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Optimizing students' practical skills through project-based learning: case study in vocational high schools

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ABSTRACT

Competition in the global era requires graduates from vocational schools to be more skilled in hard and soft skills to adapt to the industrial world. Adaptation of vocational education institutions to the industrial world is vital; thus, they can continuously update the skills of their graduate candidates. Hence, this research aims to describe the implementation of the Center of Excellence curriculum and project-based learning in a vocational high school as a form of school adaptation to the development of the industrial world in the 21st century. This research was included in a qualitative research design adopting a case study. The research respondents consisted of vocational high school residents in Central Java. Data was collected through interview techniques and observations and then analyzed interactively and descriptively. The research results then reported that the school was fully committed to implementing the Center of Excellence curriculum regarding teaching human resources and learning facilities. The project-based learning process also seemed to run optimally. Students could accept it, considering that project-based learning was implemented because it was an adaptive model to accommodate 21st century competencies. However, there is still room for improvement and optimization in order to effectively implement this operational curriculum and enhance students' ability to acquire 21st century skills.

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1. INTRODUCTION

Globalization is a process of international integration due to exchanging worldviews, products, thoughts, and other aspects of culture [1], [2]. In the era of globalization, the nation and state's skills are required to keep abreast of developments in this changing global world. Advancement is not solely limited to the realms of economics and technology, but it is also imperative in the context of education [3]. Undeniably, the advent of industrialization will bring about a transformation in the production process, transitioning it from a reliance on manual labor to a focus on mechanized manufacturing, replacing people labor with

complex technology [4]. This shift indirectly demands a change in mindset from a conventional workforce to a technologically skilled workforce while being sensitive to developments in information technology in the industrial world [5].

To realize the functions and goals of national education in Indonesia, practitioners and policymakers must design an education system oriented towards the world of work. One effort to achieve this goal is to organize and implement vocational education [6], [7]. It is hoped that vocational education will be a breakthrough in increasing the competency and professionalism of the workforce in facing economic globalization and preparing students to engage in employment [8]. As known, vocational education in several countries is commonly directed to produce a workforce whose competencies align with the needs of industrial-technological developments [9]. Besides, students in vocational education are also required to work professionally and can develop themselves and adopt and adapt to developments in industrial science and technology [10].

Indonesia continues to innovate in terms of national vocational education policies. Education observers and policymakers have been actively working towards developing practical initiatives to serve as a bridge for enhancing the standard of vocational education. This is being achieved through the implementation of the Vocational School Center for Excellence Program, which aims to formulate operational programs [11]. The primary objective of the center of excellence vocational high school program is to cultivate graduates who are actively engaged in the professional realm or venture into entrepreneurship. This is achieved through a meticulous and all-encompassing integration of vocational education with the practical demands of the working world. These graduates are envisioned to serve as beacons of excellence, fostering continuous improvement and serving as valuable resources for other vocational high schools [12], [13].

Learning is carried out in the Center of Excellence Vocational School Program, referring to the Pancasila student profile, to strengthen the student's competence, character, and work culture, an essential component in the learning implementation [14]. The Pancasila student profile in Indonesia represents the epitome of Indonesian students as perpetual learners who possess both competence and character in alignment with the values of Pancasila. This profile encompasses six key attributes: unwavering faith, reverence for the almighty and virtuous character, appreciation for global diversity, a spirit of collaboration, self-reliance, critical thinking abilities, and creativity [15]. In the context of implementing the center of excellence vocational high school program, the government offers operational curricula and instructional resources to support schools, educators, and educational institutions participating in the center of excellence vocational high school program, as designated by the government, to use the operational curriculum used in academic departments in carrying out their learning. One of the most critical components of the education system is the curriculum.

