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Evaluating High School Students' Ability in Physics Through Self-Assessment in PBL-Based Learning

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Abstract

Results of Self-Assessment Implementation in PBL-Based Learning to Evaluate Students' Abilities. *This study aims to describe the results of self-assessment in PBL-based learning of mechanical wave material to evaluate students' abilities in carrying out PBL learning activities. This type of research is a mixed-method study with two research methods, namely quantitative and qualitative, and then conclusions are drawn. The data from this study are the results of the pre-test and post-test of critical thinking skills, Self-Assessment assessments. The results of applying self-assessment in PBL-based learning were analyzed to determine the impact on PBL-based learning achievements. Additionally, the pre-test and post-test results of critical thinking skills were analyzed using the Wilcoxon Signed Rank Test to identify significant differences in average and n-gain. From this study, PBL-based Self-Assessment using an assessment instrument in the form of an assessment sheet showed that it could be used optimally in evaluating students' abilities in carrying out PBL learning activities. With the highest student completion in the cycles of "conducting individual and group investigations" and "analyzing and evaluating the problem-solving process," as many as 91.6% or 33 students.*

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INTRODUCTION

One of the skills that graduates must have to face the revolution of industry 4.0 is critical thinking skills (Alismail & McGuire, 2018). Critical thinking is part of high-level thinking skills. This skill is a basic skill for solving problems. Critical thinking skills are important to have by students. Teachers have an important role in developing thinking skills in critical students (Zubaidah, 2019).

Critical thinking covers component skills that analyze arguments, create conclusions, use reasoning that is inductive and deductive, assess or evaluate, and create decisions or solve a problem (Zakiah & Lestari, 2019). Thinking critically is thinking in a way reasoned and reflective, with an emphasis on taking and making decisions about what should be believed and carried out (Luthfiyah et al., 2019).

Suitable learning model implemented for practice skills, critical thinking is a PBL model. Problem-Based Learning (PBL) can develop the ability of Critical Thinking participants to educate in finding as well as solving related issues in life every day (Saputri, 2020). The application of PBL can produce lots of solutions to solve problems and improve critical thinking ability in students (Azizah et al., 2018). Learning model Problem Based Learning (PBL) or learning model based on problem capable support student in increase ability as well

as his skills in Critical Thinking and responsive as well as overcome problem in life in the environment around, therefore That make student more easy understand theory and concept existing physics the relation with nature and environment in life (Husnah, 2017).

Previous research, according to Agnezi (2020), stated that the use of learning models, Problem-Based Learning, can be used by teachers to develop skills in their Critical Thinking with as best as possible in activity learning. According to Yulianti (2019), it was concluded that in the learning model Problem-Based Learning (PBL) focuses students on solving problems the problem independently, so that with this action students will get used to thinking critically and have high-level critical thinking skills.

In the learning process, students can develop their assessment skills and criticize their learning process independently through self-assessment (Rachmawati et al., 2021). A form of assessment that can be used to assess deficiencies or weaknesses, students' advantages in achieving competencies, and learning development. Each student is assessed individually through self-assessment. Competent students can be identified because in its application self-self-assessment has 4 (four) stages, namely: (1) preparation; (2) implementation; (3) follow-up and evaluation; (4) replication (Luque & Mendoza, 2019).

Self-assessment is a formative assessment process in which students... reflect on the quality of their performance results, compare the quality of the achievement with the criteria that have been determined, or the students provide an assessment of the results of their performance. Therefore, assessing the progress of learning itself is an integral part of the learning process. Learning with the self-assessment method is very useful to apply because it provides opportunities for students to increase their self-confidence in improving their grade average (Hignasari & Supriadi, 2020).

Understanding concepts is the most important part of learning physics. Students' understanding of physics concepts is one of the goals of physics learning. That must be achieved. Physics contains facts, concepts, and principles that are based on observations of these phenomena and arranged systematically (Subana, 2018). In studying physics, students must understand the concept to be able to solve problems. Questions and be able to apply the learning in everyday life. Many students think that physics is a difficult subject to understand. Students also find it difficult to learn to understand some materials. Physics. Therefore, it is necessary to use learning models and apply self-assessment to determine students' critical thinking abilities.

Based on the above problems, research was conducted using the Application of Self-Assessment in PBL (Problem-Based Learning) Learning on Wave Material Mechanics for Evaluating the Achievement of Critical Thinking Skills of High School Students. Implementation: This self-assessment is used to evaluate the achievement of critical thinking skills.

METHODS

This research uses a mixed-methods research method that is mixed-methods (Parjaman & Akhmad, 2019). In mixed-methods research is a type of research from two research methods, which are quantitatively and qualitatively which resulting integrated as new findings later Conclusions drawn (Subagyo, 2020). This study uses a group pretest-posttest design. In this quantitative research, it was measured using a pretest, which was carried out before being given treatment, and a posttest, which was carried out after being given treatment for each learning series. In this qualitative research, it was measured by student reflection using self-assessment sheets. This research was conducted at SMA Negeri 1 Menganti in December–January 2025. The population in this study was class XI students. With a research sample of 1 class, namely

33 students of class XI MIPA 3. The instrument used is the Self-Assessment sheet, which contains the PBL indicator.

RESULTS AND DISCUSSION

Results

Based on the results Self-Assessment evaluates ability student's in carry out PBL learning with serve Self-Assessment sheet. Self-Assessment consists of 4 stages, namely the Preparation stage, the Implementation stage, Follow-Up and Evaluation stage, and the Replication stage. (Luque & Mendoza, 2019). The following data generated at the Implementation stage is presented in Table 4.6.

