

Think, Pair, Share, and Beyond: Cultivating Critical Thinking via Collaborative Learning in Vocational High Schools

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Abstract

The increasing complexity of modern industrial environments has intensified the need for vocational education institutions to cultivate students' critical thinking skills alongside technical competence. This study aimed to evaluate the implementation of Collaborative Learning through the Think-Pair-Share and Beyond strategy in enhancing students' critical thinking abilities at SMK Nurul Abror Al Robbaniyin. The research employed a Classroom Action Research design conducted in two cycles consisting of planning, action, observation, and reflection stages. Data were collected through classroom observation, field notes, documentation, and critical thinking assessments focusing on analytical reasoning, evaluation, interpretation, and argumentative communication. The findings revealed a progressive improvement in students' critical thinking performance and collaborative participation across the research cycles. Students initially demonstrated passive learning behavior and procedural dependence during the pre-cycle stage, but gradually developed stronger analytical engagement, reflective discussion skills, and confidence in communicating technical arguments throughout the intervention process. More substantial improvement emerged during the second cycle following the integration of contextual simulations, visual scaffolding, and guided collaborative reflection within the "Beyond" approach. The study concludes that the modified Think-Pair-Share strategy effectively strengthened critical thinking development and collaborative engagement in vocational classroom learning environments.

Keywords

Collaborative Learning; Critical Thinking; Think-Pair-Share; Vocational Education; Classroom Action Research

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1. INTRODUCTION

Technical and Vocational Education and Training (TVET) has increasingly occupied a strategic position within contemporary educational discourse due to its direct relationship with labor market transformation, technological disruption, and the acceleration of industrial digitization. The emergence of Industry 4.0 and society-oriented innovation ecosystems has altered the competency structure required from vocational graduates, shifting emphasis from procedural mastery toward adaptive reasoning, collaboration, and analytical judgment (Amin et al., 2024). Vocational schools are no longer



expected merely to produce technically proficient workers, but also reflective individuals capable of interpreting problems, evaluating alternatives, and responding to complex occupational challenges with intellectual flexibility (Ye et al., 2024). Within this evolving landscape, critical thinking has become an indispensable competency that supports sustainable employability and professional resilience. Educational institutions therefore face increasing pressure to redesign pedagogical approaches that can cultivate higher-order cognitive abilities alongside technical expertise (Mesuwini & Mokoena, 2024). Consequently, the discussion surrounding collaborative and student-centered learning models has gained prominence as educators seek strategies capable of aligning vocational education with twenty-first-century industrial expectations.

Despite substantial curricular reforms within vocational education systems, a persistent discrepancy remains between students' technical competencies and the cognitive capacities demanded by contemporary workplaces. Many vocational students demonstrate adequate procedural skills during practical instruction, yet experience difficulties when confronted with problem interpretation, decision-making processes, and analytical reasoning in unfamiliar industrial situations (Jamaludin et al., 2023). Employers frequently report that graduates struggle to communicate ideas critically, formulate alternative solutions, and engage in collaborative troubleshooting under dynamic working conditions (Lu & Wang, 2023). Such limitations become increasingly problematic because industrial environments today prioritize innovation, adaptability, and interdisciplinary coordination rather than repetitive task execution alone (Susilawati et al., 2023). In many vocational classrooms, learning practices continue to emphasize teacher-centered instruction, routine memorization, and mechanical task completion, thereby restricting opportunities for reflective inquiry and dialogic interaction. As a result, students often become passive recipients of information rather than active constructors of knowledge. This pedagogical tendency ultimately weakens the cultivation of critical thinking dispositions essential for vocational professionalism and lifelong learning.

