

Innovative Pedagogical Approach: STAD-Integrated Debate Method as a Catalyst for Developing 21st Century Skills Among Vocational Students

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Abstract

Graduates of vocational schools in Indonesia still face serious challenges regarding low absorption by industry. The high unemployment rate among vocational school graduates indicates a mismatch between graduates' competencies and the needs of the job market, creating a gap between education and the industrial world. Therefore, a learning strategy is needed that can hone these skills in a vocational school environment. This research aims to determine students' responses and skills, including critical thinking skills, communication skills, and teamwork skills, through the application of the Student Teams Achievement Division (STAD) learning model with the debate method. This research was conducted at one of the vocational schools located in the Sumedang, Indonesia. The research used a quantitative approach and a quasi-experimental design with two groups: an experimental group and a control group. The study was conducted in the Building Construction Fundamentals subject over three meetings. Based on the research results, the experimental class achieved a higher score compared to the control class. The results of students' responses to this learning model yielded an average TCR of 77.4%, which is categorized as good. This indicates that students perceive learning with this model as capable of developing activity, material understanding, and 21st-century skills. Based on the hypothesis test, the significant value is $p(0.001) < (0.05)$, which indicates that using the STAD learning model with the debate method can significantly measure students' skills.

1. Introduction

As the main foundation, education contributes significantly to improving the quality of human resources (Sanga & Wangdra, 2023). The progress of a country depends on the quality of its education. Countries that are lagging behind in the education sector will face many problems in their education sector. Nevertheless, education in Indonesia is currently facing various complex problems that require serious attention, one of which is related to issues arising in secondary education, particularly in vocational schools (Danugroho, 2022). This reality reveals that vocational school graduates continue to have the greatest jobless rate. According to data from the National Labor Force Survey (Sakernas) in August 2024, vocational school graduates had the highest Open Unemployment Rate (TPT) compared to graduates of other education levels, reaching 9.01%. This indicates that although vocational schools are designed to produce graduates with ready-to-use workforce skills, many graduates are still unemployed or facing jobs that do not match their expertise (Santika et al., 2023). The fact that vocational school graduates dominate unemployment figures suggests that the skills of vocational school graduates are not fully aligned with the evolving needs of industry (Wijaya & Utami, 2021). In the face of global challenges and industrial transformation, the industrial world is increasingly demanding that graduates not only be skilled in technical skills but also possess 21st-century competencies, which are cross-disciplinary (Samala, 2021). These 21st-century skills include critical thinking, communication, collaboration, and creativity (Zubaidah, 2018).

To address these challenges, in order to prepare optimal resources that can be absorbed into the industrial sector, vocational schools must revise the systems they operate under (Garnadi et al., 2022). Improving the quality of learning is one solution that can be implemented in an effort to improve education. The use of conventional learning models, which are still commonly used in vocational schools, does not provide sufficient active participation in the learning process (Rahayuningsih et al., 2022). Consequently, efforts to develop students' skills and potential are not adequately honed. The goal of developing critical thinking skills is to prepare students to become human resources (HR) who are adaptable and able to compete in global dynamics, both now and in the future (Supriana et al., 2023). Meanwhile, communication skills not only serve as a means of interaction but also lead to the mastery of more complex skills, including critical thinking, problem-solving, stress management, and risk-taking. Similarly, cooperation is a key element, as complex tasks can be handled

more optimally through collaboration (Yusro et al., 2021). Therefore, it is essential to implement continuous and systematic learning processes to optimize the development of students' competencies. In the current educational context, a variety of learning models have been employed to facilitate instructional practices that are not only synergistic but also efficient, ensuring that the acquisition of knowledge and skills takes place in a more holistic and sustainable manner (R. A. Putri, 2023). By utilizing this learning model, it is hoped that a fresher learning environment can be created, leading to a good learning atmosphere and providing feedback for the students (Magdalena et al., 2021)

The Student Teams Achievement Division (STAD) cooperative learning model is one that can be used in vocational schools because the learning activities focus on team collaboration to collectively achieve learning targets (Suwarsa, 2020). STAD is a learning model introduced by Slavin, (2009) This learning approach is used to create a learning environment that supports the active participation of all students. The learning process is facilitated through group work, allowing students to help each other master the material and develop interpersonal skills (Sulistio & Haryanti, 2022). This learning approach is used to create a learning environment that supports the active participation of all students. The learning process is facilitated through group work, allowing students to help each other master the material and develop interpersonal skills.

