HASIL CEK_The effectiveness game-based learning approach in improving problem-solving skills and learning motivation

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The effectiveness game-based learning approach in improving problem-solving skills and learning motivation

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Abstract

This study aimed to determine the effectiveness of the problem-based learning model with a game-based learning approach in improving problem-solving skills and motivation to learn statistics at SMKN 5 Yogyakarta. The type of research used is classroom action research which is carried out in two cycles and each cycle goes through the stages of planning, implementation, observation, and reflection. Data collection techniques in this study used problem-solving skills tests, activity observations, and questionnaires to measure students' learning motivation. The sample of this research was 22 students of class X-A, Department of Batik and Textile Creative Craft which was carried out for 1 month. The results showed an increase in the average problem-solving skills of students in the initial conditions, Cycles I and II, respectively, namely 13.43; 64.95; and 78.35. Meanwhile, the average score of students' learning motivation has increased from the initial conditions, Cycles I to II, respectively, namely 82.86 (medium category); 91.05 (high category); and 104.95 (very high category). From the results of this study, it can be concluded that the problem-based learning model with a game-based learning approach is effective for improving problem-solving skills and student motivation in statistics material.

Keywords: problem-based learning, game-based learning, problem-solving, motivation

Introduction

The era of the industrial revolution 4.0 is an era of disruptive innovation where communication technology innovation is developing so rapidly and increasingly sophisticated that it brings changes that affect various fields of human life, one of which is education (Hatip, 2019; Putrawangsa & Hasanah, 2018; Wibowo, 2019). Furthermore, Wibowo (2019) states that education plays a role in being able to produce the next generation that can compete in every challenge of this era so that in learning teachers must be able to develop in a balanced way the three contents that students must have, namely knowledge, attitudes and skills. Content of learning skills that students need to have include: *Communication, Collaboration, Critical Thinking and Problem-solving*, dan *Creative Thinking, and Innovation* (Hosnan, 2014; Trilling & Fadel, 2009; Wibowo, 2019). As one of the skills that must be provided to students, the problem-solving skills is also one of the objectives of learning mathematics as stated in the Minister of National Education Regulation Number 22 of 2006 (Depdiknas, 2006).

In learning mathematics, problem-solving skills have an important role in achieving learning objectives that require readiness, creativity, knowledge, skills, and their application in everyday life. (Nurfitriyanti, 2016; Yarmayani, 2016). Branca in Sumartini (2016) also conveys the importance of problem-solving skills as a basic ability of learning mathematics which is the general goal, core, and main process in the mathematics curriculum. Amam (2017) also states that problem-solving skills are important for students to be able to solve mathematical problems well so that they can solve real problems in everyday life.

The important role of problem-solving skills does not make teacher learning oriented to the achievement of problem-solving skills because mathematics learning in the classroom is generally still teacher centred (Gunantara dkk., 2014). Furthermore Gunantara dkk. (2014) stated that teachers always teach mathematics using the (conventional) lecture method, so it makes students more silent, only listen to the teacher's explanations and don't want to ask questions if they don't understand, which in turn causes students' low problem-solving skills. In their research, Indahsari & Fitrianna (2019) also explained that students' problem-solving skills were still low due to teacher-centred learning and the provision of routine practice questions. Sahrudin (2014) also reinforces that the lack of student solving skills is caused by teacher-centred learning, so students are not motivated to seek and find their knowledge. These studies are by the learning conditions that occur in the field where learning is still teacher-centered and teachers still use the lecture learning model (conventional).

This is reinforced by several studies showing that problem-solving skills can be improved by using innovative learning such as *Student Teams Achievement Division* STAD, Contextual Learning, and *Problem Based Learning* (PBL) which are better at improving problem-solving skills than conventional models. This is shown by the results of research conducted by Dewi dkk. (2019) that the STAD learning model assisted by learning media is better than the conventional learning model on mathematical problem-solving skills for class VII students of SMP Negeri 2 Suradadi. Dalam penelitiannya, Putra (2017) also showed that SMPN 1 Pulau Panggung students who received treatment using the Hands-On Activity-assisted contextual learning model had better problem-solving skills than those who received conventional learning/lecture treatment. The problem-solving skills of SMPN 2 Lubuklinggau students who get learning using a problem-based learning model is 11% higher than those using conventional methods (Yanti, 2017).

The results of the initial research conducted at SMKN 5 Yogyakarta reinforce the above conditions. Based on the results of interviews that the researchers showed with the mathematics teacher of grade X, the Department of Batik and Textile Creative Crafts at these school from February 2, 2022, to February 16, 2022. It was found that students had difficulty solving contextual problems that related to identifying the known elements and the adequacy of the required components. Students also have difficulty formulating problems and applying the formulation strategies. In solving problems, students also often do not explain or interpret problem-solving results correctly. These difficulties indicate that students' problem-solving skills are still lacking at SMKN 5 Yogyakarta, including in learning statistics.

The low problem-solving skills of students are supported by the results of Pramesti & Rini's research (2019), which states that several factors that cause students' low problem-solving skills in statistical material are the lack of students' understanding of contextual problems; not paying close attention to the relationship between the information obtained so that it is wrong to formulate a settlement plan; calculation error; less able to take advantage of the processing time so they do not have time to re-evaluate the results of solving the problem. Kusumawati & Irwanto's research (2016) also describe the low problem-solving skills of students with difficulty understanding problems, making plans and implementing plans for solving models and interpreting the solutions obtained. Novferma (2016) adds that the low problem-solving skills of students are caused because students are unable to remember the concepts or principles needed to solve problems and analyze whether the answers are correct or something is wrong.

