsepsi siswa berdasarkan gaya kognitif field-dependent (FD) dan field-independent (FI) melalui penerapan model pembelajaran Jigsaw, khususnya pelajaran Matematika. Subjek penelitian terdiri dari 4 siswa kelas VII di SMPN 1 Bolo, yang dibagi menjadi kelompok siswa FD dan FI berdasarkan hasil tes Group Embedded Figures Test (GEFT). Hasil penelitian menunjukkan bahwa siswa FD memiliki tingkat miskonsepsi yang lebih tinggi dibandingkan siswa FI. Sebanyak 35% siswa FD mengalami miskonsepsi. Di sisi lain, siswa FI mengalami miskonsepsi dengan persentase lebih rendah, yaitu 15%. Penerapan model pembelajaran Jigsaw berhasil mengurangi miskonsepsi di antara kedua kelompok, terutama pada siswa FI, yang secara alami lebih mandiri dalam memproses informasi. Namun, siswa FD memerlukan intervensi tambahan dalam bentuk bimbingan dan dukungan teman sebaya untuk meningkatkan pemahaman mereka. Kesimpulannya, model pembelajaran Jigsaw efektif dalam mengurangi miskonsepsi, terutama bagi siswa FI, namun tetap memerlukan adaptasi bagi siswa FD agar hasilnya lebih optimal. Selain itu, integrasi CRI yang memberikan wawasan yang bernuansa ke dalam miskonsepsi siswa. CRI memungkinkan para pendidik untuk menunjukkan tidak hanya jawaban yang salah tetapi juga tingkat kepercayaan diri yang terkait dengan kesalahan ini, yang membantu dalam mendiagnosis miskonsepsi secara lebih efektif. Penelitian di masa depan dapat menyelidiki dampak dari motivasi intrinsik dan pengetahuan sebelumnya terhadap miskonsepsi, terutama pada gaya kognitif yang berbeda. Memahami bagaimana faktor-faktor ini berinteraksi dapat memberikan wawasan untuk meningkatkan hasil pembelajaran.

Kata kunci: Miskonsepsi; Gaya Kognitif; field-dependent; field-independent; Model Jigsaw

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INTRODUCTION

Misconceptions in education are widespread and diverse, impacting students and educators in various disciplines. These misconceptions, defined as persistent ideas that are not supported by current scientific views, can significantly hinder the learning process by preventing the proper integration of new knowledge into the cognitive structure of students (Badenhorst et al., 2015; Tulak et al., 2022). The prevalence of misunderstandings is not limited to students, teachers also harbor false beliefs about teaching, learning, and academic motivation, which can lead to ineffective teaching strategies and misinterpretation of educational psychology (McAfee & Hoffman, 2021). Misconceptions among teachers can perpetuate false beliefs in students, emphasizing the need for effective correction strategies and the development of appropriate instrumentation to measure and reduce these misconceptions (McAfee & Hoffman, 2021). Additionally, misconceptions in educational topics such as class size, hands-on instruction, and value retention are influenced by factors such as subject areas, conservative orientations, and educational goals, highlighting the topic's reliance on vulnerability to misunderstandings (Asberger et al., 2021).

Understanding misconceptions in mathematics is essential for improving educational outcomes, as these misconceptions can significantly hinder students' conceptual understanding and problem-solving abilities. Misconceptions in mathematics often stem from a lack of basic understanding, procedural errors, and misapplication of formulas. One of the main causes is a widespread misunderstanding of the nature and purpose of mathematics among students, parents, and teachers, who often see it only as a tool for calculating and memorizing formulas rather than a conceptual and applicable discipline (Rohman et al., 2023). In addition, cognitive limitations and lack of basic knowledge contribute to this misunderstanding. Misconceptions can also arise from the teaching methods used by teachers. Teachers themselves have misunderstandings or lack of proficiency in mathematics so they can inadvertently pass on these misunderstandings to their students(Kusmaryono et al., 2019).

