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Vocational Students' Mathematical Disposition: Post-Instruction Analysis of Vector Learning

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ABSTRAK

Penelitian ini bertujuan untuk menganalisis disposisi matematis siswa SMK setelah pembelajaran matematika semester genap 2024/2025, khususnya pada materi vektor. Penelitian dilakukan dengan pendekatan deskriptif kualitatif melalui triangulasi data dari observasi, angket skala Likert 57 siswa, dan wawancara mendalam terhadap enam siswa dari kategori disposisi tinggi, sedang, dan rendah. Fokus wawancara diarahkan pada lima indikator yang bernilai cukup, yakni pada indikator percaya diri; gigih dan tekun; minat dan rasa ingin tahu; memonitor dan merefleksi; serta bergairah dan serius dalam belajar. Hasil analisis menunjukan bahwa disposisi matematis siswa secara umum berada dalam kategori cukup, dengan variasi mencolok antarindividu. Studi ini melengkapi penelitian sebelumnya yang memberikan gambaran kontekstual dari siswa SMK yang kurang mendapat sorotan dalam kajian disposisi matematis. Peneliian ini juga menyoroti pentingnya intervensi guru dalam menciptakan lingkungan belajar yang mendukung eksplorasi, refleksi, dan keberanian berpikir, terutama dalam mengajarkan materi yang bersifat abstrak seperti vektor.

Kata Kunci: disposisi matematis; siswa SMK; vektor

ABSTRACT

This research aims to analyze the mathematical disposition of vocational high school students after the second semester of mathematics instruction in the 2024/2025 academic year, specifically on the topic of vectors. The research was conducted using a descriptive qualitative approach through data triangulation from observations, a 57-student Likert scale questionnaire, and in-depth interviews with six students from high, medium, and low disposition categories. The interview focused on five indicators considered quite valuable: self-confidence, persistence and perseverance, interest and curiosity, monitoring and reflection, and being enthusiastic and serious about learning. The analysis results show that students' mathematical disposition is generally in the sufficient category, with significant variation between individuals. This study complements previous research by providing a contextual overview of vocational high school students, who have received less attention in studies on mathematical disposition. This research also highlights the importance of teacher intervention in creating a learning environment that supports exploration, reflection, and the courage to think, particularly when teaching abstract material such as vectors.

Keywords: mathematical disposition; vocational high school students; vectors

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1. INTRODUCTION

Mathematics is a subject that underpins the development of logic, critical thinking, and problem-solving skills. In Vocational High Schools (SMK), mathematics plays a strategic role in supporting the mastery of vocational competencies. However, SMK students often perceive mathematics as irrelevant to their field of expertise, leading to a tendency to view it as a burden (Utami et al., 2020; Mulyana & Pratiwi, 2022).

Vocational high school students are a unique population because they face not only academic demands but also vocational demands that emphasize work skills. The burden of on-the-job training, a packed schedule, and a focus on technical competencies often leads to affective aspects such as mathematical disposition being overlooked. However, mathematical disposition is crucial in building learning resilience and a positive attitude toward cognitive challenges (Schoenfeld, 2016; Mason & Scrivani, 2019; Fitriani, 2023).

Mathematical dispositions include confidence in solving problems, curiosity about mathematical concepts, perseverance, flexibility in thinking, and appreciation for the value of mathematics in real life (Schoenfeld, 2016; Fatimah & Sundayaha, 2022). These dispositions are closely related to motivation, self-perception, and students' beliefs about their ability to learn mathematics. Without positive dispositions, students tend to feel stressed, give up easily, and avoid mathematical challenges, even though they may have adequate cognitive abilities (OECD, 2018; Mason & Scrivani, 2019).

Unfortunately, the development of mathematical disposition has not been a primary focus in mathematics education at vocational high schools. The vocational high school curriculum places greater emphasis on achieving technical competencies, while character building and learning attitudes are often sidelined. The Merdeka Curriculum, which has been implemented since 2022, provides teachers with space to design student-centered learning, including fostering exploratory and reflective attitudes (Kemendikbudristek, 2022). However, there is insufficient empirical evidence to determine whether this approach has significantly shaped the mathematical dispositions of vocational high school students.

The second semester of the 2024/2025 academic year presents a strategic opportunity to reflect on how mathematics learning influences the dispositions of vocational high school students, particularly following the implementation of the new curriculum. In the context of the Industry 4.0 and Society 5.0 eras, vocational high school graduates are expected to possess critical thinking, creativity, adaptability, and the ability to flexibly solve problems, both in academic and vocational fields. Therefore, mathematics learning in vocational schools should focus on fostering confidence, persistence, and reflection in problem-solving (Mulyana & Pratiwi, 2022).

Previous research has shown that a supportive learning environment, responsive teachers, and problem-based and collaborative learning methods can improve students' mathematical dispositions (Kurniawan et al., 2021; Minggi, Arwadi, & Bakri, 2022). However, there has been little research exploring the actual conditions of vocational school students' dispositions after completing a whole semester of classroom learning. This gap is an important area that requires further study to gain a deeper understanding of how students experience and respond to the mathematics learning process.

Thus, this study aims to analyze the mathematical disposition of vocational high school students after participating in mathematics learning in the even semester of the 2024/2025 academic year. The results of this study are expected to provide input for teachers, schools, and policymakers in designing mathematics learning that is more holistic, contextual, and oriented toward fostering positive student dispositions.

2. METHOD

This study uses a qualitative descriptive method. In addition to the researcher as the main instrument, other instruments used include student activity observation sheets, mathematical disposition questionnaires, and interviews. The mathematical disposition indicators studied were: a) self-confidence; b) flexibility; c) perseverance and diligence; d) high interest and curiosity; e) monitoring and reflection; and f) enthusiasm and seriousness in learning (Imam & Sumarmo, 2019).

During the learning process, in addition to teaching, researchers also conducted participatory observations by recording student behavior relevant to mathematical disposition indicators. To maintain objectivity, researchers used structured observation sheets and systematically documented field notes. The researcher also compared the observation findings with the results of the questionnaire and interviews to ensure data validity through triangulation (Arikunto, 2013).

The mathematical disposition questionnaire was designed using a Likert scale with four options: always, often, rarely, and never. The mathematical disposition questionnaire was administered to 57 students at the end of the second semester of the 2024/2025 academic year. This was intended as a form of confirmation between students' choices on the mathematical disposition questionnaire and the observation results conducted by the researcher while students were learning vector material in class. The statements in the mathematical disposition questionnaire consisted of 17 positive statements and 13 negative statements. To analyze the attitude scale questionnaire, scoring for positive statements began with a score of 4 for 'always', a score of 3 for 'often', a score of 2 for 'rarely', and a score of 1 for 'never'. Conversely, scores of 1 were assigned for always, 2 for often, 3 for rarely, and 4 for never for negative statements.

