Improving Student Motivation and Learning Outcomes Through the Application of Problem-Based Learning Models in Mathematics Learning Specialization

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Abstract. Teachers as educational professionals have an important role in the teaching and learning process. Teachers must be able to explain their knowledge to their students through managing learning by applying teaching approaches and models that are appropriate to the subject matter and cognitive level of students. The aim is to improve the mathematics learning abilities of XI IPA 2 students at SMAN 7 Sigi even semester for the 2022/2023 academic year in the basic competence “Analyzing division and factorization of polynomials” using Problem-Based Learning. This study used classroom action research with a sample of 37 people consisting of 9 men and 28 women with data collection techniques, namely 1) non-test techniques consisting of observation and documentation, and 2) test techniques. Data validity was carried out through source triangulation and method triangulation with data analysis techniques. The data analysis techniques used in this study are non-test techniques and learning achievement tests. The results of this study indicate that 1) the application of the Problem-Based Learning (PBL) learning model that is used as a model in this learning is in fact capable of increasing residual learning motivation in mathematics learning specialization class XI IPA 2 SMAN 7 Sigi even semester of the 2022/2023 academic year; 2) The application of the Problem-Based Learning (PBL) learning model that is used as a model in this learning is in fact able to improve the remaining learning outcomes in mathematics learning specialization for class XI IPA 2 SMAN 7 Sigi even semester of the 2022/2023 academic year; 3) The application of the Problem-Based Learning (PBL) learning model that is used as a model in this learning is in fact able to increase motivation and residual learning outcomes in mathematics learning specialization class XI IPA 2 SMAN 7 Sigi even semester of the 2022/2023 academic year.

Keywords: Learning outcomes, motivation, problem based learning

1. Introduction

The learning process is never separated from the assessment. Assessment serves to see the results of learning that has been done. Permendikbud Number 66 of 2013 describes the assessment of the learning process in the 2013 curriculum using an authentic assessment approach that assesses student readiness, processes, and learning outcomes as a whole (Siswandani, 2015). The results of authentic assessment can be used by teachers to plan remedial, enrichment, or counseling services. In addition, the results of authentic assessment can be used as material to improve the learning process in accordance with educational assessment standards.

Teachers as educational professionals have an important role in the teaching and learning process. Teachers must be able to explain their knowledge to their students through managing learning by applying teaching approaches and models that are appropriate to the subject matter and cognitive level of students. In addition, the teacher must also pay attention that students are students who must be actively involved in the teaching and learning process so that the material being taught is more meaningful for students and the desired learning objectives can be achieved (Andriani & Rasto, 2019; Budiningsih, 2012).

Selection of learning approaches or strategies that will be used by teachers in the teaching and learning process can affect students' interest and motivation to learn (Kori, Pedaste, Altin, Tönisson, & Palts, 2016). In addition, it can also affect students'
understanding of the material or basic concepts which ultimately influence student motivation and learning outcomes (Tambunan, Sinaga, & Widada, 2021).

Based on the results of initial observations made by researchers, especially in class XI IPA 2 which is the research subject of researchers. The result was that out of 37 students, 31 students (83.78%) got grades below standard, and only 6 students (16.22%) completed. This condition indicates that there is a need for an improvement effort in the mathematics teaching model which can stimulate students to learn actively in the teaching and learning process.

The reality in the field is that students only memorize concepts and are less able to use these concepts if they encounter problems in real life related to the concepts they have(Trianto & Pd, 2007). Furthermore, even students are less able to determine the problem and formulate it. Low motivation for learning or teaching, especially if it is related to students' understanding of the understanding of the material being taught. The understanding in question is the student's understanding of the qualitative basis where facts are interrelated with his ability to use that knowledge in new situations. Most students are less able to make connections between what they learn and how this knowledge will be used/applied in new situations.

