

## Declaration of Revisions

Authors would like to thank the reviewers for their feedback. All comments from Reviewer “F” are highlighted in yellow.

Comments from Reviewer F

Comments 1 : Ensure your sentences are complete. Each paragraph should have three sentences at a minimum, one of which should serve as the primary or key statement and at least the 4. Other two as supporting sentences.

Response : *Thank you for the suggestion. We have checked our manuscript and ensured that each paragraph follows the guidelines mentioned by the reviewer. The modification is highlighted in the manuscript.*

Comments 2 : Tables 1 and 2 must be mentioned and explained in the body text before it appears; please cite it.

Response : *Thank you for the suggestion. We have explained Tables 1 and 2 as suggested.*

Comments 3 : Figures 1 and 2 must be mentioned and explained in the body text before it appears; please cite it.

Response : *Thank you for the suggestion. We have explained Figures 1 and 2 as suggested. In addition, we have updated the figures with a higher image resolution for better clarity.*

Comments 4 : The conclusion only consists of 1 paragraph, so that the reader can focus on the results of your paper.

Response : *Thank you for the suggestion. We have modified the conclusion as suggested.*

All changes for reviewer “F” are highlighted in yellow in the main text.

Sincerely,  
Authors

# 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 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 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, 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 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]. Undeniably, industrialization will manifest a shift in the production process from labor to manufacturing, replacing human 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. One of the efforts made by education observers and policymakers is to formulate operational programs to become an intermediary for improving the quality of vocational education by implementing the Vocational School Center for Excellence Program [11]. 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 [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]. 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 [15]. 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 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).

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. Using 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 [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]. 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 [29].

In addition, 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]. 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 [33].

These conditions have led to speculation that several professions will be lost or replaced by technology [34]. As 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, innovative learning is also highly needed in preparing superior human resources to compete in the era of the Industrial Revolution 4.0 [23].

## 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 undoubtedly affected by the basis of reference for implementing learning, in this case, the implemented curriculum [35].

The curriculum is one aspect that influences learning success 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 [36]. 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 [22],[36].

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, 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 [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. 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 [38]. Learning as an organized combination includes human elements, materials, facilities, equipment, and procedures influencing each other to achieve learning objectives [39]. 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 [40].

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 [41]. 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 [42].

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 [43]. Besides, PjBL is a framework for education that will be implemented in the future [44]. Some studies revealed that the PjBL learning model has significantly increased the competency of vocational high school students [43],[45].

A study by Roemintoyo stated that project-based learning could be applied and effective in helping students acquire practical skills [46]. Another study also conveyed that implementing PjBL has succeeded in increasing skills that could be integrated into learning media development [47]. 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 [48]. 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 [49]. 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 [50].

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 [51]. 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 project-based learning (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 Project Based Learning (PjBL). Several interview indicators are depicted in table 1:

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 [11],[17]

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 below.

Table 2. Observation Sheet Grid during Learning Activities

No.	Aspect	Indicator
1.	Opening Phase	<ul style="list-style-type: none"> <li>• Motivation</li> <li>• Chanting prayers</li> <li>• Delivering learning objectives</li> </ul>
2.	Learning Implementation Phase	<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 Phase	<ul style="list-style-type: none"> <li>• Summary</li> <li>• Feedback</li> </ul>

Adapted from [52],[53]

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 with considerations, this research employed data source triangulation [49]. 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.

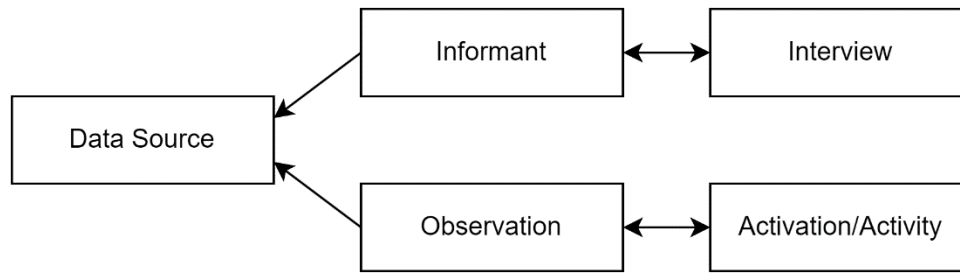


Figure 1. Triangulation of Data Sources

In this research, data obtained from various collection techniques were analyzed descriptively [54] through interactive analysis techniques referring to Miles & Huberman [55]. 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 [55]. 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 below:

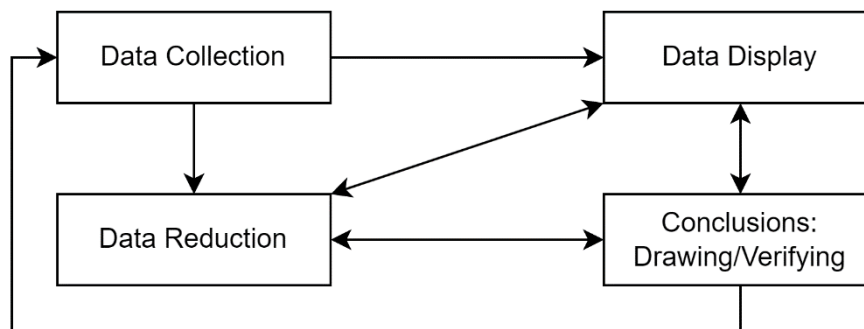


Figure 2. Interactive Data Analysis Techniques [56]