Interviews were conducted as a tool to explore in greater depth the perceptions, attitudes, and learning experiences of students that could not be revealed through observation or questionnaires alone. To maintain the effectiveness and depth of the data, the interviews focused on mathematical disposition indicators that received relatively low scores in the questionnaire. This strategy was chosen to enable the researcher to gain a deeper understanding of the causes of weakness in specific indicators, as well as how students interpret these conditions within their learning process. The selection of interview subjects was conducted using disproportionate stratified random sampling, taking into account the categories of mathematical disposition ability levels: high, moderate, and low. Of the 57 students, 9 had a high mathematical disposition, 47 had a moderate mathematical disposition, and 1 had a low mathematical disposition. Thus, the high category was represented by two students, the moderate category by three students, and the low category by one student. This was because the proportions for each category were different and uneven. This approach aligns with the guidelines from Creswell and Poth (2018), which emphasize the importance of selecting participants who represent a variety of experiences to gain a rich understanding in qualitative research. Thus, focusing on weak indicators and the representation of mathematical disposition levels allows the interviews to proceed in a more focused, in-depth, and meaningful manner.

To maintain research ethics, researchers first sought approval from the school and obtained informed consent from students before administering questionnaires or conducting interviews. Student identities were kept confidential, and data was used only for academic purposes. Interviews were conducted privately and recorded with the participants' permission. These steps were taken to ensure the credibility, ethics, and validity of the findings in this study.

3. RESULT AND DISCUSSION

During the learning process, researchers observed student behavior using structured observation sheets. Some students showed low self-confidence when faced with challenging questions, while others tended to wait for help or remain silent without trying further. In terms of flexibility, some students remained fixated on one method of solving problems and were reluctant to try other methods even after failing in their initial attempts. Perseverance and diligence varied. Some students continued to try to solve problems even after a long time, but others gave up when they encountered difficulties. Students' interest and curiosity were low; they rarely asked questions, focused only on the sources provided by the teacher, or rarely took notes on important concepts without direct instruction from the teacher. Indicators of monitoring and reflection have not developed optimally. Students rarely review their work or evaluate it themselves. Meanwhile, enthusiasm and seriousness in learning vary considerably; some

students are enthusiastic about tackling complex problems, but many remain passive when presented with sufficiently challenging problems.

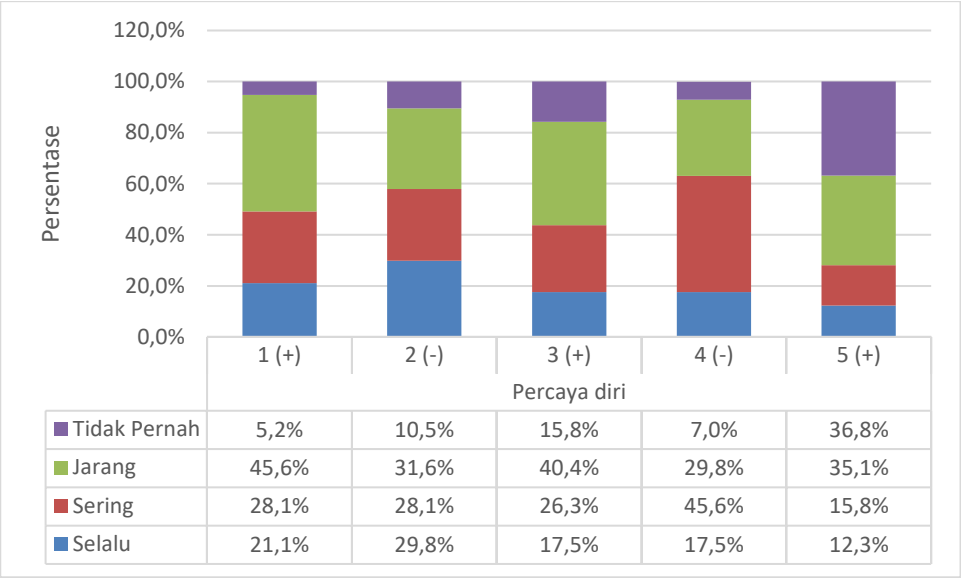
Data analysis of students' mathematical disposition was also conducted through questionnaires to observe students' tendencies toward assigned mathematical tasks, including self-confidence, flexibility, persistence, curiosity, reflective attitude, and enjoyment and seriousness in learning. Details of positive and negative indicators and statements are described in Table 1 below.

Table 1. Details of Mathematical Disposition Indicators and Statements

No	Indicator	Statement (+)	Statement (-)	Total
1	Confident	1, 3, 5	2, 4	5
2	Flexible	6, 8, 10	7, 9	5
3	Persistent and diligent	11, 14	12, 13, 15	5
4	Interested and curious	16, 18, 20	17, 19	5
5	Monitoring and reflecting	22, 25	21, 23, 24	5
6	Enthusiastic and serious about learning	26, 27, 29, 30	28	5
Total		17	13	30

Based on Table 1, it can be seen that the self-confidence indicator is broken down into five statements consisting of three positive (+) statements and two negative (-) statements; The Flexibility Indicator is broken down into five statements, consisting of 3 (three) positive statements (+) and 2 (two) negative statements (-); The Perseverance and Diligence Indicator is broken down into five statements, consisting of 2 (two) positive statements (+) and 3 (three) negative statements (-); The interest and curiosity indicator is broken down into five statements consisting of 3 (three) positive statements (+) and 2 (two) negative statements (-); The monitoring and reflection indicator is broken down into five statements consisting of 2 (two) positive statements (+) and 3 (three) negative statements (-); and the indicator of enthusiasm and seriousness in learning is broken down into five statements consisting of 4 (four) positive statements (+) and 1 (one) negative statement (-).

