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Teaching Industry Model for Improving Students' Critical Thinking Skills in Vocational Higher Education

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ABSTRACT

Critical thinking is one of the essential competencies required for vocational students to meet the demands of the industrial workplace. However, students in the Cake Decoration course still demonstrate limited critical thinking skills due to learning approaches that provide insufficient authentic industrial experience. This study aimed to develop and evaluate a Teaching Industry learning model to improve students' critical thinking skills in vocational higher education. The study employed a Research and Development (R&D) approach using the Four-D (4D) model, consisting of the Define, Design, Develop, and Disseminate stages, with implementation conducted up to the Develop stage. The participants were 67 students enrolled in the Cake Decoration course at Universitas Negeri Medan. Data were collected through observation, questionnaires, documentation, and critical thinking assessment instruments, and analyzed using descriptive statistics, correlation, and regression analysis. The findings indicate that the implementation of the Teaching Industry model was categorized as high and effectively supported authentic industrial learning experiences. Students' critical thinking achievement, measured using thirteen indicators adapted from Ennis' critical thinking framework, improved from 8.4% during the needs analysis stage to 92.3% during the field implementation stage. The model also positively contributed to students' learning independence and competency achievement. These findings suggest that the Teaching Industry model is an effective instructional approach for fostering critical thinking skills and strengthening the relevance of vocational higher education to industrial needs. The novelty of this study lies in integrating Teaching Industry-based learning into the Cake Decoration course to systematically develop students' critical thinking skills within an authentic vocational learning environment.

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INTRODUCTION

The rapid development of science, technology, and industry in the era of the Industrial Revolution 4.0 and Society 5.0 has significantly transformed the competencies required in the modern workplace. Higher education institutions, particularly vocational education programs, are expected to produce graduates who not only possess strong technical expertise but also demonstrate higher-order thinking skills, problem-solving abilities, adaptability, collaboration, and professional competence. Consequently, vocational learning should provide authentic learning experiences that enable students to integrate theoretical knowledge with practical applications relevant to industrial needs (Ennis, 2013; Facione, 2015; Rais et al., 2025).

One of the most essential competencies required in twenty-first-century education is critical thinking. Critical thinking enables students to analyze information, evaluate evidence, identify problems, formulate alternative solutions, and make rational decisions. (Ennis, 2013; Asari, 2014), and (Ghiffar et al., 2018) define critical thinking as reflective and reasonable thinking directed toward deciding what to believe and what action to take. Likewise, (Facione, 2015) and (Akbar., 2019) emphasized that critical thinking encompasses interpretation, analysis, evaluation, inference, explanation, and self-regulation. Within vocational education, these competencies are indispensable because graduates frequently encounter practical problems requiring analytical reasoning and evidence-based decision-making. Previous studies have consistently reported that critical thinking contributes positively to students' academic achievement, workplace readiness, and professional competence (Anthony et al., 2025; Duron et al., 2006; Essien et al., 2015).

Despite its recognized importance, developing critical thinking skills remains a challenge in vocational higher education. Learning activities are frequently dominated by procedural practice and teacher-centered instruction, limiting opportunities for students to analyze problems, evaluate alternatives, and make independent decisions. As a result, students often concentrate on completing assigned tasks rather than understanding the underlying reasoning behind workplace procedures. This condition highlights the need for innovative learning approaches capable of integrating authentic industrial experiences with higher-order thinking activities to better prepare graduates for the demands of contemporary industries (Kurniawati & Ruqaiyah, 2025; Anthony et al., 2025).

To address these challenges, vocational education requires learning models that closely simulate authentic industrial environments while encouraging the development of professional competence and critical thinking. One promising approach is the Teaching Industry model. Conceptually, Teaching Industry represents a further development of the Teaching Factory concept by extending industrial collaboration beyond production-based learning toward integrated industrial processes, customer-oriented services, quality assurance, teamwork, and workplace problem solving. Accordingly, Teaching Industry emphasizes not only students' technical production skills but also their ability to analyze problems, make decisions, and respond to authentic industrial situations (Indrawati, 2017; Perdana, 2019; Thompson, 2011).