In addition to the lack of students' problem-solving skills, based on interviews that researchers conducted with mathematics teachers, it was found that students felt bored during learning which was marked by a lack of desire and desire to learn mathematics; lack of drive and need to learn mathematics; lack of hopes and aspirations to get good results in math tests; and lack of self-respect and respect which is marked by disorganization in collecting assignments, this is due to the lack of availability of an interesting environment and activities in learning such as the use of variations in mathematics learning models during the covid pandemic. The lack of students in these activities shows that students' learning motivation is still low. In fact, interesting learning conditions have a significant influence on the comfort of students' learning so that they do not feel bored, tense, and anxious during learning (Andriyani dkk., 2022).

Some research results about the lack of student motivation. Harapit, (2018) argues that the low motivation of students to learn is due to the conventional nature of the learning carried out by the teacher where the teacher is more dominant in providing knowledge than students who form their knowledge independently. Subagio & Karnasih (2021) also suggested that the lack of students motivation causes failure in a mathematics learning in one of the SMKN Kutalimbaru. Next, Aunur Rohman & Karimah (2018) also stated that the lack of motivation to study at one of the Pekalongan High Schools is caused by several factors, namely the place of study, physical function, intelligence, facilities and infrastructure, time, study habits, teachers, parents, emotional and health, and peers.

Referring to the results of observations, the lack of problem-solving skills and student motivation in learning mathematics, especially statistics, is one of the causes of the conventional learning model used. Learning goes on teacher-centered. The teacher conveys more concepts, formulas, and statistical questions that are immediately resolved by applying the formula. Statistics learning has not started by orienting students to contextual problems, has not organized students to study independently/in groups, not guided students in investigative groups, not provided opportunities for students to develop and present the results of their investigations, and has not allowed students to evaluate the solving process. So that student are not trained to develop investigations and solve contextual problems both individually and in groups. In addition, the learning carried out is less attractive and interactive, because the learning tools used are more textual and have not utilized the optimal use of technology.

Based on the problems regarding the learning model used by mathematics teachers at SMKN 5 Yogyakarta which is not yet oriented towards increasing problem-solving skills and student motivation, it is necessary to study that presents contextual problems as a starting point for learning (Harapit, 2018; Sumartini, 2016) and oriented to the achievement of problem-solving skills and student motivation. One of the learning models and approaches that accommodate these learning needs is problem-based learning. PBL is a learning model that actively involves students in investigative activities to solve problems and construct knowledge independently by providing contextual problems at the beginning of learning (Murtikusuma, 2016). Contextual problems given to students should be problems that are often encountered in their lives so that students find learning needs to be able to solve these problems because they know the benefits of the knowledge learned (Junaedi, 2019; Rahayuningsih, 2020).

This is in line with the research conducted by Santoso dkk. (2020) which found that the application of the PBL model assisted by teaching aids can improve learning activities, learning motivation, and student problem-solving skills. Nurliastuti dkk. (2018) in their research revealed that the application of ethnomathematical PBL can improve problem-solving skills and student motivation. The two previous studies were strengthened by the research of Harapit (2018) which also explained that PBL has a role in improving problem-solving skills and student motivation.

PBL is learning that uses ill-structured real problems as a learning context and starting point for students to be able to form their knowledge independently (Junaedi, 2019). Joyce and Weil dalam (Junaedi, 2019), Learning syntax is a characteristic of the learning model so that every activity carried out always follows the syntax of the learning model used. PBL syntax includes 5 phases, orienting students to problems, organizing students to learn, developing individual or group investigations, developing and presenting work, and analyzing and evaluating problem-solving processes. (Junaedi, 2019).

The PBL model can maximally improve problem-solving skills and student learning motivation if it is integrated with the game-based learning (GBL) approach. GBL is a system that is applied in learning, where teachers use games to achieve learning goals, and fulfill students' cognitive and affective interests, one of which is learning motivation (Muhtadi, 2019; Vusić & Geček, 2018). This is supported by Eseryel dkk. (2014) who explains that learning motivation and student involvement when learning with the GBL approach has implications for the results of students' problem-solving skills. Eseryel et al. also revealed that it is very important to design a learning environment with a GBL approach that can increase student motivation and engagement.

Some characteristics of GBL that need to be considered for the success of the learning process according to Muhtadi, (2019) are actively involving students, having an attraction that can motivate students, providing real experiences, being able to present context, being student-centered, and providing authentic learning. The GBL characteristics that have been described can support learning success in increasing students' learning motivation and problem-solving skills. This is supported by Maula (2020) ‘s research which shows that the application of the IDEAL *Problem-solving* model with the GBL approach can increase the motivation, interest, and problem-solving skills of junior high school students in mathematics.

Based on the description above regarding the problems of learning statistics, PBL, and GBL, the researcher intends to determine the effectiveness of the application of the PBL model with the GBL approach in improving problem-solving skills and student motivation in statistical material for class X, Department of Creative Crafts, Batik and Textiles, SMKN 5 Yogyakarta.

Methods

This research is a Classroom Action Research (CAR) using the Kemmis and MC design. Taggart which has four stages in each cycle including planning, implementation, observation, and reflection. The research was carried out in two cycles. The subjects of this study were 22 students of class X-A, Department of Batik and Textile Creative Craft (X-A Textile) SMKN 5 Yogyakarta. The variables observed in this study were problem-solving skills and students' learning motivation using the PBL model with a GBL approach.