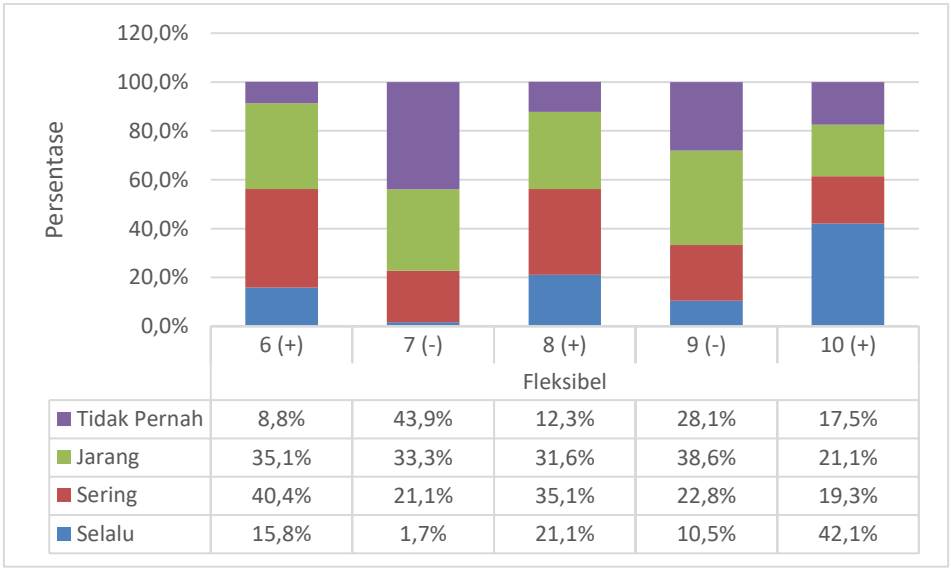
Next, an analysis of the Mathematical Disposition percentage of 57 respondents was conducted. The details are presented in Figure 1.



	1 (+)	2 (-)	3 (+)	4 (-)	5 (+)
Tidak Pernah	5,2%	10,5%	15,8%	7,0%	36,8%
Jarang	45,6%	31,6%	40,4%	29,8%	35,1%
Sering	28,1%	28,1%	26,3%	45,6%	15,8%
Selalu	21,1%	29,8%	17,5%	17,5%	12,3%

Figure 1. Results of the Self-Confidence Indicator Questionnaire

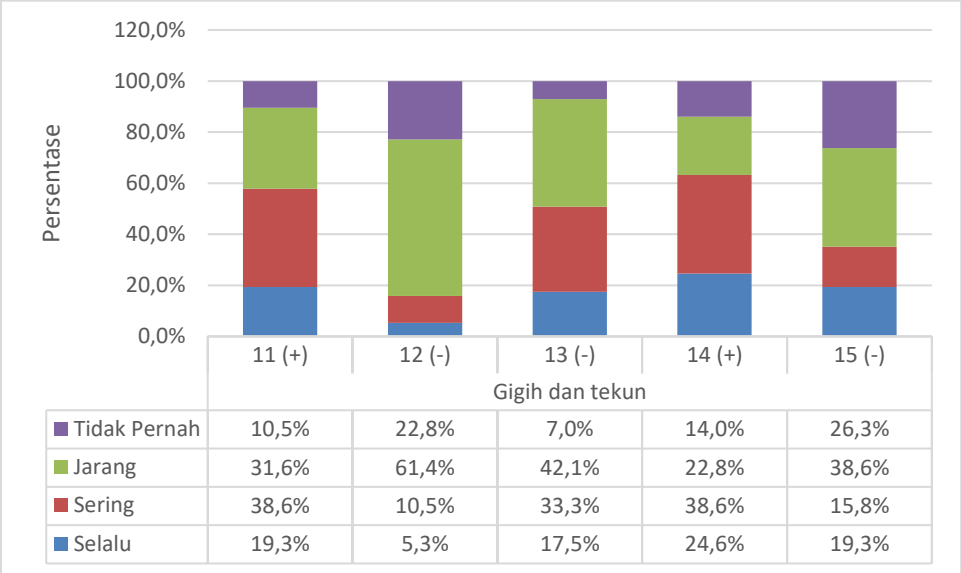
Based on Figure 1, it can be seen that 45.6% of students rarely feel confident in completing complex vector tasks, indicating low self-confidence in facing mathematical challenges. Additionally, 40.4% of students also rarely believe they can draw analogies in a case based on vector concepts. Furthermore, 31.6% of students rarely dare to draw general conclusions from observed patterns, indicating limitations in abstract thinking and conceptual generalization. Meanwhile, 45.6% of students often feel hesitant to double-check the calculation process given, indicating weak reflective abilities in learning mathematics. Even in the context of mathematical communication, 36.8% of students stated that they never dared to represent the group to explain the results of the discussion in front of the class. This is an important finding that highlights barriers to student confidence.



	6 (+)	7 (-)	8 (+)	9 (-)	10 (+)
Tidak Pernah	8,8%	43,9%	12,3%	28,1%	17,5%
Jarang	35,1%	33,3%	31,6%	38,6%	21,1%
Sering	40,4%	21,1%	35,1%	22,8%	19,3%
Selalu	15,8%	1,7%	21,1%	10,5%	42,1%

Figure 2. Results of the Flexible Indicator Questionnaire

The survey results in Figure 2 also show a positive disposition. As many as 40.4% of students often solve vector problems in various ways, demonstrating flexibility in thinking and openness to different solution strategies. Additionally, 43.9% of students never reject different opinions during discussions, reflecting a tolerance and collaboration in group activities. A total of 35.1% of students are also often willing to change their opinions when presented with new information from friends, which indicates an openness to revising their understanding. On the other hand, 38.6% of students rarely avoid trying new methods for fear of failure, indicating a willingness to take risks in the learning process. Interestingly, 42.1% of students are always happy to receive criticism from peers when working on vector problems, showing a positive attitude toward feedback as part of self-improvement. These findings indicate that most students demonstrate flexible and open dispositions in mathematics learning.