## 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. 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 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 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 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, 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:

**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.

**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.

**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 exciting matters, namely practical activities adapted to the availability of good quality and adequate equipment for students. This practical activity was carried out in detail 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 could choose where to study with the teacher who 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. 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 [57]. In addition, this industry-based certificate is also essential for teachers as a form of self-actualization as professional educators [58], as well as making teachers more professional and competent in the vocational fields they are interested in and mastered [58].

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 [59]. 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 [60], 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 [61]. Even though they work in groups, the teacher still has a vital role as a facilitator and mentor to encourage teamwork in completing projects [43]. 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 [53]. 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 [60] 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 & 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 practice, they were also asked to conduct in-depth investigations and accept and implement criticism and revision to achieve essential competencies in the 21st century [62].

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],[63].

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.

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 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.

Based on the findings of this research, suggestions emerge for further research to conduct a comprehensive study of the implementation of the Center of Excellence curriculum. In addition, it is recommended that efforts be made to implement this operational curriculum in other relevant schools so that more educational institutions can collaborate and partner with 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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Left sidebar: Mail (26), Chat, Meet, Kotak Masuk (26), Berbintang, Ditunda, Terkirim, Draf (1), Selengkapnya, Label (+)

Toolbar: Back, Forward, Refresh, Print, Reply, Reply All, Forward, Delete, Archive, Flag, Star, Unstar, Mute, Unmute, Snooze, Mark as Read, Mark as Unread, Mark as Spam, Mark as Not Spam, Mark as Important, Mark as Not Important, Mark as Read, Mark as Unread, Mark as Spam, Mark as Not Spam, Mark as Important, Mark as Not Important

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[IJERE] Editor Decision Eksternal Kotak Masuk x

Dr. Lina Handayani ijere@iaescore.com [lewat](mailto:ijere@iaescore.com) kirimdata.id kepada saya, Afrig, Waleed, Khairul, Mohammad

The following message is being delivered on behalf of International Journal of Evaluation and Research in Education (IJERE).

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-- Paper ID# 28694  
-- Authors must strictly follow the guidelines for authors at <http://iaescore.com/gfa/ijere.docx>  
-- Number of minimum references is 30 sources (mainly journal articles) for research paper  
-- and minimum 50 sources (mainly journal articles) for review paper

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Dear Prof/Dr/Mr/Mrs. Dr. Mohammad Iskandar Dzulkurnain,

It is my great pleasure to inform you that your paper entitled "Optimizing Students' Practical Skills through Project-Based Learning: Case Study in Vocational High Schools" is conditionally ACCEPTED and will be published on the International Journal of Evaluation and Research in Education (IJERE), a SCOPUS (<https://www.scopus.com/sourceid/21100934092>, SJR: 0.308 (SJR Q3), CiteScore: 1.3 and SNIP: 0.582) and ERIC (<https://bit.ly/2E18hDj>) indexed journal. Congratulations!

Please prepare your final camera-ready paper (in MS Word or LATEX file format) adheres to every detail of the guide of authors (MS Word: <http://iaescore.com/gfa/ijere.docx>, or <http://iaescore.com/gfa/ijere.rar> for LATEX file format), and check it for spelling/grammatical mistakes. Then you should upload your final paper to our online system (as "author version" under our decision, NOT as new submission).

You should submit your camera-ready paper (along similarity report by

Jum, 26 Jan, 20.25

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Browser tabs: [IJERE] Editor Decision - dzoel.i... #28694 Review

Address bar: mail.google.com/mail/u/0/?hl=en#search/ijere/FMfcgzGwJmHqbQLhPwIHdZCQwRkDqjr

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Gmail interface:

- Search: ijere
- Mail: 25
- Chat: 0
- Meet: 0
- Labels: Kotak Masuk (25), Berbintang, Ditunda, Terkirim, Draf (1), Selengkapnya

Message details:

- From: Dr. Lina Handayani (ijere@iaescore.com) [lihat kirimdata.id](#)
- To: kepada saya, Afrig, Waleed, Khairul, Mohammad
- Subject: [IJERE] Editor Decision (Eksternal) Kotak Masuk
- Date: Jum, 19 Jan, 09.40

Message content:

The following message is being delivered on behalf of International Journal of Evaluation and Research in Education (IJERE).

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- Ref. in Bahasa must be translated into English in the bracket  
Only 10 percent local references are allowed; replace with international journal as ref.

