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Optimizing Collaboration Skills in Vocational Students with Discovery Learning and Project-Based Learning

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ABSTRACT

Collaboration skills are vital for 21st-century success, particularly as advancements reshape various aspects of life. At SMK N 1 Kedawung, The Basics of Plant Agribusiness, a subject for tenth graders, emphasizes cultivating these skills. This study investigates the effects of different learning models-discovery learning and project-based learning (PjBL)-on enhancing vocational students' collaboration skills. Conducted using classroom action research with a qualitative descriptive approach, the study spanned five cycles. The findings reveal that both models significantly improve collaboration skills. Discovery learning fosters inquiry and problem-solving through active exploration, gradually enhancing teamwork and critical thinking. In contrast, PjBL centers on collaborative, real-world projects, promoting hands-on engagement and deeper learning. Quantitative results show that collaboration skills improved in all cycles, with PjBL demonstrating a more pronounced effect. Discovery learning yielded consistent yet gradual improvements over three cycles. However, PjBL facilitated quicker and more substantial progress within two cycles, underscoring its effectiveness in fostering teamwork, participation, and practical knowledge application. In conclusion, both methods positively influence collaboration skills, with PjBL offering superior outcomes. Its practical, engaging approach makes it particularly effective for vocational training, addressing the demands of 21st-century education. PjBL is thus recommended for optimal skill development.

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1. INTRODUCTION

Life today and in the future will undergo significant changes as a result of disruptive thinking, rapid technological advancements, and industrial development. These factors have eliminated boundaries between countries, allowing information to flow without filters, thereby impacting the new global life order. This phenomenon is a direct consequence of the Industrial Revolution 4.0, which has transformed all aspects of societal life (Hasan, 2019; Krishnannair et al., 2021). The era of the Industrial Revolution 4.0 must be accompanied by the development of character, which should serve as the forefront in facing these rapid advancements. 21st-century skills are considered capable of addressing these challenges (Johan et al., 2020; Kim et al., 2019). The National Education Association has identified critical thinking, creativity, communication, and collaboration as essential skills.

Education is also affected by the rapid advancement of this era, requiring changes in the learning process. According to Ki Hadjar Dewantara, education is a process of cultural development aimed not only at shaping students into good individuals but also at contributing to a better society. The cultural process within education must include dual orientations, meaning education should enable students to understand both themselves and their environment (Espinet et al., 2023; Irawati et al., 2022). In the context of rapid technological advancements, education must transform to adapt by equipping students with skills that will be useful in society.

Collaboration skills are among the abilities that need to be developed in the learning process, as there is a correlation between students' collaborative skills and their active participation in Learning (Alfaeni et al., 2022; Kori, 2023). Collaboration is a skill that trains students to work together to solve problems (Goradia, 2018; Le et al., 2018; Ramadhon et al., 2023). According to Le et al. (2018), collaborative skills involve the ability to participate in interpersonal relationships, appreciate one another, and work towards achieving shared goals. Trilling & Fadel (2009) identify three components that demonstrate collaborative skills: the ability to work effectively and respect others' opinions to achieve common goals, the capacity to accept differing perspectives, and contributing responsibly to group tasks.

Collaborative skills are crucial for vocational school (SMK) students, as these institutions prepare students with specific skills for practical work experience (PKL) or entering the workforce. Observations by Pratitis & Jama (2020) revealed that Grade XI vocational students in the beauty program at a private school scored below the standard assessment criteria. Factors contributing to these low scores include a lack of student creativity during learning activities, insufficient alignment between the material content, and limited instructional time, leading to students' lack of focus during lessons. Sidi (2020) similarly explained that students' low collaboration skills stem from teaching methods that emphasize individual tasks.

Based on these observations, teachers can design lesson plans that enhance students' creativity through collaborative activities. Collaboration in learning activities should leave meaningful impressions and understanding for students. Thus, teaching materials should involve students actively in the learning process. The preparation of teaching materials includes selecting appropriate learning models.

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Learning models, as described by Joyce, Weil, and Calhoun in Warsono & Hariyanto (2012), depict the learning environment, including teachers' behaviors during instruction. Learning models are effective for improving learning quality, as they actively involve students in the learning process, sharpening their higher-order thinking skills and fostering teamwork and cooperation within groups (Diani et al., 2023; Octavia, 2020). According to Yunita (2021), traditional lecture-based teaching methods fail to enhance students' collaborative skills, necessitating the adoption of alternative learning models.

