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## Enhancing Practical Skills Through Project-Based Learning: A Case Study in Vocational High School Students

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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 with the case study method. The research respondents consisted of vocational high school residents in Central Java. Data were collected through interview techniques and observations, 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. It could be accepted by students, considering that project-based learning was implemented because it was an adaptive model to accommodate 21st-century competencies. However, it still requires improvement and optimization to implement this operational curriculum so that results can be better in facilitating students to achieve 21st-century competencies.

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### 1. INTRODUCTION

Globalization is a process of international integration due to exchanging of 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. This progress is not only in economics and technology but is also necessary in terms of education [3]. It is undeniable that industrialization in the future will manifest a shift in the production process from laboring to manufacturing resulting in human labor being replaced by hard technology [4],[5]. 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 [6]. To realize the functions and objectives of national education in Indonesia, practitioners and policymakers must design an education system oriented

towards the world of work. One of the efforts to achieve this objective is to organize and implement vocational education [7],[8]. Vocational education is one of the breakthroughs in improving the workforce's competence and professionalism in facing economic globalization and preparing students to engage in employment [9].

Vocational education in several countries is commonly directed to produce a workforce whose competencies align with the needs of industrial-technological developments [10],[11]. 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 [12]. Indonesia does not only do nothing. One of the efforts made by education observers and policymakers is to formulate an operational program to be an intermediary for improving the quality of vocational education by implementing the Center for Excellence Vocational High School Program [13]. In general, the Center of Excellence Vocational High School Program aims to produce graduates who are occupied in the working world or become entrepreneurs through in-depth and comprehensive alignment of vocational education with the working world and are expected to become centers of quality improvement and referrals for other vocational high schools [14],[15].

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 [16]. Pancasila Student Profile in Indonesia is the embodiment of Indonesian students as lifelong students who are competent and have character according to Pancasila values with six main characteristics: faith, fear of God Almighty and noble character, global diversity, cooperation, independence, critical reasoning, and creative [17]. In the context of implementing the Center of Excellence Vocational High School Program, the Government provides operational curricula and teaching tools to help schools, teachers, and education units included in the Center of Excellence Vocational High School Program that have been determined 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 curriculum is a school planning and learning guideline structured as a document applied in class [18],[19]. The curriculum is designed to regulate the implementation of the education system. The education system can run smoothly to achieve quality education goals. One of the Government's efforts to improve the quality of education can be done by innovating in the implementation of learning in schools [20].

The operational curriculum of the vocational high school education unit is developed to include specificities based on the characteristics of the educational unit, the sociocultural and environmental context, the world of work, and the students' characteristics. It should be noted that conceptually the creation of the operational curriculum for vocational education is one of the efforts to improve the quality and efficiency of education to change people's wishes and establish close cooperation between schools, communities, industries, and the Governments in forming the students' personalities [21]. In addition, through the implementation of the operational curriculum, hopefully, there will be a link and match between the needs of the industrial world, which is supported by a relevant curriculum with content standards and graduate competency standards [5],[22]. Thus, vocational education focuses on producing quality graduates according to the demands of the Business and Industrial World (DUDI) and the needs of the working world.

In fact, one of the vocational high schools in Central Java, namely State Vocational High School (SMKN) 2 of Salatiga, was selected to be the school implementing the Center of Excellence Vocational High School Program. This school will become a reference and Center for improving the quality and performance of other vocational high schools. Consequently, SMKN 2 of Salatiga was included in the Center of Excellence Vocational High School Program; thus, the learning process must use the Operational Curriculum in the Education Unit. The use of the Operational Curriculum certainly brought many changes to the paradigm of daily learning; starting from the teachers' roles, the students' roles in learning activities, and the scope of different competencies compared to other 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 [13],[23]. 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 [24]. Meanwhile, in terms of learning activities, students are directed to the completion of a project that is packaged in the implementation of project-based learning; hence, it will provide students with real experience in the industrial world [25],[26].

