

The Effectiveness of the CORE Learning Model with a Differentiated Learning Approach on Students' Critical Thinking Skills Viewed from Learning Styles

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Received April 3, 2026; Revised June 24, 2026; Accepted June 24, 2026

Available Online June 30, 2026

Abstract:

21st century education demands high level reasoning, yet students' mathematical critical thinking skills, particularly in vocational contexts, remain suboptimal. While various models have been implemented, there is a lack of empirical evidence regarding the integration of CORE (Connecting, Organizing, Reflecting, Extending) with differentiated instruction to address diverse learning modalities. This study analyzed the effectiveness of a differentiation based CORE model on students' mathematical critical thinking skills across different learning styles (visual, auditory, and kinesthetic). Using a quasi experimental approach with a 2×3 factorial design, the research involved 64 tenth grade students at Vocational High School SMK Negeri 1 Sigi selected through purposive sampling. Data were collected via learning style questionnaires and mathematical critical thinking post tests, then analyzed using Two Way ANOVA and Welch's Test. The results indicated that: (1) there is a statistically significant difference in critical thinking skills between students taught using the CORE model with differentiated approach and those taught using conventional methods ($p < 0.001$), with the experimental group achieving higher scores; (2) no statistically significant difference in critical thinking skills among visual, auditory, and kinesthetic learning style groups ($p = 0.142$); and (3) The interaction effect between the learning model and learning styles was not statistically significant ($p = 0.396$). These findings contribute to the literature by demonstrating that the CORE model, when integrated with differentiation, provides a consistent instructional framework for vocational students regardless of their individual learning modalities. This approach is recommended for inclusive mathematics classrooms to better accommodate student diversity.

Abstrak:

Pendidikan abad ke-21 menuntut penalaran tingkat tinggi, namun keterampilan berpikir kritis matematis siswa, terutama dalam konteks kejuruan, tetap tidak optimal. Meskipun berbagai model telah diterapkan, ada kurangnya bukti empiris mengenai integrasi CORE (Connecting, Organizing, Reflecting, Extending) dengan instruksi yang berbeda untuk mengatasi beragam modalitas pembelajaran. Studi ini menganalisis efektivitas model CORE berbasis diferensiasi pada keterampilan berpikir kritis matematis siswa di berbagai gaya belajar (visual, auditory, dan kinesthetic). Dengan menggunakan pendekatan kuasi eksperimental dengan desain faktorial 2×3 , penelitian

ini melibatkan 64 siswa kelas sepuluh SMK Negeri 1 Sigi yang dipilih melalui purposive sampling. Data dikumpulkan melalui kuesioner gaya belajar dan post-test berpikir kritis matematika, kemudian dianalisis menggunakan Two Way ANOVA dan Welch's Test. Hasil penelitian menunjukkan bahwa: (1) ada perbedaan yang signifikan secara statistik dalam keterampilan berpikir kritis antara siswa yang diajar menggunakan model CORE dengan pendekatan yang diferensiasi dan yang diajarkan menggunakan metode konvensional ($p < 0.001$), dengan kelompok eksperimen mencapai skor yang lebih tinggi; (2) tidak ada perbedaan yang signifikan secara statistik dalam keterampilan berpikir kritis di antara kelompok gaya belajar visual, pendengaran, dan kinestetik ($p = 0.142$); dan (3) Efek interaksi antara model pembelajaran dan gaya belajar tidak signifikan secara statistik ($p = 0.396$). Temuan ini berkontribusi pada literatur dengan menunjukkan bahwa model CORE, ketika diintegrasikan dengan diferensiasi, memberikan kerangka kerja instruksional yang konsisten untuk siswa kejuruan terlepas dari modalitas pembelajaran individu mereka. Pendekatan ini direkomendasikan untuk ruang kelas matematika inklusif untuk mengakomodasi keragaman siswa dengan lebih baik.

Keywords:

Critical Thinking, CORE, Differentiated, Learning Style, Vocational High School

How to Cite: Wiliam, Nurhayadi, & Ismaimuza, D. (2026). The Effectiveness of the CORE Learning Model with a Differentiated Learning Approach on Students' Critical Thinking Skills Viewed from Learning Styles. *MaPan: Jurnal Matematika dan Pembelajaran*, 14(1), 156-175. <https://doi.org/10.24252/mapan.2026v14n1a9>.

