Development of Vocational Science Learning Devices to Improve Project Based Soft Skills

Khamdun
Universitas Sebelas Maret, Surakarta, Indonesia

Suparmi
Universitas Sebelas Maret, Surakarta, Indonesia

Maridi
Universitas Sebelas Maret, Surakarta, Indonesia

Ani Rusilowati
Universitas Negeri Semarang, Semarang, Indonesia

Abstract---This study aims to produce a Vocational High School Natural Science learning tool to improve project-based soft skills that are valid, practical and effective in developing student soft skills. The method used is Research and Development (R&D) referring to the 4-D model suggested by Thiagarajan with the stages namely define, design, develop, and disseminate. The population in this study were students of class XI in the machine technology group of SMK Negeri 2 Kudus in the academic year 2019/2020 (N = 61). The sample in the study were students of class XI with the expertise of machine technology (n = 34) who were taken by random sampling technique. The data were collected using the device validation sheet, the implementation observation sheet, the teacher's response questionnaire and the student response questionnaire. Data about the validity and practicality of the device in developing learning tools to improve project-based soft skills were analyzed using the right-hand t-test with α of 0.05. The results showed 1) the collected devices were analyzed descriptively, while the learning effectiveness data developed were in the very valid category with an average of 3.57, 2) the practicality of the learning device is in the very practical category with an average of 3.8, and 3). The effectiveness of the learning device is in the medium category (effective) in improving project-based soft skills. Project-based soft skills after learning are better after the implementation of learning tools than before the implementation of SMK science learning tools by increasing project-based soft skills.
Keywords---communicative language, learning device, project model, soft skills, vocational science.

Introduction

PP No.29 of 1990 states that Vocational Secondary Education prioritizes the preparation of students to enter the world of work and develop professional attitudes. Soft skills must be mastered when you want to make graduates who are superior in facing job competition. Chatudevi, et al. (2011), stated that the mastery of job-related graduate project-based skills is not enough, because the mastery of soft skills, project-based soft skills is especially important for business. This statement is strengthened by research at Harvard University in the United States where the success of a person in society is not determined solely by technical knowledge and abilities (hard skills), but rather by the ability to manage oneself and others or what is often called soft skills (Kieras & Bovair, 1984).

The low level of project-based soft skills that graduates have can hinder performance achievement. The results of empirical observations of the PSMK Directorate in 2018, the problem faced in preparing vocational students as a middle-level workforce is that there is still a gap in the competence of SMK graduates with the real needs of the business / industrial world, where SMK graduates are still weak in the soft skill aspect. An alternative solution to this problem is to insert a content of soft skills in science learning. Learning activities can be carried out properly, correctly, correctly, and optimally if the teacher has a learning strategy or model that can help students optimize their learning activities. Purnawan (2007), states that education in the engineering sector, apart from providing sufficient theories, also needs to provide examples of solving real projects by utilizing learning strategies that support engineering education. Constructivist implementation can provide learning opportunities and create conditions for the active role of students in learning (Kirkham et al., 2002; Werdistira & Purnama, 2020).

Doppelt Widodo (2015), states that one of the methods based on constructivism that supports student involvement in problem-solving situations is the Project model. Students in project-based learning are directly involved in the real life environment in solving problems, so that the knowledge gained is more permanent. The learning process is expected to produce valuable products, demands a rich and real environment, which can provide a learning experience. Based on the expected competency of SMK graduates, in general the science competencies that are expected to support and become the foundation for the group of vocational subjects (Bannert et al., 2009; Westerveld, 2003).

Although there are several research results on learning outcomes related to project models, there are still many SMKs in Indonesia that have not implemented this learning model. The results of observations made at SMK Negeri 2 Kudus show that there are several main obstacles at SMK Negeri 2 Kudus that have not applied this learning model because there is no learning device with a project model so that in teaching learning teachers tend to use books from other publishers that lead to conventional learning. Teachers also rarely use learning
models by giving students the opportunity to autonomously construct their own knowledge to produce products, where the product is the student's demands. The survey in 2019 at 3 State Vocational Schools in Kudus Widodo (2015), found that:

- Assessment of learning outcomes is only related to the final product and has not been based on product standards.
- Learning strategies are still conventional or teacher-centered so that students are patterned to carry out learning activities by listening, looking at the blackboard accompanied by taking notes based on the material in the textbook used teacher.