The specialization mathematics learning method that is appropriate to this problem is the Problem-Based Learning (PBL) learning model. Problem-Based Learning (PBL) is a form of learning that emphasizes the involvement of students in solving a problem, which means that they can construct their own knowledge from the results of the solutions they find(7)(8). In this learning process, it can help students develop ways of thinking and problem-solving skills that will be used as concepts and can learn more maturely so that students are more independent. In addition, this learning really involves students directly in learning so that the knowledge gained is easier to absorb and more durable because they discover it for themselves, which can increase their achievement. The difference between conventional learning methods and the Problem-Based Learning (PBL) model is that in the conventional model, students are required to remember all the information provided by the teacher to students, whereas in the PBL model students are only given enough information as a basis for solving other problems(Wells, Warelow, & Jackson, 2009). In addition, the Problem-Based Learning (PBL) model familiarizes students to think actively in the teaching and learning process because the application of the problem-based learning (PBL) learning model requires students to identify a problem, gather information, and use that information(Choon‐Eng Gwee, 2008; Tseng, Chiang, & Hsu, 2008). Students are expected to be able to formulate the things asked in the problem using the material that was previously given.

2. Method

This research uses classroom action research (CAR). PTK is a translation of Classroom Action Research, which is Action Research conducted in the classroom (Khasinah, 2013; Mettetal, 2002; Wijaya, 2017). PTK is research conducted by teachers in their own classes through self-reflection with the aim of improving their performance so that student learning outcomes increase(Zaenal, 2009). The procedure for this research activity was carried out through 2 cycles, each cycle consisting of four stages, namely 1) Planning, 2) Implementation, 3) Observation, 4) Reflection(Arikunto, 2021).

The subjects of this study were students in class XI IPA 2 even semester in the 2022/2023 academic year with a total of 37 students consisting of 9 males and 28 females using data collection techniques, namely 1) non-test techniques consisting of observation and documentation, as well as 2) test technique. Data validity was carried out through source triangulation and method triangulation with the following data analysis techniques:
a. Observation
Observation of student motivation using 7 indicators contained in the observation sheet of observation of learning motivation obtained during the learning process with the Problem-Based Learning (PBL) learning method, namely: There is a desire and desire to succeed; Tenacious in the face of adversity; Shows interest in various problems, prefers to work alone; Gets bored quickly in routine tasks, can defend his opinion; Enjoys finding and solving problems; Happy to follow the lesson; Diligent in studying and dealing with mathematical tasks, using formulas:

\[ P = \frac{F}{A} \times 100\% \]

Information:
P = Percentage of students' motivation to learn mathematics
F = total score of students' motivation to learn mathematics
A = total ideal maximum score of students' motivation to learn mathematics

Assessment guidelines to determine the level of completeness as explained in the table below:

<table>
<thead>
<tr>
<th>Score Range</th>
<th>Completeness Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;=70</td>
<td>Complete</td>
</tr>
<tr>
<td>&lt; 70</td>
<td>Not finished</td>
</tr>
</tbody>
</table>

Source: Score Observation Sheet (Zaenal, 2009)

b. Learning Outcome Test
Quantitative data was obtained from the results of tests done by students in cycle I. The quantitative data of this study were obtained by calculating the class average score from the test results given to students with the formula:

1) Calculating the value of students' cognitive learning outcomes individually using the formula (Purwanto, 2016):

\[ NK = \frac{R}{N} \times 100 \]

Information:
NK = student grades (sought grades)
R = total score/item answered correctly
N = maximum score of the test
100 = fixed number

2) Calculate the average value of all students (Zaenal, 2009)

\[ \bar{X} = \frac{\sum X}{\sum N} \]

Information:
\( \bar{X} \) = Grade point average
\( \sum X \) = The sum of all student scores
\( \sum N \) = The number of students
3) Calculating the percentage of completeness of students' cognitive learning outcomes using a classical formula:

\[ K = \frac{\sum X}{N} \times 100\% \]

Information:
- \( K \) = classical learning mastery
- \( \sum X \) = the number of students who scored \( \geq 70 \)
- \( N \) = the number of students
- 100\% = fixed number

Table 2. Criteria for Student Learning Completeness

<table>
<thead>
<tr>
<th>Score Achievement</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;70</td>
<td>Not finished</td>
</tr>
<tr>
<td>( \geq 70 )</td>
<td>complete</td>
</tr>
</tbody>
</table>

*Source: Completeness Criteria (Zaenal, 2009)*

The criteria for the success of the action if the action will be stopped if the success criteria have been reached. Criteria for the success of the action are determined based on the mastery learning applied by the school and based on the considerations of the researcher. The criteria for the success of this action are 1) If \( \geq 85\% \) of students complete according to the minimum completeness criteria (KKM) set by the school, namely 70.00; and 2) The average motivation of individual students is declared complete if they get a score \( \geq 70 \) and classically \( 85\% \) of the number of students increases their learning motivation.