INTRODUCTION

Education is the primary pillar of human resource development, serving as the foundation for national progress in the 21st-century era. In this era, educational institutions are required to focus on developing critical, creative, communicative, and collaborative thinking skills (Monika, Julia, & Nugraha, 2022). The Indonesian government has responded to these challenges through the Minimum Competency Assessment (AKM) since 2021 to improve students' literacy and numeracy skills, which are still categorized as low (Megawati & Sutarto, 2021). However, reality in the field reveals significant challenges; educational report card data for Central Sulawesi Province and Sigi Regency remain in the moderate category (40–70%), and in 2023, SMK Negeri 1 Sigi recorded a student numeracy achievement of only 49.97% (Kemendikbudristek, 2024). This low numeracy is rooted in students' weak critical thinking abilities in understanding complex mathematical concepts.

Several studies have been conducted to address these problems by examining the effectiveness of learning models. The state of the art in this field indicates that the Connecting, Organizing, Reflecting, and Extending (CORE) learning model has a significant ability to improve critical thinking skills because the stages in this learning model require students to connect old information with new information and reflect on their understanding (Ulfa, Rahmi, & Revita, 2019). According to studies, by showed that the CORE improved the students' critical thinking abilities better than the traditional models. Conversely, current trends of Kurikulum Merdeka (Independent Curriculum) highlight differentiated learning as a holistic approach to addressing individual student needs (Samsudi, Suprptono, Utanto, Rohman, & Djafar, 2024; Halim, Iskandar, Ansari, & Halim, 2024). The use of learning styles (visual, auditory, and kinesthetic) in the learning process has also been found to influence the internal motivation and students' response to the teaching strategies (Ditasari, Ulya, & Wanabuliandari, 2022; Sudane, 2023).

Although the CORE model and differentiated learning have been widely studied separately, the researcher identified a significant research gap. To the best of the researcher's knowledge, no study has specifically integrated the CORE learning model with a differentiated learning approach to evaluate critical thinking skills in terms of student learning styles. The scientific novelty of this research lies in combining the cognitive structure of the CORE model with the flexibility of a differentiated approach to accommodate diverse learning styles within a single framework of mathematics learning intervention.

Based on this description, the problem in this research is the low level of students' critical thinking and numeracy skills, which is presumed to be addressable through the synchronization of the CORE model and differentiation. The hypothesis proposed is that the application of the CORE model with a differentiated approach is more effective in improving students' critical thinking skills than conventional methods, with effectiveness varying depending on the student's learning style. Therefore, the objective of this research is to analyze the effectiveness of the CORE learning model with a differentiated learning approach on critical thinking skills reviewed from the learning styles of students at SMK Negeri 1 Sigi.

METHOD

This study is a quantitative research project employing a quasi-experimental approach with a 2×3 factorial design. This design was selected

to understand the effectiveness of the learning model on mathematical critical thinking skills viewed from student learning styles (Visual, Auditory, and Kinesthetic). The experimental group received the treatment of the Connecting, Organizing, Reflecting, and Extending (CORE) learning model with a differentiated approach, while the control group utilized a scientific approach.

Table 1. Research Factorial Design

No	Learning Style	Experimental Class (CORE + Differentiation)	Control Class (Scientific)
1	Visual (A_1)	9	9
2	Auditory (A_2)	15	16
3	Kinesthetic (A_3)	8	7
Total samples		32	32

A_1B_1 : 9 Students with a visual learning style in the experimental class.

A_2B_1 : 15 Students with an auditory learning style in the experimental group.

A_3B_1 : 8 Students with a kinesthetic learning style in the experimental class.

A_1B_2 : 9 Students with a visual learning style in the control class.

A_2B_2 : 16 Students with an auditory learning style in the control class.

A_3B_2 : 7 Students with a kinesthetic learning style in the control class.

The population in this study includes all tenth grade students at Vocational High School SMK Negeri 1 Sigi, consisting of 10 classes. Sampling was conducted using a technique that considers students' cognitive characteristics and diverse learning styles based on interviews with teachers. The established samples are 32 students in the experimental group and another 32 students in the control group. The research was conducted at Vocational High School SMK Negeri 1 Sigi during the even semester of the 2025/2026 Academic Year.