Meier (2002), has a similar opinion stating that many students are passive and perform tasks according to the instructions on the worksheet. Based on the findings above, it is necessary to make improvements to the implementation of learning, one of which is by developing Vocational School Science learning tools that can develop student project-based soft skills. One learning model that significantly contributes to developing student soft skills is a project. This statement is reinforced by Moerdijanto (2012), which states that with the Project model high soft skills can be achieved. In line with several other studies conducted by Rais & Lamada (2010), Ghazali (2013), Hashim et al. (2009), which in essence views that the application of the Project model can improve students' soft skills. The purpose of developing the device is to produce Vocational School physics learning tools that are valid, practical and effective in developing student soft skills. This designed model requires teachers and / or students to develop guiding questions and guide students in a collaborative project by integrating various subjects with attention to learners' understanding. The project model has six steps, namely:

- Start with the essential question.
- Design a plan for the project.
- Create a schedule.
- Monitor the student and progress of the project.
- Assess the outcome.
- Evaluate the experience.

At each learning step several indicators of soft skills can be developed. Contribution of soft skills at each learning step is mapped in Table 1.

Table 1
Mapping of project-based soft skill contribution at each learning step

<table>
<thead>
<tr>
<th>Project Step</th>
<th>Indicators developed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start with the essential question</td>
<td>Creativity, connecting with team, listening, communicate, time management,</td>
</tr>
<tr>
<td></td>
<td>Personal strength, problem solving and analysis,</td>
</tr>
<tr>
<td></td>
<td>liaise with teams, communicate, coordinate, plan and manage</td>
</tr>
<tr>
<td>Design a plan for a project</td>
<td>Time management, connecting with the</td>
</tr>
<tr>
<td>Create a schedule</td>
<td></td>
</tr>
</tbody>
</table>
team, communicating orally and in writing. Steps to monitor the student and progress of the project related to the team managing conflict, the concept of creating, taking communication risks.

**Asses the outcome**

The ability to learn time management, strengths, personal problem solving and analysis related to the team, listening, coordinating making decisions, managing conceptual conflicts, leadership.

**Evaluate the experience**

The ability to learn personal strengths in problem solving and analysis related to the communication team to hear creativity taking conceptual risks taking risks.

**Method**

In developing project-based soft skills, SMK students have designed and developed science learning tools with Pr using the 4-D project model. Learning tools developed include syllabus, lesson plans, student books, teacher handbooks and worksheets. The learning tools developed are aimed at developing project-based soft skills. Before being tested for validity, the instrument validation sheet instrument was evaluated for its feasibility by two experts who were then analyzed using the gregory validation coefficient and the instruments used to measure project-based soft skills were tested on students. The data obtained were analyzed for the reliability and internal consistency of the items using SPSS 20.0 for windows software for testing the validity of science learning tools with a project model carried out through expert tests on focus group discussions (FGD) involving senior science lecturers and teachers and empirical validation involving 8 teachers IPA SMA and SMK. Input, criticism and suggestions received are used to improve the draft learning device (Thiry, 2002; Moe et al., 2010; Ritonga et al., 2021).

Data about the validity of learning devices is obtained through the validation sheet filled out by 8 SMA and SMK science teachers, then analyzed descriptively and given the meaning of qualification using the qualification conversion guidelines as in Table 2.
Table 2
Guidelines for converting qualifications of learning tool validity

<table>
<thead>
<tr>
<th>No.</th>
<th>Score (X)</th>
<th>Qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.00 ≥ X ≥ 3.50</td>
<td>Very valid</td>
</tr>
<tr>
<td>2</td>
<td>3.50 &gt; X ≥ 2.50</td>
<td>Valid</td>
</tr>
<tr>
<td>3</td>
<td>2.50 &gt; X ≥ 1.50</td>
<td>Not valid</td>
</tr>
<tr>
<td>4</td>
<td>1.50 &gt; X ≥ 1.00</td>
<td>Very invalid</td>
</tr>
</tbody>
</table>

Data about the practicality of the learning device was obtained from the observation sheet for the implementation of the IPA learning device, a teacher response questionnaire involving 2 teachers and a student response questionnaire involving 10 class XI students. The data obtained were analyzed descriptively and given the meaning of qualification using the qualification conversion guidelines as in Table 3.