Within educational theory, Collaborative Learning has emerged as a pedagogical framework capable of fostering cognitive engagement, reflective interaction, and collective problem-solving among learners. Rooted in constructivist perspectives, this approach positions knowledge as socially negotiated through communication, argumentation, and shared intellectual experiences (Hmoud et al., 2023). Collaborative environments encourage students to articulate assumptions, defend viewpoints, evaluate evidence, and reconsider conclusions through meaningful interaction with peers (Barker et al., 2023). Such processes are highly relevant to vocational education because industrial workplaces increasingly depend upon teamwork, coordination, and adaptive communication across diverse professional contexts. Rather than viewing learning as an individual accumulation of information, Collaborative Learning emphasizes reciprocal participation that stimulates deeper comprehension and

metacognitive awareness (Miller, 2024). Previous studies have indicated that collaborative strategies can strengthen critical thinking abilities by exposing students to multiple perspectives and authentic problem situations (Ozono et al., 2025). Therefore, integrating collaborative pedagogies into vocational classrooms represents not merely an instructional variation, but a strategic educational response to the cognitive and social demands of modern industry.

Among various collaborative pedagogical models, Think-Pair-Share (TPS) has attracted considerable scholarly attention because of its capacity to structure reflective participation and equitable interaction within classroom discussions. The model generally begins with individual contemplation, followed by peer dialogue, and culminates in collective knowledge sharing, thereby enabling students to process ideas progressively and critically (Glaister et al., 2024). TPS is particularly valuable in vocational contexts because it provides students with opportunities to connect technical understanding with analytical reasoning through communicative exchange. Nevertheless, conventional TPS implementation often remains limited to basic classroom discussion without adequately addressing the complexity of vocational learning environments characterized by practical simulations, industrial case analysis, and competency-based assessment (Adhami & Taghizadeh, 2024). Consequently, the notion of “Beyond” within this study refers to the expansion of TPS into broader collaborative mechanisms incorporating contextual problem-solving, project-oriented interaction, and reflective industrial scenarios. Such modification is necessary to ensure that collaborative engagement transcends routine participation and evolves into a transformative process supporting critical inquiry and workplace-oriented reasoning (Qi & Derakhshan, 2025).

This research was conducted at SMK Nurul Abror Al Robbaniyin, a vocational institution committed to strengthening the relevance of its educational practices to contemporary industrial demands. The school accommodates students from diverse socio-educational backgrounds and emphasizes the integration of technical competence, discipline, and character formation within the learning process. Preliminary classroom observations indicated that students generally showed strong enthusiasm during practical sessions and workshop-based activities. However, many learners experienced difficulties when asked to formulate analytical arguments, evaluate alternative solutions, or participate actively in reflective academic discussions. Learning interactions frequently remained dependent on teacher explanations, while peer collaboration tended to focus on task completion rather than deeper intellectual exploration. Nevertheless, several classroom situations also demonstrated promising opportunities for collaborative engagement when students were encouraged to discuss practical problems collectively and negotiate ideas through structured interaction. These conditions suggest that the school provides a meaningful environment for examining the development of critical thinking through collaborative learning strategies in vocational education settings.

Based on these considerations, this article aims to investigate how Collaborative Learning strategies, particularly the expanded implementation of Think-Pair-Share, contribute to the cultivation of critical thinking skills among vocational high school students. The study focuses on understanding the interactional patterns, learning dynamics, and cognitive responses that emerge during collaborative activities in vocational classrooms at SMK Nurul Abror Al Robbaniyin. In addition, this research seeks to explore how collaborative instructional models can be adapted to vocational education characteristics that require the integration of practical competence and analytical reasoning. The contribution of this article lies in its effort to connect collaborative learning theory with the practical realities of vocational education in rapidly changing industrial contexts. Furthermore, the findings are expected to provide both theoretical enrichment for the discourse of innovative TVET pedagogy and practical guidance for educators seeking to strengthen critical thinking through participatory, contextual, and student-centered learning approaches.