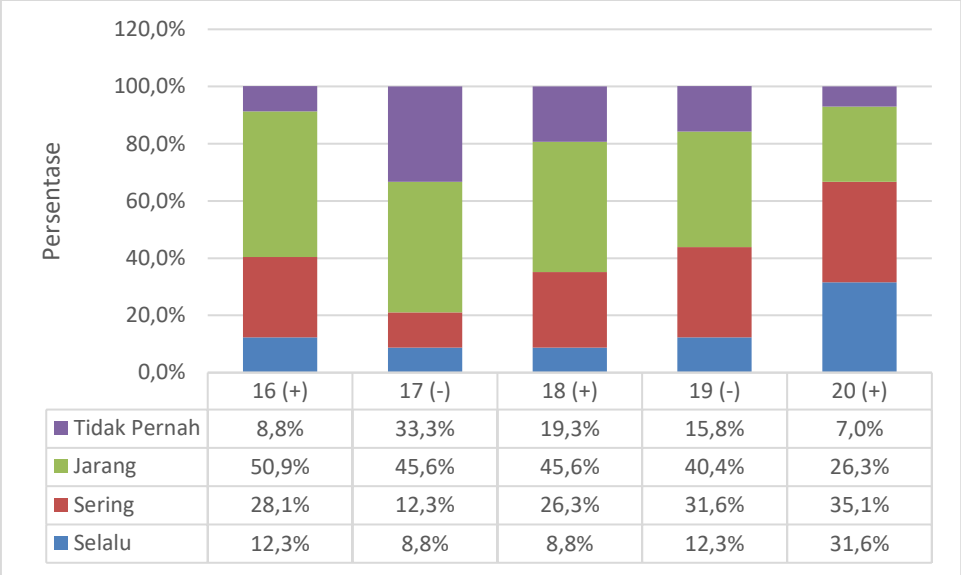


	11 (+)	12 (-)	13 (-)	14 (+)	15 (-)
Tidak Pernah	10,5%	22,8%	7,0%	14,0%	26,3%
Jarang	31,6%	61,4%	42,1%	22,8%	38,6%
Sering	38,6%	10,5%	33,3%	38,6%	15,8%
Selalu	19,3%	5,3%	17,5%	24,6%	19,3%

Figure 3. Results of the Perseverance and Diligence Indicator Questionnaire

Based on the results of the questionnaire in Figure 3, it was found that students showed a persistent and diligent disposition in learning, although to varying degrees. As many as 38.6% of students often persisted in completing complex vector problems until they were finished, even though it took a considerable amount of time, indicating perseverance in facing academic challenges. On the other hand, 61.4% of students rarely stopped practicing when faced with complex vector problems, demonstrating a never-give-up attitude in the learning process. Some students also showed independence in solving problems, as reflected in the 42.1% of students who rarely waited for help from friends when working on complex vector problems. Additionally, 38.6% of students often tried alternative solutions when previous methods failed, reflecting creativity and perseverance in seeking solutions. Meanwhile, 38.6% of students rarely feel bored when double-checking the accuracy of their calculations for complex vector problems, indicating

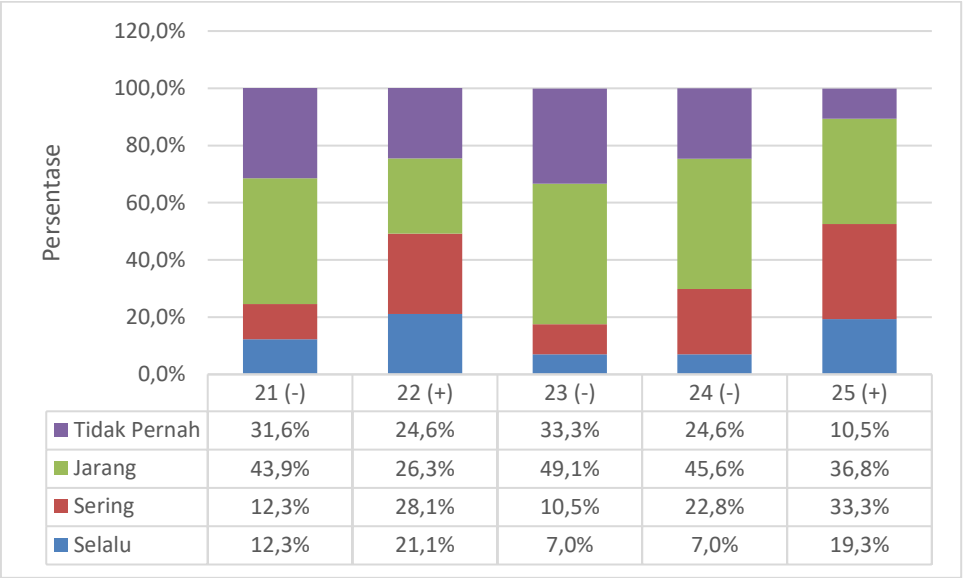
a meticulous and responsible attitude toward their work. Overall, this data suggests a positive trend toward a persistent and diligent approach to mathematics learning.



	16 (+)	17 (-)	18 (+)	19 (-)	20 (+)
Tidak Pernah	8,8%	33,3%	19,3%	15,8%	7,0%
Jarang	50,9%	45,6%	45,6%	40,4%	26,3%
Sering	28,1%	12,3%	26,3%	31,6%	35,1%
Selalu	12,3%	8,8%	8,8%	12,3%	31,6%

Figure 4. Results of the Interest and Curiosity Indicator Questionnaire

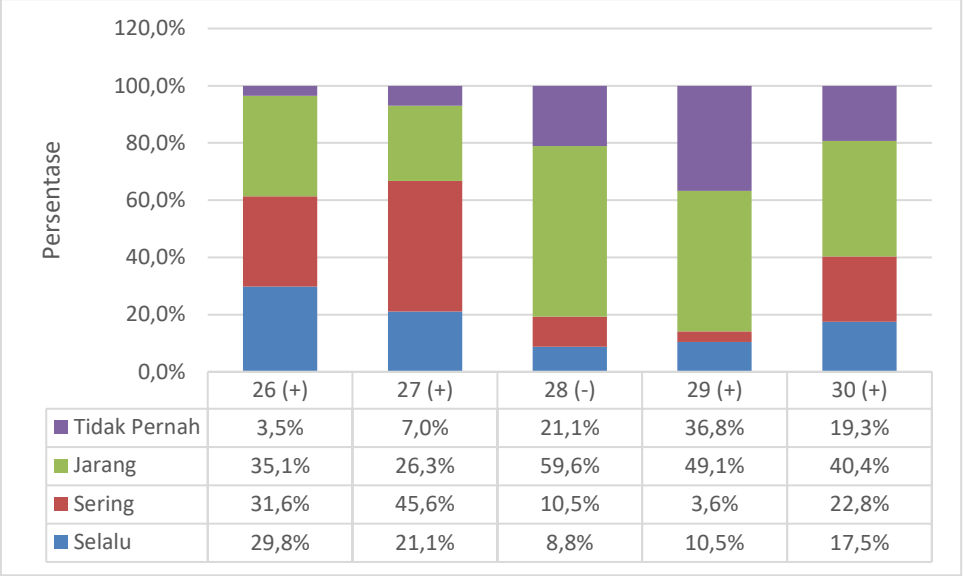
Students' mathematical disposition in terms of interest and curiosity about vector material still needs to be strengthened. Based on Figure 4, 50.9% of students rarely study vector material from various sources, indicating a lack of initiative in expanding their knowledge independently. Additionally, 45.6% of students rarely engage in summarizing essential concepts from various references, suggesting that summarizing activities have not yet become a standard part of their learning strategies. Exploratory attitudes are also still limited, as evidenced by 45.6% of students who rarely feel challenged to try new ways of solving vector problems, despite the additional effort required to learn. However, there is a positive side, as seen in 40.4% of students who rarely allow vector problems to be solved incorrectly due to time constraints, indicating a sense of responsibility for the accuracy of their work. Furthermore, 35.1% of students often show enthusiasm in trying new solution strategies despite the risk of failure, reflecting the potential to foster a spirit of learning and courage in facing challenges. These findings demonstrate that students' dispositions regarding interest and curiosity still require improvement through more active, reflective, and intrinsic motivation-building approaches.