Reviewer A:

The IJERE form to evaluate submitted papers

Content:  
Good

Significance:  
Good

Originality:  
Good

Relevance:  
Good

Presentation:  
Good

System tray: Windows logo, Search, Taskbar icons (File Explorer, Edge, Chrome, Word, etc.), System tray (Network, Sound, Power, Date: 04/09/2024, Time: 00:53)



Browser tabs: [JERE] Editor Decision - dz..., 6195-6209.pdf, Mohammad Iskandar Dzulkurnain, Scopus preview - Scopus..., Sistem Informasi Managem..., Scopus - Google Drive

Address bar: mail.google.com/mail/u/0/?hl=en#inbox/FMfcgzGwJvgZcqDBZMDWjVhrztLJznnG

Gmail interface: **Gmail**, **Telusuri email**, **Aktif**

Left sidebar: **Tulis**, **Kotak Masuk** (26), **Berbintang**, **Ditunda**, **Ter kirim**, **Draf** (1), **Selengkapnya**, **Label** (+)

Header: **Mohammad Iskandar Dzulkurnain** <dzoel.is.kandar@upy.ac.id> kepada septian@iaescore.com, ijere, Lina

Dear Editor

I hope this email finds you well. I am writing to inform you that I have completed the final revisions for my paper titled "Optimizing Students' Practical Skills through Project-Based Learning: Case Study in Vocational High Schools" which is declared accepted in the International Journal of Evaluation and Research in Education (IJERE). Along with this email, I have attached some requested files according to the previous email. Here are the details.

- Paper Information:**
  - ID Paper: 28694
  - Title : Optimizing Students' Practical Skills through Project-Based Learning: Case Study in Vocational High Schools
  - Author : Mohammad Iskandar Dzulkurnain, Afrig Aminuddin, Waleed A. Hammod, Khairul Hafezad Abdullah, Mohammad Badrul Alam Miah
- Similarity Check Result**
  - 19% through Turnitin
- Payment Proof (Journal's APC)**
  - Page(s) : 12 pages
  - Amount of Payment : 535 USD, or in Indonesian Rupiah (Rp.) 8.405.000
  - Payment time : 05 February 2024.

Thank you for your attention, I am also waiting for the Certificate of Acceptance, kindly send it to my mail. I am looking forward to hearing from you soon regarding the publication process.

Best regards,  
Dr. Mohammad Iskandar Dzulkurnain  
Universitas PGRI Yogyakarta, Yogyakarta, Indonesia

3 Lampiran • Dipindai dengan Gmail

- Payment Proof pa...
- 19% - Final Paper ...
- Final Paper Dzul...

Taskbar: 79°, Search, Windows icons, System tray: ENG, 27/08/2024, 00:08

Browser tabs: [IJERE] Formal Acceptance, 6195-6209.pdf, Mohammad Iskandar Dzuli, Scopus preview - Scopus, Sistem Informasi Manajem, Scopus - Google Drive

URL: mail.google.com/mail/u/0/?hl=en#inbox/FMfcgzGxStrjGxSGWLxpBXNgGWNCvzsx

Gmail interface: Search "Telusuri email", "Aktif" status, Google logo

Left sidebar: Tulis, Mail (26), Chat, Meet, Kotak Masuk (26), Berbintang, Ditunda, Terkirim, Draf (1), Selengkapnya, Label (+)

Subject: [IJERE] Formal Acceptance of Manuscript for Publication - Optimizing students' practical skills through project-based learning: case study in vocational high schools (Eksternal, Kotak Masuk)

From: editorialijere@gmail.com (kepada saya) | Date: Jun, 26 Apr, 15:12

Dear Dr./Professor Mohammad Iskandar Dzulkumain, Afrig Aminuddin, Waleed A. Hammood, Khairul Hafezad Abdullah, Mohammad Badrul Alam Miah

We are delighted to formally notify you of the acceptance of your manuscript, titled "Optimizing students' practical skills through project-based learning: case study in vocational high schools," for publication by International Journal of Evaluation and Research in Education (IJERE).

The editorial team thoroughly reviewed your work and found it to be a valuable contribution to the field. A formal certificate of acceptance is attached to this email for your reference.

Your manuscript is currently undergoing the layout process and a final editorial review to ensure it adheres to our publication standards. We anticipate this process to be completed and your manuscript will be published for Vol 13, No 5: October 2024 issue. Following the completion of these steps, we will contact you to discuss the fine tuning and any further details.

Congratulations on this achievement! We are honored to publish your work and look forward to its successful release.

Sincerely,  
Rendhy Saryanto  
International Journal of Evaluation and Research in Education (IJERE)  
<https://ijere.iaesscore.com/index.php/IJERE/index>

Satu lampiran • Dipindai dengan Gmail

Attachment: Certificate of Acc... (PDF)

Windows taskbar: 79° Search, 27/08/2024 00:06

International Journal of Evaluation and Research in Education (IJERE)

# CERTIFICATE OF ACCEPTANCE

The manuscript (IJERE- 28694) entitled:

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

Authored by:

Mohammad Iskandar Dzulkurnain, Afrig Aminuddin, Waleed A. Hammood, Khairul Hafezad Abdullah, Mohammad Badrul Alam Miah

The manuscript has been accepted in IJERE (ISSN 2252-8822)

<https://ijere.iaescore.com>

April 26, 2024



Prof. Dr. Yeo Kee Jiar  
Editor-in-Chief