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 [27],[28]. 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 [29] 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 [5].

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 [30]. 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 [31],[32]. 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 significant matters in this research was theoretically and practically expected to benefit the development of the world of learning, especially in implementing and developing the Center of Excellence Vocational Curriculum in the Excellence Center Vocational School Program. Certainly, the benefits of this research will be felt by stakeholders, teachers, and considerations of policymakers in formulating the learning process in schools.

The depiction and brief descriptions above indicate that the Center for Excellence Vocational High School program is part of the Government's efforts to respond to the challenges of economic globalization, especially in responding to the challenges of Industry 4.0, which is vital and urgent to be implemented immediately. Some crucial matters on operational curriculum that need to be implemented immediately are strengthening human resources at Centers of Excellence Vocational High School, Qualified Work Competency and Character Learning, Strengthening of Practical Student Learning, Data-Based School Management, and Assistance by Universities. The curriculum method's shift 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 policy instruments and social, economic, political, and employment policy instruments. Vocational is sensitive to social problems and changes in society. Vocational education prepares students for employment [33],[34]. New vocational education is always close to the working world [35]. Furthermore, Wardiman argues that students need programs that can provide skills, knowledge, work attitudes, experience, insight, and networks that can help them get jobs according to their career choices [36]. Vocational education is secondary education that prepares students to be ready to work in specific skill areas. Graduates' Competency Standards (SKL) in vocational secondary education units (SMK) aim to improve intelligence, knowledge, personality, noble character, and skills to live independently and attend further education according to their profession [37]. In addition, Vocational High School is a form of vocational education that prioritizes harmony between the working world and learning (link and match). This alignment is obtained by increasing the network to help get jobs according to the student's choice. The network between schools and the industrial world is packaged in theoretical and practical learning, the hallmark of learning applied in Vocational High Schools [38].

In the 21st century, various kinds of challenges will face graduates from vocational schools. One of them is the alignment and updating of competency details that must be mastered by vocational high school graduates [39]. 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 [40]. Some of the challenges in the 21st century include 1) information technology security issues; 2) production machine reliability and stability; 3) lack of adequate skills; 4) reluctance to change from stakeholders; and 5) the loss of many jobs because they have turned into automation using the role of technology [41].

These conditions have led to speculation that in the future, several professions will be lost or replaced by technology [42]. One of the efforts to be able to answer the challenges of the 21st century, vocational education must be oriented to the industrial world, the business world, and the world of work; have a curriculum that focuses on psychomotor, affective, and cognitive aspects; multicompetence based; have sensitivity to changes and developments in the world of business, industrial, and work (DUDIKA); require adequate facilities and infrastructure; have 21st-century skills. In addition, the importance of implementing innovative learning is also highly needed in preparing superior human resources to compete in the era of the industrial revolution 4.0 [30].

## 2.2. Center of Excellence Vocational High School Program for 21st-Century Learning

Indeed, vocational education is different from regular education or other types of education because this vocational education has several characteristics, including 1) oriented toward individual performance in the workplace; 2) Specific justification for real needs in the field; 3) Curriculum focus on psychomotor, affective, and cognitive aspects; 4) The benchmark for success is not only limited to schools; 5) Sensitivity to workplace developments; 6) Requires adequate facilities and infrastructure; and 7) Learning environment support. It is certainly affected by the basis of reference for implementing learning, in this case, the implemented curriculum [43].

The curriculum is commonly known as one of the aspects that influence the success of learning in an educational institution. The curriculum emphasizes processes or experiences starting from the assumption that students are born with the potential to think, act, solve problems, and learn and develop independently [44]. Meanwhile, operational learning uses the Education Unit Operational Curriculum to implement the Center of Excellence Vocational High School Program. It is explained in the Guidelines for the Implementation of the Center for Excellence Vocational High School Program that the Education Unit Operational curriculum employed in education units for learning is developed and managed by the education unit, referring to the basic framework and curriculum structure for the Center for Excellence Vocational School Program established by the Government [29],[43]. Components of the Education Unit Operational Curriculum that are developed and employed in educational units consist of the characteristics of the education unit, vision, mission, objectives, learning organizers, lesson plans, and evaluation assistance and professional development.