	21 (-)	22 (+)	23 (-)	24 (-)	25 (+)
Tidak Pernah	31,6%	24,6%	33,3%	24,6%	10,5%
Jarang	43,9%	26,3%	49,1%	45,6%	36,8%
Sering	12,3%	28,1%	10,5%	22,8%	33,3%
Selalu	12,3%	21,1%	7,0%	7,0%	19,3%

Figure 5. Results of the Monitoring and Reflection Indicator Questionnaire

The results of the questionnaire, as shown in Figure 5, indicate that students' ability to monitor and reflect on their learning process with vector material is still at a level that needs improvement. As many as 43.9% of students rarely show indifference toward their vector test results, indicating that most students still care about their academic achievements. Additionally, 28.1% of students frequently compare their work with that of more skilled peers, which may reflect efforts to evaluate themselves through constructive comparison. However, this reflective attitude is not yet entirely consistent. This can be seen from the fact that 49.1% of students rarely actively assess their learning success when faced with complex vector problems, and 45.6% of students rarely double-check the correctness of their solutions due to time constraints, indicating that the process of self-evaluation has not yet become a learning habit. Furthermore, 36.8% of students rarely consider various strategies before performing complex vector calculations, indicating a lack of awareness of the thinking process. Overall, these findings indicate that although some students are beginning to demonstrate reflective abilities, strengthening the mathematical disposition to independently monitor and evaluate the learning process and outcomes is greatly needed in mathematics education.



	26 (+)	27 (+)	28 (-)	29 (+)	30 (+)
Tidak Pernah	3,5%	7,0%	21,1%	36,8%	19,3%
Jarang	35,1%	26,3%	59,6%	49,1%	40,4%
Sering	31,6%	45,6%	10,5%	3,6%	22,8%
Selalu	29,8%	21,1%	8,8%	10,5%	17,5%

Figure 6. Results of the Questionnaire on Enthusiasm and Seriousness in Learning

Students' attitudes toward seriousness and enthusiasm for learning vector material show diverse dynamics. Based on Figure 6, 35.1% of students rarely feel enthusiastic about solving complex vector problems despite the need for hard work, indicating that their resilience in facing challenges still needs to be developed. On the other hand, there are positive indications, as 45.6% of students often feel happy trying new ways to solve vector problems, despite the need for more time, which reflects a connection to the exploratory process. However, 59.6% of students rarely avoid practice problems that require reasoning or justification, and 49.1% of students rarely deliberately choose complex problems as reinforcement for learning, indicating that motivation to face challenges has not yet fully developed. Additionally, 40.4% of students rarely make it a habit to list the concepts used in solving problems, indicating that the connection between concepts and procedures has not yet become a primary focus in their learning process. Overall, although some students demonstrate a positive attitude toward challenges and varied strategies, the disposition to learn diligently and purposefully still needs to be strengthened through an educational approach that requires courage, conceptual reflection, and intrinsic motivation.

From the results of the student questionnaire, the researcher then interpreted the attitude scale. Each student's response to the questionnaire items was scored based on a four-point Likert scale, where 4 indicated 'always', 3 indicated 'often', 2 indicated 'rarely', and 1 indicated 'never' for positive statements, and vice versa for negative statements. The scores obtained by each student were summed up and then interpreted into categories of mathematical disposition quality. To interpret the scores, the classification guidelines from Sundayana (2020) were used, which divided the score range into five categories: excellent, good, adequate, poor, and very poor. The details of the score ranges and interpretations are presented in Table 2.

Table 2. Classification of Student Attitude Interpretation in General

Score Range	Clasification
1.710 ≤ skor < 2.736	Very poor
2.736 ≤ skor < 3.762	Poor
3.762 ⩽ skor < 4.788	Fair
4.788 ⩽ skor < 5.814	Good
5.814 ⩽ skor ⩽ 6.840	Very good

Based on the results of the questionnaire data analysis, students' mathematical dispositions are generally in the adequate category, with a total score of 4,525 out of an ideal score of 6,840. This indicates that, although students have demonstrated some positive aspects in their mathematical dispositions, there is still significant room for improvement.

Interpretations were also conducted for each indicator of students' mathematical disposition. Similarly, the details of the score ranges and interpretations are presented in Table 3.

Table 3. Classification of Student Attitude Interpretation on Each Indicator

Score Range	Clasification
285 ⩽ skor < 456	Very poor
456 ⩽ skor < 627	Poor
627 ⩽ skor < 798	Fair
798 ⩽ skor < 969	Good
969 ⩽ skor ⩽ 1.140	Very good

On the confidence indicator, students scored 661 out of a possible score of 1,140, which is also classified as adequate, indicating that many students still lack complete confidence in their ability to solve math problems. In contrast, the flexibility indicator scored 807 out of 1,140. It was categorized as good, indicating that most students are open to various problem-solving strategies and capable of adapting their mathematical thinking. Meanwhile, the perseverance and diligence indicator scored 772 out of 1,140 and remains in the adequate category, indicating that students' perseverance and resilience in facing difficulties still need improvement. The interest and curiosity indicator scored 754 out of 1,140, monitoring and reflection scored 797 out of 1,140, and enthusiasm and seriousness in learning scored 734 out of 1,140, all of which indicate a sufficient trend. These findings emphasize the importance of more meaningful and motivating learning interventions, enabling students' mathematical dispositions to develop optimally across all indicators.

Next, we moved on to the interview stage. Interviews were conducted with six students representing each category of high, medium, and low disposition. The interviews focused on indicators that received a sufficient score (within the range of 627 ⩽ score < 798) from the questionnaire results, namely self-confidence, perseverance and diligence, interest and curiosity,

monitoring and reflection, and enthusiasm and seriousness in learning. The main findings from the interviews are as follows.