The vocational education operational curriculum is developed by considering the characteristics of the educational unit, socio-cultural context, environment, world of work, and students. This is a conceptual step to improve the quality and efficiency of vocational education, reflecting a response to societal needs. This process involves close collaboration between schools, society, industry, and the government to shape students' personalities [16]. In addition, through the implementation of the operational curriculum, hopefully, there will be a link and match between the needs of the industrial world, supported by a relevant curriculum with content standards and graduate competency standards [4], [17]. Thus, vocational education focuses on producing quality graduates according to the demands of the Business and Industrial World (DUDI).

Central Javanal High School (SMKN) 2 of Salatiga is one of the vocational high schools located in Central Java, was selected to be the school implementing the center of excellence vocational high school program. This school will serve as a model and hub for enhancing the standards and achievements of other vocational high schools. As a result, SMKN 2 of Salatiga has been selected to be part of the center of excellence vocational high school program. Therefore, the teaching and learning activities must follow the operational curriculum in the Education Unit. Using the operational curriculum certainly brought many changes to the paradigm of daily learning, starting from the teachers' roles. The students' responsibilities in educational tasks, and the extent of their various skills in comparison to alternative curricula.

The implementation of the operational curriculum in the Education Unit promotes learning independence. It provides a consequence for teachers in using learning materials based on the interests of students' talents [11], [18]. To implement the operational curriculum in the Education Unit, teachers must design learning methods according to the principles of operational curriculum development in the Education unit [19]. Meanwhile, in learning activities, students are directed to completing a project that is packaged in implementing project-based learning; hence, it will provide students with real experience in the industrial world [20].

SMKN 2 of Salatiga organized education in technology and engineering in synergy with the industrial world and vocational universities that focused on implementing link and match [21]. One of the departments, namely light vehicle engineering, which was oriented toward automotive products, demanded to produce graduates whose skills meet industry needs. Indeed, the ongoing learning process in the department

must follow what has been planned by the teachers. Therefore, teachers must understand professionalism in their assignments [22] because it is undeniable that teachers are the main actors in the learning process, especially in vocational education. Ideally, these teachers must master teaching methods theory and practice relevant to the competencies as targets because productive learning has characteristics that cannot be equated with other learning [4].

One of the learning methods to encourage participants to achieve competence in skills, knowledge, and attitudes is to employ an approach whose work is project-based learning. Project-based learning is nothing new. John Dewey popularized it in the early 20th century and became popular in the 1970s [23]. Project-based learning will encourage students to actively learn to take roles, ask questions, make decisions, analyze, think critically, and construct and present learning outcomes [24], [25]. The application of project-based learning as a central part of the Center of Excellence Vocational curriculum, in its implementation at SMKN 2 of Salatiga, especially in the light vehicle engineering major, since the beginning of the 2021-2022 academic year, has experienced quite significant progress. It is evident from the many works produced by students from the learning process. However, some teachers do not understand project-based learning in the learning process.

One of the essential things in this research is that, theoretically and practically, it is hoped that it will be helpful in the development of the world of learning, especially in the implementation and development of the Center of Excellence Vocational Curriculum in the Center of Excellence Vocational School Program. The benefits of this research will undoubtedly be felt by stakeholders, teachers, and policymakers considering formulating the learning process in schools. The description and brief description above show that the Vocational School Center for Excellence program is part of the government's efforts to answer the challenges of economic globalization, especially in responding to the challenges of Industry 4.0, which is very important and urgent to be implemented immediately.

The shift in curriculum methods has directly placed schools, teachers, and students in different learning adaptations. In its implementation, indeed, schools as role models still faced obstacles. Therefore, this research is expected to explore the implementation of the Center of Excellence vocational high school curriculum at SMKN 2 of Salatiga, especially in the light vehicle engineering department.

The importance of implementing the Center of Excellence curriculum in vocational high schools still tended to be new, and teachers faced obstacles in the implementation process. Moreover, it is hoped that educators can apply project-based learning to optimize the implementation of the Center of Excellence curriculum in optimal vocational schools. Hence, this research aims to describe and analyze the vocational high school teachers' understanding of project-based learning and its implementation on light vehicle engineering material that the school is currently implementing.