2. METHOD

This study employed a Classroom Action Research (CAR) design using a cyclical model consisting of planning, action, observation, and reflection stages conducted systematically in repeated cycles (Kovari, 2025). The research was carried out at SMK Nurul Abror Al Robbaniyin with the participants consisting of eleventh-grade vocational students selected based on the characteristics of collaborative classroom learning and the need to enhance critical thinking abilities. The Classroom Action Research approach was chosen because the study was directed toward improving instructional practices through active collaboration between the teacher and the researcher during the implementation process (Hopfenbeck et al., 2022). The instructional strategy applied in this study was a modified Think-Pair-Share model integrated with a “Beyond” approach emphasizing contextual discussion, practice-based problem solving, and reflective group interaction aligned with vocational education characteristics. Each cycle was implemented based on reflective evaluation of the previous cycle, enabling continuous refinement of instructional procedures and learning interactions according to the classroom dynamics observed throughout the research process (Sugrah, 2023).

The data collection instruments included student activity observation sheets, field notes, learning documentation, and critical thinking tests developed based on indicators of analysis, interpretation, evaluation, and logical inference (Sofiwati et al., 2025). Observation sheets were utilized to identify the level of student participation during the implementation of Collaborative Learning activities, while field notes were used to document classroom interaction patterns, instructional challenges, and student responses toward the modified Think-Pair-Share strategy. Quantitative data were obtained from students’ critical thinking test scores administered at the end of each cycle and analyzed using

descriptive percentage techniques to determine the extent of learning improvement across cycles. Meanwhile, qualitative data derived from observations and field records were analyzed through data reduction, data display, and conclusion drawing procedures in order to strengthen the interpretation of instructional outcomes. The research was considered successful when at least 75% of the students achieved the “Critical” category based on the predetermined critical thinking assessment indicators, indicating that the instructional objectives had been satisfactorily accomplished and the action cycle could therefore be concluded.

3. FINDINGS AND DISCUSSION

Finding

3.1. Critical Thinking Development Across Research Cycles

The implementation of Collaborative Learning through the modified Think-Pair-Share strategy produced a progressive transformation in students’ critical thinking performance and classroom interaction patterns at SMK Nurul Abror Al Robbaniyin. Prior to the intervention, vocational learning activities were predominantly characterized by procedural instruction, teacher explanation, and task completion orientation. Students generally demonstrated sufficient technical ability in executing practical assignments; however, they experienced difficulty when required to explain operational reasoning, evaluate alternative procedures, or formulate analytical responses toward contextual vocational problems (Siller & Ahmad, 2024). Initial classroom observations revealed that students tended to wait for direct instructions before taking action and rarely initiated reflective questioning during practical sessions. In several learning situations involving computer network troubleshooting and digital design correction, students focused primarily on obtaining correct answers rather than understanding the logical process underlying technical decisions. Consequently, classroom interaction remained passive, and collaborative discussion was limited to superficial exchanges without deeper conceptual engagement. This condition indicated that students’ vocational competence had not yet been accompanied by adequate critical thinking development (Sharma et al., 2024).

To measure the improvement of students’ critical thinking skills systematically, assessment was conducted at the pre-cycle stage and at the end of each research cycle using indicators consisting of analytical interpretation, evaluation of alternative solutions, logical reasoning (Irmayani & Adriana, 2025), and argumentative communication. The results demonstrated a gradual yet convincing increase in students’ performance following the implementation of collaborative instructional intervention (Othman et al., 2026). The progression of achievement across research cycles is presented in the following table.

Research Stage	Average Score	Mastery Percentage	Critical Thinking Level	Dominant Classroom Characteristics
Pre-Cycle	60.4	58%	Basic	Passive participation, procedural dependence, limited analytical discussion
Cycle I	72.1	72%	Developing	Initial collaborative engagement, emerging analytical interaction, weak verbal argumentation
Cycle II	88.3	88%	Critical	Active debate, reflective communication, contextual problem-solving collaboration