Hopefully, implementing this curriculum will provide clear direction and goals and accommodate the need for synergy between learning and industry [40]. In the learning process in Vocational High Schools, its application will take a crucial role in providing a framework for competency requirements that must be mastered by students so that graduates can be engaged in the working world and are closely familiar with manufacturing technologies [45].

## 2.3. Center of Excellence Vocational High School Program for 21st-Century Learning

Learning is a basic education process, the formal sphere of education. Dimiyati and Mudjiono 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 [46]. Learning as an organized combination includes human elements, materials, facilities, equipment, and procedures influencing each other to achieve learning objectives [46]. Learning is a process in which a person's environment is deliberately managed to enable him to participate in certain behaviors under special conditions. Learning is acquiring character, knowledge, and attitude [47].

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 proactive scope [29]. Through productive program subjects, it also equips mentality, skills, and participative management with mental attitudes and skills in particular fields, prioritizing quality and totality of work [38]. Therefore, special 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 [48]. PjBL emphasizes a long-term learning process that involves students directly with various issues and problems of daily life, learns to understand and solve real problems, is disciplined in nature, and involves students as the main actors [49].

Project-based learning supported by contemporary technology is a particular strategy for transforming non-traditional classrooms. When students learn on real projects, every aspect of their experience is touched. 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 [50]. Besides, PjBL is a framework for education that will be

implemented in the future [51]. Some studies revealed that the PjBL learning model has significantly increased the competency of vocational high school students [50],[52]. A study by Roemintoyo stated that project-based learning could be applied and effective in helping students acquire practical skills [53]. Another study also conveyed that the implementation of PjBL has succeeded in increasing skills that could be integrated into the development of learning media [54],[55]. 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 to 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 [56]. As a 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 [57]. This research investigated and analyzed the phenomena that occurred in the sample school. A case study can be applied in various ways, including by interviewing sources to obtain data, making observations, or tracing and searching for secondary data in the form of supporting documents, as other factors are needed in these research variables [58].

This research focused on implementing project-based learning (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 [59]. 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.

Data collection in this research was carried out using the non-test method [58], consisting of several methods, including interviews and observations. The semi-structured in-depth interview technique [5] was selected as a data collection technique. Furthermore, resource persons as respondents were interviewed as a form of gathering information related to the ongoing learning process through the application of project-based learning (PjBL), learning support facilities, teachers' understanding of the Center of Excellence curriculum, and student enthusiasm during learning to apply a project-based learning model. Some of the interview indicators are:

Table 1. Interview Grids

| No. | Aspect  | Indicator   |
|-----|---|---|
| 1.  | Teachers' understanding                             | <ul style="list-style-type: none"> <li>• Good: has attended a training/ workshop on the Center of Excellence Curriculum and has learning tools for the Center of Excellence Curriculum</li> <li>• Enough: has attended the training, but the learning administration is incomplete</li> <li>• Less: have not participated in training/ do not have learning administration</li> </ul>   |
| 2.  | Students' activities in the learning implementation | <ul style="list-style-type: none"> <li>• Good: students are enthusiastic and understand the learning that has implemented <i>project-based learning</i></li> <li>• Enough: students are enthusiastic but do not understand the learning that has implemented <i>project-based learning</i></li> <li>• Less: students are less enthusiastic and do not understand the learning that has implemented <i>project-based learning</i></li> </ul> |

Adapted from [13],[22]

The observation technique was intended for data obtained from the learning implementation in class. This technique objective is expected to provide an accurate description of the implementation of project-based learning, which has been applied to learning activities in class. In the following, the grid is presented on the observation sheet.