The researcher utilized two main types of instruments validated by expert lecturers: the Learning Style Questionnaire, adapted from Sugianto, (2021) instrument to map students into visual, auditory, or kinesthetic categories, because it passed the validation test. Critical thinking ability test: consisting of essay questions on trigonometry material, measuring indicators of understanding, strategy/procedure, and answer accuracy. The instruments were tested for validity using the pearson product moment correlation and for reliability using the Cronbach's alpha formula. The researcher also conducted an analysis of item discrimination and difficulty levels to ensure the quality of the instrument items before they were used in the posttest. In order to protect the experiment's internal validity from testing effects and instrumentation

sensitization, this study purposefully used a post-test only design. Both the experimental and control classes utilized the identical post-test instrument, aiming to maintain a comparable level of difficulty between the two groups. (Fraenkel, Wallen, & Hyun, 2012) state that giving a pre test on subjects like mathematics that require higher-order thinking runs the danger of creating a testing interaction effect in which students become accustomed to or remember particular approaches to problem-solving.

Data analysis was carried out in two stages: (1) Descriptive Statistics: Used to describe the central tendency and dispersion of data (mean, median, standard deviation, and variance) from the posttest results. (2) Inferential Statistics: The researcher performed prerequisite tests, including the Kolmogorov-Smirnov normality test and Levene's homogeneity of variance test. Subsequently, the hypothesis was tested using a Two-Way ANOVA to analyze the main effects of the learning model, the effects of learning styles, and the interaction between the two on students' critical thinking skills. All statistical calculations were assisted by IBM SPSS 26 software. The decision-making criterion in the hypothesis test is to reject H_0 if the significance value (p-value) is < 0.05 , indicating a significant influence of the variables studied.

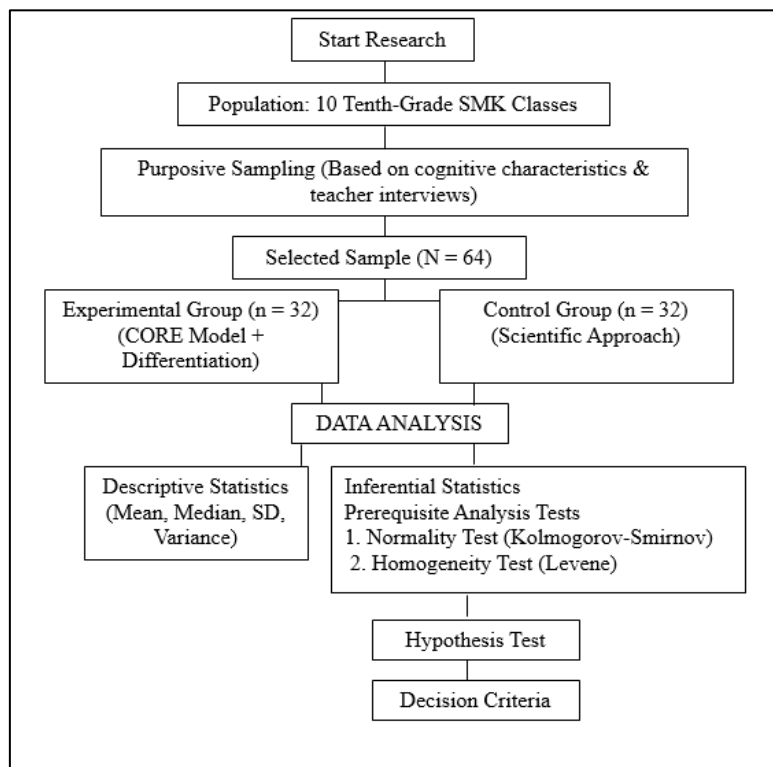


Figure 1. Flowchart of The Data Analysis

RESULTS AND DISCUSSION

This research was undertaken at SMK Negeri 1 Sigi, a school of vocational education that has a strategic function as a Vocational Center of Excellence (SMK Pusat Keunggulan) in Sigi Regency, Central Sulawesi Province. The school's specialization in agricultural agribusiness and animal husbandry offers a unique backdrop for research in mathematics instruction. SMK Negeri 1 Sigi, being the only Center of Excellence in the region, has implemented the Kurikulum Merdeka (Independent Curriculum) where academic competency must be integrated with industrial needs; However, there are still cases of using teaching approaches that do not entirely meet the standards of the curriculum. A unique characteristic that was both a problem and an opportunity in this study was the deployment of a semi-block learning system. The mathematics curriculum in this approach is taught in one intensive block. Thus, a solution was devised applying the CORE (Connecting, Organizing, Reflecting, and Extending) paradigm with a process differentiation strategy to sustain student cognitive engagement during these prolonged periods.