The implementation of Teaching Industry is highly relevant to vocational education because it creates learning environments that closely resemble actual workplace conditions. Previous studies have demonstrated that industry-based learning contributes positively to students' technical competence, employability skills, learning motivation, and work readiness (Indrawati, 2017; Perdana, 2019). Furthermore, learning environments integrating industrial experiences have been reported to improve collaboration, self-directed learning, and critical thinking among vocational students (Yuniarti et al., 2024; Maryani & Surjono, 2026). These findings indicate that industry-oriented learning provides opportunities for students to integrate theoretical knowledge with practical experience while strengthening competencies required in professional practice.

In Indonesia, the implementation of the Merdeka Belajar Kampus Merdeka (MBKM) policy encourages universities to strengthen partnerships with industry and provide contextual learning experiences that support competency development. The Teaching Industry model aligns closely with these objectives because it facilitates experiential learning, industrial engagement, and the development of twenty-first-century competencies. Nevertheless, several important research gaps remain. First, previous studies have predominantly focused on technical competence, employability skills, and workplace readiness. Second, empirical evidence regarding the contribution of Teaching Industry to improving students' critical thinking skills remains limited. Third, studies specifically examining the implementation of Teaching Industry within Culinary Education, particularly in Cake Decoration courses, are still scarce despite the complex analytical and decision-making processes required in this field (Rais et al., 2025); (Heydemans et al., 2025); (Plomp & Nieveen, 2013). These gaps indicate the need for further investigation into the contribution of Teaching Industry to the development of critical thinking in vocational higher education.

The Cake Decoration course in the Culinary Education Study Program requires students to master not only technical decorating skills but also analytical thinking, creativity, quality evaluation, customer-oriented decision-making, and problem-solving abilities. Students are expected to identify customer needs, select appropriate decoration techniques, evaluate product quality, solve production-related problems, and make decisions based on established industrial standards. Therefore, implementing the Teaching Industry model provides a meaningful learning environment for fostering critical thinking while simultaneously strengthening students' professional competence (Ige et al., 2022; Kalelioğlu & Gülbahar, 2014).

Based on these research gaps, this study seeks to answer the following research question: *How does the implementation of the Teaching Industry learning model contribute to improving students' critical thinking skills in the Cake Decoration course of the Culinary Education Study Program?* Therefore, this study aims to analyze the implementation of the Teaching Industry model and examine its contribution to improving students' critical thinking skills in the Cake Decoration course of the Culinary Education Study Program, Universitas Negeri Medan. The findings are expected to provide empirical evidence regarding the potential of Teaching Industry as an industry-based learning approach that supports the development of critical thinking and professional competencies relevant to the needs of modern industries

METHOD

This study employed a Research and Development (R&D) approach aimed at developing Teaching Industry-based learning tools to improve students' critical thinking skills in the Cake Decoration course. The research was conducted in the Culinary Education Study Program, Faculty of Engineering, Universitas Negeri Medan. The research subjects

consisted of 67 students who were enrolled in the Cake Decoration course. A total sampling technique was employed because all students enrolled in the course during the research period participated in the study. This sampling technique was selected to ensure that all participants experienced the implementation of the developed Teaching Industry learning model.

The development process adopted the Four-D (4D) model proposed by Thiagarajan, Semmel, and Semmel, which consists of four stages: Define, Design, Develop, and Disseminate. However, this study was limited to the Develop stage. The Disseminate stage was not conducted because the primary objective of this study was to develop, validate, and evaluate the feasibility and effectiveness of the Teaching Industry learning model through field implementation. Large-scale dissemination was beyond the scope of the present study and is recommended for future research.

The Define stage aimed to identify and analyze the learning needs related to the development of critical thinking skills among students. Activities conducted at this stage included front-end analysis, student analysis, concept analysis, and task analysis. The analysis focused on identifying learning problems, students' characteristics, curriculum requirements, and learning materials related to cake decoration in the Merdeka Belajar Kampus Merdeka (MBKM) curriculum.