Besides the STAD model, learning optimization for vocational students can be done using the debate method. Debate can be one of the methods used to develop a variety of student skills (Tarigan, 2023). The characteristics of debate force students to construct arguments consisting of claims, reasons, and evidence, as well as respond to counterarguments. This process enhances analytical and evaluative abilities, which are key elements in critical thinking (Maulina et al., 2016). Additionally, debates provide a space for students to speak in front of the class, which directly trains their oral communication skills, including intonation, articulation, persuasion, and the ability to logically structure their arguments (Fauziah et al., 2022). Using the debate method can provide challenges and competition that can increase students' emotional engagement. The courage to voice opinions, recognition from peers, and the responsibility to prepare arguments make students feel more motivated (Fauziah et al., 2022). Another advantage of using the debate method in the learning process is that it allows for a more objective assessment because teachers can directly participate in the learning process. This enables teachers to assess various aspects of students and measure how well they have taught.

It is anticipated that the integration of the Student Teams Achievement Division (STAD) learning model with the debate method will foster students' abilities in communication, critical thinking, and teamwork, which are recognized as core competencies of the 21st century. Although empirical investigations in this specific area remain limited or even scarce, existing studies on the application of the STAD model and the incorporation of debate activities within instructional settings have reported positive outcomes. For instance, research conducted by Savitri and Mukaromah, (2023) His findings demonstrated that the use of debate significantly enhanced students' critical thinking skills. Similar results were also reported in other studies, further reinforcing the potential of debate as an effective pedagogical strategy for fostering higher-order thinking skills Khuzairi, (2023). This study concludes that the STAD learning model has the potential to enhance students' teamwork skills. Previous research indicates that this approach has been widely applied across educational levels, including elementary, middle, high school, and even university contexts. However, studies focusing on its implementation in vocational education remain limited. In response to this gap, the present research investigates the application of the STAD learning model in combination with the debate method among vocational school students. The novelty of this study lies in its integration of a cooperative learning model with structured debate, while simultaneously assessing critical thinking, communication, and teamwork skills. Accordingly, the primary aim of this research is to examine the effectiveness of the STAD model combined with the debate method in fostering and evaluating essential 21st-century skills among vocational school students.

2. Method

This research employs an experimental approach, which is a research method designed to determine the impact of administering a specific treatment on the observed variables. Arikunto, (2013) defines experimental research as a method used to discover the causal relationship between two variables. The research method employed in this study is an experimental method with a quasi-experimental design, specifically the non-equivalent post-test control group design. The research methodology for this study involves grouping students who will then receive treatment in the experimental class. This design is employed as a means to evaluate students' critical thinking, communication, and teamwork skills by implementing the debate method. The research design for the non-equivalent posttest-only control group can be seen in Table 1.

Table 1. Research Design Non-Equivalent Posttest Only Control Group Design

Class	Treatment	Posttest
Experiment	X	Y
Control		Y

This study was carried out in July It took place in one of the schools in the Sumedang area. The sample was selected through a non-probability purposive sampling technique, whereby participants were intentionally selected according to specific criteria deemed most aligned with the research objectives. (Lenaini, 2021). This technique allows sampling based on characteristics deemed important to the study (Amelia & Safitri, 2021). The research sample comprised 33 students from class X Building Information Modeling design 2, designated as the control group, and 32 students from class X Building Information Modeling design 3, designated as the experimental group. The selection was based on students' prior performance in the Basic Building Construction subject, with class X Building Information Modeling design 3 assigned as the experimental group due to its lowest average score. Table 2 presents the distribution of the research samples.

Table 2. Research Sample

Class	Sample
X2	33
X3	32
Total	65

The data collection methods employed in this study involved three instruments: a teaching module validation sheet, tests, and questionnaires. The teaching module validation sheet was used to evaluate the feasibility and quality of the module prior to its implementation in the learning process. Its purpose was to ensure that the module content aligned with learning objectives, was relevant to students' needs, and was systematically organized according to pedagogical principles. The validation was conducted by a panel of experts, consisting of teachers, who provided constructive feedback to improve the module so that the final version would be suitable and effective for instructional use.