The respondents involved 64 students divided equally into two groups: the experimental group and the control group. The selection of these two classes was based on in-depth discussions with four senior mathematics teachers who had mapped student learning style profiles since enrollment via diagnostic tests. The decision to use classes with an even distribution of learning styles (visual, auditory, and kinesthetic) aimed to allow the researcher to observe the effectiveness of the differentiation approach across the entire spectrum of student learning modalities. This is crucial because, under the Kurikulum Merdeka, educational success is no longer measured solely by class averages but by the extent to which each individual receives educational treatment tailored to their cognitive needs.

Before primary data collection, a series of rigorous instrument quality tests was conducted to ensure the validity of the results. Validity tests on the learning style questionnaire administered to 32 students showed that the 14 formulated items had a significance value of 0.000, meaning the instrument was valid for mapping student learning preferences.

Table 2. Item Total Statistics

No	Questionnaire Items	r-Calculated	p-value (Sig.)	Decision
1	P1-P4	0.58	0	Valid
2	P5-P8	0.36	0	Valid
3	P9-P10	0.5	0	Valid
4	P11-P12	0.3	0	Valid
5	P13	0.61	0	Valid
6	P14	0.6	0	Valid
Summary Results		Cronbach's Alpha = 0.714	Mean = 11.53	Stability: Strong (Guilford, 1956)

In table 2, statistically, the Cronbach's Alpha value of 0.714 indicates high reliability. Referring to Guilford's (1956) criteria, this figure proves the instrument possesses strong internal stability. The researcher noted that items P13 and P14 contributed significantly with correlation values of 0.614 and 0.570, respectively, showing the instrument accurately captured the nuances of student learning behavior. Descriptive data with a mean of 11.53 and a standard deviation of 2.30, suggesting that the respondents' responses regarding their learning styles were reasonably consistent across items. Subsequently, the critical thinking ability test instrument was tested on 30 students outside the research sample.

Table 3. Descriptive Statistics of Test Instrument

No	Item	Mean	Std. Dev	N	Correlation	Difficulty	Discrimination	Sig.
1	Item_1	3.30	1.32	30	.795**	3.30	0.73	.000
2	Item_2	3.23	1.19	30	.956**	3.23	0.93	.000
3	Item_3	3.17	1.18	30	.965**	3.17	0.94	.000
4	Item_4	2.93	1.28	30	.937**	2.93	0.89	.000
5	Item_5	2.70	1.44	30	.881**	2.70	0.79	.000

At table 3, analysis using IBM SPSS showed an exceptionally high Cronbach's Alpha of 0.944, indicating very strong consistency. The difficulty levels ranged from 2.70 to 3.23, categorized as "difficult" according to Megawati & Sutarto (2021). Item discrimination indices (0.726 to 0.944) indicate that these

items possessed strong discriminatory power to differentiate between higher and lower-performing students. Interestingly, Item 5 was identified as the most challenging (mean 2.70), while Item 1 was the most accessible (mean 3.30). This variation allowed for a comprehensive evaluation of students' cognitive depth.

Implementation in the experimental class took place over an 8-hour block session, starting with the Connecting stage. Here, students' cognitive schemas regarding the Pythagorean Theorem were reactivated through dialectical discussion. Rather than simply providing formulas, the researcher invited students to explore why the relationship between the squares of the sides of a right-angled triangle remains constant. This stage was vital, as Deswita and Kusumah (2018) state that new knowledge can only be absorbed if anchored to solid prior knowledge. Real world illustrations, such as the angle of elevation of the school flagpole, were used to transform abstract concepts into tangible problems.

In the Organizing stage, specific process differentiation interventions were applied: (1) Visual group: Analyzed interactive animation videos visualizing side ratio changes as angles moved dynamically. (2) Kinesthetic group: Used physical props like large triangular rulers, protractors, and measuring tapes for direct measurements in the school environment. (3) Auditory group: Received intensive guidance through verbal Q&A regarding the construction of sine, cosine, and tangent formulas.