The Design stage focused on designing Teaching Industry-based learning tools, including the Semester Learning Plan (RPS), Student Worksheets (LKM), learning media, and assessment instruments. The learning tools were developed by integrating industrial work procedures, problem-solving activities, and authentic learning experiences into the learning process.

The Develop stage involved the refinement and implementation of the developed learning tools through limited trials and field implementation. The development process included expert validation of the learning tools, followed by a small-group trial, a medium-group trial, and field implementation involving all research participants. Feedback obtained during each stage was used to improve the learning tools before proceeding to the subsequent trial stage. The effectiveness of the Teaching Industry approach was evaluated through students' critical thinking performance and learning outcomes during the implementation process.

Data were collected using observation sheets, questionnaires, documentation, and learning outcome assessments. The instruments were designed to measure the implementation of the Teaching Industry model, students' learning independence, critical thinking skills, and competency achievement in the Cake Decoration course. The critical thinking assessment rubric was developed based on thirteen critical thinking indicators adapted from Ennis' framework, including open-mindedness, evidence-based decision making, problem analysis, information seeking, systematic problem solving, generating alternatives, and the use of credible sources. Prior to implementation, the research instruments were reviewed by subject-matter experts to ensure content validity and their suitability for measuring the intended constructs.

The collected data were analyzed using descriptive statistical techniques to describe the implementation of the Teaching Industry model, students' learning independence, critical thinking skills, and competency achievement. Correlation and regression analyses were also conducted to determine the contribution of the Teaching Industry model and learning independence toward the improvement of students' competencies in the Cake Decoration course. Although this study employed a Research and Development (R&D) approach, descriptive statistics, correlation analysis, and regression analysis were used to evaluate the effectiveness of the developed learning model and to examine the relationship between the implementation of the Teaching Industry model, students' learning independence, and competency achievement during the field implementation stage.

RESULTS

The implementation of the Teaching Industry model was evaluated based on four aspects: learning facilities and infrastructure, learning process, lecturers' performance, and students' participation. The descriptive statistics are presented in Table 1.

Table 1. Descriptive Statistics of Teaching Industry Implementation

Class	N	Range	Min	Max	Sum	Mean	Std. Deviation	Presentation
Class A	33	12.00	23.00	35.00	1919.00	274,14	2,26	71,6%
Class B	34	40.00	100.00	140.00	6959.00	277,18	7,85	82,7%
	67							

The results indicate that the implementation of the Teaching Industry model was categorized as high in both classes, with achievement percentages of 71.6% for Class A and 82.7% for Class B. These percentages indicate that most components of the Teaching Industry model were implemented successfully throughout the learning process.

The successful implementation of the model was reflected in the adequacy of learning facilities, the readiness of lecturers to facilitate industrial-based learning activities, and the active participation of students throughout the learning process. These findings support previous studies indicating that Teaching Industry can bridge the gap between academic learning and industrial needs while improving students' engagement in vocational education (Perdana, 2019; Jufriadi et al., 2022).

Students' Learning Independence

Students' learning independence was evaluated through indicators including perseverance, learning interest, responsibility in completing assignments, achievement orientation, and self-directed learning. The descriptive statistics are presented in Table 2.

Table 2. Descriptive Statistics of Students' Learning Independence

Class	N	Range	Min	Max	Sum	Mean	Std. Deviation	Percentage
Class A	33	12.00	30.00	42.00	2495.00	277,12	2,69	82,8%
Class B	34	08.00	17.00	25.00	1434.00	286,80	2,04	85,6%
	67							

The findings show that students' learning independence was categorized as high, with percentage achievements of 82.8% in Class A and 85.6% in Class B. These results indicate that students became more responsible for managing their own learning activities during the implementation of the Teaching Industry model. The findings also suggest that authentic industrial learning activities encouraged students to seek information independently, organize production tasks, and solve practical problems according to industrial standards. Such learning conditions supported the development of self-directed learning and increased students' responsibility for achieving learning objectives.