Data collection techniques in this study are using tests, observations and questionnaires. The test was given at the beginning of the study and at the end of each cycle. The test given consists of two contextual and ill-structured description questions. The scoring rubric is made to increase objectivity in scoring student answers. Answers from student work are compared with rubrics and then given a score according to the level of correctness of answers based on the scoring rubric made. The problem-solving skills scoring rubric is based on four indicators of problem-solving skills according to Sumarmo in (Yarmayani, 2016) namely (1) identifying the elements that are known, asked about and the adequacy of the required elements; (2) formulating mathematical problems or formulating mathematical models; (3) apply strategies to solve various problems inside or outside mathematics; and (4) explain or interpret the results of the problem using mathematics in a meaningful way.

Student learning motivation questionnaires were given three times, namely before the cycle, at the end of the first and second cycles. The questionnaire sheet given to students contains 25 statements, consisting of 16 positive statements and 9 negative statements. The statement developed refers to indicators of learning motivation according to Uno (2011) namely (1) the desire to carry out activities; (2) the existence of encouragement and the need to carry out activities; (3) the existence of hopes and ideals; (4) there is self-respect, (5) there is a good environment, and (6) there is an interesting environment. Learning motivation questionnaire was measured using a Likert Scale with each statement containing 5 (five) alternative responses. Then each statement will be given a score as in the following Table 1 below.

Table 1. Learning motivation questionnaire scoring criteria

Positive Statement	Score	Negative Statement	Score
Always	5	Always	1
Often	4	Often	2
Sometimes	3	Sometimes	3
Seldom	2	Seldom	4
Never	1	Never	5

Based on the scoring criteria for the student learning motivation questionnaire, the score for each student's learning motivation is obtained by adding up all scores based on the student's choice of each question item.

The following data analysis techniques are used.

1. Problem-solving skills data were analyzed by determining the average score of students' mathematics tests in one class with the following formula.

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

with:

$\bar{x}$ = the average value of students' problem-solving skills

x_i = each of student score

n = total of students

Furthermore, the data on student test results are qualified based on the Minimum Completeness Criteria (MCC) for mathematics subjects, which is 75. The criteria for student completeness are shown in the following Table 2 below.

Table 2. Criteria for completeness of students' mathematics scores

Mathematic score	Category
$75 \leq \bar{X} \leq 100$	Passed
$0 \leq \bar{X} < 75$	Not Passed

(based on CCM class X SMKN 5 Yogyakarta)

In this study, the CCM of students was 75 following the provisions of the CCM for Mathematics for class X SMKN 5 Yogyakarta. Furthermore, student scores are also used to review the classical completeness of learning (CCL). The increase in the percentage of classical learning completeness will be seen from the initial conditions, the end of cycles I and II. The following is the formula for the percentage of CCL.

$$\text{CCL} = \frac{\text{Total of students passed}}{\text{Total of students}} \times 100\%$$

2. Student learning motivation data were analyzed by calculating each student's learning motivation score and the average classical learning motivation score and then converting both to qualitative

values. The qualitative value is determined according to the actual conversion table to a five-scale value of Widoyoko (2014) as follows Table 3:

Table 3. Category of student learning motivation

Score Interval	Category
$104,88 < X$	Very High
$84,96 < X \leq 104,88)$	High
$65,04 < X \leq 84,96$	Medium
$45,12 < X \leq 65,04$	Low
$X \leq 45,12$	Very Low

The average score of students' learning motivation in one class is obtained by the formula:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

with:
$\bar{x}$= the average score of learning motivation
x_i= each of student's score
n = total of students

Research is said to be successful if it meets 2 indicators of success, namely (1) the average value of students' problem-solving skills has increased from cycle to cycle or after being given action with classical student learning completeness of at least 55%; and (2) the average score of students' learning motivation has increased from cycle to cycle or after the action and at least is in the high criteria.

Results

Description Before Action

Researchers interviewed mathematics teachers to find out the problems that occurred during the learning process. Some of the information obtained is that the problem-solving skills and student motivation are still low. Next, the researcher asked the students to fill out a learning motivation questionnaire and work on the problem-solving skills pretest. Based on the test results, the average problem-solving skills score is 13.43, which is very far from the set CCM. The percentage of students' complete problem-solving skills before the action is as follows Table 4.

Table 4. Student Problem-solving Skills Data Before Action

Category	Total of students	Percentage
Passed	0	0%
Not Passed	22	100%

The table above shows that no students have completed the test yet. Based on the table above, it can be said that the average problem-solving skills of students in class X-A Textile is still not good. In addition, the results obtained that the average score of student learning motivation is 82.86 in the medium category. The presentation of the data in the initial conditions shows that there is a need for improvement in mathematics learning by applying the PBL model with a GBL approach in accordance with the plan.

Description of Research Results After Action

Cycle I

Planning

At the planning stage of the first cycle, researchers identify problems and find the best solution to overcome the issues found. Researchers observe to identify difficulties in class X-A Textile SMKN 5 Yogyakarta by interviewing mathematics teachers. Based on the analysis results, students' learning difficulties were found as indicated by not achieving the MCC for the average daily test score. Furthermore, the researchers conducted a literature review to find the right solution. Based on the literature review, it is believed that the answer to this problem is to apply appropriate learning models and approaches according to the material's characteristics and students' characteristics. The PBL model with the GBL approach is the right choice for this problem. In the next step, researchers develop learning tools, namely learning implementation plans, student activity sheets, and teaching materials in the form of modules containing learning videos, designing puzzles and assessment instruments that will be used during learning. The tools are prepared by implementing the models and approaches used and indicators of the skills to be improved on the material of single and group data means.