The test was one of the instruments employed in this study to measure the dependent variable (Y), namely the skills of vocational high school students. The test was administered at the end of the learning process through a posttest. It consisted of 10 questions accompanied by a scoring rubric for evaluating students' skills. This instrument was designed to assess the development of students' skills in both the experimental and control groups. Prior to its use in data collection, the instrument underwent procedures to examine validity, reliability, item discrimination, and difficulty level to ensure its appropriateness. Accordingly, the research instrument comprised two main components: the test items and the scoring rubric, which provided a basis for conducting the research objectively and systematically. The assessment rubric used in this study is presented in table 3

Table 3. Rubric Used

Skill	Aspect	Indicator	Score 1	Score 2	Score 3	Score 4
Critical Thinking	Integration	Students are able to integrate various skills and characteristics in the process of decision-making.	Not relevant	General	Focus enough	Relevant and sharp
	Analysis	Students are able to identify conclusions, reasons, or main ideas, as well as to recognize or infer basic assumptions.	Unable	Limited	Quite logical	Critical and logical
	Focus on the problem	Students are able to identify or formulate problems and establish criteria for evaluating possible solutions.	Unable	Enough	Capable	Very Capable
Communication	Clear	Students are able to communicate clearly and in a well-structured manner.	Unclear	Enough	Clear	Very clear
	Fluent	Students are able to speak fluently, with minimal repetition or unnecessary pauses.	Not Fluent	Less	Quite suitable	Very Suitable
	Effective	Students are able to influence, persuade,	Unable	Less	Capable	Very capable of implementation

Skill	Aspect	Indicator	Score 1	Score 2	Score 3	Score 4
Team Work	Collaborative	and actively listen to the audience.				
		Team members actively contribute, support one another, and demonstrate both individual and collective responsibility	Does not contribute	Less contributing	Contribute	Highly contributing
		Team members are able to manage conflicts effectively.	Cannot manage	Poorly managed	Manage	Manage well
	Team Involvement	Individuals play an active role, remain motivated, and receive recognition for their efforts.	Unable to participate	Less involved	Less involved	Highly involved

To examine the validity and reliability of the instrument, a trial test was administered to the students. Validity refers to the degree to which the instrument accurately measures the construct or variable intended by the researcher, ensuring that the data obtained truly reflects the reality being investigated. In validity testing, correlation analysis techniques developed by Karl Pearson can be used, specifically using the Pearson Product Moment formula.

$$r_{xy} = \frac{n\sum XY - (\sum X)(\sum Y)}{\sqrt{n\sum X^2 - (\sum X)^2} \sqrt{n\sum Y^2 - (\sum Y)^2}} \quad (1)$$

To test the validity of the instrument, a trial was conducted with students who served as respondents. The purpose of this trial was to examine the clarity of the test items, their comprehensibility, and whether the level of difficulty was appropriate for the students' cognitive abilities. Through this process, the researcher was able to determine whether each test item employed clear and unambiguous language. The r-table value is determined to be 0.339, based on 34 respondents at a 5% significance level. The statistical analysis indicates that all test items exhibit r-calculated values exceeding the r-table threshold. This result demonstrates that the research instrument satisfies the validity criteria.

Reliability testing functions as a means to assess the consistency and stability of a research instrument when administered repeatedly to the same subjects. In this context, reliability reflects the degree to which measurement results remain stable across multiple administrations of the same instrument applied to an identical phenomenon. In this study, the reliability of the instrument was assessed using Cronbach's Alpha coefficient, following the procedure outlined by Riduwan, (2019), as presented in the following formula:

$$r_{11} = \left(\frac{k}{k-1}\right) \left(1 - \frac{\sum S_i^2}{S_t^2}\right) \quad (2)$$

In this study, reliability testing will be conducted using the SPSS software application to calculate the reliability coefficient value (ri). Cronbach's Alpha coefficient was calculated at 0.838, this value falls within the *very high* category. This indicates that the research instrument demonstrates strong reliability, characterized by high internal consistency and the capacity to yield stable and valid data. Such reliability ensures that the instrument can be effectively utilized to support data analysis and the formulation of research conclusions.

After collecting student skills data through the assessment rubric, the subsequent step involved conducting a descriptive statistical analysis. Descriptive statistical analysis encompasses data examination by presenting the results in tables, graphs, and pie charts, as well as measuring central tendency (mean, median, mode) and variability (dispersion), such as the standard deviation (Sugiyono, 2019). Based on these calculations, the data were subsequently categorized into the following classifications: 81%–100% (Excellent), 61%–80% (Good), 41%–60% (Fair), 21%–40% (Poor), and 0%–20% (Very Poor).