Students' misconceptions in math learning can be significantly influenced by their cognitive style. Cognitive style refers to a person's characteristics and is consistent in responding, remembering, organizing, processing, thinking, and solving problems (Putra et al., 2020). One of the cognitive styles used is the field-independent (FI) cognitive style and the

field-dependent (FD) cognitive style (Marwazi & Putra, 2019). FD students may find it difficult to remember previously taught material and are often unable to determine the right formula or strategy to solve a math problem without guidance (Ginting & Nasution, 2024). They tend to think globally and are less systematic in their approach, which often results in conceptual, procedural, and technical errors, such as misinterpreting problem statements and making calculation errors (Hardiansyah et al., 2024; Yudianto et al., 2022). Meanwhile, FI students can recall information faster and more accurately, plan and execute problem-solving strategies effectively, and represent mathematical concepts across a variety of models and indicators (Ginting & Nasution, 2024; Sobirin et al., 2023). They can represent problems using a variety of models and symbols, plan solutions effectively, and perform calculations accurately, although they may still make technical mistakes (Ginting & Nasution, 2024; Nasrullah, 2023; Sobirin et al., 2023). Overall, understanding the different characteristics and challenges associated with FD and FI cognitive styles can help educators develop more effective teaching strategies to address and reduce student misunderstandings in math problem-solving (Exacta et al., 2024; Widahyu & Zul Amry, 2022).

Several studies have examined ways to identify and address such misconceptions. The use of a cooperative learning model to overcome misconceptions in junior high school students (Novita and Herlina, 2015). The study shows that cooperative learning can help students correct incorrect conceptual understanding, but does not explore differences in students' cognitive styles. In addition, Rahman and Putra (2017) examined the differences in conceptual understanding between students with field-dependent and field-independent cognitive styles. They found that students with a field-independent cognitive style tended to have a better understanding of concepts than students with a field-dependent cognitive style. However, their research did not utilize specific learning models such as Jigsaw to see how these differences in cognitive styles could be accommodated in learning strategies. In a recent study, Setiawan (2020) used a Jigsaw learning model to improve students' understanding of concepts in science subjects. Although this study showed the effectiveness of the Jigsaw model in improving students' comprehension in general, it did not consider aspects of students' different cognitive styles.

Starting from the above problems, this study will try to apply the Jigsaw learning model to identify differences in the understanding of students who have different cognitive styles.

The Jigsaw model is a cooperative learning technique that involves several structured steps to improve student engagement, understanding, and collaboration. This process usually begins with the formation of original groups, where students are divided into small, diverse teams (Son, 2023; Latifa & Hidayat, 2023). Each member of the original group is then assigned a different segment of material to study, becoming an "expert" on that segment (Son, 2023; Surtiningsih, 2023). This is followed by the expert group stage, where students from different Indigenous groups who have the same segment meet to discuss and master the material together (Son, 2023; Latifa & Hidayat, 2023). After this, students return to their original group to teach their segments to their peers, ensuring that all group members understand the entire material (Son, 2023; Surtiningsih, 2023). The process ends with the evaluation stage, where the student's understanding is assessed, and the feedback stage, where reflection and improvement are discussed (Son, 2023).

In this study, the researcher wanted to identify students' misconceptions based on *field dependent* and *field independent* cognitive styles through a jigsaw learning model in mathematics subjects. The focus of this research is 1) How are students' misconceptions based on field dependent cognitive styles through the jigsaw learning model? 2) How are students' misconceptions based on field-independent cognitive styles through the jigsaw learning model? The purpose of this study is to identify students' misconceptions based on their cognitive style through the Jigsaw learning model.

METHODS

This study uses a qualitative descriptive approach. This research will be conducted on grade VII students of SMPN 1 Bolo. The subjects of this study consisted of two students with a field-independent cognitive style and two students with a field-dependent cognitive style who had the highest percentage of misconceptions, as identified through the Certainty of Response Index (CRI). The selection of these four students was guided by the need for in-depth qualitative analysis to explore how cognitive styles influence misconceptions in mathematics. By focusing on students with the highest misconception percentages, the study aimed to understand the mechanisms behind these misconceptions and provide targeted insights into how the Jigsaw learning model can address such issues. The limited number of

participants was also chosen to allow for detailed exploration of their cognitive processes and learning behaviors, which may not have been feasible with a larger sample size.

The instruments used in this study were the Group Embedded Figures Test (GEFT) and a mathematics misconception test with a Certainty of Response Index (CRI). The GEFT, developed by Witkin et al. (1971), was used to classify students into field-dependent (FD) and field-independent (FI) cognitive styles (Nasution, 2018; Sobirin et al., 2023). The test consists of a series of visual tasks requiring students to identify simple geometric shapes embedded within complex patterns, which assesses their ability to separate relevant details from a distracting context. The validity and reliability of the GEFT have been widely established in prior studies, with a reported reliability coefficient of 0.82 in educational settings.