Several learning models, such as discovery learning and project-based learning, can improve students' collaborative skills. According to research by Alfaeni et al. (2022), students' collaborative skills improved with the Project-Based Learning model. Similarly, research by Nurjanah et al. (2020) showed a significant improvement in collaborative skills through the use of student worksheets (LKPD) based on Discovery Learning compared to conventional learning methods.

Discovery Learning and Project-Based Learning have distinct characteristics in their implementation, which warrant analysis to determine the most suitable model for improving students' collaborative skills. According to Permendikbud No. 22 of 2016, discovery learning emphasizes concepts, meanings, and relationships through intuitive processes that lead to conclusions. This model aims to encourage students to actively participate in discovering and solving problems by analyzing and organizing information (Dehong et al., 2020). According to Ratumanam (2015), Discovery Learning consists of six stages: 1) stimulation, 2) problem identification, 3) data collection, 4) data processing, 5) verification, and 6) generalization.

Project-Based Learning, on the other hand, emphasizes exploration and assessment using problems as the starting point for gathering and integrating new knowledge based on experiences. The syntax for Project-Based Learning, according to Sani (2015), includes 1) project determination, 2) planning and resolution steps, 3) project schedule development, 4) project report completion with teacher facilitation and monitoring, and 5) process and outcome evaluation.

Based on the differing processes in student understanding, this study aims to analyze the most suitable learning model for improving vocational students' collaborative skills using Project-Based Learning and Discovery Learning models.

2. METHODOLOGY

This research was conducted at SMK N 1 Kedawung Sragen during April–May of the 2022/2023 academic year. The type of research used is descriptive qualitative research, which aims to describe an existing condition. In this study, the focus was on describing students' collaborative skills during learning activities in the subject Fundamentals of Agribusiness in Plant Cultivation.

The research method applied was Classroom Action Research (CAR). The procedure in CAR consists of four stages: planning, action, observation, and reflection. The design employed in this study was the time series design, which does not involve random assignments or control groups but rather utilizes a single group. The research was carried out over five teaching

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cycles, each employing a different learning model, namely Discovery Learning and Project-Based Learning.

The population of this study consisted of students from Grade X Agritan 3 at SMK N 1 Kedawung in the 2022/2023 academic year, totaling 36 students (18 male and 18 female). To measure students' collaborative skills, the study utilized collaboration skill indicators proposed by several experts (Greenstein (2012; Mosensen & Fox, 2011; Sagala et al., 2019; Sorensen, 2014).

Table 1. Indicators of Students' Collaborative Skills

Statement	Indicator	Operational Statement
Actively contributing in group work (Greenstein, 2012)	1. Students participate actively, contribute, and take responsibility for completing group tasks (Greenstein, 2012).	1.1 Presenting ideas in group discussions.
	2. Students have the skills to prioritize and promote group interests over personal interests.	1.2 Listening to the ideas of others.
Organizing group tasks (Sagala et al., 2019)	1. Students are capable of sharing roles in completing group tasks	2.1 Carrying out their assigned tasks in the group.
Interacting and sharing roles in groups (Greenstein, 2012)	1. Students possess the ability to act as part of a team to complete group tasks	3.1 Accepting role assignments in group tasks.
	2. Students are capable of handling conflicts effectively within a group while respecting others' opinions.	3.2 Maintaining cohesiveness within the group
	3. Students complete assigned tasks responsibly	3.3 Completing assigned worksheets (LKPD) as part of the group.
Being responsible for completing tasks (Mosensen & Fox, 2011)	1. Students are responsible for ensuring their tasks align with the group's overall goals.	4.1 Collaborating with group members to complete worksheets (LKPD).
	2. Students complete tasks on time	4.2 Completing worksheets (LKPD) on time

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Statement	Indicator	Operational Statement
Working together, respecting, and valuing others (Sorensen, 2014)	1. Students demonstrate respect and appreciation for others' opinions	5.1 Valuing others' ideas during group discussion

The observation assessment system used is a scoring scale from 1 to 4, ranging from "Very Poor" to "Very Good." Students' collaborative skills scores can be calculated using the following formula:

$$\text{Score} = \left(\frac{\text{Total Score}}{\text{Maximum Score}} \right) \times 100$$

Table 2. Scoring System for Observing Students' Collaborative Skills

Score Interval	Category
80 < X 100	Very Good
70 < X ≤ 80	Good
60 < X ≤ 70	Sufficient
40 < X ≤ 60	Poor
0 < X ≤ 40	Very Poor

The observation assessment system employed in this study uses a scoring scale ranging from 1 to 5, categorizing students' collaborative skills from "Very Poor" to "Very Good." To quantify these observations, scores are calculated using a systematic formula that translates the observed behaviors into numerical values. This structured scoring system ensures a comprehensive and objective assessment of students' collaborative skills, enabling precise tracking of their progress and the effectiveness of the applied learning models.