2. LITERATURE REVIEW

2.1. Vocational education and challenges of the 21st century

Vocational education is developed using educational, social, economic, political, and employment policy instruments. Vocational is sensitive to social problems and changes in society. Vocational education prepares students for employment [26]. New vocational education is always close to the working world [27]. Furthermore, Wardiman argues that students need programs that can provide skills, knowledge, work attitudes, experience, insight, and networks to help them get jobs according to their career choices [28]. The graduates' competency standards (SKL) in vocational secondary education units (SMK) have the goal of enhancing intelligence, knowledge, personality, moral values, and independent living skills, as well as preparing students for further education in their chosen profession [29]. In addition, a vocational high school is a form of vocational education that prioritizes harmony between the working world and learning (link and match). The network between schools and the industrial world is packaged in theoretical and practical learning, the hallmark of learning applied in vocational high schools [30].

In the 21st century, vocational school graduates will face various challenges. One of them is the alignment and updating of competency details that must be mastered by vocational high school graduates [31]. The challenges of the 21st century that educational institutions must face as creators of superior human resources must be dynamic and adaptive, so they are not inferior to change [32]. In the 21st century, there are several challenges that we face. These challenges include problems with information technology security, ensuring that production machines are reliable and stable, a shortage of necessary skills, resistance to change from stakeholders, and the loss of jobs due to automation and technology [33].

These conditions have led to speculation that several professions will be lost or replaced by technology [34]. In order to effectively address the demands of the 21st century, vocational education needs to align itself with the realms of industry, business, and employment. This can be achieved by developing a curriculum that emphasizes the psychomotor, affective, and cognitive dimensions of learning. Additionally, vocational education should adopt a multicompetence approach, enabling students to acquire a diverse range of skills. It is crucial for vocational education to remain attuned to the ever-evolving landscape of business,

industry, and work, as well as provide the necessary facilities and infrastructure. Ultimately, vocational education must equip students with the essential skills required to thrive in the 21st century. Furthermore, it is crucial to embrace innovative learning methods in order to equip our workforce with the necessary skills to thrive in the era of the Fourth Industrial Revolution [23].

2.2. Center of excellence vocational high school program for 21st century learning

Vocational education stands apart from conventional education and other forms of education due to its distinct characteristics. These include its emphasis on individual performance within the workplace, its specific alignment with real-world needs in the respective field, and its curriculum that focuses on psychomotor, affective, and cognitive aspects. Moreover, the measure of success in vocational education extends beyond the confines of educational institutions alone. It also encompasses a keen awareness of developments within the workplace, necessitating the provision of adequate facilities and infrastructure. Additionally, the learning environment plays a crucial role in supporting vocational education. Undoubtedly, the implementation of vocational education is influenced by the chosen curriculum, which serves as the foundation for the learning process [35].

The educational institution's learning success is greatly influenced by the curriculum. The curriculum focuses on processes or experiences, based on the belief that students possess innate abilities to think, act, problem-solve, and learn and grow autonomously [11]. The education unit operational curriculum uses operational learning to carry out the center of excellence vocational high school program. The Guidelines for the Implementation of the center for excellence vocational high school program state that the education unit operational curriculum is created and overseen by the education unit, in accordance with the government's fundamental framework and curriculum structure for the program [22], [36].

The education unit operational curriculum consists of different parts that are created and used in educational units. These parts include the defining features of the education unit, its goals and purpose, objectives, learning materials, lesson plans, evaluation support, and opportunities for professional growth. Hopefully, implementing this curriculum will provide clear direction and goals and accommodate the need for synergy between learning and industry [32]. In the learning process in vocational high schools, its application will be crucial in providing a framework for competency requirements that students must master so that graduates can be engaged in the working world and are closely familiar with manufacturing technologies [37].