The mathematics misconception test, designed based on key concepts in the curriculum, was used to identify specific areas of misunderstanding. This test was supplemented with the Certainty of Response Index (CRI), a diagnostic tool that measures students' confidence levels in their answers (Nasution, 2018). The CRI scale ranges from 1 to 5, with higher scores indicating greater confidence. Misconceptions were identified when students provided incorrect answers with a CRI score of ≥ 2.5, as per the guidelines established by Nasution (2018). The mathematics test underwent expert validation by three mathematics education specialists to ensure content validity, achieving an agreement index of 0.87, and a pilot study was conducted to confirm its reliability, resulting in a Cronbach's alpha of 0.85.

Table 1. CRI Scale (Response Certainty Index)

CRI	Criterion
1	If the student answers by guessing
2	If the student answers by guessing but there are elements considered
3	If students feel hesitant in answering
4	If students feel confident in the answer
5	If students feel very confident in the answer

Furthermore, the analysis of the relationship between students' answers on each test item and the quality of students' answer certainty in answering each test item (Nasution, 2018).

Table 2. Interpretation of CRI Results

Response Quality Scale (CRI)	Answering Concept Questions	
	Wrong Answer	Correct Answer
Low CRI (< 2,5)	Students do not understand the concept	Students understand the concept
High CRI (≥ 2,5)	Students experience misconceptions	Students understand concepts well

RESULTS AND DISCUSSION

Result

This study aims to identify student misconceptions based on field-dependent (FD) and Field Independent (FI) cognitive styles through Jigsaw model learning. The results obtained through two stages of the test, namely the initial test to determine cognitive style and the second test equipped with the Certainty of Response Index (CRI) instrument to measure students' misconceptions after the learning process, provide a significant picture of the relationship between cognitive style and student misconceptions.

Analysis Based on Cognitive Style (FD/FI)

The Group Embedded Figures Test (GEFT) is used to identify students' cognitive styles, i.e. whether they fall into the category of Field Independent (FI) or Field Dependent (FD). In this test, students are faced with a series of visual patterns that require them to find hidden shapes within larger patterns. Field-independent cognitive style is characterized by students' ability to separate relevant information from complex contexts, while field-dependent tends to process information more globally and is influenced by broader visual contexts.

From the total 32 students who took the GEFT test, 18 students were identified as having FI cognitive styles, while 14 students were categorized as FDs. These results indicate that the majority of students are more likely to have stronger analytical abilities and can separate information from its context, while others rely more on the overall context in processing information.

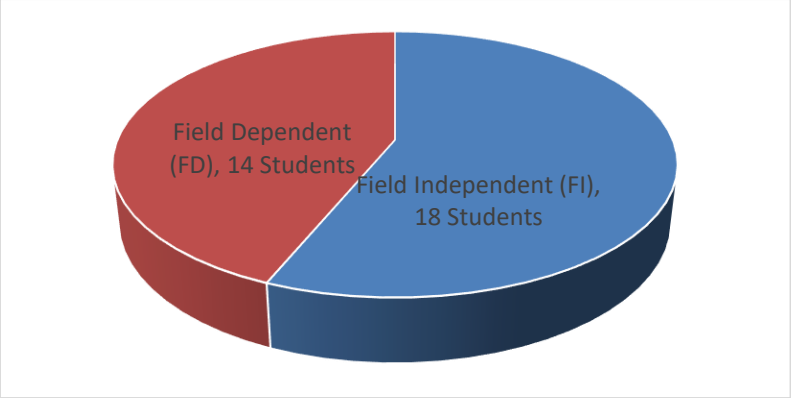

Diagram 1. Distribution of Students Based on Cognitive Style

For further research purposes, four students were selected, two each from the FI and FD categories. This selection criterion is based on students who show the highest percentage of misconceptions in the second test, which is a test designed to measure conceptual understanding after they have been taught using a jigsaw learning model. The selected students had the highest Confidence Rating Index (CRI) score on the wrong answer, which indicates a high level of confidence in the wrong concept. This is important because these students not only make mistakes but also feel confident that their answers are correct, indicating a deep misconception.

Table 4. Distribution of the main subjects of the study based on cognitive style

Cognitive Style	Selected Subjects	Percentage of Misconceptions
Field Independent (FI)	Student 1 and Student 2	15%
Field Dependent (FD)	Student 3 and Student 4	35%

Misconceptions After Jigsaw Learning

In the second test, conducted after students participated in learning using the Jigsaw method, students were presented with concept-based questions designed to measure their understanding of the material. The test was enhanced with a Certainty of Response Index (CRI) to more accurately identify students' misconceptions. The CRI required students to not only answer the questions but also indicate their confidence level in each response. This dual-layer approach is critical because misconceptions are most apparent when students provide incorrect answers with high confidence levels.