3. RESULT AND DISCUSSION

The research was conducted over five cycles of face-to-face learning activities. During these five sessions, two different learning models were used: the discovery learning model and the project-based learning (PjBL) model. Learning activities using the discovery learning model were implemented in cycles 1, 3, and 5, with each cycle allocated 3 sessions of 40 minutes. Meanwhile, learning activities using the project-based learning model were conducted in cycles 2 and 4, with each cycle allocated 6 sessions of 40 minutes.

The learning process was carried out using distinct syntax for each model. In discovery learning, students were encouraged to discover concepts related to factors affecting plant production, generative and vegetative reproduction in plants, and modern plant reproduction (tissue culture). For these three topics, students, in groups, identified concepts based on the instructions provided in worksheets prepared by the teacher. The results of group discussions were then presented, followed by the teacher providing material reinforcement and reflections in the final stage.

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The project-based learning model (PjBL) was applied to two topics: proving the factors influencing plant production and identifying plants that can be reproduced generatively or vegetatively. The PjBL model emphasized project-based activities in which students constructed their understanding through group projects.

Collaboration skills are the ability to participate in relationships that foster mutual respect and contribute to achieving shared goals. In the learning process, these skills are instrumental in achieving shared learning objectives despite differences in student characteristics. Collaboration skills among students can be assessed using five indicators: active contribution to the group, organizing group work, adapting to various roles within the group, being responsible for completing tasks, and cooperating to accept decisions. Observations of students in class X Agritan 3 during the five learning cycles showed significant data, as represented in the following diagram:

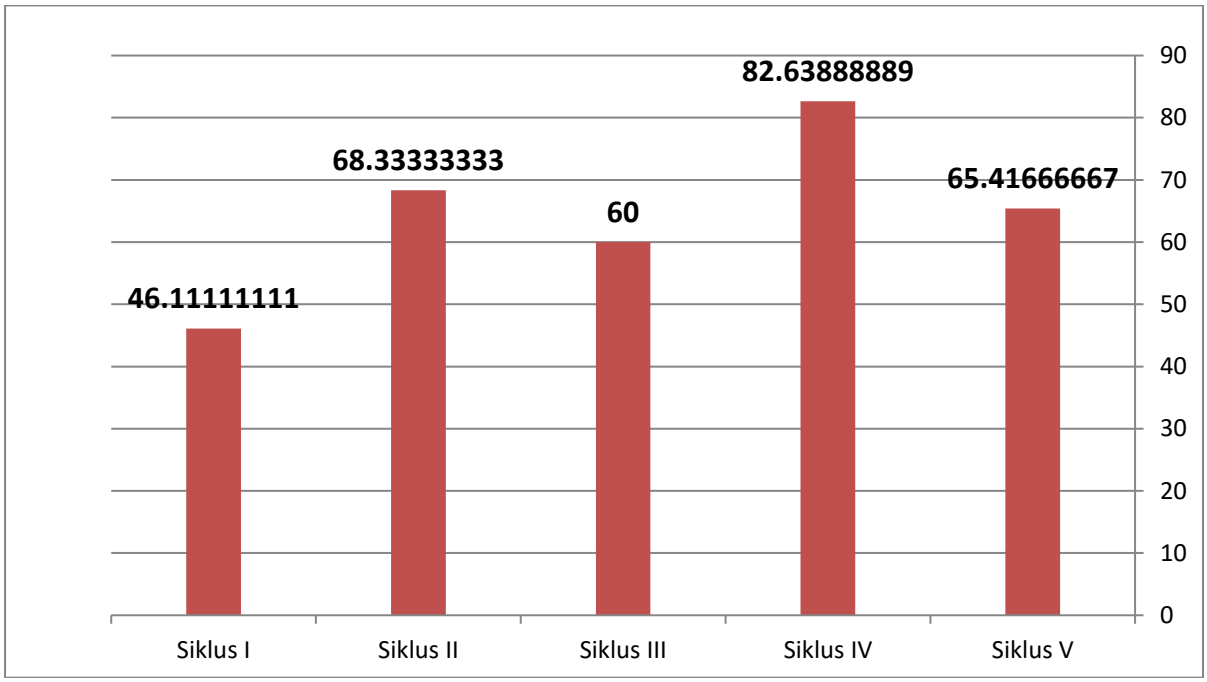

Figure 1. The Results of Observing Class X Agritan 3 Students During Five Learning Cycles