3. Results and Discussion

Before carrying out research by applying the Problem-Based Learning (PBL) learning model, the researcher first conducted learning observations to find out the problems faced by teachers in the learning process in class. Based on the results of classroom observations, a general description of the problems faced by teachers in the learning process of mathematics specialization in class XI IPA 2 SMAN 7 Sigi can be presented, including the following: a) Classroom learning still uses the expository method and is teacher-centered so that student involvement in the learning process is less optimal and students become passive learners; b) When specialization mathematics learning takes place there are still students who are not paying attention, chatting, disturbing friends and even busy with their own activities; c) The involvement of students in the learning process is still not optimal, the teacher does not carry out learning innovations, especially the use of learning resources that are only oriented towards textbooks and gives little opportunity for students to construct mathematical ideas of their own interest. Classroom action research through the application of the Problem-Based Learning (PBL) learning model in class XI IPA 2 SMAN 7 Sigi was carried out in 2 cycles. Each cycle consists of four stages, namely: 1) Initial reflection, 2) Planning, 3) Implementation, and 4) Observation. 1) Initial reflection, 2) Planning, 3) Implementation, 4) Observation. Each stage will be described as follows:
3.1 Cycle I

Planning

Cycle I action planning was designed based on the results of initial reflection when the researcher made initial observations on the implementation of learning in class XI IPA 2. In cycle I focused on achieving indicators: 1) Understanding the meaning, solution, and application of polynomials in real problems; 2) Analyzing the results of addition, subtraction, and multiplication of two polynomials and applying them to solve real problems; 3) Analyze the divisibility and factorization properties of polynomials; 4) Analyze the Remainder Theorem and polynomial factorization to facilitate problem-solving; 5) Understanding the similarity of the two pilots.

As for the implementation plan for cycle I, namely 1) Prepare learning materials, which consist of a) Preparing an even semester XI class syllabus; b) Developing a learning plan that is oriented towards the Problem-Based Learning method; c) Making student worksheets; d) Prepare student motivation observation sheets; e) Forming cycle I test questions and their assessment rubrics; and 2) Form groups of students in learning activities. Class XI IPA 2 students with a total of 37 students were divided into 5 groups. Each group consists of 7 students and there are 2 groups with 8 members based on the level of student ability.

Implementation

Implementation of actions based on the RPP that has been prepared at the planning stage. In cycle I, the implementation of the action was carried out in two meetings. The first meeting was held on Tuesday 10 January 2023. The indicators to be achieved in cycle I are: 1) Understand the meaning, solution and application of polynomials in real problems; 2) Analyze the results of addition, subtraction and multiplication of two polynomials and apply them to solve real problems; 3) Analyze the divisibility and factorization properties of polynomials; 4) Analyze the Remainder Theorem and polynomial factorization to facilitate problem solving; 5) Understanding the similarity of the two pilots.

The implementation of cycle I actions can be described as follows:

1) Preliminary activities, namely: a) Researchers say greetings and then present the presence of students; b) The researcher conveys the material, objectives and benefits of the competencies to be studied, as well as the learning methods to be carried out during the learning process; c) The researcher gave a little motivation to students about the benefits of learning mechanical engineering drawing.