The findings revealed significant differences in the number and types of misconceptions between students with field-independent (FI) and field-dependent (FD) cognitive styles.

Students with FD cognitive styles exhibited a higher percentage of misconceptions, reaching 35%, compared to 15% for FI students. FD students, who tend to process information globally, were more prone to misconceptions, particularly when faced with questions requiring in-depth analytical skills. This tendency may also stem from their reliance on contextual cues, which can lead to difficulty distinguishing relevant information from distractions.

Conversely, FI students, who excel at separating relevant details from contextual noise, demonstrated fewer misconceptions. Their ability to critically evaluate their answers and reflect on their understanding contributed to their lower percentage of misconceptions. This reinforces the notion that cognitive styles significantly impact students' abilities to accurately understand and analyze mathematical concepts.

The Role of the Jigsaw Model and CRI in Identifying Misconceptions

While the Jigsaw learning model promotes collaboration, active participation, and peer learning, its primary role in this study was to encourage students to engage deeply with the material. However, it is the integration of the CRI that provides a nuanced insight into students' misconceptions. The CRI allows educators to pinpoint not only incorrect answers but also the confidence levels associated with these errors, which helps in diagnosing misconceptions more effectively.

If another learning model, such as traditional direct instruction or problem-based learning, were used in place of the Jigsaw method, it is plausible that the percentage of misconceptions might differ. The collaborative and distributed learning structure of Jigsaw likely played a role in exposing misconceptions during group discussions and individual teaching roles. Nevertheless, the CRI remains the primary diagnostic tool in identifying misconceptions by linking confidence levels to students' responses. Therefore, while the Jigsaw method facilitates a collaborative learning environment, the effectiveness of identifying misconceptions lies heavily in the application of the CRI.

Table 5. Results of the Mathematics Ability Test Based on Misconceptions Experienced by Students

Cognitive Style	Average Second Test Score	Percentage of Misconceptions
Field Independent (FI)	72,4	15%

Cognitive Style	Average Second Test Score	Percentage of Misconceptions
Field Dependent (FD)	54,7	35%

From the results above, it is evident that field-dependent students have a higher average percentage of misconceptions (35%) compared to field-independent students (15%). The collaborative nature of the Jigsaw model may benefit FI students more effectively, as their cognitive style aligns with independent analysis and information filtering. However, FD students, who rely on external validation, may require additional support to fully benefit from this learning approach. Regardless of the learning model used, the CRI remains a pivotal instrument for identifying misconceptions, emphasizing its value in educational diagnostics.

Mechanism of Misconception

Based on interviews conducted with selected students, several key insights were gained about their thought processes when answering questions, as well as the influence of cognitive styles on their learning strategies and conceptual understanding. These findings were cross-referenced with test results to provide concrete evidence.

1. Thinking Patterns that Lead to Misconceptions

The first finding pertains to how students approach problem-solving, which often leads to misconceptions. For example, one FI student expressed confidence in their understanding of algebraic concepts but admitted to not double-checking their answers. This pattern aligns with the CRI data, where the student scored highly on incorrect responses, indicating strong confidence in their misconceptions. Such behavior demonstrates that overconfidence without verification contributes to persistent errors in conceptual understanding.

In contrast, an FD student reported struggling with independent problem-solving tasks. They relied heavily on peer guidance during the Jigsaw activity but failed to perform well when no external validation was available during the test. This reliance is evident in the CRI data, where the student frequently displayed uncertainty in their correct answers and confidence in their incorrect ones. This highlights how dependence on external cues can hinder independent critical thinking, leading to misconceptions.

2. Relationship Between Cognitive Style and Learning Strategies

The second finding examines how cognitive styles shape learning strategies and their relationship to misconceptions. FI students tended to adopt a more analytical and self-reliant

approach. For instance, one FI student successfully identified patterns in geometry problems during the Jigsaw activity but failed to apply the same logic during the individual test due to a lack of reflection on their initial understanding. This example underscores the importance of reinforcing metacognitive skills, even among independent learners.

FD students, on the other hand, showed improved comprehension when provided with structured guidance during group discussions. One FD student noted that they felt confident explaining a concept to peers after receiving direct support from the teacher. However, in the absence of this structured environment during the test, the same student struggled to connect the concepts, leading to errors in problem-solving. These findings reveal how learning strategies directly influence the occurrence of misconceptions.