During the Reflecting stage, students presented their findings. The visual group showed graphs, the kinesthetic group demonstrated field measurements, and the auditory group explained the logic of the ratios found. This created a perspective-rich environment where the researcher acted as a facilitator to correct misconceptions, such as misidentifying "opposite" and "adjacent" sides. This aligns with (Wati, Hidayati, Wulandari, & Ahied, 2019), who found that reflection sharpens students' analysis of their own logical errors.

The final stage, Extending, brought students into the agribusiness context. Students modeled land slope problems using clinometers to determine the steepness of agricultural land. They calculated tangent values to decide if the land required terracing or cover crops to prevent erosion. They also simulated irrigation pipe slopes using sine principles for optimal gravity-fed flow. These activities demonstrated the practical application of mathematics as a relevant technical tool within the agricultural context, reinforcing the views of Sutarni and Gatinigsih (2022) that contextual relevance is a key variable in knowledge retention for SMK students. Both the experimental and control

classes utilized the identical post test instrument, aiming to maintain a comparable level of difficulty between the two groups. The learning outcome data show a significant difference between the two classes.

Table 4. Descriptive Statistics Between Classes

No	Experimental Class	Control Class
1	Eksperimen	Mean
		95.5
		Median
		97
		Variance
		17.9
2	Control	Std. Deviation
		4.23
		Minimum
		80
		Maximum
		100
		Mean
		73.3
		Median
		79
		Variance
		323
		Std. Deviation
		18
		Minimum
		20
		Maximum
		100

The experimental class achieved an average post-test score of 95.53 with a median value of 97. This median, which is higher than the mean, indicates that the majority of students were reflecting the potential of the CORE model to support the majority of students in achieving higher scores. This finding is consistent with the research by Muizaddin & Santoso (2016), which states that the CORE model is significantly capable of improving learning outcomes due to its structure that encourages students to be actively involved in constructing knowledge.

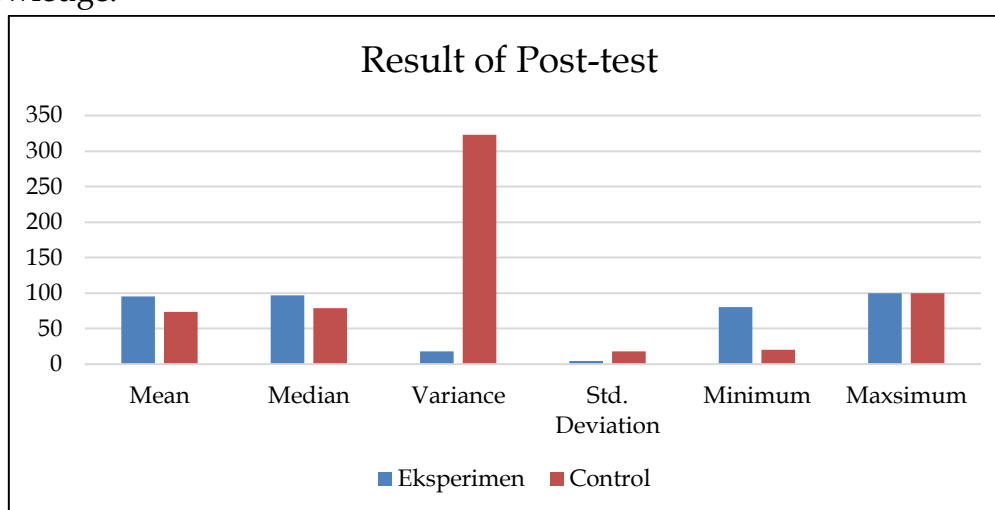


Figure 2. Result of Post test

The very small standard deviation in the experimental class (4.23) reflects a very dense and homogeneous distribution of scores. This homogeneity in learning outcomes suggests that the CORE model could help bridge the gap among students with diverse initial abilities, enabling them to meet the expected competency standards. This is further supported by the argument of Nasriyanti, Cahyaningsih, and Nahdi (2021), who emphasize that the Connecting and Organizing phases in CORE allow students to systematically bridge old concepts with new information, thereby minimizing the understanding gap within the classroom.

In contrast, the control class, which used the scientific model, only obtained an average of 73.31 with a very wide standard deviation of 17.97. The wider score range in the control class (minimum 20 and maximum 100) highlights a substantial disparity in student achievement when learning styles are left unaccommodated. This finding explicitly supports the study by Elmawati and Juandi (2022), which states that without proper management of learning styles, the variation in student achievement in mathematics will be very wide. Furthermore, this gap reflects the views expressed by Ditasari, Ulya, and Wanabuliandari (2022) that direct learning models often fail to reach the individual needs of students, especially in materials requiring high abstraction, such as trigonometry.