2.3. Project-based approaches in vocational education

Learning is a basic education process, the formal sphere of education. Dimyati and Mudjiono [38] believe that learning is a preparation prepared by the teacher to attract and provide information to students so that preparations designed by the teacher can help students face objectives. Learning as an organized combination includes human elements, materials, facilities, equipment, and procedures influencing each other to achieve learning objectives [8]. Learning is a process in which a person’s environment is deliberately managed to enable him to participate in certain behaviors under particular conditions. Learning is acquiring character, knowledge, and attitude [39].

The learning activities in vocational high schools must facilitate graduates with the skills to work according to their competence and area of expertise. Learning in vocational high schools has a normative, adaptive, and productive scope [22]. Therefore, unique learning models are needed, which, if applied during learning, will be more optimal to facilitate students in obtaining the various competencies needed, such as project-based learning. Project-based learning (PjBL) is a learning model that involves students in activities that produce products. Student engagement starts with planning, designing, creating, and reporting results in products and reports [40]. PjBL emphasizes a long-term learning process involving students directly with various daily life issues and problems, learning to understand and solve real problems, being disciplined, and involving students as the main actors [41].

Project-based learning supported by contemporary technology is a strategy for transforming non-traditional classrooms. Teachers are no longer content experts who share information with students but tend to be facilitators. Students’ behavior will change not because they follow the teacher’s directions but based on their experiences to create learning meaning [42]. Besides, PjBL is a framework for education that will be implemented in the future [43]. Some studies revealed that the PjBL learning model has significantly increased the competency of vocational high school students [42], [44].

A study by Roemintoyo [45] stated that project-based learning could be applied and effective in helping students acquire practical skills. Another study also conveyed that implementing PjBL has succeeded in increasing skills that could be integrated into learning media development [46]. It can be seen from the relevant studies’ findings that project-based learning should be one of the models referred to by teachers in vocational schools to help students achieve competence and improve their learning outcomes.

3. METHOD

This research belonged to the qualitative research design. It was intended to make analyzing the topics/problems easier [47]. As qualitative research, this research adopted a case study model expected to investigate phenomena in depth in the context of daily continuity in the learning process [48]. This research investigated and analyzed the phenomena that occurred in the sample school. A case study can be applied in various ways, including interviewing sources to obtain data, making observations, or tracing and searching for secondary data in supporting documents, as other factors are needed in these research variables [3].

This research focused on implementing PjBL in a vocational high school that applied an operational curriculum, namely the Center of Excellence curriculum. The research samples were selected using a purposive sampling technique [49]. Thus, these research samples consisted of the school principal, vice principals for curriculum and facilities and infrastructure, light vehicle engineering teachers, and 23 vocational high school students.

This research collected data using the non-test method [50], consisting of several methods, including interviews and observations. The semi-structured in-depth interview technique was selected as a data collection technique. Furthermore, resource persons as respondents were interviewed to gather information related to the ongoing learning process through PjBL implementation. In this research, we formulated several indicators to serve as a reference in formulating interview questions. Several aspects that will be the focus of data mining through this interview activity are: i) teachers' understanding of the Center of Excellence curriculum in vocational high schools, and ii) students' enthusiasm during learning by implementing PjBL. Several interview indicators are depicted in Table 1.

Table 1. Interview grids [11], [17]

No.	Aspect	Indicator
1.	Teachers' understanding	Good: has attended a training/workshop on the Center of Excellence curriculum and has learning tools for the Center of Excellence curriculum. Enough: has attended the training, but the learning administration is incomplete. Less: have not participated in training/ do not have learning administration
2.	Students' activities in the learning implementation	Good: students are enthusiastic and understand the learning that has implemented PjBL. Enough: students are enthusiastic but do not understand the learning that has implemented PjBL. Less: students are less enthusiastic and do not understand the learning that has implemented PjBL.

Another data collection used is observation. The observation technique is intended to obtain data from classroom implementation. This technique aims to provide an accurate picture of the implementation of project-based learning, which has been applied to classroom learning activities. In this research, we formulated several aspects that are the basis for viewing the learning process. These aspects consist of i) the opening phase during the learning process, which will contain motivation indicators, conveying learning objectives, and praying; ii) the learning implementation phase of course in this aspect will contain several indicators that are observed, for example, class management and use of learning media, and iii) aspects closing, which contains indicators for conveying conclusions and feedback to students as they follow the learning process. Several aspects and indicators explained earlier are depicted in Table 2.

