PROBLEM-BASED LEARNING TO IMPROVE STUDENTS’ CRITICAL THINKING SKILL

Mochamad Cholik1, Tri Riyanto2, Ridzwan bin Che’Rus3, Ari Sriantini4.
1 Universitas Negeri Surabaya, Indonesia
2 Universitas Negeri Surabaya, Indonesia
3 Tanjong Malim Perak Darul Ridzuan, Malaysia
4 Universitas Hang Tuah Surabaya, Indonesia

Email: 1mochamadcholik@unesa.ac.id, 2tririjanto@unesa.ac.id, 3ridzwan@fptv.upsi.edu.my, 4ari.sriantini@hanagtua.ac.id

DOI: https://doi.org/10.37758/jat.v5i3.505

Abstract:
Problem-based learning is learning by presenting contextual problems. Mechanical Engineering Subjects to support the competence and competitiveness of students majoring in Mechanical Engineering at Vocational High School. The purpose of the research is to describe the results of the application of problem-based learning in order to improve students’ critical thinking skills and improve problem solving skills in mechanical engineering subjects. This research is classroom action research. The subject of this study involved students of class XI of the Mechanical Engineering Study Program at SMK Negeri 3 Bojonegoro, 32 people, in the 2021/2022 academic year. This critical thinking skill uses indicators developed by Ennis. The results of cycle 3 for good criteria are 44% and very good are 28%. The number of percentages in solving problems is 72%. The results in cycle 3 for good criteria are 44% and very good are 31%. Total percentage for critical thinking ability is 75%. This shows that both of these things have exceeded the minimum percentage set at 70%, or in other words, the problem-based learning process can develop students' critical thinking skills in mechanical engineering subjects in SMK. The results of the research above can be said that there is a relationship between the problem-based learning process on students' critical thinking.

Keywords: Problem-based learning, Critical Thinking skill, Machinery Engineering.

Abstract:
Pembelajaran berbasis masalah adalah pembelajaran dengan menghadirkan masalah kontekstual. Mata Pelajaran Teknik Mesin untuk menunjang kompetensi dan daya saing siswa jurusan Teknik Mesin di SMK. Tujuan penelitian adalah mendeskripsikan hasil penerapan pembelajaran berbasis masalah dalam rangka meningkatkan kemampuan berpikir kritis siswa dan meningkatkan kemampuan pemecahan masalah pada mata pelajaran teknik mesin. Penelitian ini merupakan penelitian tindakan kelas. Subjek penelitian ini melibatkan siswa kelas XI Program Studi Teknik Mesin SMK Negeri 3 Bojonegoro sebanyak 32 orang, pada tahun ajaran 2021/2022. Keterampilan berpikir kritis ini menggunakan indikator yang dikembangkan oleh Ennis. Hasil siklus 3 kriteria baik 44% dan sangat baik 28%. Jumlah persentase dalam menyelesaikan soal adalah 72%. Hasil pada siklus 3 untuk kriteria baik 44% dan sangat baik 31%. Persentase total untuk kemampuan berpikir kritis adalah 75%. Hal ini menunjukkan bahwa kedua hal tersebut telah melampaui persentase minimal yang ditetapkan sebesar 70%, atau dengan kata lain proses pembelajaran berbasis masalah dapat mengembangkan kemampuan berpikir kritis siswa pada mata pelajaran teknik mesin di SMK. Hasil penelitian di atas dapat dikatakan bahwa ada hubungan antara proses pembelajaran berbasis masalah terhadap berpikir kritis siswa.

Keywords: Problem-based learning, Critical Thinking skill, Machinery Engineering.
INTRODUCTION

Vocational High School (SMK) is a secondary level vocational education aimed at preparing students who are competent and virtuous, have high competitiveness, and are able to perform technological engineering. Therefore, there needs to be real efforts that need to be made to achieve this goal, one of which is applying a teaching model that is estimated to be able and able to increase students' motivation and creativity. (Rahmawati, Dyah; Widiastuti, Indah; Harjanto, 2015; Yuwono et al., 2015), (Hidayati & Wagiran, 2020), (Syarifuddin Hidayatullah et al., 2020), (Suparman et al., 2021).