In this study, Google Forms was utilized as the medium for distributing a set of statements to the respondents. The research instrument employed was a closed-ended questionnaire, functioning as a data

collection tool that presented statements with predetermined response options, enabling respondents to choose the answers that most accurately represented their opinions or experiences. This instrument was adapted from the questionnaire developed by Mawaddah and Authary, (2020) the questionnaire consisted of ten statements designed to assess students' responses to the implementation of the STAD learning model. A five-point Likert scale was employed to capture these responses, enabling a more detailed evaluation of the intensity of students' attitudes. The questionnaire data were subsequently analyzed using the TCR formula, as presented below.

$$TCR = \frac{\text{Average Score}}{\text{Maximal Score}} \times 100\% \quad (3)$$

With the results presented as percentages, they can be categorized 81%-100% (Excellent), 61% - 80% (Good), 41% - 60% (Fair), 21% - 40% (Poor), 0% - 20% (Very Poor).

3. Results and Discussion

3.1. Results of Descriptive Statistical Analysis

3.1.1. Student Skill

A post-test quiz administered after three sessions of traditional learning was utilized to assess the critical thinking, communication, and teamwork abilities of 33 students in the control group. According to the descriptive analysis, the control class had a maximum score of 75 and a minimum score of 25, with a mean score of 46.72% and a standard deviation of 12.66 in critical thinking skills. These results suggest that students in the control group have "fair" critical thinking skills. Communication skills scores varied from 33 to 75, with a mean of 53.79% and a standard deviation of 12.66, putting them in the "Fair" category. Similarly, teamwork abilities received scores ranging from 75 to 33, with an average of 53.28% and a standard deviation of 11.96, putting performance in the "Fair" category. These data, taken together, present a holistic picture of students' abilities in the three assessed domains: critical thinking, communication, and teamwork.

The students' skill achievements after the learning process provide an overview of their proficiency in three domains: critical thinking, communication, and teamwork. Overall, the three assessed skill domains fall within the "Fair" category, albeit with notable variations in achievement and distribution. The descriptive analysis results for the control class indicate a relatively broad variation in achievement across the three domains. The minimum scores indicate that several students demonstrate skills below the expected standard. Conversely, the relatively high maximum scores suggest that some individuals are capable of achieving optimal outcomes, even when learning is conducted through conventional methods without specialized instructional interventions. Furthermore, the relatively large standard deviations across all three skill domains reflect disparities in student performance, resulting in an uneven distribution of skills. This pattern underscores that the learning process in the control class has not produced a consistent impact in enhancing students' skills uniformly. Consequently, significant individual differences remain evident in critical thinking, communication, and teamwork.

Similar to the control class, the experimental class took part in a quiz competition as a posttest to assess their skill progress. The results revealed that, in terms of critical thinking skills, the experimental obtained a maximum score of 100 and a minimum score of 50, with a mean of 80.47 and a standard deviation of 15.50, classifying their performance as "Good." For communication skills, the scores ranged from 75 to 100, with an average of 88.80 and a standard deviation of 8.36, which also falls into the "Excellent" category. Likewise, teamwork skills recorded a maximum score of 100 and a minimum of 67, with a mean of 88.28 and a standard deviation of 9.67, thereby also being categorized as "Excellent."

Overall, the descriptive statistical analysis indicates that the experimental class achieved "Excellent" performance across all three skill domains: critical thinking, communication, and teamwork. The high average scores suggest that most students were able to demonstrate strong abilities in logical reasoning, clear expression of ideas, and effective collaboration. The highest achievement was observed in communication and teamwork skills, which displayed relatively consistent performance across a high score range, as reflected by lower standard deviations. In contrast, although critical thinking skills were also categorized as "Excellent," the wider gap between minimum and maximum scores indicates greater variability among students, suggesting potential areas for improvement. Interestingly, while communication and teamwork skills exhibited almost identical mean scores, the differences in standard deviation suggest that communication skills were more evenly distributed across students than teamwork skills. This discrepancy may be attributed to the fact that communication can be practiced individually as well as in groups, whereas teamwork relies heavily on group dynamics and synergy, which may not always function optimally in every group setting. To facilitate a clearer

comparison, The descriptive analysis results for both the control and experimental classes are illustrated in the figure 1.