Table 2. Observation Sheet Grid

| No. | Aspect         | Indicator  |
|-----|----------------|--|
| 1.  | Opening        | <ul style="list-style-type: none"> <li>• Motivation</li> <li>• Chanting prayers</li> <li>• Delivering learning objectives</li> </ul>   |
| 2.  | Implementation | <ul style="list-style-type: none"> <li>• Apperception of material</li> <li>• Skill in explaining the material</li> <li>• The use of media</li> <li>• Class management</li> <li>• Project division to groups</li> </ul> |
| 3.  | Closing        | <ul style="list-style-type: none"> <li>• Summary</li> <li>• Feedback</li> </ul>  |

Adapted from [60],[61]

The data collected through several data collection techniques or methods was then validated. In short, the data validation technique in this research used triangulation. From several triangulation techniques,

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with considerations, this research employed data source triangulation [57]. The following is an illustration of the adopted data source triangulation technique.

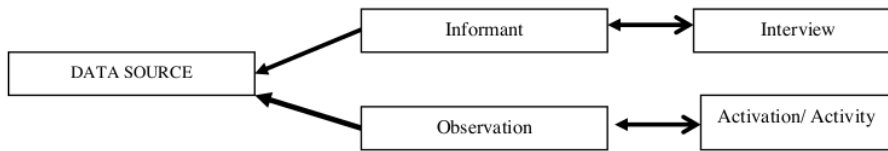


Figure 1. Triangulation of Data Sources

In this research, data obtained from various collection techniques were analyzed descriptively [62] through interactive analysis techniques referring to Miles & Huberman [63]. 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 [63]. The technical procedure for data analysis is shown in the following figure:

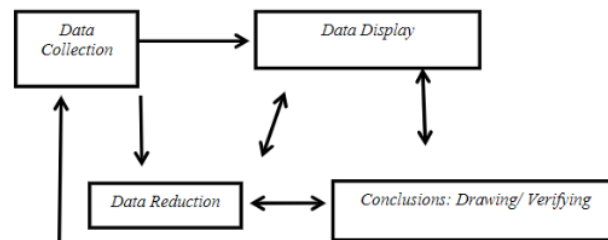


Figure 2. Interactive Data Analysis Techniques [64]

#### 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 the challenges of the current Development."* (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. Another form of commitment was to collaborate with tertiary vocational institutions to share experiences in managing ICT-

based learning to provide graduates with digital literacy. It was stated in excerpts from the interview with Informant 2:

“...*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 practice equipment with excellent quality with the hope that 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. It was stated in the interview excerpts regarding preparing student facilities and activities while implementing the operational curriculum.

“...*has allocated a budget for procuring equipment that focuses on the practical needs of students with business and industry standards ... for the improvement of 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 practice, teachers must be able to prepare andragogic and project-based learning materials and adjust subject matter to the needs of the industrial world with learning support using innovative media. In addition, teachers who have attended workshops and socialization of the Center of Excellence curriculum implementation also appear to be more prepared than some teachers who have not attended. The teacher would act as a mentor, teacher, and coach during the implementation of this curriculum, which was supported by information technology in the learning process, enabling to make space for collaboration between teachers and students. Teachers were also required to have adequate literature in terms of industry and technology to formulate what projects students must work on during learning activities. It was different from the opinion of some teachers who have not participated in outreach activities and workshops because it is considered that teachers who have not attended workshops tend to have difficulty planning ICT-based learning, compiling teaching modules, and collaborating with teachers and students regarding the integration of subjects or material they would convey 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, which includes the philosophy of 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).

<sup>7</sup> Based on the results of the interviews, it was identified that the implementation of the Center of Excellence Vocational High School curriculum had been included in the good 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 during 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:

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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. Furthermore, closing the ceremony activities by praying for the smooth running of practical activities in the Practical Workshop/ Lab.