Grade 12 students with a high mathematical aptitude admitted to feeling anxious and challenged when working on difficult vector problems, but they still tried to remain calm and do their best. Their level of confidence was greatly influenced by their mastery of the concepts, where a good understanding would increase their confidence and vice versa. Grade 12 students recognize the importance of perseverance and demonstrate a determination to study harder after experiencing unsatisfactory test results. Their perseverance and diligence are reflected in their continued efforts to solve vector problems, despite encountering difficulties and fatigue. However, time constraints and other tasks sometimes cause them to postpone further practice outside of class. Nevertheless, the spirit to try other approaches still emerges as a form of perseverance. In terms of interest and curiosity, S-12 students admit that they have not explored much material outside of class; however, they become quite enthusiastic when they encounter challenging problems and recognize the importance of understanding concepts rather than just obtaining answers. Indicators of monitoring and reflection appear to be well-developed; S-12 students are accustomed to reviewing their answers, comparing them with those of their peers, and evaluating their understanding through graded exercises. S-12 students are already aware of the importance of identifying mistakes for self-improvement and have their strategies for selecting problem-solving methods. Finally, indicators of enthusiasm and seriousness in learning are reflected in the attitudes of S-12 students who are enthusiastic about challenging questions, dare to try new strategies even if there is a risk of failure, and are open to criticism from friends. S-12 students also strive to maintain the accuracy of their answers even under time constraints. Overall, the interviews indicate that S-12 students possess positive dispositional potential but still require reinforcement and practice in terms of strategy exploration, self-reflection, and the courage to think creatively.

S-4 students with high mathematical aptitude often admit to feeling anxious when faced with complex problems, yet they still have the desire to try to solve them. Their level of confidence depends heavily on their mastery of concepts and previous experience. If the problems given are similar to exercises they have done before, S-4 students feel more confident, and vice versa. However, S-4 students still try even if they have failed before, because they want to know where they went wrong. When their test results are less satisfactory than those of their peers, S-4 students tend to be reflective by trying to improve themselves and asking their friends for help. In terms of persistence and diligence, S-4 students admit that they tend to give up easily and prefer to ask questions when they encounter difficulties; however, they still make an effort to complete the questions due to their curiosity. Although they rarely practice at home due to fatigue, S-4 students are willing to try again with a different approach or discuss with friends.

Regarding the indicators of interest and curiosity, S-4 students demonstrate intrinsic motivation in understanding the material, marked by their initiative to search for educational videos and take notes before the material is explained in class. S-4 students also emphasize the importance of solving complex problems as a means to deepen their understanding. In terms of interest and curiosity, S-4 students showed intrinsic motivation in understanding the material, as evidenced by their initiative to search for educational videos and take notes before the material was explained in class. S-4 students also emphasized the importance of completing difficult questions, as it can foster a deeper understanding. In terms of monitoring and reflection, S-4 students mentioned the habit of double-checking answers as a form of caution, as well as comparing their work with peers to identify mistakes or find alternative strategies. S-4 students believe that recognizing their own mistakes is important to prevent repeating the same errors. However, when choosing problem-solving strategies, S-4 students still tend to use methods they already understand without giving them much initial consideration. Finally, regarding the indicator of enthusiasm and seriousness in learning, S-4 students expressed that they felt challenged when given difficult questions, although sometimes feelings of fear or reluctance to try arose. S-4 students demonstrate a willingness to attempt more difficult problems to develop their skills and tend to accept criticism from peers as constructive feedback. Despite time constraints, S-4 students strive to ensure the accuracy of their answers. Overall, this interview suggests that S-4 students possess positive dispositional potential, although they still need to develop independence, consistency, and courage in exploring mathematical thinking strategies.

Undergraduate students with moderate dispositions exhibit fluctuating levels of self-confidence. When faced with difficult questions, feelings of anxiety and doubt often arise, but they remain motivated to try because of their curiosity. The self-confidence of undergraduate students increases when the questions they face are similar to the examples provided, and even though they often feel unsure when working on difficult questions, they continue to try. Even after experiencing failure, undergraduate students do not immediately give up and tend to try again, for example by seeking out similar questions. When their test scores are lower than those of their peers, the attitude they exhibit is one of acceptance and awareness of their abilities, which indeed still need refinement. The perseverance and diligence of undergraduate students are evident in their responses to difficulties. When encountering complex problems, undergraduate students will ask their peers for help or try to study harder, though this motivation sometimes only arises before midterm or final exams. Undergraduate students often feel bored and tired, yet they still complete the questions they are working on by seeking help from their classmates. If they cannot solve a question in one attempt, undergraduate students will try it first before asking for help. However, the habit of continuing practice at home remains low and is more dependent on the period leading up to midterm and final exams. Their interest and curiosity are

pretty evident, though still limited. Undergraduate students often seek explanations from learning videos, especially those shared by teachers. Curiosity arises when undergraduate students do not understand the material, although if it feels too difficult, they tend to feel confused and want to give up. Undergraduate students are accustomed to taking notes on the teacher's explanations as a form of personal summary. When the teacher presents a different question, they will undoubtedly be surprised, but they will try to solve it first. In terms of monitoring and reflection, undergraduate students typically check their answers by comparing their results with those of their peers. Although they do not evaluate fully, undergraduate students know that they should reread the material. Unfortunately, at home, undergraduate students often forget to reread the material because they lack guidance. When faced with challenging questions, undergraduate students attempt to solve them first, but if they feel the questions are too tricky, they tend to remain silent or stop. S-1 students also rarely explore new methods for solving problems. Under time constraints, S-1 students tackle problems they can solve first, and if they cannot, they answer logically or by guessing. S-1 students recommend a more relaxed and interactive environment, such as group learning, using digital devices, or incorporating game elements as strategies to help them focus and feel more comfortable learning mathematics.