2) Core Activities, namely before starting to explain the learning material the researcher divided students into five groups. One group consists of 7 or 8 people. The division of groups is carried out based on the level of ability of students. After dividing into groups, students pay attention to the initial explanation from the teacher. When the researcher explained the material, there were still many students who had not paid attention to the researcher’s explanation so the learning atmosphere was not conducive, students looked indifferent to the material presented by the researcher and only a few students asked about the material. After giving an explanation of the material, the teacher calls each group leader to take questions made in the form of LKPD. Students discuss work on the discussion questions with their group members. During the discussion process, it was seen that there were still many students who had not participated in working on the discussion questions. They were still chatting with their friends while handing over the discussion task to the group leader.
Then the results of the discussions that have been carried out by each group are presented in front of the class according to the material, the group leader is responsible for its members during the presentation. Then each group is given the opportunity to ask the group that is presenting the results of their discussion in front of the class, other groups are allowed to provide opinions or suggestions related to the material presented.

3) Final Activity, namely after groups 1, 2, 3, 4, and 5 have finished presenting the results of their discussions, the researcher evaluates and concludes the learning outcomes. The following week the researcher gave posttest questions as a learning motivation tool to students to determine the level of student motivation in participating in the learning process.

Before ending the learning process the researcher provides related information about the material to be discussed at the next meeting, then the researcher gives group assignments to find material for the next meeting.

An explanation of the results of the implementation of learning activities in the first cycle of classroom action research as explained below:

Table 3.

Recapitulation of First Cycle Final Test Results

<table>
<thead>
<tr>
<th>No</th>
<th>Completeness</th>
<th>Amount</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Complete</td>
<td>29</td>
<td>78.38</td>
</tr>
<tr>
<td>2</td>
<td>Not Completed</td>
<td>8</td>
<td>21.62</td>
</tr>
<tr>
<td></td>
<td>Amount</td>
<td>37</td>
<td>100.00</td>
</tr>
<tr>
<td></td>
<td>Lowest value</td>
<td>50.00 (4 people)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The highest score</td>
<td>80.00 (11 people)</td>
<td></td>
</tr>
</tbody>
</table>

Source: Results of data processing

The table above can be explained as follows the average value of learning outcomes in the implementation of the first cycle of learning improvement, the number of students who have completed their studies is 29 students or 78.38% and the number of students who have not completed their studies is 8 students or 21.62%. The highest score is 80 as many as 11 people and the lowest score is 50 as many as 4 people.

From the explanation mentioned above, it can be concluded that the results of the formative test scores have increased from the initial conditions because prior to the completion of the improvement, 6 students (15.38%) increased to 29 students (78.38%). From these data, it shows that the research results in the first cycle are not in accordance with the indicators, namely at least 85% of the total number of students is declared complete or gets a minimum score equal to KKM 70.

Observation

Explanation regarding the assessment of student motivation using an observation sheet with 7 indicators, namely: There is a desire and desire to succeed; Tenacious in the face of adversity, shows interest in various problems, prefers to work alone; Gets bored quickly in routine tasks, can defend his opinion; Enjoys finding and solving problems; Happy to follow the lesson; Diligent in learning and dealing with math tasks shows results as described in Table 4:
Table 4.
Recapitulation of Observation Results of Student Motivation in First Cycle Learning Activities

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>Amount</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Complete Student</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Complete Percentage</td>
<td>78.38</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Incomplete Students</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Incomplete Percentage</td>
<td>21.62</td>
<td></td>
</tr>
</tbody>
</table>

*Source: Results of data processing*

From the table above it can be concluded that out of 37 students, there were 29 people who had completed their learning motivation (78.38%), while 8 students (21.62%) had not completed it. Seeing the results above, the researcher together with the observer agreed to carry out learning improvements in cycle II with the hope that in cycle II student learning motivation can achieve acquisitions above 85% in accordance with predetermined success criteria.

Reflection

Reflection was carried out by the researcher and the observer. Reflection is carried out in line with the implementation of actions and at the end of cycle I. Based on the results of reflection it can be said that in general the implementation of specialization mathematics learning using Problem-Based Learning in cycle I in class XI IPA 2 has been going well, but several steps have not been carried out optimally. The first step is to orient students to the problems they are already working with.