The data indicate that the average class score increased consistently from 60.4 during the pre-cycle stage to 72.1 in Cycle I and reached 88.3 in Cycle II. Likewise, the mastery percentage improved from 58% to 72% and finally reached 88%, indicating that the majority of students achieved the expected critical thinking criteria by the end of the intervention. Beyond numerical improvement, substantial behavioral transformation was also observed throughout the research process (Nurlaika et al., 2024). During the pre-cycle stage, students tended to remain silent during instructional discussion and frequently avoided responding to analytical questions posed by the teacher. Most responses were short, procedural, and focused exclusively on technical execution (Li & Tu, 2024). However, after the implementation of collaborative learning activities, students gradually demonstrated greater willingness to participate in reflective dialogue. By Cycle II, several students began questioning classmates' troubleshooting strategies, proposing alternative technical procedures, and defending arguments through logical explanation supported by practical reasoning. Such behavioral changes indicate that the intervention contributed not only to cognitive improvement but also to the development of reflective communication and collaborative confidence within vocational classroom settings (Septiani, 2026).

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Figure 1. Improvement of Students' Critical Thinking Mastery Across Research Cycles

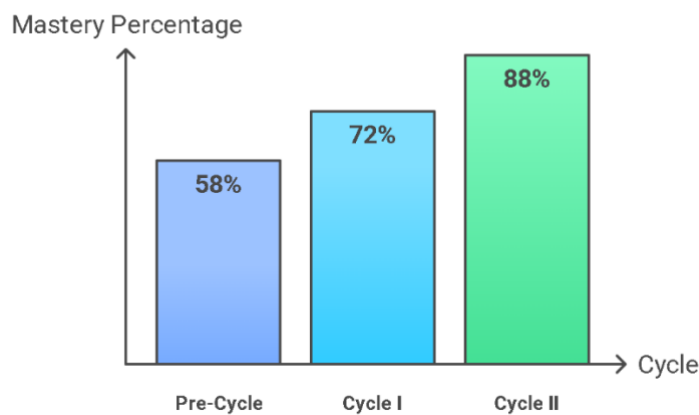


Figure 1 demonstrates a gradual and realistic increase in students' critical thinking mastery throughout the Classroom Action Research cycles. The most substantial improvement was identified during Cycle II after the implementation of the "Beyond" intervention involving visual scaffolding, contextual vocational simulations, and structured reflective discussion. The figure also confirms that collaborative instructional refinement contributed significantly to strengthening students' analytical participation and argumentative communication during vocational learning activities (Azizi et al., 2025).

3.2. Cycle I Results

The implementation of Cycle I focused on introducing students to Collaborative Learning through the foundational stages of Think-Pair-Share integrated with contextual vocational problems (Šinko et al., 2024). During the "Think" phase, students were asked to analyze technical cases individually before entering peer discussion. The vocational problems presented included unstable network configurations, hardware connection failures, and inconsistencies in digital interface layouts frequently encountered in practical workshop activities. Initial observations demonstrated that students were capable of identifying visible technical symptoms; however, many still experienced difficulty when required to explain causal relationships or evaluate alternative solutions critically (Shahzad et al., 2025). Several students tended to search for direct procedural answers instead of exploring analytical reasoning independently. Nevertheless, the individual reflection stage gradually encouraged students to become more attentive toward problem analysis and operational logic (Martin-Alguacil et al., 2024).

During the "Pair" phase, collaborative interaction began to emerge more actively compared to the preliminary classroom condition. Students started exchanging technical opinions, comparing troubleshooting strategies, and discussing possible corrective procedures with peers (Lin et al., 2024). In

several groups, students demonstrated enthusiasm when discussing practical vocational cases because the learning material was closely connected to real workshop experiences. However, the quality of collaborative discussion remained uneven. More confident students frequently dominated conversations, while less communicative students preferred listening passively without contributing substantial ideas (Aggrawal & Magana, 2024). Classroom observation data indicated that peer discussion often focused on identifying correct technical procedures rather than critically evaluating the effectiveness or efficiency of alternative solutions. Although collaborative interaction had started to develop, reflective analytical communication remained relatively limited during this stage of implementation (Figueiredo & García-Peñalvo, 2024).