Problem-based learning is learning by presenting contextual problems through the stages: orientation of students to problems, organizing students so that the learning process, mentoring, and observing individually or in groups, describing or presenting work, analyzing or evaluating solutions to problems so that they can motivate students to actively learn, improve and develop dexterity of critical thinking, and foster creativity of students to work, and communication between students in groups (Cho et al., 2015; Saputra, 2013; Simanjuntak & Sudibjo, 2019; Tan.T, 2017), (Syamsul Arifin, Punadji Setyosari, Cholis Sa’dijah, 2020). There are seven indicators in solving problems (Rosy, B., & Pahlevi, 2015), (Jabarullah & Iqbal Hussain, 2019), namely: 1) observing a problem; 2) formulate a problem; 3) analyze a case; 4) draw conclusions; 5) determine the solution; 6) conduct an evaluation; 7) and solve a problem.

Mechanical Engineering Subjects to support the competence and competitiveness of students majoring in Mechanical Engineering at SMK. Students are required to have critical thinking, be active in conveying ideas and make decisions in solving problems. Critical thinking can be interpreted as a process of how to use the mind effectively in helping someone evaluate, and apply appropriate decisions to what is believed and done. According to (Siswono, 2018), (Bernadetha & Lamhot, 2020), skills of thinking about critical thinking as an effort to: 1) compare; 2) differentiate; 3) estimate, 4) draw conclusions; 5) affect; 6) generalization, 7) specialization; 8) classify; 9) grouping; 10) sort; 11) predict; 12) validate; 13) prove; 14) linking; 15) analyze; 16) evaluate, and build critical thinking patterns in mechanical engineering emphasizing problem solving, concept mastery, and topic controversy in mechanical engineering learning. Developing critical thinking skills in mechanical engineering does not only involve mental states, but must also emphasize basic reasoning skills.

Based on experience in the field, students' critical thinking skills are low. This is indicated: students who tend to be passive when receiving lessons, students are less able to solve problems properly and correctly, learning is not yet student-oriented. So that students are less trained in developing their skills in conveying ideas, ideas, and solving problems. Therefore, it is necessary to make an effort so that the pattern of developing skills towards critical thinking is needed. Problem-based learning patterns. The formulation of the research problem is whether the application of problem-based learning will be able to develop skills for critical thinking, and students will have the ability to solve problems in mechanical engineering subjects? The machining techniques in this
study include: 1. Lathe Machining Engineering; 2. Milling Machinery Engineering; 3. Grinding Machining Techniques; 4. Mechanical Engineering NC/CNC and CAM.

The benchmark of critical thinking skills of research by applying the benchmark developed by Ennis (in Rahmawati, Dyah; Widiastuti, Indah; Harjanto, 2015), (Sholihah & Lastariwati, 2020) are: (1) focusing questions, meaning paying attention to or exploring important situations, conditions, problems, or matters that all require answers (2) analyzing arguments, being able to describe, distinguishing information, causes, demands that are relevant or irrelevant and able to rationalize the results of arguments (3) asking or answering explanatory questions, meaning being able to determine accurate facts (4) considering the credibility of a source, meaning being able to determine sources with accurate credibility (5) observing and considering the results of observations, this is able to ensure the observed objective things (6) defining terms and considering definition, it is able to interpret and describe and describe a term to have a meaning that can be clearly understood (7) make and consider decisions, be able to determine the strongest argument and have the lightest consequences or risks (8) decide on an action, be able to examine thoroughly and choose things to be done in a targeted manner (9) interact with other people, meaning being able to communicate in one direction or two directions and be tolerant of the opinions and views of others means being able to communicate in one direction or two directions and tolerant of the opinions and views of others means being able to communicate in one direction or two directions.

RESEARCH METHODS
The data is processed descriptively. The criteria for this activity is said to be successful if it has met two criteria, namely the data on the achievement of students' critical thinking and problem solving skills of 70%. This 70% percentage is obtained from the achievement or mastery of the instruments used to measure the above. The calculated score is a score that is above the good value of the instrument.

Research subject
Class XI students in the Mechanical Engineering Study Program at SMK Negeri 3 Bojonegoro, totaling 32 people, for the 2020/2021 academic year, were the subjects in this study.
Research procedure
The research uses three cycles, each stage is carried out in 2 meetings or 4 hours of learning. Each stage consists of 4 stages, namely: 1) planning; 2) Action; 3) observation; 4) reflection.