Good. Students have been directed to the problems that will be discussed in learning. Steps to organize students to learn is good. Students have worked in small groups, but in groups, there are students who do not work and the class atmosphere is crowded because student discussions are less focused and uncontrolled. The next step is to guide the investigation, at this stage, the activities have not been carried out optimally due to time constraints if each group is still not independent and asks a lot of questions to the teacher. Investigation activities are carried out by students in groups, if there are groups that experience difficulties the teacher or observer will help to provide direction. The next step is the step in developing and presenting the work. In developing the work, each group is required to make the results of the problem-solving discussion which will then be presented in front of the class. Students do not have the courage to present their work without being appointed by the teacher. In the step of analyzing and evaluating the results of the problem-solving process, students need to be provoked with questions so that they dare to express opinions in analyzing and evaluating the results of problem-solving that has been obtained. Students are given the opportunity to express their opinions. From the results of observing the implementation of learning, the percentage of learning implementation using Problem-Based Learning has been implemented, although it still needs improvement in several aspects.

The obstacle from the first cycle was in working on still questions many are not systematic so there are steps that are skipped or sometimes there are steps that should not be necessary and result in inaccurate results so the conclusions from the settlement results obtained are also inaccurate. The action plan to be carried out in cycle II based on the results of reflection from cycle I is to improve every aspect of problem-solving ability.

This is implemented by further optimizing every step of the way learning Problem-Based Learning. Students are given problem-solving questions and discussed in groups. The teacher directs each group to be more optimal in
participating in learning and more coherent in solving each given problem in accordance with the four aspects of problem-solving.

3.2 Cycle II

Classroom action research on the application of the Problem learning model Based Learning (PBL) was carried out in 2 meetings:

Planning

At the planning stage in cycle II, the first thing to do was to make a Learning Implementation Plan (RPP) about the material for calculating the average value, mean median, and group data mode. The Learning Implementation Plan was prepared by researchers and observers. Next, the researcher compiled the learning material to be taught and prepared observation sheets and questionnaires to determine the success of the Problem-Based Learning learning model in cycle II. This observation sheet will be used by researchers as a guide in observing classes and the level of motivation and student abilities during learning activities. After that, the researcher compiled and prepared questions that would be used to measure students' ability to understand the subject matter. The question is in the form of a post-test to assess how well students understand the material after the learning process is carried out. Before starting the lesson, previous researchers and teachers along with observers jointly provided motivation to increase students' enthusiasm for learning in the classroom so that students were able to follow the lesson well and to create a conducive learning atmosphere.

1. Implementation of Cycle II Actions, namely at the implementation stage of the action, the researcher who act as a teacher carrying out actions in accordance with the steps learning steps with the Problem-Based Learning model as in the RPP that has been prepared as in the implementation of the actions in cycle I, but the indicators are different where in cycle II the indicators are: a) Determine the value of a polynomial; b) Determine the quotient and remainder of a polynomial by stacking and horner; c) Determine the remainder of a polynomial by (ax+b); d) Determine the remainder of division by (x-a)(x-b); f) Understand the factor theorem.

During the implementation of the action, the researcher was assisted by fellow researchers in making observations. Observations were made based on the observation guidelines that had been prepared, and the results were recorded in observation sheets and field notes.