Improvement of Critical Thinking Skills

Students' critical thinking skills were evaluated using thirteen indicators adapted from the critical thinking framework proposed by (Ennis, 2013). These indicators included open-mindedness, evidence-based decision making, problem analysis, information seeking, systematic problem solving, generating alternatives, and utilizing credible sources.

Table 3. Analysis of Students' Critical Thinking Skills

Nu.	Criteria	Needs Analysis	Small Trial	Medium Trial	Field Trial
1	Open-minded	5,7	37,1	71,4	94,3
2	Taking a stand when evidence and reasons are sufficient	8,6	42,9	80	85,7
3	Considering the whole situation	5,7	28,6	57,1	88,6
4	Equipping oneself with information	2,9	51,4	74,3	97,1
5	Searching for truth/accuracy as much as possible	5,7	34,3	62,9	97,1
6	Solving problems systematically	11,4	42,9	80	91,4
7	Searching for alternatives	11,4	45,7	68,6	91,4
8	Searching for reasons/causes	8,6	51,4	85,7	94,3
9	Searching for a clear statement of a problem	8,6	42,9	82,9	100
10	Remembering the main/fundamental points	14,3	40	71,4	88,6
11	Using credible sources and citing them	14,3	54,3	74,3	97,1
12	Striving to be relevant to the main idea	5,7	34,3	65,7	88,6
13	Sensitive to the feelings, knowledge level, and ability level of others	5,7	42,9	60	85,7
	Average	**8,4**	**42,2**	**71,9**	**92,3**

The findings reveal a substantial improvement in students' critical thinking skills throughout the implementation stages. The average score increased from 8.4% during the needs analysis stage to 42.2% during the small-group trial, 71.9% during the medium-scale trial, and 92.3% during the field implementation stage.

The highest achievement was found in the indicators of identifying clear problem statements (100%), seeking accurate information (97.1%), equipping oneself with relevant information (97.1%), and utilizing credible sources (97.1%). These findings indicate that the Teaching Industry model effectively facilitated students in analyzing problems, evaluating information, and developing solutions based on real industrial situations.

The improvement of critical thinking skills is consistent with the view of Robert H. Ennis that critical thinking develops through active engagement in problem-solving activities. Similarly, Peter A. Facione emphasized that analysis, evaluation, and inference are essential dimensions of critical thinking that can be strengthened through authentic learning experiences.

Improvement of Students' Competence

The implementation of the Teaching Industry model also contributed to the improvement of students' competence in the Cake Decoration course. The descriptive statistics are presented in Table 4.

Table 4. Descriptive Statistics of Students' Competence Achievement

Class	N	Range	Min	Max	Sum	Mean	Std. Deviation	Percentage
Class A	33	02.00	04.00	06.00	383.00	63,83	0,65	95,3%
Class B	34	10.00	11.00	21.00	1276.00	63,80	2,01	95,2%
	67							

The findings indicate that students' competence achievement was categorized as very high, with percentage scores of 95.3% in Class A and 95.2% in Class B. These results suggest that the Teaching Industry model successfully supported the development of students' cognitive, psychomotor, and affective competencies. The integration of industrial practices into the learning process enabled students to gain practical experience and apply theoretical knowledge in authentic work situations. Consequently, students demonstrated improved competency achievement that was aligned with industry expectations.