3. External Factors Affecting the Learning Process

External factors, such as the learning environment and group dynamics, were found to significantly impact FD students. For example, during the Jigsaw activity, one FD student thrived in a collaborative setting, citing feedback from peers as a key factor in their understanding of mathematical concepts. However, this reliance proved detrimental during the individual test when such external input was unavailable.

Conversely, FI students were less influenced by external environments but could develop misconceptions due to over-reliance on their independent reasoning. One FI student remarked that they "didn’t need help" from peers during the activity but acknowledged missing key details when reflecting on their test errors. This suggests that misconceptions can arise even among self-reliant learners when they neglect critical reflection.

Table 6. Summary of Interview Findings Regarding Misconceptions

Cognitive Style	Factors Causing Misconceptions	Thinking Patterns
Field Independent (FI)	Overconfidence in concept understanding	Analytics, self-contained, but less verified
Field Dependent (FD)	Dependence on external information	Relying on help, less critical of one's own answers

Discussion

The Influence of Cognitive Style on Misconceptions

The results of the GEFT (Group Embedded Figures Test) test and the second misconception test showed that students with the field-dependent (FD) cognitive style had a higher percentage of misconceptions compared to students with the field-independent (FI) style. These findings confirm that cognitive style has a significant effect on the way students understand and process information in learning. Fundamental differences in the way FD and FI process information can help explain the level of misconception that occurs in each group.

Students with the Field Dependent cognitive style tend to rely heavily on external cues, such as teacher instructions or peer assistance, to build their understanding. This reliance makes them more vulnerable to misconceptions, particularly in situations that require independent information processing without direct guidance (Vosniadou, 2020). In collaborative learning environments, such as the Jigsaw method, FD students may benefit from peer interaction but can still struggle when expected to process information independently. Tulak et al. (2022) highlight that while group settings may reduce misconceptions for FD students, their effectiveness depends largely on the quality of peer explanations and guidance.

Research by Nasution (2018) also found that FD students often had difficulty in generalizing algebraic concepts and applying rules, due to a lack of fundamental understanding and reliance on external guidance. In geometry, FD students may be able to explain and classify concepts verbally, but they have difficulty connecting the various mathematical concepts that exist, thus increasing the risk of misunderstanding (Marufi et al., 2018)

In contrast, students with a Field Independent cognitive style tend to be more independent in thinking. They have stronger analytical skills, which allows them to understand and process material effectively without external help. Even so, FI students are not completely immune to misconceptions. They tend to be more confident in their answers or initial understanding, which can be a cause of misconceptions if they don't re-verify. For example, in geometry learning, FI students tend to be better at connecting different concepts, which ultimately helps them reduce the risk of misconceptions (Marufi et al., 2018). However, excessive confidence in their initial understanding without reassessing the conclusions drawn can also be a cause of misconceptions, as expressed by Nasution (2018).

The Effectiveness of Jigsaw Learning in Identifying Misconceptions

The Jigsaw learning method has proven to be an effective strategy for reducing misconceptions, especially among students with the field-independent (FI) cognitive style, who are more able to think independently. This method involves students becoming experts in a particular part of the learning material and then teaching it back to their group, which creates a collaborative learning environment. However, students with the Field Dependent (FD) cognitive style, who rely more often on external validation, may still experience misconceptions if support from friends or resources is inadequate (Ulum et al., 2023).

FI students derive significant benefits from the Jigsaw method because it corresponds to their tendency to learn independently, allowing them to assimilate information more effectively through interaction with their peers. Studies show that this method improves FI students' ability to comprehend complex material, such as that recorded in physics learning, where FI students experience a significant increase in concept mastery (Ulum et al., 2023). The application of the Jigsaw method is also successful in the context of translation learning, where students improve translation accuracy through collaborative learning (Zanah & Annaningtyas, 2024).

On the other hand, students with the FD cognitive style often rely more on external support to validate their understanding, so they are more susceptible to misconceptions if such support is not available or inadequate. In the Jigsaw method, FD students may face difficulties if they do not get adequate guidance from their groupmates. Therefore, additional interventions, such as structured tutoring and the provision of appropriate resources, are needed to help FD students overcome these challenges and strengthen their understanding (Morgan, 2014; Ulum et al., 2023).

Overall, the Jigsaw learning method has proven to be effective in reducing misconceptions and improving learning outcomes, especially for FI students. However, for FD students, more careful implementation is necessary by providing adequate additional support. Therefore, educators need to consider students' cognitive styles in designing and implementing these learning strategies to ensure maximum benefits.