Implementation

Learning by applying the PBL model with the GBL approach was carried out in 3 meetings. The first two meetings were to act, and the third was to carry out a problem-solving skills test and fill out a student learning motivation questionnaire. At the first meeting, the teacher taught the single data mean material by the learning implementation plan assisted by using student worksheets and puzzles. The teacher also uses the module as an additional reference to complete each task in the student worksheets. At the beginning of learning, the teacher assigns students to look at the material in the module related to assigned activities in the student worksheets. The six activities in the student worksheets were developed by considering models, approaches and indicators of problem-solving skills.

At the beginning of the lesson, the teacher opens by greeting, praying, and checking students' attendance. Furthermore, the teacher provides motivation and apperception related to the material; asks students to prepare learning materials and form groups of 4-5 people; distributes student modules and worksheets; and asks students to pay attention to the learning objectives, work instructions/modules and game rules on the module and student worksheets.

The core learning activity begins by directing students to pay attention to certain parts of the module and then continues by assigning students to complete their worksheets in groups. Next, the teacher selects student representatives to present the results of their discussions with the group. The representative group of students will get several puzzle pieces according to the correctly stated completion points. The learning activities are continued with discussion forums, which provide opportunities for other groups to evaluate the discussion activities' results. Representatives of groups with different solutions or who want to complete their friends' answers can voice their opinions. After all student opinions are accommodated, the teacher confirms the solution. If there are remaining puzzle pieces from the activities discussed, the teacher will give the puzzle pieces to the group that completes their friend's completion. The series of activities in activities 1-6 will be the same: looking at modules, completing student worksheet activities, and discussing and giving puzzle pieces. Each activity has many different puzzle pieces to distribute to students who successfully present their results correctly.

At the end of the lesson, the teacher instructs students to write down the group identity on each puzzle piece, asked the students to keep the puzzle pieces, and reminded them to bring them to the third meeting. Then, the teacher asks the students to return to their seats; convey an impression of the learning carried out; giving independent assignments, namely working on formative questions about mode for single data and studying mode for group data material in the module. The teacher closed the class by praying and greeting.

At the end, the teacher gave instructions to mark each puzzle piece that each group had. Then, the teacher instructs the representatives of each group to assemble the puzzle in the middle of the class. Then, the teacher asked the students to observe and mention the puzzle pieces obtained from each group, then recorded them to be accumulated with the puzzle pieces obtained in the next meeting. Next, the teacher asks students to return to their seats and convey their impressions of the learning carried out. Then, the teacher gave an independent task, namely working on formative questions about the single data mean and studying the group data mean material in the module. The teacher closed the class by praying and greeting.

The second meeting discussed the group data mean material. The learning sequence of this meeting is almost the same as the previous meeting, the difference is that if at the first meeting the students were asked to look at the module given that day, then at the second meeting the teacher asked the students to recall the mean group data on the module they had studied at home. Another difference lies at the end of the lesson, namely the teacher gives a reward to the group that has the most puzzle pieces from the accumulated acquisition at meetings 1-2.

At the third meeting the teacher supervised the end of the cycle I final test and asked students to fill out a learning motivation questionnaire by clicking on the link that had been sent in the whatsapp group. Then, the teacher distributes modules for cycle II to be studied at home.

Observation

1. Student problem-solving skills data

From the results of the post-test cycle I, the lowest and highest scores were 28.90 and 100.00. Based on the data obtained, the average post-test score for the first cycle was 64.95. The following is data on students' problem-solving skills based on CCM completeness and their percentages as presented Table 5.

Table 5. Result of problem solving skills post test at cycle I

Category	Total of Students
Passed	9
Not Passed	13

Result of comparation to CCM (score = 75) many students who passed and not passed are presented in the following Figure 1 below.

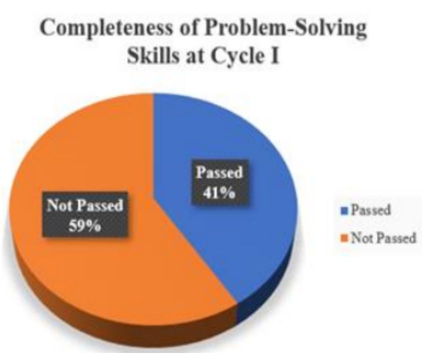

Figure 1. Persentage of completion of problem-solving skills cycle I

2. Student learning motivation data

The questionnaire consists of 25 statements with 5 choices mentioned above. From the questionnaire data analysis, the minimum and maximum student learning motivation scores were 73 and 114. The average student motivation score was 91.05 in the high category. The distribution of the results of the learning motivation questionnaire responses is presented in the following Figure 2.