The most significant challenge during Cycle I appeared in the “Share” phase. Many students demonstrated hesitation when presenting discussion results publicly in front of classmates. Verbal communication remained fragmented, and several groups relied heavily on written notes when explaining technical reasoning (Torres-Peña et al., 2024). Students often avoided responding to critical questions from peers because they lacked confidence in defending arguments analytically. In one observed classroom interaction, a group proposing a network troubleshooting solution was unable to explain why a particular configuration method was considered more efficient than other alternatives. Similar conditions appeared during digital design evaluation sessions, where students could identify layout errors but struggled to justify design improvement decisions conceptually. These findings suggest that although students had begun engaging collaboratively, the transition from procedural understanding toward argumentative critical thinking had not yet fully developed (An & Zhang, 2024). Therefore, reflective evaluation conducted after Cycle I concluded that additional instructional support was required to strengthen students’ communicative confidence and analytical articulation.

3.3. Instructional Refinement Through the “Beyond” Approach

Based on reflective findings from Cycle I, several instructional modifications categorized as the “Beyond” intervention were implemented in Cycle II to strengthen the depth of collaborative engagement and analytical communication. First, additional scaffolding techniques were introduced through guided questioning strategies designed to stimulate deeper reasoning (Dai et al., 2025). Instead of asking students merely to identify technical errors, students were encouraged to explain causal relationships, predict operational consequences, and compare alternative troubleshooting procedures systematically (Sánchez-García & Reyes-de-Cózar, 2025). Second, visual learning media such as troubleshooting flowcharts, design simulation displays, and operational workflow mapping were integrated into classroom activities to assist students in organizing technical arguments more

coherently. Third, contextual industrial scenarios were expanded to resemble authentic workplace conditions requiring collective decision-making and collaborative problem solving (Mariyono, 2024).

Another important refinement involved restructuring the collaborative presentation process. Prior to the “Share” stage, students were instructed to formulate concise group reasoning summaries containing problem identification, technical alternatives, selected solutions, and justification arguments (Boampong et al., 2024). This procedure reduced students’ anxiety during oral presentation because they possessed clearer conceptual preparation before communicating ideas publicly. In addition, peer response sessions were redesigned into structured reflective dialogue activities where students were encouraged to provide constructive criticism and alternative perspectives rather than merely agreeing with classmates’ explanations (H.-Y. Chang et al., 2024). These instructional modifications aimed not only to improve classroom participation but also to cultivate deeper evaluative reasoning and argumentative interaction aligned with the objectives of critical thinking development in vocational education (Fan et al., 2025).

3.4. Cycle II Results

The implementation of Cycle II demonstrated a substantially stronger level of cognitive engagement, collaborative participation, and analytical communication among students (Budiyanto et al., 2024). During the “Think” phase, students showed improved ability to analyze vocational problems independently before discussing them with peers. In network troubleshooting simulations, several students began identifying multiple possible causes of connection failure rather than relying on single procedural assumptions (Rohman & Fuady, 2026). Likewise, in digital design correction tasks, students demonstrated greater awareness of functional and aesthetic considerations simultaneously when evaluating layout effectiveness. This development indicates that students had started engaging in more reflective analytical reasoning rather than procedural imitation alone (Cheng et al., 2024).

The “Pair” phase during Cycle II evolved into a significantly more dynamic collaborative process. Students no longer exchanged answers superficially but actively negotiated technical reasoning and evaluated operational alternatives critically (Aini et al., 2024). Observation records indicated that students frequently questioned peers’ assumptions, compared troubleshooting effectiveness, and debated design correction strategies using logical justification. In one discussion session, students argued about whether software configuration failure originated from system compatibility or incorrect protocol sequencing, demonstrating increasingly sophisticated evaluative interaction. Such collaborative dialogue reflected the emergence of higher-order cognitive processes involving interpretation, comparison, evaluation, and analytical synthesis within vocational learning contexts.