Table 3
Guidelines for Converting Qualifications of Practicality of Learning Devices

<table>
<thead>
<tr>
<th>No.</th>
<th>Score (X)</th>
<th>Qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.00 ≥ X ≥ 3.50</td>
<td>Very practical</td>
</tr>
<tr>
<td>2</td>
<td>3.50 &gt; X ≥ 2.50</td>
<td>Practical</td>
</tr>
<tr>
<td>3</td>
<td>2.50 &gt; X ≥ 1.50</td>
<td>Not practical</td>
</tr>
<tr>
<td>4</td>
<td>1.50 &gt; X ≥ 1.00</td>
<td>Very impractical</td>
</tr>
</tbody>
</table>

Data about the effectiveness of learning tools were obtained from data on changes in student project-based soft skills which were collected using a questionnaire sheet involving 33 students of SMK Negeri 2 Kudus in class XI with the one group pretest posttest design technique. The data obtained is used to test the research hypothesis. The data analysis technique used is the right-hand t test with the help of SPSS 20.0 for windows. Before testing the data hypothesis the normality is first tested with the help of SPSS 20.0 for windows. Posttest design. The data obtained is used to test the research hypothesis. The data analysis technique used is the right-hand t test with the help of SPSS 20.0 for windows. Before testing the data hypothesis the normality is first tested with the help of SPSS 20.0 for windows (Heckman & Kautz, 2012; Ngang & Chan, 2015).

Student soft skill measurement data is also used to determine the improvement of student project-based soft skills after the application of learning tools, technical analysis of the data used is to use gain score using qualification conversion guidelines as in Table 4.

Table 4.
Gain score qualification conversion guidelines

<table>
<thead>
<tr>
<th>No.</th>
<th>Score (X)</th>
<th>Qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(g) &gt; 0.7</td>
<td>High gain</td>
</tr>
<tr>
<td>2</td>
<td>0.7 ≥ (g) ≥ 0.3</td>
<td>Medium gain</td>
</tr>
<tr>
<td>3</td>
<td>(g) ≤ 0.3</td>
<td>Low gain</td>
</tr>
</tbody>
</table>
Results and Discussion

The results of the data analysis of the validity of learning tools which include student books, teacher books, lesson plans, syllabus and worksheets meet very valid requirements. In detail, the results of the validation by science teachers for each component are presented in Table 5 below.

<table>
<thead>
<tr>
<th>No</th>
<th>Learning Tool Components Category</th>
<th>Mean Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Syllabus 3,50</td>
<td>Valid</td>
</tr>
<tr>
<td>2</td>
<td>RPP 3,60</td>
<td>Very valid</td>
</tr>
<tr>
<td>3</td>
<td>LKS 3,60</td>
<td>Very valid</td>
</tr>
<tr>
<td>4</td>
<td>Student Book 3,58</td>
<td>Very valid</td>
</tr>
<tr>
<td>5</td>
<td>Teacher’s Handbook 3.56</td>
<td>Very valid</td>
</tr>
<tr>
<td></td>
<td>Average score 3.57</td>
<td>Very valid</td>
</tr>
</tbody>
</table>

Based on Table 5, learning devices that have been successfully developed are categorized as very valid or very suitable for use, but there are still suggestions that must be followed up for revision. Obtaining valid and feasible learning tools is caused by several factors including:

- The components of the learning tools developed are in accordance with the indicators set on the validity instrument.
- The learning tools fulfill the content validity and construct validity. The learning device meets the content validity because in its development it has been based on the content of the material and the theory which is the basis for the formulation of learning objectives. Meanwhile, the learning device has fulfilled the construct validity, meaning that in its development, it pays attention to the relationship between one component and another and is systematically arranged. Student books that have been prepared in accordance with the characteristics of SMK science learning with a project model to develop project-based soft skills. Student books are equipped with worksheets that can train an active role in a science project to develop project-based soft skills. To further emphasize the impact of the accompaniment, the student books also include project-based soft skill indicators developed for each syntax in learning. The teacher’s handbook is arranged according to the student book so that it guides the teacher in learning science with a project model. The teacher’s handbook contains a student book, syllabus, lesson plans with a project model, project-based description questions that are equipped with instructions for completion. The learning steps designed in the lesson plan and the instructions for using books can help teachers in carrying out learning that leads students to be able to complete a science project related to the material and develop project-based soft skills for students to be better in accordance with the soft skill indicators to be developed in each syntax, learning model. Student books designed with a project model in each syntax include indicators of soft skills being developed. The determination of project-based soft skills I indicators that are included is in accordance with the description of student
activities carried out in each syntax. Details of teacher-student activities that are linked to the project-based soft skill indicators developed are included in the specific instructions for using the teacher’s book. Regularity in the presentation of material that guides students to complete a project can change students' thinking patterns to be better and more focused.

- Student books and teacher handbooks in their development are prepared in accordance with the demands of the 2013 curriculum at SMK and Permendikbud No. 54 of 2013 concerning graduate competency standards where several skills development is obtained through trying, creating and creating activities. The factors mentioned above cause the learning tools developed to meet the valid criteria as expected, both in terms of content and construct, so that they are suitable for use in science learning.

The results of data analysis on the practicality of learning devices meet the very practical requirements. LKS meet the very valid requirements. In detail, the practicality of the learning tools for each of the measured aspects is presented in Table 6 below.

### Table 6
Data summary of the practicality of learning devices

<table>
<thead>
<tr>
<th>No.</th>
<th>Learning Tool Components</th>
<th>Category Average</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The performance of the device</td>
<td>3.61</td>
<td>Very practical</td>
</tr>
<tr>
<td>2</td>
<td>Teacher responses to tools</td>
<td>3.78</td>
<td>Very practical</td>
</tr>
<tr>
<td>3</td>
<td>Student responses to student books</td>
<td>3.80</td>
<td>Very practical</td>
</tr>
<tr>
<td></td>
<td>Average Score</td>
<td>3.7</td>
<td>Very practical</td>
</tr>
</tbody>
</table>

From the results of the research on the implementation of learning devices, it was obtained a score of 3.61 with very practical criteria, the teacher’s response to learning was obtained a score of 3.78 with very practical criteria, and the student’s response to the student book obtained a score of 3.80 with very practical criteria. The total average of the practicality of this learning device is 3.7 with very practical criteria. The results of the study have shown that the learning tools developed have been meet the requirements of practicality. The practicality of this device is due to the fact that teachers and students easily use the tools developed because they are arranged in communicative language and are in accordance with a predetermined time allocation, so that students and teachers respond positively to the learning carried out (Herianto, 2017; Haris, 2019).

Judging from the implementation of the learning tools at the first meeting, it was obtained an average score of 3.52, this means that the tools at the first meeting were very practical for the teacher but could not be said to be optimal. There are several obstacles experienced by the teacher during the learning activities at the first meeting. These constraints are:

- Students are not accustomed to doing activities as in student books which require students to produce a real product. This can be seen when the teacher explains about project-based learning which requires them to work on a project in groups within a certain period and produce a real product / real, most students complain because they are afraid to start this activity.
In carrying out practicum activities, students are asked to use the practical activity guidelines in the student book, most students still have difficulty and confusion because students do not understand what activities they have to do, so the teacher needs to explain in detail about project-based learning.