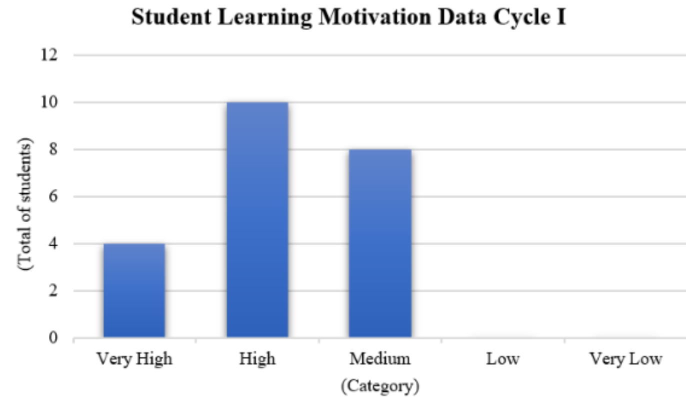

Figure 1. Student learning motivation data cycle I

Based on the results, classically students' learning motivation is included in the high criteria and 13 students have not completed the problem-solving skills test. Because it did not meet one indicator of research success, the learning continued to cycle II.

Reflection

In general, the learning that has been carried out using the PBL model with the GBL approach in class X-A Textiles in Cycle I goes according to plan. However, based on the results of the researcher's reflection, several problems occurred during the first cycle of learning, namely:

a) Students have difficulty in filling out SW.
b) Work on SW is not optimal because many students do not focus on learning.
c) Students with low academic skills are less able to participate in learning.
d) Students are not used to solving contextual problems that are ill-structured.
e) Most students are still passive in both small and classical group discussions.
f) To complete each series of activities takes longer than the estimated time so that learning mathematics slightly exceeds the time it should take.

Based on the problems found in the first cycle, so for the next better learning, a solution for the improvement will be sought at the planning stage of the second cycle.

Cycle II

The implementation of the second cycle is the result of the follow-up of the results of the research in the first cycle in the form of improvements.

Planning

At the planning stage of the second cycle, the researcher looks for the right solution to overcome the problems that arise in the implementation of the first cycle as follows:

a) The teacher explains that the use of the module is only as a guide for completing student worksheets.
b) The teacher asks the students to focus during the learning process and cooperate in following the directions.

c) The day before learning, the teacher reminds students to study the material in the module to be discussed. Then the teacher divides groups of students with various skills based on the results of the post-test cycle I.
d) The teacher assigns students to re-study the module and work on a package of formative questions.
e) The teacher appoints students who are not actively involved in the discussion to express their opinions, so that the teacher can assess the activity of these students.
f) The teacher arranges all the puzzles in the third meeting.

Then the researchers prepared learning tools that will be used in cycle II. The learning tools in cycles I and II were made identical.

Implementation

Cycle II learning was carried out for 3 meetings with meetings 1 and 2 for implementing actions and meeting 3 for preparing puzzles, implementing problem-solving skills tests and filling out student motivation questionnaires. At the first meeting, the material discussed was single data mode. In the same way as the first cycle, the teacher carried out the learning in the second cycle including the six activities in the student worksheets. The core learning activities are also identical to the learning activities in cycle I, except that the material that is the subject of discussion is single and group data mode.

At the end of the lesson, the teacher instructs students to write down the group identity on each puzzle piece. Then, the teacher asked the students to keep the puzzle pieces and reminded them to bring them to the third meeting. Then, the teacher asks the students to return to their seats; convey an impression of the learning carried out; giving independent assignments, namely working on formative questions about single data mode and studying group data mode material in the module. The teacher closed the class by praying and greeting.

The learning steps at the second meeting of cycle II were almost the same as the previous meeting, the difference was that in the second meeting students were given independent assignments to work on a package of formative questions in the module to prepare themselves for the post-test cycle II. At the third meeting, after the teacher opened the class. The teacher invites students to assemble puzzles, determine the winning group, and give rewards to the group. Then, the teacher distributed the test and answer sheets; supervise the second cycle test; asked students to fill out a learning motivation questionnaire; and finally closed the lesson by praying and greeting.

Observation

1. Student problem-solving skills data

From the results of the post-test cycle II, the lowest and highest scores were 57.40 and 97.06. The average post-test score in cycle II was 78.35. The following is data on students' problem-solving skills based on CCM completeness and their percentages as presented Table 6.

Table 6. Result of problem solving skills post test at cycle II

Category	Total of Students
Passed	13
Not Passed	9

Result of comparation to CCM (score = 75), the distribution of students who passed and did not pass is presented in the following Figure 3.

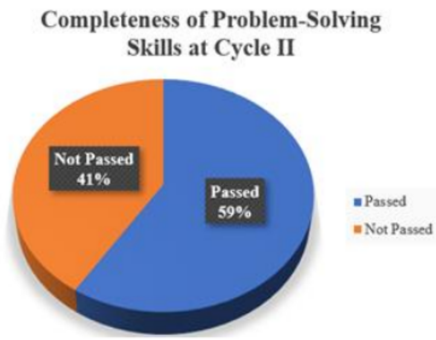

Figure 2. Percentage of completion of problem-solving skills cycle II

The percentage of students' problem-solving skills completeness reaches 59% and has exceeded the target indicator of research success.

2. Students learning motivation data

The questionnaire given contains the same contents as the previous cycle. From the analysis, the minimum and maximum student learning motivation scores were 90 and 123. The average student motivation score was 104.95 in the very high category. The distribution of the questionnaire responses results shows in the following Table 4.