Student S-34, who has an average disposition, admits to being curious and immediately tries to solve problems even if he is not sure he can do so. His confidence often emerges, even though he ultimately needs help. Problems that differ from the examples make him less confident, but he still tries to accept failure openly. When his test results are lower than those of his other friends, he does not feel inferior; instead, he is determined to improve in the next exam. Student S-34 also enjoys asking questions to peers, teachers, and even utilises AI assistance when facing difficulties. He doesn’ t give up immediately, though he sometimes needs a break before trying again. The daytime learning environment makes him easily tired, but it doesn’ t diminish his determination to keep trying. At home, he rarely continues his practice because he is more focused on his hobbies, but he occasionally still accesses math content on social media. When a problem cannot be solved immediately, he keeps trying until he understands it. Their interest in learning is reflected in their habit of taking notes, marked with a highlighter, for essential sections. Indeed, this S-34 student is not particularly curious about vector concepts, but they still seek materials from various sources such as AI, peers, and even the TikTok platform. When faced with problems that differ from the usual, they often feel confused and hesitant to ask questions, especially if their peers seem to understand. S-34 students are also accustomed to rereading their answers to ensure there are no spelling mistakes. Understanding is usually evaluated based on test results, and students sometimes compare their results with those of their friends for motivation, even though they accept whatever score they receive. S-34 students

realise the importance of knowing their own mistakes so they can improve in the future. Problem-solving strategies are adapted to examples of problems previously studied, or they ask the teacher if they encounter a new type of problem. Additionally, Student S-34 demonstrates a strong desire to learn when given challenging issues. They are willing to try new methods even if they may fail, though they have never specifically chosen complex problems for practice. When receiving criticism and suggestions from peers, they accept them well and use them as material for improvement. Even in time-constrained situations, they tackle questions they are confident about first, while attempting difficult questions to the best of their ability.

Grade 6 students with moderate dispositions tend to exhibit low levels of self-confidence when solving math problems. When faced with complex problems, grade 6 students feel nervous because they are afraid they will not be able to answer them. They rarely feel confident in solving problems without help and are only assured when the issues are relatively straightforward. When they fail, grade 6 students tend to ask others for help rather than trying again. When their test scores are lower than those of their peers, they feel disappointed, though they do not show excessive reactions. When facing difficulties, S-6 students ask for help from friends and attempt to solve the problem up to three times before giving up. Despite often feeling bored and tired, especially when they have to study while others have already gone home, they still try again. However, they admit they do not continue practising at home because they are too lazy to open their books after school. Student S-6's interest in vector material is still relatively low. He does not seek additional references from the internet because he finds it difficult to understand, and he rarely feels curious about the concepts taught. He does not take notes or make summaries because he feels the material from the teacher is sufficient. When the teacher presents problems differently, he feels frustrated because it is difficult to adapt. Nevertheless, he realises the importance of attempting complex issues to avoid confusion when facing similar problems in the future. This sixth grader rarely checks his answers. He usually evaluates his understanding by attempting difficult questions, although he never compares his work with that of his classmates. He realises the importance of identifying his mistakes so that he does not repeat them in the future. However, he is not yet able to devise specific strategies for answering questions because he is still confused about where to start. The S-6 student's motivation to learn depends on their mood. They are willing to attempt challenging questions when in a good mood. However, they are not interested in trying new methods and prefer easier questions over practising with difficult ones. When receiving criticism from peers, they choose to listen and view it as constructive feedback. In time-constrained situations, the S-6 student does not strive to ensure that answers are correct or incorrect; they do their best.

S-30 students with low disposition admit to feeling confused when faced with complex vector problems and often ask their friends for help in solving them. Confidence only arises when

the issues are still relatively easy. When problems are considered too complex, S-30 students tend to feel uncertain and reluctant to attempt them on their own. Even so, S-30 students still try to imagine and understand the problems first before finally asking questions. When their test results are lower than those of their peers, S-30 students often remain indifferent, believing this is simply a reflection of their ability level. When faced with difficulties, S-30 students prefer to ask their peers or teachers for help. They are willing to discuss the problem as long as their peers are eager to talk, but if there are no peers who can help, they will choose to remain silent because they feel embarrassed. Feelings of boredom and the desire to give up often arise, but this does not always cause them to stop trying. Student S-30 admits that they do not continue practising at home because they feel that self-study is more difficult. This student also rarely feels curious about math material and only takes notes when instructed by the teacher. Their efforts to find additional material online are minimal because they believe the material on YouTube is too difficult to understand. When the teacher presents problems differently, he feels surprised and confused, then tries to find similar issues. He has not yet recognised the importance of attempting complex problems because he often feels unable to solve them. S-30 students are also not accustomed to reviewing their answers before submitting them, as they prioritise completing the assignment. They have never evaluated their understanding of vector material, nor have they compared their work with that of their peers. In their view, identifying their own mistakes is not considered necessary, and their strategy for solving problems is usually to look for similar issues without further planning. When given challenging problems, Student S-30 often feels confused and lacks enthusiasm. They are willing to try new things, but if they fail, they choose to remain silent. The student has never intentionally chosen complex problems to practice. They accept criticism from peers and use it as material for improvement. Under time constraints, they solve problems as best as they can, without overly focusing on the accuracy of their answers.

b. Discussion

In general, students' mathematical dispositions are in the adequate category, with a total score of 4.525 out of an ideal score of 6.840. This suggests that, although some students have demonstrated a positive attitude toward learning mathematics, reinforcement in various aspects is still necessary. These results align with the findings of Hasanah & Maryati (2020), who stated that vocational high school students tend not to have developed optimal learning dispositions, particularly in the context of abstract material such as vectors.

The confidence indicator fell into the adequate category, with a score of 661 out of a possible ideal score of 1,140. As many as 45.6% of students admitted that they rarely felt confident in solving complex vector problems. Observations reinforced this data, showing that

many students tended to wait for help from teachers or friends when they encountered difficulties. Interviews revealed that students' confidence was greatly influenced by their mastery of concepts and previous learning experiences. This phenomenon aligns with the view of Siregar & Asmin (2021), who state that confidence in mathematics does not develop instantly but is influenced by successful experiences in solving problems. Therefore, teachers need to provide students with opportunities to experience gradual success through scaffolding approaches and positive feedback.

Student flexibility is quite good, with a score of 807 out of an ideal score of 1,140. Questionnaire data shows that 40.4% of students often use varied strategies in solving problems, and 43.9% of students do not reject differences of opinion in discussions. Interviews support these findings: students are open to new ideas, although some remain fixated on one method if it has not yet been successful. The high flexibility score compared to other indicators may be due to several possibilities. First, flexibility is more likely to emerge in an open group learning context, where students feel free to express themselves without pressure from final results (Ariyanti & Kartono, 2021). Second, the types of statements in the flexibility indicator are closely related to collaborative attitudes and openness to peers' ideas, which are more readily acknowledged in a questionnaire. According to Setyaningrum & Nugroho (2023), flexibility in mathematical thinking can be developed through open-ended problem approaches and collaborative learning that encourages the exploration of various strategies. Further reinforcement can be achieved through the integration of interactive media, which allows students to explore multiple visual models and enhance their understanding of vector concepts.