Correlation and Regression Analysis

The correlation analysis revealed positive relationships among the implementation of the Teaching Industry model, students' learning independence, and competence achievement. The correlation coefficient between the implementation of the Teaching Industry model and competence achievement was 0.653, indicating a strong positive relationship. Likewise, the correlation coefficient between learning independence and competence achievement was 0.663, which also indicates a strong positive relationship. Furthermore, the correlation coefficient between the implementation of the Teaching Industry model and learning independence was 0.418, indicating a moderate positive relationship. The regression analysis further demonstrated that the implementation of the Teaching Industry model significantly contributed to competence achievement, as represented by the regression equation:

$$\mathbf{Y = 17.358 + 0.656X_1}$$

Similarly, students' learning independence significantly contributed to competence achievement, as represented by the equation:

$$\mathbf{Y = 16.828 + 0.629X_2}$$

The multiple regression analysis revealed that the implementation of the Teaching Industry model and students' learning independence jointly contributed to competence achievement. The resulting regression equation was:

$$\mathbf{Y = 3.555 + 0.457X_1 + 0.448X_2}$$

These findings indicate that both the implementation of the Teaching Industry model and students' learning independence play important roles in improving competence achievement in the Cake Decoration course

DISCUSSION

The findings of this study indicate that the implementation of the Teaching Industry model contributed positively to the improvement of students' critical thinking skills in the Cake Decoration course. This improvement can be observed from the increase in the average critical thinking score from 8.4% during the needs analysis stage to 92.3% during the field implementation stage. These results suggest that learning activities designed through authentic industrial experiences provide opportunities for students to actively engage in problem-solving processes, evaluate information, and make decisions based on evidence.

The significant improvement in critical thinking skills can be explained by the characteristics of the Teaching Industry model, which integrates learning activities with real industrial practices. Through this approach, students are required to identify problems, analyze customer needs, select appropriate materials and techniques, evaluate product quality, and develop solutions to challenges encountered during production processes. Such activities encourage students to apply higher-order thinking skills rather than merely following procedural instructions. This finding is consistent with Ennis (2013), who stated that critical thinking involves reasonable and reflective thinking focused on deciding what to believe or do.

The improvement in students' critical thinking was not merely the result of increased practical experience but was primarily driven by the authentic decision-making processes embedded within the Teaching Industry model. During learning activities, students were required to interpret customer needs, compare alternative decoration techniques, determine appropriate materials, evaluate product quality, and revise products based on feedback. These repeated cognitive activities encouraged students to justify their decisions using evidence rather than intuition alone. Consequently, critical thinking developed naturally because students continuously analyzed problems and reflected on the effectiveness of their decisions throughout the production process.

The results also showed that several critical thinking indicators experienced substantial improvement, particularly in identifying clear problem statements, seeking accurate information, and utilizing credible sources. These findings indicate that students became more capable of gathering relevant information and evaluating evidence before making decisions. According to Facione (2015), effective critical thinkers are characterized by their ability to interpret information, analyze arguments, evaluate evidence, draw conclusions, and regulate their own thinking processes. Therefore, the improvement observed in this study reflects the successful development of essential critical thinking dimensions.

Among the various learning activities implemented, authentic problem-solving and collaborative production tasks appeared to be the most influential factors contributing to the improvement of critical thinking skills. Students worked in production teams where they discussed design alternatives, solved production problems, evaluated product quality, and negotiated decisions before completing the final product. These collaborative interactions exposed students to different perspectives and encouraged reflective thinking, allowing them to evaluate evidence critically before reaching conclusions. Such learning conditions are difficult to achieve through conventional practical instruction, where students generally follow predetermined procedures without substantial opportunities for independent analysis and decision-making.

Another important finding is the high level of students' learning independence during the implementation of the Teaching Industry model. Students demonstrated strong responsibility for completing learning tasks and actively participated in learning activities. The authentic nature of Teaching Industry learning encourages students to become more independent because they are required to complete tasks that resemble real workplace situations. This finding supports previous studies showing that industry-based learning environments promote student autonomy, responsibility, and professional readiness (Perdana, 2019).

The correlation analysis further revealed a positive relationship between the implementation of the Teaching Industry model and students' competence achievement ($r = 0.653$). In addition, learning independence also showed a strong positive relationship with competence achievement ($r = 0.663$). These findings indicate that competence development in vocational education is influenced not only by the learning model used but also by students' willingness to learn independently and take responsibility for their own learning progress. The relatively strong correlation coefficients suggest that authentic industrial learning and learning independence complement each other in supporting competency development. Students who actively regulate their learning while engaging in authentic industrial tasks tend to demonstrate better academic and practical performance than those who rely primarily on lecturer guidance.