- Teachers are not accustomed to carrying out learning activities as required in the teacher’s handbook. This can be seen from the difficulties faced by the teacher in implementing the project model set out in the lesson plan.
- Students are not used to determining a project in learning and find it difficult to work together in groups.
- Teachers in the learning process are not used to being facilitators and guides so that activities are not optimal.
- In small discussions in class, the teacher has not yet optimized peer tutors in their groups, this can be seen from some groups still working independently and not collaborating with friends in their groups to discuss/determine topics to be raised as projects and project design.

Based on the obstacles faced at the first meeting, the researchers together with the science teacher who were invited to observe the implementation of learning discussed the handling plan for the obstacles experienced in learning. The handling design given based on the results of the discussion is:

- The teacher motivates students by asking students to look again at the description of the activities on the LKS. From this activity, students' personal strength in accepting assignments can be developed.
- The teacher guides students and slowly the help is reduced. From this activity, indicators of soft skills were developed experiencing confusion and doubt in carrying out activities carried out in accordance with the procedures in the LKS.
- The teacher looks back at the project learning steps as designed in the lesson plan and makes previous preparations. There are several things that must be answered by the teacher before using project learning, namely how to prepare students so that student projects can run smoothly, what is the level of difficulty of the project they have to do, what are the benefits of this project for students, both in terms of curriculum objectives and added value, what references which can be used as a reference for student projects, how many face-to-face hours are needed to provide direction and presentation of results, how to arrange scheduling for monitoring students in working on projects and how / technical assessments to be carried out.
- The teacher must understand that the learning carried out can improve the quality of learning in the classroom with the hope of developing project-based soft skills.
- The teacher provides the opportunity for students to discuss with their group friends. By realizing also that the position of the teacher as a facilitator in terms of directing students to an understanding of the concepts being learned is not merely a provider of information to students in the hope of changing the teacher’s paradigm from teaching to teaching students.
The teacher must provide guidance intensively by observing each group and providing motivation to increase cooperation with group members.

The teacher stimulates students to become peer tutors by providing opportunities for students who have more ability to explain material that has not been understood by their friends. The existence of peer tutors makes learning more effective because communication between students becomes more open without being haunted by fear and shame. So that it can develop project-based soft skill indicators on the aspects of communicating and listening. The teacher provides the opportunity for other groups to respond to presentations from the group of presenters so that cross communication occurs to solve the problems at hand.

The learning implementation at the second meeting was adjusted to the reflection on the obstacles experienced at the first meeting and the improvement efforts made. Based on the handling of improvements designed by researchers and physics teachers, it can have a positive impact on the implementation of learning at the second meeting. This can be demonstrated the increase in the average score of the implementation of learning tools at the second meeting was 3.69. This means that practical learning tools are carried out by the teacher. Quantitatively, the increase in the average implementation score at the second meeting was 0.17 compared to the first meeting.

Based on the reflection results of the second meeting, there were several changes that led to a positive direction compared to the first meeting, including:

- Students began to get used to doing activities in accordance with what was required in the LKS. This is marked by the attitude of students who begin to pay attention to and carry out activities in accordance with the procedures listed in the LKS.
- The teacher begins to get used to learning according to the learning steps listed in the lesson plan.
- The teacher begins to get used to position himself as a facilitator so that learning is dominated by students.
- Teachers have started to utilize peer tutors so that learning becomes more effective.
- Students have started to discuss with their group friends to discuss project completion.
- The teacher provides the opportunity for the presenter group to explain their work and other groups are also given the opportunity to respond to the presenter’s group work. This shows that there has been cross communication between groups of presenters and other groups.

Obstacles at the first meeting can be overcome, but there are still obstacles experienced at the second meeting, including: students have not been able to design projects and schedule project implementation. This can be seen from the absence of a division of tasks within the group, and what activities can be included in project design. Students have not been able to communicate, take advantage of their time and manage their assignments properly. Its effectiveness is measured through the achievement of learning objectives using tools that have been developed. The learning device is applied to a class with 33 students using
one group pretest posttest design. Summary of pretest and posttest data is presented in Table 7.