Based on the cycle in Figure 1, it is described as follows:
Cycle I
1. Planning
   Phase 1 researchers provide observation sheets on the implementation of learning on the basis of problems and analysis sheets to measure students' critical thinking skills,
2. Implementation
   Stage 2 is the implementation of the plan. The implementation of the action will be displayed in written form which includes: 1) the results of the analysis of the critical thinking dexterity of students, and the acquisition of observations on the implementation of the learning process. Observations made at this stage intend to ensure that teachers and students have implemented problem-based learning. The activities of teachers and students in teaching with a problem-based learning model are listed in table 1:

Table 1. The working steps of the Problem-Based Learning Model

<table>
<thead>
<tr>
<th>Work steps</th>
<th>Teacher Activities</th>
<th>Student activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student identification of problems</td>
<td>The teacher explains the problem to be solved together</td>
<td>The group looks closely to find out what rights are expressed by the teacher</td>
</tr>
<tr>
<td>Organizing student learning</td>
<td>The teacher clearly understands the group members and understands each task</td>
<td>Students discuss and share tasks to prepare preparations and tools needed to complete the tasks they get</td>
</tr>
<tr>
<td>directing students individually or in groups</td>
<td>The teacher supervises the activities of students to collect information</td>
<td>Students find and examine data or information as discussion material in groups</td>
</tr>
<tr>
<td>Develop/display the work</td>
<td>The teacher pays attention to the explanation, rationalizes the students and directs the preparation of the report, until it is ready to be presented</td>
<td>Groups carry out discussions that result in problem solving</td>
</tr>
<tr>
<td>Observing and measuring the process of resolving matters that need to be answered</td>
<td>The teacher directs students to explain and encourage the group and give appreciation and input to other groups. Teachers and students make conclusions.</td>
<td>Each group carries out presentations and other groups provide input. Then draw conclusions according to the input.</td>
</tr>
</tbody>
</table>

3. Observation
Observations were carried out by 3 observers, the observers were Unesa mechanical engineering students. This observer before carrying out the observation is provided with a common perception of the observation points. This is done in order to minimize the obstacles that can occur when making observations. This observation is to record all activities and aims to obtain information about the classroom learning process related to the activities of teachers and students. Activities during learning are observed and evaluated and the problems that arise are used as reflection material.

4. Feedback
At the feedback stage, the results of observations are observed and analyzed, then used as reflections. The results of observations and reflections are used to improve the next learning cycle. In stages II & III, the steps are basically the same as in cycle I. Cycle II feedback is used to observe and distinguish between stages I and stage II, whether there is a change in critical thinking skills or no difference, if there is no change in improvement, then This step is repeated.

Data collection technique
Data were collected through observation using an observation sheet. Observations are carried out during the learning process. Observation sheets are designed according to critical thinking indicators, while problem-based learning is raised in the implementation of learning.

Data analysis technique
Analysis of problem-solving skills and critical thinking skills is carried out by observation during learning. Students are measured based on predetermined benchmarks. The benchmarks on critical thinking used by research consist of: formulating problem formulations, answering questions, carrying out appropriate procedures, reporting observations, making assumptions, drawing conclusions, defining variables, and formulating problem solving Ennis (in Raudhah, Hartoyo, & Nursangaji, 2019), (Suparman et al., 2021). Fase on the ability to think critically as much as 5 aspects, with 8 indicators. The assessment
ranges from 1 to 4. Each critical thinking indicator is done descriptively using percentages. According to Ngalim (in Amanda, Muharrami, Rosidi, & Ahied, 2018), the assessment criteria are:
54% is not good; 55 to 59% is less; 60 to 75% is enough; 76 to 85% is good; 86 to 100% is very good.
The calculation of the percentage score of critical thinking skills uses the following formula:
\[ \text{Np} = \frac{R}{SM} \times 100\% \]
which thing,
\( \text{Np} = \) The percentage value of skills on critical thinking
\( R = \) Score obtained
\( SM = \) Max score

RESULTS AND DISCUSSION
1. Students' ability to solve problems
Based on the research results, the results of the development of students' abilities in solving problems in cycles 1, 2, and 3 are shown in Table 2 below:

Table 2. The development of the results of scoring students' ability to solve problems