The regression analysis demonstrated that the implementation of the Teaching Industry model significantly contributed to students' competence achievement. This result confirms that industrial-based learning provides meaningful learning experiences that enable students to connect theoretical knowledge with practical applications. Similar findings have been reported in previous studies indicating that Teaching Industry and other forms of work-integrated learning enhance students' professional competencies, employability skills, and workplace readiness (Indrawati, 2017; Perdana, 2019).

Although previous studies consistently reported that the Teaching Industry model improves vocational competence and workplace readiness, most of them focused primarily on technical skills and employability outcomes. The present study extends these findings by providing empirical evidence that the Teaching Industry model also contributes substantially to the development of critical thinking skills. By assessing thirteen indicators adapted from Ennis' critical thinking framework, this study demonstrates that Teaching Industry not only prepares students for

industrial practice but also strengthens higher-order cognitive abilities that are essential for problem-solving and lifelong learning. Therefore, the present findings broaden the existing literature by highlighting the cognitive contribution of Teaching Industry beyond its traditional role in improving vocational competence.

From the perspective of vocational education, the findings of this study support the objectives of the Merdeka Belajar Kampus Merdeka (MBKM) policy, which emphasizes contextual learning experiences and stronger collaboration between higher education institutions and industry. By exposing students to authentic industrial environments, Teaching Industry not only improves technical competencies but also develops critical thinking skills that are essential for lifelong learning and professional success in the twenty-first century (Jufriadi et al., 2022).

Despite these promising findings, several limitations should be acknowledged. First, the study was conducted in a single study program with a relatively limited number of participants, which may restrict the generalizability of the findings to other vocational education contexts. Second, the study focused on learning outcomes during the implementation period and did not investigate the long-term retention of students' critical thinking skills after course completion. Future research should involve larger samples from different institutions and conduct longitudinal evaluations to examine the sustainability of the Teaching Industry model in improving critical thinking and professional competence.

Therefore, the Teaching Industry model can be considered an effective instructional approach for vocational higher education, particularly in practical courses such as Cake Decoration. The model provides opportunities for students to develop critical thinking skills, learning independence, and professional competencies simultaneously, thereby increasing the relevance of higher education to industry needs.

CONCLUSION

This study demonstrates that the implementation of the Teaching Industry model was positively associated with the development of students' critical thinking skills, learning independence, and competency achievement in the Cake Decoration course at the Culinary Education Study Program, Universitas Negeri Medan. The progressive improvement in critical thinking performance across the implementation stages suggests that authentic industry-based learning provides meaningful opportunities for students to engage in analysis, problem-solving, and evidence-based decision-making within vocational learning contexts.

The findings contribute to the growing body of knowledge on vocational education by providing empirical evidence that the Teaching Industry model supports not only the development of technical competence but also higher-order cognitive skills, particularly critical thinking. This study extends previous research that predominantly emphasized employability and workplace readiness by highlighting the cognitive value of integrating authentic industrial experiences into vocational learning.

From a practical perspective, the findings suggest that vocational lecturers and curriculum developers may consider incorporating Teaching Industry principles into practical courses to create more authentic, student-centered learning environments. Such learning experiences have the potential to strengthen students' professional competence while simultaneously fostering independent learning and critical thinking, which are essential competencies for graduates entering today's industrial workplace.

This study has several limitations. The research was conducted within a single study program and focused on learning outcomes during the implementation period, limiting the generalizability of the findings to other vocational education contexts. Furthermore, although positive relationships were identified through correlation and regression analyses, the research design does not permit strong causal inferences regarding the effectiveness of the Teaching Industry model. Future studies should involve larger samples, multiple institutions, and more rigorous experimental or longitudinal designs to provide stronger evidence of its long-term educational impact

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