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 made a design 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 were working to make molds in groups which showed communication and collaboration to get the best pattern/ picture of 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 key chains by printing resin into molds that each student had determined. The mixture of resin and hardener greatly affected the drying process. If much hardener were used, it would dry faster, but the results were not maximal or blurry. Vice versa, if too little hardener were used, it would be slow in the drying process, but the results were brighter/clear.

Closing Stage. In the closing section, the teacher conveyed a summary of practical activities and provided good feedback in the form of encouragement and gratitude for the participation of students during practical activities. 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.

Based on the observed data, there were several interesting matters, namely practical activities adapted to the availability of good quality and adequate equipment for students. In detail, this practical activity was carried out in the light vehicle engineering workshop. When the project-based practical activities occurred, it was seen that the students carried out the activities with enthusiasm and fun. They were free to choose where to study with the teacher, who then facilitated the 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. Discussions

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. This workshop activity is an arena for channeling competencies from one teacher to another [65]. Providing technical workshops on implementing learning based on the Center of Excellence curriculum will help teachers to identify several things they need to adjust to what they have previously done [43]. Workshop activities are also essential to increase teacher competence to start something new [66]. 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 to 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 [67]. In addition, this industry-based certificate is also essential for teachers as a form of self-actualization as professional educators [68],[69], as well as making teachers more professional and competent in the vocational fields they are interested and mastered [69].

The curriculum is a center of excellence apart from the aspect of 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 [70]. The research results revealed that project-based learning has been implemented correctly and, as a characteristic, was creating a product, namely keychains. The characteristics of project-based

learning, i.e., students are divided into several groups to complete specific projects [71], and the output is a product based on the learning objectives. On the other side, aligning competencies with the industrial world as a form of integrating 21st-century skills into learning makes students happy to work on projects in groups [72]. Even though they work in groups, the teacher still has a vital role as a facilitator and mentor to encourage teamwork in completing projects [50]. This learning activity becomes the first step and a form of skill-related training 21st century [7] 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 [55]. Another study was conducted by Yudiono [30], which stated that when students learn by being involved in an industry-based project, it will help them achieve better competence in the aspects of 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 [71] stated that PjBL was a learning model that could improve students' critical thinking skills. Their study has proved that students had sufficient skills in thinking 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 & Azid's research [22], 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 as a whole 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. Indeed, it could not be separated because project-based learning and the Center of Excellence curriculum could help students to achieve a variety of 21st-century competencies. In practice, they were also asked to carry out in-depth investigations and accept and implement criticism and revision; as one of the efforts to achieve essential competencies in 21st century [73]. The relationship between schools and the world of industry was also improving with the implementation of the Center of Excellence curriculum in vocational schools because the schools would discuss with the industry the competencies currently needed. Therefore, learning in schools would become more factual and more relevant to the needs of the industrial world [40],[74].

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. It 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. This research was still limited to exploring the application of the Center of Excellence curriculum and the implementation of project-based learning as an indicator of its implementation. The optimal implementation of the curriculum was not only seen from the success of the implementation of project-based learning but also from school relations and cooperation with the industrial world, extracurricular learning that supports strengthening the profile of Pancasila students as well as several other indicators that can be followed up by further research.

## 5. CONCLUSION

Through this research, it can be ascertained that the residents of the vocational high school as the research subjects had a high understanding and commitment to optimally implementing this Center of Excellence curriculum. This finding could be seen in the results of interviews with several officials in the school environment who stated that they would be fully committed to implementing this operational curriculum. Besides, most teachers had technical skills regarding implementing this operational curriculum to plan and carry out learning activities according to the foundation they used, namely the Center of Excellence curriculum. In addition, the implementation of learning in the automotive engineering department with a concentration on light vehicle engineering has implemented project-based learning quite optimally with the availability of facilities to achieve learning objectives.

Based on the research results, a suggestion emerged for further researchers to conduct a thorough review of the implementation of the Center of Excellence curriculum and attempt to apply this operational curriculum to other relevant schools so that more and more educational institutions collaborate and partner with the industrial world; hence, the competencies provided to students will tend to be more updated.

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