Table 2. Observation sheet grid during learning activities [51], [52]

No.	Aspect	Indicator
1.	Opening phase	Motivation Chanting prayers Delivering learning objectives
2.	Learning implementation phase	Apperception of material Skill in explaining the material The use of media Class management Project division to groups
3.	Closing phase	Summary Feedback

The validation of the data obtained from various data collection techniques or methods was subsequently conducted. To be precise, this research employed the method of data validation known as triangulation. Among several triangulation techniques available, data source triangulation was chosen for this study based on careful considerations [48]. Triangulation of data sources in this research will briefly contain several steps to obtain the desired information relevant to the research theme. Information will be extracted

from data sources: interviews with related informants, research subjects, and steps for searching and extracting data. Furthermore, the same data source is through observing activities carried out by research subjects, both before the implementation of learning and during the learning process. In short, the triangulation flow of data sources we adapted for this research is depicted in Figure 1.

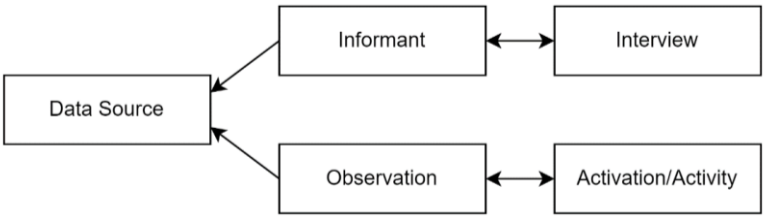

Figure 1. Triangulation of data sources

In this research, data obtained from various collection techniques were analyzed descriptively [53] through interactive analysis techniques referring to Miles *et al*. [54]. It was inseparable from the research objectives, namely to describe and analyze the data obtained regarding teachers' understanding of the Center of Excellence curriculum and the implementation of project-based learning in vocational high schools. Miles Huberman's interactive data analysis technique includes data reduction, data presentation, conclusions, and verification [54]. Briefly, in this research, the use of interactive data analysis aims to filter field data that is genuinely relevant to the research topic so that meaning will emerge from the qualitative data that has been collected. The first step is data reduction, which is reduced into units that can be managed and understood. Furthermore, data is presented in various forms, both visually and descriptively, to help identify patterns or relationships. The following process is drawing conclusions and verification, where the researcher develops an interpretation and tests the validity of the findings by referring to the initial data. Finally, data presentation is done through narrative or visualization to explain the results comprehensively, an illustration of data analysis is shown in Figure 2.

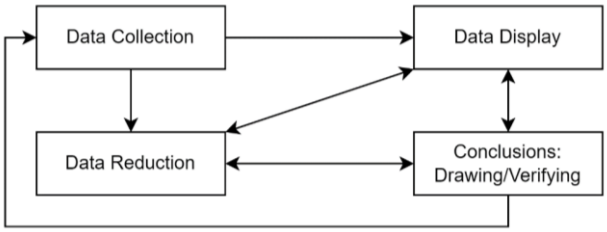

Figure 2. Interactive data analysis techniques [55]

4. RESULTS AND DISCUSSION

4.1. View of teachers on implementation of the Center of Excellence curriculum

This section will describe the findings from various data sources regarding their understanding of the Center of Excellence curriculum they have implemented in schools. In this section, the data obtained came from unstructured interviews conducted with several data sources: the school principal, the vice principal of the curriculum sector, the vice of the facilities sector, and several vocational high school teachers. According to the perspective of the school principal as education manager, the success of implementing the Center of Excellence curriculum is a shared responsibility, considering that they, as executors, also have a high commitment to the challenges that graduates will face. Therefore, educators in schools have committed to implementing the operational curriculum. It could be seen from the number of teachers with industry-based expertise certificates. The school also had a network of cooperation with the industrial world, as well as aligning the curriculum for each subject with practice and needs in the field (industrial world) so that graduates could be hired in the working world because their competencies were relevant to the needs of the industrial world. This result was stated in the interview's quote with Informant I:

> *"The successful implementation of tasks is a shared responsibility. It can be achieved if all school members have high integrity, commitment, and sensitivity in facing current development challenges.*" (Principal)

Heretofore, ongoing implementation of the Center of Excellence curriculum has also received full support from schools. As mentioned, the school community has committed to including vocational education to compete globally. It was then supported by training and mentoring activities for educators to manage ICT-based learning and the industrial world. It is undoubtedly with the assumption that when learning management was aligned with industrial developments, there would be competence relevance and strengthening of competencies possessed by graduates based on the Pancasila character. Informant 2 mentioned in the interview excerpts that another way of demonstrating commitment was through partnering with tertiary vocational institutions to exchange knowledge on managing ICT-based learning, with the aim of equipping graduates with digital literacy skills.

> *"….The learning implementation is oriented towards strengthening competence under the needs of the business and the industrial world as well as character development under Pancasila values…."* (Vice Principal of Curriculum)

Aside from preparing human resources for school members, facilities were also critical issues to pay attention to so that this curriculum could be implemented optimally. Indeed, the school has allocated a budget to meet the need for excellent-quality practice equipment, hoping they could practice and carry out practical simulations as if they were in a company. In addition, another implication of this operational curriculum implementation was that various extracurricular and intra-curricular options were oriented towards strengthening the profile of Pancasila students, such as *pencak silat*, scouts, and other activities that supported the achievement of Pancasila characters. The interview excerpts stated that preparing student facilities and activities while implementing the operational curriculum was important.

> *"…has allocated a budget for procuring equipment that focuses on the practical needs of students with business and industry standards … for improving industry-based facilities and infrastructure."* (Vice Principal of Facilities and Infrastructure)
> *"…holding activities for its students both intracurricularly and extracurricularly oriented towards strengthening the profile of Pancasila students..."* (Vice Principal of Student Affairs)

In terms of policy, the school community has been highly supportive and committed to optimizing the implementation of the Center of Excellence curriculum. Furthermore, it can be seen that most of the teachers also had a complete commitment so that implementing this curriculum could be optimal. In practical terms, educators should possess the capability to develop instructional materials that incorporate andragogy and project-based learning, while also adapting the content to align with the requirements of the industrial sector. Furthermore, teachers who have participated in workshops and engaged in the socialization process of the Center of Excellence curriculum implementation seem to exhibit a higher level of readiness compared to their counterparts who have not had such opportunities.

The teacher played multiple roles as a mentor, instructor, and guide while implementing this curriculum. Information technology was used to support the learning process and create opportunities for collaboration between teachers and students. In order to plan learning activities, teachers needed to have sufficient knowledge about industry and technology. This approach differed from the perspective of teachers who did not participate in outreach activities and workshops. It was believed that teachers who did not attend workshops faced challenges in planning ICT-based learning, creating teaching modules, and collaborating with teachers and students to integrate subjects or materials during the learning process.

Some of these descriptions were supported through interview excerpts regarding the readiness of the teaching staff in implementing the Center of Excellence curriculum.

> *"… In implementing the Center of Excellence curriculum, teachers prepared the administration with a project-based andragogic learning system. The things needed in implementing the curriculum included input from the industry, materials needed in the industrial world, applicable media, and real media…"* (Teacher 1).
> *"…can carry out collaborative learning between subjects with learning administration, including strengthening the Pancasila Student Profile. .... The teacher can coach, mentor, and teach students in project-based learning."* (Teacher 2).

> *"….What is needed in implementing the Center of Excellence curriculum was sufficient literature, adequate information technology…. in implementing the Center of Excellence curriculum."* (Teacher 3).
> *"Unprepared in implementing the Center of Excellence curriculum because they have not attended a workshop on the Center of Excellence curriculum that was intensively sustainable …"* (Teacher 4).