Table 5. Normality Test Results (Kolmogorov Smirnov)

No	Category	Difference	Std. Deviation
		$F_N(X) - F_0(X)$	
1	A ₁ B ₁	0.2	6.927
2	A ₂ B ₁	0.2	2.556
3	A ₃ B ₁	0.16	2.43
4	A ₁ B ₂	0.19	14.82
5	A ₂ B ₂	0.11	21.88
6	A ₃ B ₂	0.13	7.12

Normality tests showed all groups were normally distributed. However, Levene's Test revealed that variances were not homogeneous, 0.031. ($p < 0,05$).

Table 6. Levene's Test of Equality of Error Variances

No	Score	Levene's	df1	df2	Sig.
1	Based on Mean	11.865	5	58	0.031
2	Based on Median	9.11	5	58	0
3	Based on the median of df	9.11	5	26.955	0
4	Based on Mean eliminate	11.485	5	58	0

This heterogeneity of variance suggests that the treatment in the experimental class yielded a more concentrated clustering of scores, whereas student performance in the conventional class remained highly dispersed. In the context of mathematics education in vocational high schools (SMK), heterogeneity of variance often arises due to complex interactions between teaching methods and students' learning readiness. Pitaloka and Arsanti (2022) explain that the diverse characteristics of learners demand different treatments; when such treatments are provided through process differentiation within the CORE model, the result is a more stable increase in ability within the experimental class. As suggested by Games and Howell (1976), under these conditions of heteroscedasticity, the use of the Welch ANOVA test is the most robust and valid procedure.

Table 7. ANOVA Results

No	Source	Sum of Squares	df	Mean Square	F	Sig.
1	Between Groups	7898.766	1	7898.766	46.354	.000
2	Within Groups	10564.844	62	170.401		
3	Total	18463.609	63			

The results of the Welch ANOVA test for the first hypothesis show a significance value ($p < 0.001$), leading to the rejection of the Null Hypothesis (H_0). This indicates that there is a statistically significant difference in critical thinking skills between students taught using the CORE model with a differentiated approach and those taught using conventional methods. This finding reinforces the study by Handayani (2019), which also reported a significant difference in mathematical critical thinking skills between students taught with the CORE model compared to the expository model. This improvement occurs because CORE trains students to engage in reflecting on

their own thinking processes a metacognitive skill that is crucial for critical thinking.

Table 9. The Welch ANOVA Test

No	Source	Statistic ^a	df1	df2	Sig.
1	Welch	2.055	2	38.116	.142
2	Brown-Forsythe	1.410	2	56.345	.253

Regarding the influence of learning styles (second hypothesis), the results of the Welch ANOVA test show a significance value of 0.142 ($p > 0.05$). Although descriptively the kinesthetic group achieved the highest average (90.00), the difference is not statistically significant. This is further reinforced by the Games Howell post hoc test, where all pairwise comparisons of learning styles showed significance values above 0.05. This finding is notable as it suggests that individual learning style preferences do not necessarily hinder students from attaining high performance, provided the instruction is adaptive and the teacher is capable of delivering inclusive instructional strategies. This discovery aligns with the argument of Fauzia and Ramadan (2023), stating that learning styles are merely preferences for absorbing information and not determinants of an individual's intellectual capacity. Furthermore, (Fauziah, Carlian, & Mahmud, 2025) emphasize that the essence of implementing the Kurikulum Merdeka is to accommodate these learning styles through differentiated learning so that no single learning style group is left behind.

Table 9. Interaction Test

No	Source	Type III Sum of Squares	df	Mean Square	F	Sig.
1	Corrected Model	8695.095 ^a	5	1739.019	10.325	.000
2	Intercept	422670.773	1	422670.773	2509.584	.000
3	Class	6201.472	1	6201.472	36.821	.000
4	Learning Style	506.126	2	253.063	1.503	.231
5	Class * Learning Style	317.207	2	158.604	.942	.396
6	Error	9768.514	58	168.423		
7	Total	474595.000	64			
8	Corrected Total	18463.609	63			

The interaction test (third hypothesis) yielded a significance value of 0.396 ($p > 0.05$), confirming that there is no interaction between the learning model and learning styles regarding critical thinking skills. This indicates that the CORE model with a differentiated approach was consistently effective across different learning modalities. The framework showed a robust capacity to support critical thinking skills regardless of whether students preferred visual, auditory, or kinesthetic learning. This aligns with the theory proposed by Fitra (2022), which suggests that from a progressivism perspective, education must favor the students by providing them the freedom to develop according to their potential through concrete learning experiences.