The most substantial transformation became evident during the “Share” phase in Cycle II. Students who previously remained passive gradually developed confidence in communicating technical arguments publicly. Several groups demonstrated the ability to explain troubleshooting procedures systematically while responding critically to questions raised by classmates. The classroom atmosphere became more dialogical, reflective, and intellectually interactive compared to the earlier cycles. Students were observed defending technical decisions with operational reasoning, challenging alternative viewpoints respectfully, and proposing revised procedures supported by practical evidence. Importantly, argumentative interaction no longer generated communication anxiety but instead functioned as a collaborative learning mechanism encouraging collective understanding. These behavioral changes strongly indicate that the modified Think-Pair-Share strategy succeeded in fostering critical thinking development through reflective collaborative interaction relevant to vocational education characteristics.

Discussions

The findings of this study confirm that Collaborative Learning implemented through the modified Think-Pair-Share strategy possesses substantial potential for strengthening critical thinking development within vocational education settings. The progressive increase in students’ achievement from the pre-cycle stage to Cycle II supports constructivist perspectives emphasizing that cognitive growth emerges through social interaction, reflective dialogue, and collaborative meaning construction (Prabawati, 2023). In this study, critical thinking development did not occur instantly through direct instruction alone, but evolved gradually as students became increasingly involved in analytical discussion and contextual problem-solving activities. The classroom transformation observed throughout the research demonstrates that vocational students require learning environments encouraging reflective inquiry rather than procedural dependence. When students were given opportunities to examine authentic technical problems collaboratively, they began constructing deeper conceptual understanding connected to practical vocational experience. Consequently, Collaborative Learning functioned not merely as an interactional strategy but as a pedagogical framework capable of transforming classroom culture from passive procedural learning into reflective analytical engagement.

The “Think” phase contributed significantly to the activation of students’ individual cognitive processes before collaborative interaction occurred. Vocational students are frequently accustomed to mechanically oriented instructional routines emphasizing technical accuracy and task completion (Massitoh, 2024). As a result, many students initially experienced difficulty when required to explain operational logic or evaluate procedural effectiveness analytically (Barradas et al., 2024). Through structured individual reflection activities, students were encouraged to pause, interpret technical

situations critically, and formulate preliminary reasoning independently before receiving peer influence. This stage proved particularly important because it prevented immediate dependence on group consensus and stimulated personal cognitive responsibility (Fakaruddin et al., 2024). Students gradually became more aware that technical decisions required logical justification rather than procedural memorization alone. The improvement observed during Cycle II suggests that repeated engagement in analytical reflection strengthened students' metacognitive awareness and ability to connect practical experience with conceptual reasoning (Hardiansyah et al., 2024).

Meanwhile, the "Pair" phase played a crucial role in expanding students' analytical perspectives through dialogical interaction. During collaborative discussion, students encountered differing assumptions, troubleshooting strategies, and operational interpretations proposed by peers (Schatzman, 2024). Such interaction stimulated evaluative reasoning because students were required to compare ideas, defend opinions, and reconsider technical conclusions critically. The emergence of argumentative dialogue during Cycle II demonstrates that collaborative discussion can encourage vocational students to engage in higher-order thinking processes involving interpretation, evaluation, and synthesis (L.-C. Chang et al., 2024). Importantly, the collaborative interaction observed in this study differed substantially from conventional group work characterized by passive division of tasks. Instead, peer discussion evolved into an intellectual negotiation process through which students collectively constructed understanding and refined technical reasoning. These findings reinforce theoretical assumptions suggesting that social interaction functions as a catalyst for deeper cognitive development within collaborative learning environments (Bordás & Debrenti, 2025).

Another important aspect highlighted by this research concerns the effectiveness of the "Beyond" intervention integrated into Cycle II. The incorporation of visual scaffolding, guided questioning, and authentic vocational simulations significantly enhanced students' communicative confidence and analytical coherence during collaborative activities. Visual workflow mapping assisted students in organizing complex technical reasoning more systematically, while contextual industrial cases increased the authenticity and relevance of classroom discussion. The effectiveness of this instructional refinement suggests that vocational students require concrete and contextually meaningful learning stimuli to engage critically with theoretical concepts. When collaborative learning activities were connected directly to authentic vocational challenges, students demonstrated greater motivation to participate actively and defend arguments logically. Therefore, the success of the intervention was influenced not only by collaborative structure itself but also by the contextual relevance and instructional support embedded within the learning design.