Based on the interviews, it was identified that implementing the Center of Excellence Vocational High School curriculum had been included in the excellent category because many teachers have participated in workshop activities. Policymakers were also highly committed and supported these activities. However, some teachers were still not optimal in planning learning activities and preparing learning materials.

4.2. Project-based learning activities

Observation activities implementing project-based learning were significant, considering that one of the indicators set was the optimal implementation of project-based learning. Therefore, how activities in the field regarding the implementation of this agenda were fundamental to describe. This observation was carried out during four Light Vehicle Automotive Engineering Department meetings. From the results of observations, researchers managed to identify several facts that occurred, including:

4.2.1. Preparation stage

Practical learning began with morning ceremony activities led by the class leader. Then, the teacher checked the attendance of the students. Furthermore, the teacher explained the practical objectives and technical operations of project-based practical activities that students would carry out. Afterward, the students performed physical warm-up activities by running around the school garden and closing the ceremony by praying for the smooth running of practical activities in the Practical Workshop/Lab.

4.2.2. Learning stage

The practice activities for the Entrepreneurship Creative Product subject in the Light Vehicle Engineering workshop are considered attractive and fun. It was illustrated by the expressions of the students who participated. From the data in the field, the teacher explained the initial activities of making key chains as learning material using the project-based learning method. The learning activity lasted for one meeting with a material introduction program and the materials and processes to go through in making key chains.

The teacher designed a budget and cost plan (RAB) at the end of the first meeting, which students would discuss or present in the following learning meeting. The second meeting demonstrated that there were comprehensive student activities with the activities that had been planned at the beginning of the entrepreneurship product (PKK) subject with project material for making key chains. The students worked to make molds in groups, which showed communication and collaboration to get the best pattern/ picture of the molds. At the third meeting, the mold-making activities were still the same as in the previous meeting. However, several groups of students did it outside the Light Vehicle Engineering (TKR) workshop area. This activity implied freedom in learning, which did not require a specific place to develop innovation and creativity.

Furthermore, the fourth meeting culminated in making critical chains by printing resin into molds that each student had determined. The mixture of resin and hardener greatly affected the drying process. It would dry faster if much hardener were used, but the results were not maximal or blurry. On the other hand, if too little hardener were used, the drying process would be slow, but the results were brighter/clearer.

4.2.3. Closing stage

At the end, the teacher summarized the hands-on activities and gave positive feedback by showing appreciation and gratitude for the students' active participation. It was undoubtedly a positive activity that must be maintained, considering that this section was also significant so that students could once again recall the material presented during the learning process.

According to the data we observed, there were many interesting things happening. Specifically, the students were able to participate in practical activities that were tailored to their needs and had access to high-quality equipment. These practical activities took place in the light vehicle engineering workshop. During project-based activities, we noticed that the students were enthusiastic and enjoyed themselves. They had the freedom to choose where they wanted to study, with the guidance of their teacher who supported project-based learning. It could be considered that the application of the Center of Excellence curriculum has become an innovation for creating human resources and graduates who are ready to work and in harmony with the needs of the industrial world.

4.3. Discussion

In the implementation of the Center of Excellence curriculum applied at Vocational High Schools, it has been evident how teachers understood the implementation of the curriculum. Most teachers have participated in the Center of Excellence Vocational School Curriculum workshop. Providing technical workshops on implementing learning based on the Center of Excellence curriculum will help teachers identify several things they need to adjust to what they have previously done [36]. Workshop activities are also essential to increase teacher competence to start something new [23]. Workshop activities related to increasing the competence of teachers will further optimize the implementation of central curriculum-based learning superiority.

Besides the workshop, one of the essential indicators is an optimal implementation of this curriculum; there are also intensive training and mentoring activities to help teachers obtain industry-based competency certificates. Industrial competency-based training is commonly known as one of the essential things for teachers in vocational schools to relate what they learn at school with the competencies needed in the industrial world [56]. In addition, this industry-based certificate is also essential for teachers as a form of self-actualization as professional educators [57], as well as making teachers more professional and competent in the vocational fields they are interested in and mastered [57].