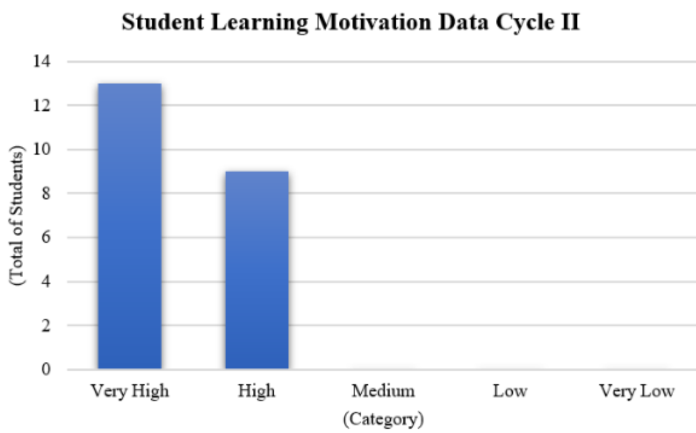

Figure 3. Student learning motivation data cycle II

Reflection

Based on the observations above, the percentage of problem-solving skills completeness is 59% and the average score of students' learning motivation is very high. This research stopped at the end of cycle II because it had met the indicators of research success.

Positive things in cycle II are students are more independent in working on SW, almost all students are actively involved in discussions, student-centered learning, students feel challenged to solve math problems, students are confident in presenting their solutions and expressing opinions, students are proficient in solving contextual problems that are ill-structured.

Discussion

Based on the initial condition data analysis, problem-solving skills and student motivation tend to be low. Students have not been able to identify the elements that are known, asked and the adequacy of the elements needed. Students have difficulty in formulating problems and applying formulation strategies to solve mathematical problems. Students cannot explain or interpret the results of problem-solving using mathematics in a meaningful way. In addition, students feel bored when learning mathematics, have no desire to do activities and are more preoccupied with other activities outside of learning mathematics. After learning using the PBL model with a GBL approach, problem-solving skills and student motivation have increased.

The PBL model was chosen so that students could solve ill-structured contextual problems according to the indicators of problem-solving skills. The GBL approach was chosen because it has the characteristics of reducing student boredom and increasing student learning motivation. Some of the characteristics of GBL in question are interesting, exciting, challenging, interactive, there is feedback, social interaction both between individuals and individuals in groups (Wibawa dkk., 2021), actively involving students, being able to motivate students, providing real experiences, presenting context, student-centered, and providing authentic learning (Muhtadi, 2019). The application of the PBL model with the GBL approach is expected to improve problem-solving skills and student motivation.

There was an increase in problem-solving skills and student motivation after giving the first and second cycles of action. The results of data analysis of students' problem-solving skills in activities before action, cycles I and II are presented in the following Table 7.

Table 6. Completeness of student problem-solving skills before action, after cycle I, and II

	Before Cycle	After Cycle I	After Cycle II
Score Average	13,43	64,95	78,35
Total of Passed Students	0	9	13
Percentage	0%	41%	59%

The results of the data analysis of learning motivation in activities before action, cycles I and II are presented in the following Table 8.

Table 7. Student learning motivation data in before action, after cycle I and II

Score Interval	Category	Percentage		
		Before Action	After Cycle I	After Cycle II
$104,88 < X$	Very High	0%	18%	59%
$84,96 < X \leq 104,88)$	High	50%	45%	41%
$65,04 < X \leq 84,96$	Medium	50%	36%	0%
$45,12 < X \leq 65,04$	Low	0%	0%	0%
$X \leq 45,12$	Very Low	0%	0%	0%
Total		*100%*	*100%*	*100%*
Average score on		***82,86***	***91,05***	***104,95***

Tables 7 and 8 show that in the initial conditions no students have completed the problem-solving skills test and the average obtained is 13.43 then the average score of learning motivation is 82.86 in the medium category. In the first cycle, the average value of students' problem-solving skills increased from 51.52 to 64.85 with a classical mastery percentage of 41%; and the average score of student learning motivation is 91.05 in the high category. Although there has been improvement, the research has not been successful because one of the indicators of success has not been achieved. This phenomenon is caused by the learning cycle I is still not optimal. Therefore, several improvements were made to be applied in the second cycle of learning. Learning improvement solutions were obtained from the results of consultations with mathematics teachers. The explanation of the improvement solutions for the first cycle can be seen in the second cycle planning.

Repair actions in cycle II can improve problem-solving skills and student motivation. The average value of students' problem-solving skills is 78.35 with a classical completeness percentage of 59%; and the average score of student learning motivation became 104.95 in the very high category. This shows that the average value of problem-solving skills and student motivation is good because it meets the indicators of success.

The improvement of problem-solving skills in learning the statistical material shows the effectiveness of implementing the PBL model with a GBL approach. By applying the PBL model with the GBL approach, students can identify the elements that are known, asked about and the adequacy of the elements needed to solve ill-structured contextual problems through discussion sessions. Students become more proficient in formulating mathematical problems and applying strategies to solve them. Students also can interpret the results of problems using mathematics in a meaningful way.

Identical modules and SW and also puzzle games in learning can actually increase students' learning motivation. Students are challenged to solve problems in student worksheets, be independent to understand the modules so they can solve problems, and actively discuss with friends or teachers so they can understand the problem well and finally be able to find the right solution. Learning becomes more lively with the discussion, so that there is no opportunity for students to do other things. In order to become a winner, students become more daring to present their solutions. So, using modules and SW makes students active in forming knowledge and solving problems independently. These two things make students' problem-solving skills better.

Another success of the PBL model with the GBL approach is

- Modules as learning resources are able to improve problem-solving skills and student motivation to form knowledge independently.
- Students are enthusiastically involved in discussions to find solutions to student worksheet problems.
- Students enjoy participating in learning activities because they do not just sit and listen but actively involve them in every process.
- Students can interpret the results of the problem in a meaningful way.