The communication patterns emerging during collaborative activities also reflect competencies increasingly demanded within contemporary industrial environments. Modern workplaces emphasize

teamwork, adaptive communication, collaborative troubleshooting, and collective decision-making as essential professional skills (Kodirun et al., 2025). The interactional dynamics observed at SMK Nurul Abror Al Robbaniyin indicate that students gradually developed the ability to negotiate ideas, evaluate differing viewpoints, and coordinate technical understanding collectively. Such competencies are highly relevant to industrial practice where operational problems are rarely solved individually. Furthermore, the emergence of respectful argumentative dialogue among students demonstrates that collaborative learning can cultivate professional communication habits necessary for workplace adaptation. Students were not merely learning technical procedures but also developing interpersonal and analytical competencies supporting long-term employability within dynamic industrial contexts (Geçikli, 2025).

Despite the positive outcomes obtained during the research process, several limitations remained evident throughout the implementation of the action cycles. Time allocation constraints occasionally restricted the depth of reflective discussion, particularly during the “Share” phase where several groups required additional opportunities to elaborate technical reasoning comprehensively (Geçikli, 2025). Differences in students’ communication confidence also influenced participation balance during collaborative interaction, especially among students who were previously accustomed to teacher-centered instructional environments. In addition, the preparation of contextual vocational scenarios and visual scaffolding materials required substantial instructional planning to ensure alignment with learning objectives. Nevertheless, these limitations do not diminish the overall significance of the findings. Instead, they indicate the importance of continuous instructional adaptation and sustained collaborative practice in developing critical thinking skills effectively within vocational education settings (Szymańska, 2024).

4. CONCLUSION

The findings of this study demonstrate that the implementation of Collaborative Learning through the Think-Pair-Share and Beyond strategy contributed significantly to the improvement of students’ critical thinking skills at SMK Nurul Abror Al Robbaniyin. At the beginning of the research, classroom learning was still characterized by passive interaction patterns, strong dependence on teacher instruction, and students’ tendency to complete vocational tasks procedurally without engaging in deeper analytical reasoning. Following the implementation of the first cycle, gradual improvement became evident through increased student participation in discussion, collaborative interaction, and idea exchange, although argumentative communication remained relatively limited. More substantial development emerged during Cycle II after the integration of the “Beyond” modifications involving contextual simulations, visual scaffolding, and guided reflective discussion. These instructional

refinements encouraged students to communicate technical reasoning more confidently, evaluate alternative solutions critically, and engage more actively in collaborative problem-solving activities. The study therefore confirms that the effectiveness of the intervention was shaped not only by the conventional Think-Pair-Share structure, but also by its contextual adaptation to the characteristics and learning demands of vocational education.

The results of this study carry important implications for the development of pedagogical practices in vocational high schools, particularly in strengthening the integration between technical competence and higher-order thinking skills. Collaborative learning designed around authentic vocational problems was found to create a more reflective, communicative, and intellectually engaging classroom environment in which students were encouraged to analyze, negotiate, and evaluate technical decisions collectively. Accordingly, vocational educators should move beyond instructional approaches that focus solely on procedural accuracy and instead provide learning opportunities that stimulate analytical dialogue, collaborative reasoning, and contextual problem solving. The implementation of the “Beyond” approach further indicates that visual support, authentic simulation, and conceptual scaffolding can enhance students’ participation and confidence more evenly during collaborative activities. Ultimately, the cultivation of critical thinking should be regarded as an essential component of vocational education, as industrial environments increasingly require graduates who are not only technically competent, but also capable of making rational decisions, adapting to complex situations, and participating effectively within collaborative professional settings.

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