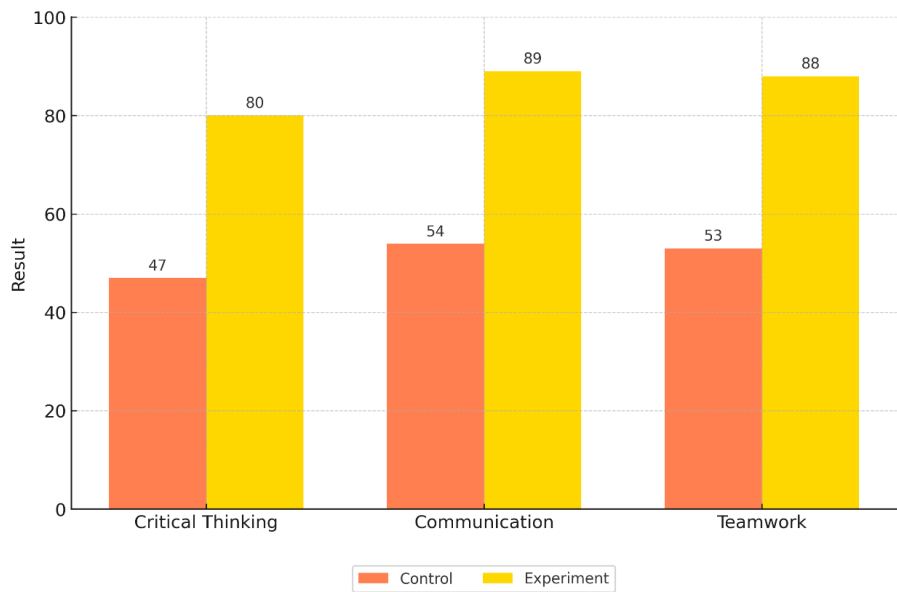


Figure 1 Average Student Skill

3.1.2. Student Response

Regarding students' responses to the learning process that employed the STAD learning model combined with the debate method, the analysis using TCR produced a score of 77.4%, which is categorized as "good." For a more detailed look at the results of the response obtained from students regarding the learning model provided, please refer to Table 4. Result Student Response.

Table 4. Result Student Response

No	Aspect	Average Score	Maximum Score	Percentage	Categorized
1	Learning Motivation	130	160	81%	Excellent
2	Active Participation in Learning	122	160	76%	Good
3	Perceptions of Learning	125	160	78%	Good
4	Skill Measurement	116	160	72%	Good
Average				77,4%	Good

Overall, students responded positively to the application of the STAD learning model with the debate method. More precisely, student opinions imply that this technique not only improves active engagement but also contributes to improving content comprehension and developing 21st-century abilities. Nevertheless, several limitations remain that require attention.

Accordingly, the application of the STAD model with the debate method demonstrates considerable potential as a strategic pedagogical approach to foster active engagement and strengthen 21st-century competencies. However, its effectiveness and sustainability within the context of vocational education depend on careful instructional planning and systematic classroom management.

3.2. Assumption Test Results

The prerequisite analysis serves to ensure that the collected data fulfill the fundamental assumptions necessary for statistical testing, particularly parametric methods. If these assumptions are not met, the results may be biased and the conclusions drawn could be inaccurate. Therefore, conducting a prerequisite analysis is a critical step in strengthening the validity and reliability of the research findings. In this study, two types of prerequisite tests were employed: the normality test and the homogeneity test. The normality test was carried out to confirm that the data distribution approximated a normal curve, which is a key condition for applying parametric statistical techniques. Meanwhile, the homogeneity test was used to assess whether the variances across the groups under comparison were equal, as variance inequality could undermine the validity of the test results.

The normality test was carried out using SPSS version 27.0. Since the sample size in this study was fewer than 50 participants, the Shapiro-Wilk test was employed. The results showed that the control class obtained a

significance value of 0.220, while the experimental class yielded 0.125. As both values were greater than 0.05, it can be concluded that the data from the two groups were normally distributed. In addition, the homogeneity test produced a significance value of 0.618, which is above the 0.05 threshold, thereby confirming that the variances between the groups were homogeneous.