a. Preliminary Activities, namely 1) Researchers say greetings and pray then present the presence of students; 2) Researchers make commitments with students when lessons are in progress, with agreed commitments between teachers and students it is expected to create a conducive learning atmosphere so that students feel comfortable in the learning process; 3) The researcher conveys the material, objectives, and benefits of the competencies to be studied, as well as the learning methods to be carried out during the learning process; 4) Researchers convince each student that they are capable of doing the tasks given and are able to produce the best results; 5) Researchers accustom students to thinking that in learning making mistakes is a natural thing so that all students are expected to be active and not afraid of making mistakes when conducting discussions and presentations; 6) The researcher conveys to give prizes to individuals and groups who get the best values and attitudes.
b. Core Activities, namely the researcher re-explains the chronology of Problem-Based Learning to provide motivation to students so that the classroom atmosphere becomes active and conducive. After motivating students, the researcher evaluates the results of the investigation to determine students' interest in participating in the learning process. The researcher divided the groups and divided the topics into each group according to the material that had been determined. The topics that each group will get are obtained by lottery so each group does not yet know what topics they will discuss. Then, the researcher explained some material in accordance with the learning objectives to be achieved, namely: 1) Determine the value of a polynomial; 2) Determine the quotient and remainder of a polynomial by stacking and horner; 3) Determine the remainder of a polynomial by \((ax+b)\); 4) Determine the remainder of division by \((x-a)(x; 5)\) Understand the factor theorem. When the researcher explained the material, most of the students could follow the explanation well so as to create a conducive learning atmosphere. Next, the researcher directed the students to sit based on the groups that had been determined by the researcher at the meeting in cycle I. After that, each group leader took a topic that they would discuss based on the LKPD they got. The results of the discussions that have been discussed by each group are then presented in front of the class the same as with the presentation in cycle I, the group leader is responsible for its members during the presentation, then each group is given the opportunity to ask questions to the group presenting the results of the discussion in front of the class. Other groups are allowed to provide opinions or suggestions related to the material presented.

c. End activities  
After groups 1, 2, 3, 4, and 5 finished presenting the results of their discussions, the researcher evaluated and concluded the learning outcomes. Then the following week the researcher gave posttest question 2. The researcher gave awards in the form of prizes to the best students and groups. After that, the researcher closed the lesson and gave greetings.

An explanation of the results of activities in the second cycle of classroom action research as explained in table 5:

<p>| Table 5. Recapitulation of Second Cycle Final Test Results |</p>
<table>
<thead>
<tr>
<th>No</th>
<th>Completeness Criteria</th>
<th>Cycle II</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Complete</td>
<td>Amount</td>
</tr>
<tr>
<td></td>
<td></td>
<td>34</td>
</tr>
<tr>
<td>2</td>
<td>Not Completed</td>
<td>Amount</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Lowest value</td>
<td>Amount</td>
</tr>
<tr>
<td></td>
<td>60.00 (3 people)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The highest score</td>
<td>Amount</td>
</tr>
<tr>
<td></td>
<td>90.00 (6 people)</td>
<td></td>
</tr>
</tbody>
</table>

*Source: Results of data processing*

From the table above, it can be explained as follows that the average value of learning outcomes in the implementation of the second cycle of learning improvement is the number of students who have completed their studies as many as 34 people (91.89), and there are no students who have not yet completed their studies as many as 3 people (8.11%). The highest score is 90 as many as 6 people, and the lowest score is 60 as many as 3 people.

From the explanation mentioned above, it can be concluded that the results of formative test scores have increased from cycle I because in cycle I students completed 29 students (78.38%) increased to 34 people (91.89%). Seeing the results above, the
researcher together with the observer concluded that the learning completeness had reached a rate above 85% so the learning improvement process was declared successful and complete in cycle II.

Observation

An explanation of the assessment of student motivation using an observation sheet with 7 indicators, namely the desire and desire to succeed, being tenacious in facing difficulties, showing interest in various problems, preferring to work alone, quickly getting bored with routine tasks, being able to defend one's opinion, likes to seek and solving problems, enjoying learning, being diligent in learning and dealing with math assignments show results as described in table 6:

Table 6. Recapitulation of Observation Results of Student Motivation in Second Cycle Learning Activities

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>Amount</th>
<th>information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Complete Student</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Complete Percentage</td>
<td>94,59</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Incomplete Students</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Incomplete Percentage</td>
<td>5,41</td>
<td></td>
</tr>
</tbody>
</table>

Source: Results of data processing

From the table above it can be concluded that out of 37 students, there were 35 students who completed their studies (94.59%) judging from their learning motivation. Seeing the results above, the researchers together with the observer concluded that the results of observations on increasing learning motivation had reached figures above 85%, so the learning improvement process was declared successful and complete in cycle II.