Based on the explanation above, this research is able to answer the problem of the low problem-solving skills and learning motivation of students in class X-A Textile Negeri 5 Yogyakarta. Classroom action research that implements the PBL model with a GBL approach has met the indicators of research success. The implementation of these learning models and approaches shows an effort to improve the quality of teacher learning to improve students' problem-solving skills. Andriyani dkk., (2020) also mention that the quality of teacher learning is showed by the effectiveness of student success and the selection of appropriate learning designs, including the selection of learning models and approaches that are suitable to the characteristics and students need.

Conclusions

The conclusion is mathematics learning process using a PBL model with a GBL approach is effective to improve problem-solving skills and learning motivation of class X-A students of the

Department of Batik and Textile Creative Crafts at SMKN 5 Yogyakarta. The average value of problem-solving ability and students' learning motivation from the initial conditions, cycle I to cycle II increased. The average value of students' problem-solving abilities increased from 13.43 to 64.95 and finally to 78.35 at the end of the second cycle. Meanwhile, the average student learning motivation also increased from a score of 82.86 to 91.05 and finally 104.95 at the end of the second cycle. Students' learning motivation classically changed from being in the medium category to high at the end of the first cycle and very high after the implementation of the second cycle. Both of problem-solving skills and student motivation have increased and met the established indicators of research success.

Suggestions

Researchers who interested in conducting research using a PBLmodel with a GBL approach are expected to be able to carry out other innovations, such as choosing different games, materials, or applying them to other dependent variables.

References

Amam, A. (2017). Penilaian Kemampuan Pemecahan Masalah Matematis Siswa SMP. *TEOREMA: Jurnal Teori dan Riset Matematika*, *2*(1), 39–46.

Andriyani, A., Santosa, A. B., & Saryadi, W. (2022). Effectiveness of Microsoft Kaizala and Google Classroom towards students' mathematical communication skill and self-efficacy in learning statistics. *Bulletin of Applied Mathematics and Mathematics Education*, *2*(1), 33–46. https://doi.org/10.12928/bamme.v2i1.5523

Andriyani, Buliali, J. L., & Sugiyarta, A. W. (2020). *Analisis Pemahaman Konsep Lingkaran Berdasarkan Gaya Belajar Siswa Tunarungu Di Slb Negeri 2 Bantul*. *6*(3), 12.

Aunur Rohman, A., & Karimah, S. (2018). Faktor-Faktor Yang Mempengaruhi Rendahnya Motivasi Belajar Siswa Kelas XI. *At-Taqaddum*, *10*(1), 95–108. https://doi.org/10.21580/at.v10i1.2651

Depdiknas. (2006). *Permendiknas Nomor 22 Tahun 2006 Tentang Standar Isi Sekolah Menengah Atas*. Depdiknas.

Dewi, A. S., Isnani, I., & Ahmadi, A. (2019). Keefektifan Model Pembelajaran Stad Berbantuan Media Pembelajaran Terhadap Sikap Dan Kemampuan Pemecahan Masalah Matematika. *JIPMat*, *4*(1), 7–11. https://doi.org/10.26877/jipmat.v4i1.3509

Eseryel, D., Law, V., Ifenthaler, D., Ge, X., & Miller, R. (2014). An Investigation of the Interrelationships between Motivation, Engagement, and Complex Problem-solving in Game-based Learning. *Educational Technology & Society*, *17*(1), 42–53.

Gunantara, G., Suarjana, M., & Ristiani, Pt. N. (2014). Penerapan Model Pembelajarajaran Problem-Based Learning Untuk Meningkatkan Kemampuan Pemecahan Masalah Matematika Siswa Kelas V. *Jurnal Mimbar PGSD Universitas Pendidikan Ganesha*, *2*(1), 10.

Harapit, S. (2018). *Peranan Problem-Based Learning (Pbl) Terhadap Kemampuan Pemecahan Masalah Dan Motivasi Belajar Peserta Didik*. *2*, 6.

Hatip, A. (2019). Pembelajaran Matematika Di Era Industri 4.0. *Optimalisasi Hots Dalam Pembelajaran Matematika Melalui Budaya Literasi Pada Era Industri 4.0*, 896–906.

Hosnan, M. (2014). *Pendekatan Saintifik Dan Kontekstual Dalam Ppembelajaran Abad 21*. Ghalia Indonesia.

Indahsari, A. T., & Fitrianna, A. Y. (2019). Analisis Kemampuan Pemecahan Masalah Siswa Kelas X Dalam Menyelesaikan Spldv. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *2*(2), 77–66. https://doi.org/10.22460/jpmi.v2i2.p77-86

Junaedi, I. (2019). *Pendalaman Materi Matematika: Modul 1 Geometri*. Kemendikbud.

Kusumawati, E., & Irwanto, R. A. (2016). Penerapan Metode Pembelajaran Drill untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis Siswa Kelas VIII SMP. *EDU-MAT: Jurnal Pendidikan Matematika*, *4*(1), 49–57. https://doi.org/10.20527/edumat.v4i1.2289

Maula, N. K. (2020). Analisis Peningkatan Keterampilan Problem-Solving Siswa SMP dalam Pembelajaran Matematika dengan IDEAL Problem-Solving berbasis Game-Based Learning. *JURNAL PETIK*, *6*(2), 71–80. https://doi.org/10.31980/jpetik.v6i2.764

Muhtadi, A. (2019). *Modul 3 Pembelajaran Inovatif*. Kemendikbud.