In the control class, auditory students experienced the greatest difficulty, with a standard deviation reaching 21.88; however, within the experimental group, such challenges appeared to be minimized during the structured Organizing stage. The absence of interaction demonstrates that the CORE model is a robust instructional framework for addressing classroom heterogeneity in vocational schools. This outcome suggests that the Extending stage, which challenges students to apply concepts to new scenarios, was accessible to students across different learning modalities (Agustianti & Amelia, 2018).

An in depth discussion regarding the dynamics in the experimental class reveals that the 8 hour semi-block lesson system became an advantage when paired with the CORE model and process differentiation. The effectiveness of this integration is clearly measurable through specific mathematical critical thinking indicators evaluated in the post test. During the Connecting stage, students demonstrated the indicator of Formulating Clarification; they were able to identify and structure known trigonometry variables from real-world situations. The extended duration allowed the Organizing and Extending stages to reach the phase of field data collection in the school's farmland. In this phase, students worked within their learning modalities visual students sketched the farm topography, kinesthetic students measured land slopes using clinometers, and auditory students organized the data through verbal coordination. This active process directly stimulated the indicator of Building a Basis and Drawing Inferences (assessed in question 1 and question 2), where students accurately selected the tangent formula to calculate the actual height of agricultural objects.

Furthermore, students did not feel rushed during the Reflecting stage. This phase accommodated the indicators of Advanced Clarification and Strategies and Tactics (assessed in question 3 and question 4). Students across all learning styles were able to evaluate logical errors in their initial calculation

steps and justify their mathematical decisions when modeling irrigation flow problems. This concrete progression across critical thinking indicators serves as a solution to the common problems faced by teachers in developing 4C skills, where time constraints are often the primary obstacle (Monika, Julia, & Nugraha, 2022). Conversely, in the control class, 8-hour lessons filled with lectures and routine exercises failed to stimulate these higher-order indicators. Students remained at the surface level of memorization without reaching the Inference or Strategies stages, which is reflected in the low minimum student score of 20. This finding provides empirical insight for the curriculum management at SMK Negeri 1 Sigi, showing that the achievement of specific critical thinking indicators within the block system highly depends on the instructional methodologies used by the teacher. Theoretically, the systematic achievement of these critical thinking indicators can be explained through Cognitive Load Theory. By tailoring the information organization process based on learning styles, the extraneous cognitive load was minimized. This created more space for germane cognitive load to construct long-term mathematical schemas regarding trigonometric ratios (Juliarida, Widiati, & Wahyuni, 2025). The structural clarity of these indicators reinforces the research by Djalo, Missa, and Ndukang (2024) and Ulfa, Rahmi, and Revita (2019), demonstrating that active, discovery based learning combined with differentiation provides measurable paths for students to attain high-level critical evaluation skills.

The successful integration of agricultural problems (land slope and irrigation) also addresses the numeracy literacy challenges emphasized in national policies. Students no longer asked, "Why am I learning trigonometry?" because they witnessed its application in efficient agricultural land management. The application of realistic mathematics in a vocational context, as expressed by Indarta, Jalinus, Waskito, Samala, Riyanda, and Adi (2022), is proven effective in increasing student engagement because the material studied has direct relevance to their lives and professional futures. This aligns with the findings of (A'yun, Rusilowati, & Lisdiana, 2020), stating that contextual teaching materials effectively encourage students' cognitive engagement in solving complex technical problems. With an average achievement of 95.53, this study illustrates how student profile oriented pedagogical innovation can align with the instructional expectations of a Vocational Center of Excellence.

This strategy empirically supports Samsudi, Supraptono, Utanto, Rohman, and Djafar (2024) regarding the importance of meeting individual needs. Passive students in conventional settings became highly active when

provided with media matching their learning styles, thereby helping to mitigate potential sensory barriers in processing mathematical information. The integration of the structured CORE model and the differentiated process approach served as an effective instructional strategy in this specific vocational school context. This approach not only improves critical thinking skills but also builds a positive mathematical disposition (Aprilia & Diana, 2023). This success is measured not only by significant statistical figures but also by the creation of an inclusive learning climate where every student feels facilitated according to their unique learning style. Agung, Dewi, and Salsabila (2024) emphasize that differentiation in content, process, and product is the key to implementing the Kurikulum Merdeka to improve learning outcomes holistically.