The curriculum is a center of excellence apart from teacher competence, and cooperation with the industrial world has increased. Learning activities have also experienced a paradigm shift. One indicator of the successful implementation of this curriculum is the implementation of project-based learning [58]. The research results revealed that project-based learning had been implemented correctly and, as a characteristic, was creating a product, namely keychains. The characteristics of project-based learning are that students are divided into several groups to complete specific projects [59], and the output is a product based on the learning objectives.

Conversely, aligning competencies with the industrial world to integrate 21st century skills into learning makes students happy to work on group projects [60]. Even though they work in groups, the teacher still has a vital role as a facilitator and mentor to encourage teamwork in completing projects [42]. This learning activity becomes the first step and a form of skill-related training in the 21st century, which students must master to be engaged in the industrial world.

Researchers argued that project-based learning was a learning model that provided a stimulus; thus, students were more active and innovative in creating a product assigned to them [52]. Another study was conducted by Yudiono [23], which stated that when students learn by being involved in an industry-based project, it will help them improve their competence as collaborators, critical thinkers, and creative innovators. In addition, the results of other studies also revealed that PjBL was a learning model that was relevant to use nowadays. Furthermore, Mutakinati [59] stated that PjBL was a learning model that could improve students' critical thinking skills. Their study has proved that students had sufficient thinking skills to critique their plans for systematic practice and to build a realistic critique of the power of their thinking to solve contextual problems. It is in line with Isa and Azid's research [17], arguing that if project-based learning has been used for a long time, especially in developing countries, students in the project-based learning group performed significantly better in the project design learning process compared to groups that employed project-based learning directly using the interview method.

Referring to various field findings and relevant studies, it appeared that project-based learning could positively impact student competency achievement in vocational schools. The findings in the field also indicated that they had employed project-based learning, and its implementation has been more optimal since the implementation of the Center of Excellence curriculum. In practical terms, they were additionally requested to carry out thorough examinations and embrace and execute criticism and revision in order to attain fundamental skills in the 21st century [5]. The relationship between schools and the world of industry was also improved by implementing the Center of Excellence curriculum in vocational schools because the schools would discuss the competencies currently needed with the industry. Therefore, learning in schools would become more factual and more relevant to the needs of the industrial world [32], [61].

The application of the Center of Excellence curriculum was also considered to indirectly influence whether or not the implementation of project-based learning was optimal. Nowadays, students are active and have developed specific skills at the beginning of the learning process due to project-based learning, which can ultimately create specific products under learning objectives. This is due to the characteristics of project-based learning, which emphasizes students as learning subjects and learning centers so that they can become active learners. It is critical to note that this research had limitations. The study focused on examining the use of the Center of Excellence curriculum and project-based learning. The effectiveness of the curriculum was not only measured by the success of project-based learning, but also by the school's relationships with the industry, extracurricular activities that enhance the Pancasila student profile, and other indicators that require further research.

5. CONCLUSION

Through this research, it can be ascertained that the Vocational High School students who are research subjects show a high understanding and commitment to implementing the Center of Excellence curriculum. This was revealed through interviews with several school officials, who expressed their willingness to fully commit to implementing this operational curriculum. Most teachers are also proven to have adequate technical skills in implementing this curriculum, planning and implementing learning activities according to the foundation they have determined. Implementing learning, especially in the automotive engineering department with a concentration in light vehicle engineering, shows that project-based learning has been carried out optimally, supported by adequate facilities to achieve learning objectives. According to the research findings, there are suggestions for conducting a thorough study on the implementation of the Center of Excellence curriculum. Additionally, it is advised to implement this curriculum in other relevant schools to encourage collaboration and partnership between educational institutions and companies. In this way, the competencies given to students will remain up-to-date and relevant to the needs of various employment opportunities.

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