<table>
<thead>
<tr>
<th>Solve the problem</th>
<th>The first stage</th>
<th>Second Stage</th>
<th>Third phase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Many Students</td>
<td>%</td>
<td>Many Students</td>
</tr>
<tr>
<td>Very good</td>
<td>4</td>
<td>13%</td>
<td>44</td>
</tr>
<tr>
<td>Good</td>
<td>10</td>
<td>31%</td>
<td>11</td>
</tr>
<tr>
<td>Enough</td>
<td>18</td>
<td>56%</td>
<td>15</td>
</tr>
<tr>
<td>Not enough</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Not good</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Amount</td>
<td>32</td>
<td>100%</td>
<td>32</td>
</tr>
</tbody>
</table>

Table 2 and Figure 2, it is known that students' ability to solve problems has increased in each cycle. In cycle 1 and cycle 3, both very and good categories increased, initially only 13% increased to 28% Likewise, the good category also experienced an increase, which was originally 31% to 44%. While the moderate category decreased from cycle 1 by 56%, and in cycle 3 by 28%.
The criteria for achieving students' ability to solve problems must have a score of 70%. This score consists of the sum of the percentages of the good to very good categories at stage 3. The results at stage 3 for good criteria are 44% and very good are 28.00%. The number of percentages in solving problems is 72%. Thus it can be said that 72% of students have reached the limit of students' ability to solve problems.

2. Students' Critical Thinking Ability
The results of the activity, the results of the development of critical thinking skills and students' abilities in solving problems during the first, second, and third stages are shown in the following third table:

<table>
<thead>
<tr>
<th>Critical thinking</th>
<th>The first stage</th>
<th>Second Stage</th>
<th>Third phase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Many Students</td>
<td>%</td>
<td>Many Students</td>
</tr>
<tr>
<td>Very good</td>
<td>5</td>
<td>16%</td>
<td>8</td>
</tr>
<tr>
<td>Good</td>
<td>9</td>
<td>28%</td>
<td>11</td>
</tr>
<tr>
<td>Enough</td>
<td>18</td>
<td>56%</td>
<td>13</td>
</tr>
<tr>
<td>Not enough</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Not good</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Amount</td>
<td>32</td>
<td>100%</td>
<td>32</td>
</tr>
</tbody>
</table>

Table 3 and Figure 3, it is known that the development of students' thinking skills increases in each cycle. In the first cycle and the third cycle, the very good categories increased initially only 16% increased to 31% as well as the good category there was an increase, which was originally 28% increased to 44%. While the category is quite decreased from cycle 1 by 56%, and in cycle 3 by 25%. The
criteria for achieving students' critical thinking skills must have a score of 70%. This score consists of the sum of the percentages of good and very good categories. The sum of the results in the first cycle was 44%, in the third cycle it was 75%. Thus it can be said that as much as 75% of students have reached the limit of critical thinking skills.

![The state of students' critical thinking skills - Stages 1, 2, and 3](image)

The results of this study can be said, with problem-based skills learning activities, will be able to develop students' critical thinking skills. According to (Tan. T, 2017), (Sholihah & Lastariwati, 2020), because the learning model provides encouragement for critical thinking, when students are given a problem related to daily habits it will be able to increase theory into practice about critical thinking, besides problem-based learning also makes students more active in the learning process. This is in line with what was conveyed by (Ahmad, 2017; Amanda et al., 2018; Ningsih et al., 2018; Simanjuntak & Sudibjo, 2019), (Jabarullah & Iqbal Hussain, 2019), that thinking skills become better through problem-based learning, which is able to parse problems and solutions require intelligent skills for thinking and good mastery of concepts and theories.

**CONCLUSION**

Problem-based learning is an excellent alternative for students to develop their critical thinking skills. This can be seen in table 2 cycle 3. The percentage is 72%, while table 3 cycle 3 is 75%. This shows that both of these things have exceeded the minimum percentage set at 70%, or in other words The problem-based learning process can develop students' critical thinking skills in mechanical engineering subjects in SMK. The results of the research above can be said that there is a relationship between the problem-based learning process on students' critical thinking.
Problem-based learning process and critical thinking skills are approaches to achieve learning products. Related to this, the thing that needs to be considered in similar or advanced research is the scoring technique for data collection. In the scoring, it is necessary to consider the sensitivity of the scoring to be used, so that the data obtained has high accuracy, so that the research results are more optimal.

REFERENCES