3.3. Hypothesis Test Results

The t-test results for students’ skills in The experimental and control groups are shown in the table. including the findings of Levene’s Test for Equality of Variances. The test yielded an F value of 1.100 with a significance level of 0.29. Since this value is greater than 0.05, it can be concluded that the variances between the two groups are homogeneous, indicating that the variability of the data in the experimental and control classes is relatively similar. Therefore, the t-test analysis was performed under the assumption of equal variances.

Based on this assumption, the calculated t-value was 9.550 with 64 degrees of freedom (df). The significance level (Sig. 2-tailed) of 0.000 reflects an extremely low probability of error in rejecting the null hypothesis, far below the 5% significance threshold (0.05). Consequently, the null hypothesis (H_0), which states that there is no difference in skills between the two groups is refused. However, the alternative hypothesis (H_1) is accepted, confirming the presence of a statistically significant difference in student skills comparing the experimental and control groups.

This conclusion is reinforced by the mean difference value of 11.515, demonstrating that students in the experimental class had higher average skill scores than those in the control group. The standard error of the mean difference was 1.206, indicating a precise and consistent estimate with little variation. Furthermore, the 95% confidence interval, ranging from 9.106 to 13.924, lies entirely within the positive range. This provides strong evidence that the experimental class consistently outperformed the control class in terms of skill achievement. The detailed t-test results are presented in Table 5.

Table 5. Student Skill Results

Independent Samples Test		Levene’s Test for Equality of Variances					t-test for Equality of Means		95% Confidence Interval pf The Difference	
		F	Sig.	t	df	Sig. (2- tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Student Skill	Equal Variances assumed	1.100	.298	9.550	64	<.001	11.515	1.206	9.106	13.924
	Equal Variances not assumed			9.550	46.364	<.001	11.515	1.206	9.106	13.942

3.4. Discussion

3.4.1. Student Skill

Overall, the experimental class demonstrated excellent performance in two skill domains and good performance in one domain, characterized by a high mean score, more controlled score variability, and a more even distribution of results. The highest levels of achievement were observed in communication and teamwork, both of which showed relatively consistent outcomes. In contrast, critical thinking, while still categorized as excellent, exhibited a wider range of scores, indicating the need for further attention and targeted improvement. The results of this study demonstrate that the implementation of the STAD model in combination with the debate method significantly enhanced students’ skill achievement in the experimental class compared to the control class. Whereas the control class attained only the sufficient category, the experimental class reached the excellent category. These findings suggest that the integration of collaborative group interactions and structured debate activities plays a pivotal role in optimally fostering both cognitive development and social competencies. The learning focus includes critical thinking skills, communication, and teamwork. The critical thinking skills of the experimental class students are in the excellent category, because debate requires students to analyze information, evaluate arguments, and formulate solutions based on logical reasoning (Zebua et al., 2024). Debate methods played an important role in achieving this, as each student was expected to identify the issues and topics being discussed in demanding situations, gather and select relevant supporting data, construct arguments systematically and persuasively, and anticipate and respond to opponents’ rebuttals constructively.

This finding aligns with the opinions of Bain et al., (2018) and Bintari et al., (2023), who assert that debate is an effective method for training students' thinking abilities. Additionally, research conducted by Walenta et

al., (2024) also states that using effective debate improves critical thinking skills. Communication skills in the context of learning not only encompass the ability to speak in public but also include active listening skills, responding to arguments, and conveying ideas clearly and structured (Sahara & Satria, 2025). The research results show that the experimental class achieved a very good category in communication skills, while the control class only reached a sufficient category. This research aligns with the findings of a study conducted by Yuliarsih et al., (2025), who stated that using the debate method resulted in improvements in vocabulary usage, fluency, and clarity. In this study, the success of the experimental class is inseparable from the STAD work pattern, which allows students to prepare the material together as a team, ensuring that each member has a solid understanding before speaking. Through debate activities, students are accustomed to expressing ideas clearly and persuasively, while simultaneously honing their listening skills and responding to arguments from others with a positive and constructive attitude (Fitri et al., 2025). Teamwork skills are an important ability in facing the increasingly collaborative challenges of the working world (Rofiudin et al., 2024). In this study, the experimental class achieved a very good category, while the control class only reached a sufficient category. The STAD model is specifically designed to build a positive sense of interdependence within small groups. Each member has a responsibility toward the team's success, so individual and group success are interconnected (Ramadhani & Witjoro, 2025). This result aligns with research conducted by Amirudin, (2023) and R. Putri et al., (2019), which suggests that STAD is more effective than TSP in improving student collaboration.