Reflection

Reflection was carried out by the researcher and the observer. Reflection is carried out in line with the implementation of actions and at the end of cycle II. Based on the results of reflection, it can be said that in general the implementation of specialization mathematics learning using Problem-Based Learning in cycle II in class XI IPA 2 has been going well and has improved from the previous cycle. Every step of Problem-Based Learning learning has been carried out properly. Students' problem-solving abilities have increased in cycle II as seen from the results of the problem-solving ability tests in this cycle. The average percentage for each aspect has increased from the previous cycle. Students are coherent in solving problems, are right in choosing a settlement plan, and are able to conclude and re-examine the results of problem-solving. The obstacle from the first cycle was that in working on the questions there were still many that were not systematic, so there were steps that were skipped or sometimes there were steps that shouldn't have been necessary and resulted in inaccurate results, so that the conclusions obtained were also inaccurate. Based on this reflection and it has been corrected in cycle II, the problem-solving abilities of students specializing in mathematics have increased.

Based on the results of the research above, it can be described that the observational data obtained when observing students, especially on student motivation in specialization in mathematics. While the learning outcomes data obtained from the results of the final test which is carried out at the end of each PTK cycle.

Clearly, the results of data analysis of the results of the implementation of this research activity can be seen in the following table 7:
Table 7. Increasing Value, and Completeness of Student Learning Cycle I and Cycle II

<table>
<thead>
<tr>
<th></th>
<th>Complete</th>
<th>%</th>
<th>Not Completed</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle I</td>
<td>29</td>
<td>78.38</td>
<td>8</td>
<td>21.62</td>
</tr>
<tr>
<td>Cycle II</td>
<td>34</td>
<td>91.89</td>
<td>3</td>
<td>8.12</td>
</tr>
</tbody>
</table>

Source: Results of data processing

The table above shows that implementing the Problem-Based Learning model in learning mathematics specializing in class XI IPA at SMAN 7 Sigi in the even semester of the 2022/2023 Academic Year can improve learning outcomes. This is indicated by an increase in the completeness of the learning outcomes per cycle wherein the first cycle there were 29 students or 78.38%, and in the second cycle there were 34 students or 91.89%, these results are in accordance with the specified indicator, namely at least 85 students complete % of the total number of students. This shows that in the second cycle, the average learning outcomes also meet the completeness criteria, which is at least equal to the KKM of 70.

Student motivation in each cycle has increased, this is measured from the results of observations of collaborators related to student motivation with 7 indicators, namely the desire, and desire to succeed, being tenacious in facing difficulties, showing interest in various problems, preferring to work alone, quickly getting bored with routine tasks, can defend his opinion, likes to find and solve problems, likes to follow lessons, is diligent in studying and dealing with mathematical tasks in full can be seen in the following table 8:

Table 8. Increasing Student Learning Motivation in Cycle I and Cycle II

<table>
<thead>
<tr>
<th></th>
<th>Complete</th>
<th>%</th>
<th>Not Completed</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle I</td>
<td>29</td>
<td>78.38</td>
<td>8</td>
<td>21.62</td>
</tr>
<tr>
<td>Cycle I</td>
<td>35</td>
<td>94.59</td>
<td>2</td>
<td>5.41</td>
</tr>
</tbody>
</table>

Source: Results of data processing

The table above shows that the implementation of the Problem-Based Learning model in learning mathematics specializing in class XI IPA 2 SMAN 7 Sigi even semester of the 2022/2023 academic year can increase learning motivation. This is indicated by an increase in learning motivation per cycle where in cycle I there were 29 students or 78.38%, and in cycle II there were 35 students or 94.59%. This result is in accordance with the specified indicators, namely the active and very active categories which reach 85%. Based on the results above, it shows an increase from cycle I and cycle II, in other words the actions of researchers in implementing mathematics at XI IPA 2 SMAN 7 Sigi even semester of the 2022/2023 school year. In the process of learning and guiding the learning completeness value and the desired indicator, namely 85%, is achieved.