This research asserts that mathematics teachers in vocational schools must transform into architects of learning environments that are responsive to the diversity of student profiles to produce graduates with the sharp critical thinking skills necessary to face the dynamics of the Agriculture 4.0 industrial world. The critical thinking skills honed through the CORE model are not merely academic skills but essential life skills for real-world problem-solving (Alawiah, Maksum, & Madani, 2024).

CONCLUSION

Based on the results of data analysis and hypothesis testing, it can be concluded that the application of the CORE (Connecting, Organizing, Reflecting, Extending) learning model with the differentiated process approach is proven effective in improving the mathematical critical thinking skills of students at SMK Negeri 1 Sigi. The scientific results of this study proved that the differentiated process method included in the CORE syntax had a good effect on diverse learning types (visual, aural, and kinesthetic). The lack of a significant interaction between the learning model and learning styles suggests the generalizability and benefit of the CORE model in the context of this study; the success of the model is not dependent on particular sensory preferences, but rather on the model's ability to address student learning needs inclusively.

In practice, this study finds that the key to improving critical thinking abilities in vocational high schools is the synchronization between contextual mathematics content and responsive instructional management. The ability of students to use trigonometric principles in the technical field of agriculture is evidence of deep learning, which occurs when teachers function as facilitators who can provide a variety of learning materials related to the world of work.

The results show the existence of heteroscedasticity due to the ceiling effect of the maximum scores in the experimental class for future researchers. Thus, they should incorporate better controls on the baseline attributes of the sample in future studies. Further research can be conducted by broadening the scope of investigation to mathematical topics other than trigonometry, lengthening the period of the Organizing and Extending phases that require in-depth group exploration, and evaluating the effectiveness of differentiated instruction from the perspective of content or product differentiation to provide a more holistic completion to these findings.

RECOMMENDATION

Based on the findings of this study, it is recommended that mathematics teachers in Vocational High Schools (SMK) implement the CORE learning model with a differentiated approach as an alternative strategy to enhance critical thinking skills. Teachers should be more proactive in practicing adaptive classroom management by providing varied learning resources (visual, auditory, and teaching aids) to ensure every student receives equitable cognitive access. Furthermore, collaboration between vocational subject teachers and mathematics teachers should be strengthened to design contextual problems that are more relevant to the students' specific fields of expertise.

Several constraints identified during this study should be considered by future researchers, specifically the time limitations in executing each CORE syntax particularly the Organizing and Extending stages, which require significant duration for group exploration. Additionally, the processing of initial data for mapping student learning styles requires high precision to ensure that process differentiation is accurately targeted. For future researchers, it is suggested to expand the scope of research to different mathematical topics and examine differentiation from the perspectives of content or product, to complement the findings regarding the effectiveness of differentiated learning holistically.

ACKNOWLEDGMENT

The author would like to express sincere gratitude to all parties who have contributed to the completion of this research. Special appreciation is extended to Ir. Yarpatiyani Tanning, the Principal of Vocational High School SMK Negeri 1 Sigi, for providing the opportunity and administrative support to conduct this study. Furthermore, profound thanks are offered to Prof. Dr. Pathuddin, S.Pd.,

M.Si. and Prof. Junaidi, S.Si., M.Si., Ph.D who served as both instrument validators and examiners, for their critical reviews and constructive feedback that significantly improved the quality of this work. Finally, the author thanks the teachers and students of Vocational High School SMK Negeri 1 Sigi for their cooperation and active participation, which made this research possible.

DECLARATIONS

- Author Contribution : WI: Conceptualization, Methodology, Instrument creation, Data analysis, Writing - Original Draft, Writing - Review & Editing.
NU: Methodology refining, Formal analysis, Writing-Review & Editing.
DI: Data curation; Writing-Review & Editing; Data analysis help.
- Funding Statement : This work was sponsored by the author's personal cash.
- Conflict of Interest : The authors declare no conflict of interest.
- Additional Information : Additional information can be obtained from the corresponding author on reasonable request.

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