### Table 7
Data summary of pretest and posttest scores

<table>
<thead>
<tr>
<th>No.</th>
<th>Soft skill</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pretest</td>
<td>173.30</td>
</tr>
<tr>
<td>2</td>
<td>Posttest</td>
<td>210.12</td>
</tr>
</tbody>
</table>

Starting from the value in Table 6, the calculation of the one-tailed hypothesis test results in a value of 7.28. This calculation results in a greater t value of t table, so that Ho is rejected. Therefore, it can be concluded that the soft skills of class XI students of the machine technology group of SMK Negeri 2 Kudus are better than before the implementation of science learning tools with a project model to develop soft skills. A summary of the results of the project-based soft skills analysis per aspect is presented in Table 8.

### Table 8
Summary of student project-based soft skill analysis results by aspect

<table>
<thead>
<tr>
<th></th>
<th>Project</th>
<th>Average</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.43</td>
<td>4.05</td>
<td>Moderate</td>
</tr>
<tr>
<td>2</td>
<td>3.58</td>
<td>4.59</td>
<td>High</td>
</tr>
<tr>
<td>3</td>
<td>3.52</td>
<td>4.33</td>
<td>Moderate</td>
</tr>
<tr>
<td>4</td>
<td>3.34</td>
<td>3.79</td>
<td>Low</td>
</tr>
</tbody>
</table>

Based on Table 8, the average soft skills of students in this study have increased. Soft skills of students are getting better because the tools used are learning tools with projects. Based on the average acquisition of student soft skills, it can be said that the SMK science learning tools with Project settings are effective in improving / developing student project-based soft skills. The increase in the value of project-based soft skills is because in the learning process the teacher continuously reminds and motivates students to always interact optimally in the team, present the results of group discussions, extract information from various sources for an assignment, and problem-based learning with, using project learning. The acquisition of science learning tools with an effective project model is due to several factors, including:

- First, the learning tools developed in accordance with the 2013 Curriculum which are being applied in class XI learning of the machine engineering group at SMK Negeri 2 Kudus. As a vocational school, the project model is very suitable to be applied in learning because it brings students to the real world of work.
- Second, the learning tools developed are presented in a structured, interactive manner with an attractive appearance that creates a sense of desire to know and motivation of students in learning. Student books are presented with many pictures of activities that are close to the daily lives of students that make students happy to read them. The teacher's handbook is equipped with a syllabus and lesson plans so that teachers no longer make lesson plans enough to prepare material for teaching. Maximum
teacher readiness is also one of the factors supporting the success of learning.

- Third, the learning tools developed are adapted to existing facilities in schools and in the community, making it easier for students and teachers to find tools or materials used in this project-based learning activity.
- Fourth, the learning tools that are arranged have a consistent or consistent relationship between the syllabus, lesson plans and student books and teacher handbooks, making it easier to implement in class because of the clarity of each stage presented.
- Fifth, science learning tools using the project model are prepared by inserting project-based soft skill aspects that can be developed by students at each learning stage so that they can provide information and motivation for students to develop their soft skills. Aspects of project-based soft skills include the ability to manage yourself (managing self), the ability to communicate (communicating), the ability to manage people and tasks (managing people and tasks), the ability to mobilize innovation and change (mobilizing innovation and change).

The increase or development of student project-based soft skills for the four aspects of soft skills as measured through a questionnaire was caused by the application of learning tools with a project model in science learning.

**Conclusion and Suggestions**

Based on the discussion that has been described, the following conclusions can be drawn:

- The SMK science learning tools with the project model have met the validity requirements for developing student project-based soft skills.
- The SMK science learning tools with the project model have met the practical requirements for developing student project-based soft skills.
- Vocational school science learning tools with a project model have met the effectiveness requirements for developing student project-based soft skills.

Based on the findings and discussion that has been described, the following suggestions are proposed:

- Teachers, in order to carry out development research, it should be developed in science subjects on other sub-subjects or other subjects because it is proven to be able to develop student project-based soft skills.
- To the District Education Office, efforts are made to facilitate training for subject teachers on the development of learning tools, especially the development of science learning tools to develop student project-based soft skills.
- To other researchers who are interested in perfecting this research, the tools that are developed should be tested in other classes and schools by different teachers.
References