Cycle 1 with the discovery learning model showed results in the less category, namely with a score of 46.1. Cycle 2 obtained a score of 68.3 with a Good category using the PjBL learning model. In cycle 3 using the discovery learning model, a score of 60 was obtained with a less category. Cycle 4, with the PjBL learning model, obtained a score of 82.6 with a very good category. Cycle 5 obtained a score of 65.4, with a good category using the discovery learning model.

The increase in scores in each learning model can be seen clearly. In the discovery learning model, there was an increase from a score of 46.60 to 65, so the increase in score was 19 with 3 learning cycles, while in the PjBL learning model, it showed an increase of 15 with 2 learning cycles. The results of the data obtained showed that there was an increase in using both the discovery learning and project based learning models. The increase in scores in the discovery

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learning model was indeed not as significant as using the PjBL learning model, but the increase in each model showed a positive trend.

The Discovery Learning model has been shown to effectively enhance students' collaboration skills, aligning with previous research findings (Hoerudin et al., 2023; Nusantari et al., 2021; Syafii, 2022; Usman et al., 2022). This improvement reflects the model's capacity to engage students in active inquiry, exploration, and problem-solving, fostering a cooperative learning environment. Similarly, Balqist et al. (2019) highlighted that the Discovery Learning model positively impacts students' collaboration abilities by encouraging teamwork, critical thinking, and active participation in the learning process. These studies underscore the effectiveness of Discovery Learning in developing essential 21st-century skills, such as collaboration, by promoting an interactive and student-centered approach to education. This is evident from the initial scores of students which were initially in the less category in the first cycle then increased in the third cycle to sufficient until they reached the good category in the fifth cycle. The increase in each of these cycles explains that the discovery learning model can be used to improve collaboration skills in students.

The Project Based Learning learning model shows a very high increase in scores using only 2 learning cycles. In the second cycle, it showed a good score, namely at a value of 68, then the score increased very drastically in the fourth cycle, namely at a value of 82. Learning in these 2 cycles shows that the PjBL learning model is very effective for improving students' collaboration skills because, in this learning model, students work actively with groups to build their understanding. This aligns with findings from previous studies, which emphasize that the PjBL learning model effectively increases the role of students in the learning process (Distyasa et al., 2021; Eliza et al., 2019; Maros et al., 2023). Research conducted by Pratitis & Jama (2020) explains that the project based learning model can effectively improve students' abilities in cognitive and psychomotor aspects. Based on the description of the data, it can be explained that students who are actively involved in learning activities directly can improve their collaboration skills with each other. The discovery learning model provides students with understanding but is not actively involved in learning activities because, in the process, they only find concepts. In contrast, in project-based learning, more emphasis is placed on activities to find themselves from basic things so that students can build their understanding by collaborating with fellow students in the group.

4. CONCLUSION

The Discovery Learning model demonstrated a consistent increase in scores across the three implemented learning cycles. Similarly, the Project-Based Learning (PjBL) model also showed a very significant improvement in scores over two learning cycles. Both learning models—Discovery Learning and Project-Based Learning—were able to demonstrate positive score improvements in each cycle, making them both reliable for enhancing students' collaboration skills. However, the Project-Based Learning model is more recommended due to its higher effectiveness in supporting the development of students' collaboration skills.

The findings of this study have important implications for educators and curriculum designers in vocational education. Implementing Project-Based Learning can significantly

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enhance students' teamwork and practical application abilities, aligning well with 21st-century skill requirements. While Discovery Learning provides a gradual improvement, its integration can be further optimized by combining it with project-based elements to balance inquiry-based learning with practical engagement.

Future research should explore the long-term effects of these learning models on collaboration skills and other competencies, such as problem-solving and critical thinking. Additionally, studies could investigate the integration of digital tools within these models to enhance their effectiveness and engagement levels. Expanding the research to different vocational disciplines and student demographics would also provide a more comprehensive understanding of the model's broader applicability.

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