Teamwork in STAD also facilitates intensive social interaction, which in turn strengthens social bonds and builds a sense of community among students. In addition, the findings from research conducted by Cristyanto & Firdaus, (2025) show that the implementation of the STAD model is proven to be able to improve student achievement and engagement. The results of this study show a strong correlation between the teaching methods used and students' skill achievement. Debate provides a learning context that requires critical information processing and effective idea delivery, while STAD ensures a cooperative structure that facilitates social and academic support among students. Theoretically, this finding is supported by Lesatri, (2018), who states that debate engages students in complex cognitive and linguistic activities, thus not only training critical thinking skills but also improving students' communication, presentation, and public speaking confidence. Slavin, (1995) also asserts that the STAD type of cooperative learning model is able to increase students' active involvement in the learning process through intensive interaction within the group.

The research results show that students' communication skills developed the most compared to their communication and teamwork skills after implementing the Student Teams Achievement Division (STAD) learning model with the debate method. The dominant development in this communication aspect is inseparable from the characteristics of debate itself, which inherently demands students' active participation in conveying ideas, listening to opposing arguments, and responding directly with counterarguments. The debate method places students in an authentic learning situation where they must be able to think quickly, organize ideas, and verbally convey their thoughts using clear and persuasive language (Al Fahmi et al., 2025).

On the other side, while discussions can assess critical thinking and teamwork, the intensity of development in these two areas is not as high as the improvement in communication skills. Critical thinking is more internal and reflective since it involves cognitive processes such as assessing material, recognizing flaws in opponents' arguments, and developing logical arguments (Rendi et al., 2024). Although critical thinking tasks are present in debate sessions, not all students clearly demonstrate them. This is especially noticeable among students who are passive or who prefer to prepare arguments rather than actively participate in the delivering process. Furthermore, the study's preliminary phase found that pupils were more acclimated to learning through project-based activities that included visual or image-based assignments. While such approaches were effective in other ways, they hampered students' ability to systematically develop and refine their critical thinking skills. Furthermore, teamwork which is regarded as a core ability in the Student Teams Achievement Division (STAD) cooperative learning model improved significantly. Within the framework of debate, collaboration was most evident during the stages of material preparation and role coordination among group members. This indicates that although debate promotes collaborative involvement, its impact on collaboration skills is more significant in the preparatory and organizational phases than in the actual presentation of arguments during the debate (Jaiswal et al., 2021).

In optimizing students' critical thinking skills, teachers are expected to provide more innovative learning, such as case study-based learning, and to regularly give questions that challenge cognitive levels C4–C6 based on Bloom's taxonomy. By providing innovative and integrated learning, it is hoped that critical thinking skills can be improved more effectively.

3.4.2. Student Response

The results of the TCR, which included eleven statements, showed that the average respondent rating fell into the good category. This finding indicates that, in general, the implementation of the STAD learning model with the debate method received a positive response from the students. In detail, student perceptions show that learning with this model is able to develop activity, understanding of the material, and 21st-century skills. Based on the findings from the field, the majority of students feel that the learning atmosphere has become more

enjoyable and interactive and encourages active student participation. This constructive atmosphere is an important catalyst for students to dare to express their opinions, systematically construct arguments, and respond to opposing viewpoints with a critical yet constructive attitude. The debate method provides space for students to hone their ability to express ideas and defend arguments supported by relevant data or knowledge. entry-level skills (Walenta et al., 2024). Meanwhile, the implementation of the STAD model strengthens learning through small group work mechanisms. In a group, each student has a responsibility for the team's success, which creates a sense of positive interdependence (Sari et al., 2025).

Based on the high Response Achievement Level (RAL) scores obtained, this means that students have positive feelings toward the implementation of the STAD learning model with the debate method. This positive response is reflected in the students' enthusiasm for learning, their enjoyment of debate activities that stimulate interaction, and their confidence in expressing their opinions. These results align with the theory proposed by Slavin, (2009) that the STAD model is able to actively increase student engagement through group cooperation, which in turn strengthens intrinsic motivation during the process. Debate activities as part of a learning strategy encourage students to think critically and defend arguments with logical reasoning. Additionally, collaboration in small groups provides opportunities for students to help each other, overcome material difficulties, and build solidarity. This condition aligns with the theory of Johnson & Jhonson, (1999), which states that cooperative learning can increase a sense of ownership toward the learning process because the success of the group depends on the contribution of each member.