The aspects of persistence and diligence fall into the adequate category, with a score of 772 out of a possible score of 1,140. Most students (61.4%) stated that they rarely give up when faced with difficult questions. Interviews revealed that students with high dispositions continue to try even when the results are not as expected. However, students with moderate and low dispositions tend to give up quickly or postpone practice outside of class due to fatigue or loss of motivation. These findings support Rahmawati & Arifin's (2021) assertion that persistence in learning is closely linked to intrinsic motivation and self-regulation strategies. Perseverance can be cultivated by creating a learning environment that fosters exploration without fear of making mistakes and emphasises the importance of the process, rather than just the result.

Interest and curiosity indicators are also considered adequate, with a score of 754 out of 1,140. 50.9% of students reported rarely studying material from other sources, and 45.6% are not accustomed to summarising key concepts independently. However, some students find challenges in problems intriguing and attempt to seek references online, even using platforms like YouTube and TikTok. Fadilah & Mardiyana (2020) state that curiosity and interest in learning develop when material is linked to real-life contexts or media that are close to students. Project-

based learning and the use of interactive digital media such as Canva, GeoGebra, or animation-based simulations have been proven to increase students' interest in material that is considered abstract.

The indicator for monitoring and reflection scored 797 out of 1,140, which is still in the adequate category. Nearly half of the students rarely check their work, and 49.1% seldom evaluate their learning success. Student reflection is generally passive, such as merely comparing grades or final results with peers. According to Prasetyo & Yulianti (2023), reflection is a crucial metacognitive skill in mathematics learning. To develop this ability, teachers can provide self-check questions, weekly reflection sheets, or discussion forums that encourage students to evaluate their strategies, mistakes, and thinking processes.

The score for the indicator of seriousness and enthusiasm for learning was 734 out of 1,140 (sufficient category). Some students appeared enthusiastic when faced with difficult questions, but only a few consciously chose challenging questions as a means of developing their abilities. As many as 49.1% of students admitted that they rarely chose difficult questions intentionally, and 40.4% were not accustomed to listing the concepts used in their solutions. Wahyuni & Anggraini (2021) emphasise that optimal learning enthusiasm will emerge if students have a strong mathematical identity, that is, the awareness that mathematical thinking is not only about correct answers but also about the process and justification of concepts. Teachers need to encourage students to write down their solution strategies, mention the formulas used, and discuss the logical reasons behind their answers.

Interviews with six students reinforced the quantitative results and provided an overview of the spectrum of mathematical dispositions from high to low. Students with high dispositions generally had a positive influence from their mastery of concepts, previous learning experiences, and good self-regulation strategies. They are able to evaluate themselves, are open to criticism, and have internal motivation. Conversely, students with moderate and low dispositions are still highly dependent on teacher or peer assistance, rarely reflect on their learning processes, and easily give up when faced with difficulties. Factors such as mood, learning environment, and a lack of exploratory habits contribute to the low dispositions in this group. These findings align with Cai et al. 's (2021) disposition model, which states that disposition is the result of the interaction between attitudes, values, thinking habits, and learning experiences. Learning interventions cannot be singular but must consider students' profiles holistically.

When linked to the curriculum being implemented, the respondents, who are currently vocational high school students, are using the Merdeka Curriculum, which emphasizes student-centered learning and the strengthening of the Pancasila learner profile. However, there is still a mismatch between the curriculum, which emphasizes exploration, reflection, and problem-solving, and the implementation of learning, which tends to be procedural and exam-oriented.

This has an impact on students who are not accustomed to taking the initiative to learn independently or evaluating their thinking processes. This aligns with Surya and Ningsih's (2022) assertion that the implementation of the Merdeka Curriculum in vocational schools still faces obstacles in terms of strengthening the learning character and habit of reflection in mathematics.

Globally, several studies have also confirmed the challenges in developing mathematical dispositions among vocational high school students. For example, a survey by Hannula et al. (2019) in Finland found that although students had adequate mathematical abilities, dispositions such as self-confidence and persistence in learning declined when they entered vocational education. Meanwhile, a study by Arslan & Yavuz (2020) in Turkey found that vocational students tend to lack confidence and are less accustomed to solving open-ended problems that require flexibility and reflection. In Southeast Asia, research by Tan & Kaur (2021) in Singapore noted that learning based on productive struggle and mathematical discourse is efficacious in improving students' reflective and flexible dispositions, but requires teacher training and profound changes in learning culture. Thus, local research findings align with global trends, indicating that strengthening mathematical dispositions cannot be achieved solely through problem-solving exercises but requires reflective, contextual, and curriculum-aligned learning strategies.

4. CONCLUSION

The most notable finding in this study is that flexibility indicators are the strongest mathematical dispositions demonstrated by vocational high school students in vector material. Students appear to be quite open to alternative strategies and their peers' ideas in problem solving, indicating the potential for developing varied thinking skills. Conversely, other indicators such as self-confidence, interest and curiosity, reflective ability, and seriousness in learning are still in the adequate category and tend to require special attention. These findings reflect that mathematics learning in vocational high schools has not yet fully formed a mature mathematical disposition holistically. Interview data indicate that students with high dispositions tend to have positive learning experiences, exhibit good self-regulation, and possess strong intrinsic motivation. Meanwhile, students with moderate and low dispositions show dependence on external assistance, irregular self-directed learning, and limitations in concept exploration.

Considering these results, this conclusion leads to more operational recommendations. Teachers need to actively create a learning environment that supports the development of mathematical dispositions, particularly in fostering students' self-confidence and reflective abilities. One strategy that can be tested is the implementation of open-ended, problem-based learning, utilising interactive visual media such as GeoGebra or Canva to stimulate curiosity, and providing structured exploration and reflection spaces. Schools also need to encourage

mentoring programs such as peer tutoring, weekly reflection, or additional learning to support students with low dispositions.

As a direction for further research, it can be hypothesised that the integration of interactive media-based learning and reflective activities has the potential to consistently improve self-confidence, learning interest, and the ability to monitor thinking processes in vocational high school students, especially in abstract subjects such as vectors. Therefore, experimental studies and classroom action research are highly recommended to test the effectiveness of this strategy in a real learning context. On the other hand, balancing the development of cognitive and affective competencies should be a primary focus in implementing the Merdeka Curriculum. Mathematics education should not solely focus on academic achievement, but also aim to cultivate strong thinking dispositions, such as self-confidence, perseverance, openness to new ideas, and reflective skills, as integral components of students' character, aligned with the Pancasila Student Profile.

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