Murtikusuma, R. P. (2016). Pengembangan Perangkat Pembelajaran Matematika Model Problem-Based Learning Berbantuan Media Powerpoint Untuk Siswa Kelas Xi SMK Materi Barisan Dan Deret. *Saintifika*, *17*(2), 20–33.

Novferma, N. (2016). Analisis Kesulitan Dan Self-Efficacy Siswa Smp Dalam Pemecahan Masalah Matematika Berbentuk Soal Cerita. *Jurnal Riset Pendidikan Matematika*, *3*(1), 76–87. https://doi.org/10.21831/jrpm.v3i1.10403

Nurfitriyanti, M. (2016). Model Pembelajaran Project Based Learning Terhadap Kemampuan Pemecahan Masalah Matematika. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *6*(2), 149–160. https://doi.org/10.30998/formatif.v6i2.950

Nurliastuti, E., Dewi, N. R., & Priyatno, S. (2018). Penerapan Model PBL Bernuansa Etnomatematika untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis dan Motivasi Belajar Siswa. *PRISMA 1*, 99–104. https://journal.unnes.ac.id/sju/index.php/prisma/article/view/19581

Pramesti, S. L. D., & Rini, J. (2019). Analisis Kemampuan Pemecahan Masalah Peserta didik Berdasarkan Strategi Polya pada Model Pembelajaran Problem-Based Learning Berbasis Hands On Activity. *Journal of Medives : Journal of Mathematics Education IKIP Veteran Semarang*, *3*(2), 223–236. https://doi.org/10.31331/medivesveteran.v3i2.768

Putra, F. G. (2017). Eksperimentasi Pendekatan Kontekstual Berbantuan Hands On Activity (HoA) Terhadap Kemampuan Pemecahan Masalah Matematik. *Al-Jabar : Jurnal Pendidikan Matematika*, *8*(1), 73–80. https://doi.org/10.24042/ajpm.v8i1.1148

Putrawangsa, S., & Hasanah, U. (2018). Integrasi Teknologi Digital Dalam Pembelajaran Di Era Industri 4.0 Kajian dari Perspektif Pembelajaran Matematika. *Jurnal Tatsqif*, *16(1)*, 42–54.

Rahayuningsih, R. K. (2020). Implementasi Model Pembelajaran Problem-Based Learning untuk Meningkatkan Motivasi dan Prestasi Belajar Matematika Siswa SMK. *Jurnal Pendidikan Surya Edukasi (JPSE)*, *6*(1), 1–15. https://doi.org/10.37729/jpse.v6i1.6485

Sahrudin, A. (2014). Implementasi Strategi Pembelajaran Discovery Untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis dan Motivasi Belajar Siswa SMA. *Jurnal Pendidikan UNSIKA*, *2*(1), 1–12.

Santoso, B., Putri, D. H., & Medriati, R. (2020). Upaya Meningkatkan Motivasi Belajar Dan Kemampuan Pemecahan Masalah Siswa Melalui Model Problem-Based Learning Berbantu Alat Peraga Konsep Gerak Lurus. *Jurnal Kumparan Fisika*, *3*(1), 11–18. https://doi.org/10.33369/jkf.3.1.11-18

Subagio, L., & Karnasih, I. (2021). Meningkatkan Motivasi Belajar Siswa Dengan Menerapkan Model Discovery-Learning dan Problem- Based-Learning Berbantuan Geogebra. *Jurnal Pendidikan Matematika Raflesia*, *06*(02), 15–26.

Sumartini, T. S. (2016). Peningkatan Kemampuan Pemecahan Masalah Matematis Siswa melalui Pembelajaran Berbasis Masalah. *Mosharafa: Jurnal Pendidikan Matematika*, *5*(2), 148–158. https://doi.org/10.31980/mosharafa.v5i2.270

Trilling, B., & Fadel, C. (2009). *21st Century Skills: Learning for Life in Our Times*. Jossey-Bass.

Uno, H. B. (2011). *Teori Motivasi Dan Pengukurannya*. PT Bumi Aksara.

Vusić, D., & Geček, R. (2018). Instructional design in game based learning and applicationsused in educational systems. *Tehnički Glasnik*, *12*(1), 11–17. https://doi.org/10.31803/tg-20180312141348

Wibawa, A. C. P., Mumtaziah, H. Q., & Sholaihah, L. A. (2021). Game-Based Learning (Gbl) Sebagai Inovasi Dan Solusi Percepatan Adaptasi Belajar Pada Masa New Normal. *INTEGRATED (Information Technology and Vocational Education)*, *3(1)*, 17–22.

Wibowo, T. (2019). Pembelajaran Matematika Dan Risetnya Di Era Revolusi Industri 4.0. *Prosiding Sendika*, *5(1)*, 676–686.

Widoyoko, E. P. (2014). *Penilaian Hasil Pembelajaran di Sekolah*. Pustaka Pelajar.

Yanti, A. H. (2017). Penerapan Model Problem-Based Learning Terhadap Kemampuan Komunikasi Dan Kemampuan Pemecahan Masalah Matematika Siswa Sekolah Menengah Pertama Lubuklinggau. *Jurnal Pendidikan Matematika Raflesia*, *2*(2), 118–129.

Yarmayani, A. (2016). Analisis Kemampuan Pemecahan Masalah Matematis Siswa Kelas XI MIPA SMA Negeri 1 Kota Jambi. *Jurnal Ilmiah DIKDAYA*, *6*, 12–19.

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