Additionally, the consistency of these findings is supported by previous research. A study conducted by Danggu et al., (2023) showed that the implementation of the STAD model received positive evaluations from students, with an average rating of good. The study emphasized that the STAD model can make learning participatory and also motivate students to achieve common goals. Furthermore, Hasibuan et al., (2021) also found that the implementation of the STAD model is relevant to students' needs because it can create a fun learning atmosphere, encourage collaboration, and facilitate meaningful interaction between students. Thus, it can be concluded that the positive responses of students in this study are not merely a reflection of satisfaction with the method used but also evidence that the combination of the STAD model and the debate method is capable of impacting students' skills. This model not only helps in achieving learning outcomes but also creates a motivating, challenging, and meaningful learning environment, making it suitable to be an innovative learning strategy at the vocational secondary education level.

3.4.3. Hypothesis Test Results

The results of the independent samples t-test show that the significance value (p-value) is far below the established significance level. This condition indicates that the null hypothesis (H_0), which states that there is no difference in skill measurement between the two groups, is rejected. Conversely, the alternative hypothesis (H_1), which states that there is a significant difference in measurement between the two groups, is accepted. In other words, statistically, there is a significant difference between students in the experimental class who used the Student Teams Achievement Division learning model with the debate method and students in the control class who used the conventional method.

These results strengthen the argument that the STAD learning model combined with the debate method can optimize students' potential through active interaction, group discussions, and the structured presentation of arguments. The learning process in STAD requires students to work together in heterogeneous teams, exchange ideas, and collectively find solutions to the problems presented (Siregar, 2021). Meanwhile, the debate method encourages students to hone their analytical thinking skills, construct logical arguments, and persuasively defend their opinions (Alfian and Nurcaerani, 2024). This combination of strategies creates a learning environment that is both collaborative and competitive, which has proven effective in encouraging active participation and mastery of the material.

This finding aligns with various previous studies. Research by Aulia et al., (2025) shows that implementing debate-based learning (debate instruction) has a significant impact on improving students' critical thinking skills and speaking abilities. From the perspective of the STAD model, the research by Manalu and Simanjuntak, (2023). shows that the application of this STAD learning model has a positive and significant relationship with the improvement of students' cooperative abilities. This indicates that the more optimal the application of this model in the learning process, the higher the quality of students' interaction, coordination, and contribution in working together to achieve group goals. Even research conducted by Jamhari, (2024) shows a significant improvement in all aspects of cooperation skills after implementing the STAD learning model. Specifically, the contribution aspect showed an average increase in the initial stage after the intervention, reflecting increased active participation, engagement in completing group tasks, and willingness to contribute ideas and support the team's success.

Overall, the results of this study provide strong empirical evidence that implementing the STAD learning model with the debate method significantly improves vocational high school students' 21st-century skills. This

includes critical thinking skills, communication skills, and teamwork skills, which are core competencies for facing challenges in the workplace and community life. In other words, learning that integrates collaborative and argumentative elements can be an effective strategy for producing vocational school graduates who are not only technically competent but also excel in social and communication skills.

4. Conclusion

Based on the research findings, it can be concluded that the implementation of the STAD learning model with the optimal debate method is effective in measuring the skills of 10th-grade DPIB students at one of the vocational schools in the Sumedang area in the subject of Building Information Modeling design. The students' responses were considered good, with an achievement level of 77.4%, indicating that the combination of teamwork and debate activities was able to foster enthusiasm, active participation, and critical thinking skills in evaluating ideas. The optimally measured skills include critical thinking, communication, and teamwork, with communication being the most dominant aspect. Compared to conventional learning, this model not only improves mastery of the material but also fosters a collaborative, argumentative learning environment that motivates students to interact constructively. These findings confirm that integrating cooperative and argumentative strategies can be an effective learning alternative for measuring 21st-century competencies in vocational high school students. As a suggestion, future research could expand the variables measured, such as creativity or problem-solving skills, and extend this model to other subjects or learning contexts to enrich the findings and explore the potential for developing student competencies more comprehensively.

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Data Availability

The datasets generated during and/ or analysed during the current study are available from the corresponding author on reasonable request.

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