The Role of Students' Beliefs on Misconceptions

Student beliefs play an important role in the formation and persistence of misconceptions, especially in students with a Field Dependent (FD) cognitive style. These misconceptions are not only caused by a lack of understanding but are often exacerbated by

a high level of confidence in the wrong answers. The Cognitive Reflection Indicator (CRI) highlights that FD students often show high levels of confidence in their incorrect answers, making it more difficult to correct misconceptions. This phenomenon is further exacerbated when FD students rely more on external sources such as friends or teachers for clarification, which if those sources are also wrong, can reinforce further misconceptions (Dellantonio & Pastore, 2021).

Misconceptions are often deeply embedded in students' belief systems, forming broad explanatory frameworks that contradict scientific concepts. Students' belief in incorrect answers can lead to resistance to accepting correct concepts, as seen in studies where misconceptions persist despite being given educational interventions (Felita et al., 2023; Rodhiyah et al., 2024). Misconceptions are not the result of momentary errors but are part of a larger network of beliefs that involve the student's perspective on certain concepts.

Misconceptions are not just misinformation, but errors embedded in a more complex network of beliefs, making them difficult to change simply by delivering the right information. For students with FD cognitive styles, this challenge is even more severe because they tend to rely on external validation and have difficulty developing critical reflection independently (Vosniadou, 2020).

Critical thinking and deep reflection are essential to overcome misconceptions, as they encourage students to examine and revise their beliefs (Dellantonio & Pastore, 2021). Instructional strategies such as creating cognitive conflicts and presenting counterarguments to wrong concepts can be effective in triggering students' awareness of their misconceptions. However, for FD students, this strategy may not always be enough, as they need additional support to be able to understand more independently (Vosniadou, 2020).

Additionally, strengthening teacher pedagogy and adopting more varied teaching approaches, including the use of interactive and collaborative learning media, can help reduce misconceptions significantly (Qian & Lehman, 2018). By providing a supportive learning environment and facilitating reflection, educators can help students overcome their misconceptions, especially among students who tend to depend on external help such as FD.

Practical Implications in Classroom Settings

The findings of this study highlight the importance of understanding cognitive styles when designing instructional strategies. In classroom settings, teachers can address

misconceptions by tailoring their teaching approaches to meet the needs of both Field Dependent (FD) and Field Independent (FI) students. For FD students, incorporating structured guidance and external support during learning activities is essential. Teachers can achieve this by: 1) Providing step-by-step instructions and scaffolding during independent tasks; 2) Encouraging peer mentoring, where students with stronger conceptual understanding help explain concepts to FD students; 3) Utilizing collaborative tools, such as guided worksheets or structured group discussions, to ensure FD students stay engaged and receive sufficient support.

For FI students, teachers can leverage their analytical skills by: 1) Incorporating reflective activities, such as asking students to justify their reasoning or re-evaluate their answers after completing tasks; 2) Offering opportunities for independent problem-solving while encouraging self-assessment and peer feedback to minimize overconfidence; 3) Designing tasks that require critical analysis and synthesis of information to deepen their understanding of complex concepts.

Future Research Directions

Future research could investigate the impact of intrinsic motivation and prior knowledge on misconceptions, particularly across different cognitive styles. Understanding how these factors interact could offer insights into improving learning outcomes.

CONCLUSION

This study revealed a significant difference in the level of misconception between students with field-independent (FI) and field-dependent (FD) cognitive styles after learning using the Jigsaw method. Students with FD cognitive style showed a higher percentage of misconceptions compared to FI students. This suggests that FD students tend to be more susceptible to misconceptions, especially in situations where they must rely on self-understanding in the absence of external help. The Jigsaw method, while effective in improving interaction and cooperation between students, seems to be more advantageous to FI students who have analytical and independent thinking skills. In contrast, FD students who rely more on external information and interaction with groups need additional strategies to reduce the rate of misconceptions.

The results of in-depth interviews also revealed that misconceptions in FD students are often caused by their reliance on peer or teacher guidance, while FI students, although more independent, can experience misconceptions if they are too confident in their understanding without further verification.

This research provides important implications for teachers and educators in designing learning strategies that are more adaptive to the needs of students with different cognitive styles. In the application of collaborative methods such as Jigsaw, specific interventions for FD students are needed, such as providing more feedback or facilitating additional sources of information, to ensure that they do not rely solely on their peers.

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