From the explanation above, it can be concluded that the indicators of learning success criteria have been achieved in the second cycle, so that the implementation of learning improvements is declared complete and complete in the second cycle. Based on the data from the results of the implementation of the improvement of the Problem-Based Learning model as described above in the form of data on the results of the final cycle I test, the final test cycle II, and the observation data from cycles I and II, it can be concluded that the use of the Problem-Based Learning model can improve problem solving skills students' mathematics specialization in the material "Polynomial" this is
evidenced by the increased learning outcomes and student activity in learning mathematics specializing in the basic competence "Analyzing division and factorization of polynomials" in class XI IPA 2 SMAN 7 Sigi even semester of the 2022/2023 academic year.

**Discussion**

Thus, the way to increase learning motivation by using the Problem-Based Learning learning method is to explain the learning objectives to be achieved to students, the clearer the learning objectives conveyed to students, the greater the motivation of students in learning, create discussion groups to plan ideas that will be realized in other groups, giving encouragement to students to learn by giving maximum attention to students, besides that the teacher makes students interested in the material presented by using learning methods that are interesting and easy for students to understand, namely the Problem-Based Learning method, giving prizes to students and groups who get the best grades, resulting in competition during the learning process takes place because competition that occurs between individuals and groups is a good means to increase student motivation, give praise if students can complete their tasks well.

Meanwhile, to improve learning outcomes, namely by giving encouragement or motive to students to excel, creating a conducive learning atmosphere so that students feel comfortable participating in the learning process, the teacher can provide good explanations so that students easily accept and understand the material taught by the teacher, and the teacher can direct students' attention to the ongoing lesson.

In the first cycle, student motivation and learning outcomes were still low, this was because students had not been able to follow the course of the action process in cycle I and students had not understood the Problem Based Learning learning method. Whereas in cycle II, student motivation and learning outcomes have increased, this is because the teacher is more intensive in providing encouragement to students so that students are encouraged to achieve more, the teacher directs students' attention to the ongoing learning process such as during discussions and presenting the results of the discussion, as well as the teacher adding time during the presentation of the results of the discussion, so that students become more active in presenting the results of the discussion of each member of their group and are more active in answering questions raised by other groups.

This study aims to improve the mathematics learning abilities of XI IPA 2 students at SMAN 7 Sigi even semester for the 2022/2023 academic year in the basic competency "Analyzing division and factorization of polynomials" using Problem-Based Learning. The action given to students is to give students the opportunity to solve problems in groups. In addition, it also provides worksheets to help students be systematic in solving problems, writing down what is known, asked, illustrated pictures and solutions. An other action is that researchers always give advice so that students follow the lesson well and always remind them to solve problem solving problems coherently.

To find out the problem solving abilities of students specializing in mathematics, there are four aspects that are observed, namely understanding the problem, planning the settlement, solving the problem, and re-examining the results. The four steps are interrelated and must be coherent in the process. Based on the results of learning observations, in every meeting researchers always provide opportunities for students to express the results of their discussions. In cycle I, only a few students dared to present their discussion results, and even then because of a request and a little coercion from the teacher. After developing and presenting the work, students with the guidance of researchers analyze and evaluate the results of problem solving. Based on the results of observations of the implementation of learning, in cycle I there were no students who dared to voluntarily respond to the presentation results. The courage of students to
analyze and respond began to appear in cycle II. In this stage, several questions and answers occur between students. The discussion took place with the guidance of the researcher. After the discussion was over, the researcher evaluated the results of each group’s investigation and lured students to conclusions.

2. Conclusion

From the results of the analysis of research data by applying the Problem-Based Learning (PBL) learning model, it can be concluded that: 1) The application of the Problem-Based Learning (PBL) learning model used as a model in this learning is apparently able to increase the remaining learning motivation in learning mathematics specialization class XI IPA 2 SMAN 7 Sigi even semester 2022/2023 academic year; 2) The application of the Problem-Based Learning (PBL) learning model that is used as a model in this learning is in fact able to improve the remaining learning outcomes in mathematics learning specialization for class XI IPA 2 SMAN 7 Sigi even semester of the 2022/2023 academic year; 3) The application of the Problem-Based Learning (PBL) learning model that is used as a model in this learning is in fact able to increase motivation and residual learning outcomes in mathematics learning specialization class XI IPA 2 SMAN 7 Sigi even semester of the 2022/2023 academic year.

References


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