Table 1. *Results of Completing the Self-Assessment Sheet at the Implementation Stage*

No	PBL Cycle	Statement	Not enough (%)	Enough (%)	Good (%)	Very good (%)	Completed (%)
1.	Orientation on the problem	I understand the illustration of the problem provided by the Teacher	0.0 (0)	5.6 (2)	66.7 (24)	27.8 (10)	**86.1 (31)**
		I can formulate the problem	0.0 (0)	22.2 (8)	50.0 (18)	27.8 (10)	
2.	Organizing (Grouping)	I am proactive in group transitions during the learning process.	0.0 (0)	22.2 (8)	47.2 (17)	33.3 (12)	**83.3 (30)**
		I prepare everything needed during the process of learning	0.0 (0)	11.1 (4)	47.2 (17)	41.7 (15)	
3.	Individual investigations or group	I am actively working together with a group of friends at the time of the implementation of practical work	0.0 (0)	13.9 (5)	58.3 (21)	27.8 (10)	**91.6 (33)**
		I follow as well as and able to take part in the practicum.	0.0 (0)	5.6 (2)	44.4 (16)	50.0 (18)	
		I joined and participated in practical data collection	0.0 (0)	5.6 (2)	47.2 (17)	47.2 (17)	

No	PBL Cycle	Statement	Not enough (%)	Enough (%)	Good (%)	Very good (%)	Completed (%)
4.	Develop and present the results of the work	I can analyze the results of practical data	0.0 (0)	22.2 (8)	63.9 (23)	16.7 (6)	**80.5 (29)**
		I can convey the results of the practicum in written or unwritten form. (presentation)	5.6 (2)	11.1 (4)	44.4 (16)	38.9 (14)	
		I Active Doing question and answer	5.6 (2)	19.4 (7)	50.0 (18)	25.0 (9)	
5.	Analyze and evaluate the process solution to the problem	I can conclude that learning activities are appropriate	2.8 (1)	2.8 (1)	58.3 (21)	36.1 (13)	**91.6 (33)**
		I can reflect on the shortcomings and advantages during learning	0.0 (0)	11.1 (4)	47.2 (17)	41.7 (15)	
TOTAL							**86.1 (31)**

From table 1, it can be stated that an average of 31 students participated in the learning and practical activities well, and were able to evaluate themselves regarding the learning activities that had been carried out completely.

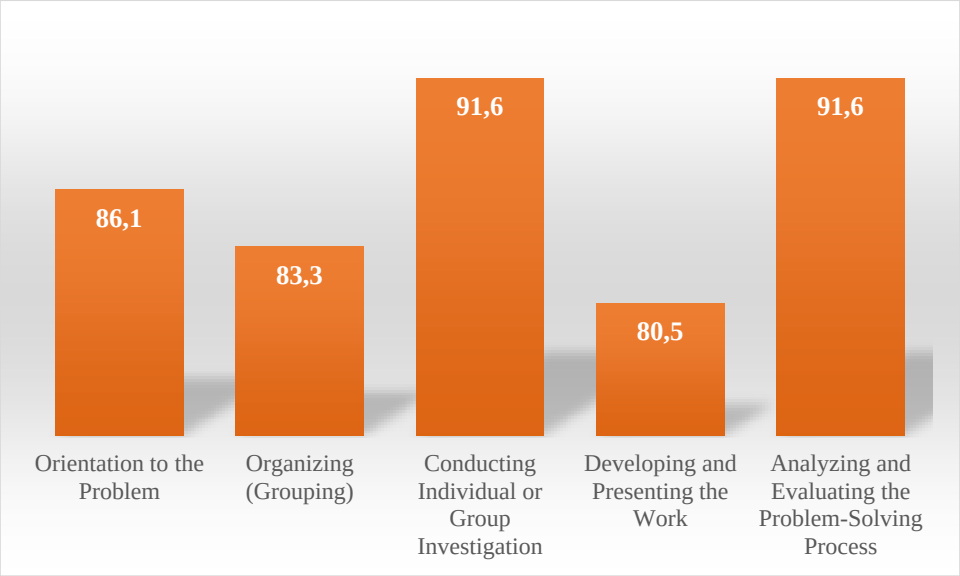

Figure 1. *Completion Data Student to PBL Cycle*

From the completion of the Self-Assessment sheet, it can be stated that the highest student completion is in the cycle of" conducting individual and group investigations" and" analyzing and evaluating the problem-solving process," with as many as 91.6% or 33 students. The lowest student completion is in the cycle of" developing and presenting work results," with as many as 80.5% or 29 students.

Discussion

How to evaluate the achievement ability of students in carrying out activity PBL (Problem-Based Learning) based learning material, Wave Mechanics, obtained from the implementation of Self-Assessment. In the learning process, students can develop their ability and assess and criticize the learning process in an independent way through Self-Assessment (Rachmawati et al., 2011). Self-Assessment Sheet This serves in 4 stages, namely Preparation stage, Implementation stage, Follow-Up and Evaluation stage, and Replication stage (Leque & Medonza, 2019). In this Preparation stage, students prepare self for doing an evaluation of self during the activity learning that has been done with truth.

At the Implementation stage, it is presented table by table 4.5. Students fill in the statement under the condition that students follow the rubric statement. For mark completeness, the biggest thing that was obtained in the PBL cycle was "Doing investigation individually and also in groups "and" analyzing and evaluating the problem solving process" by 91.6% or as many as 33 students. So, it can be stated that 33 students have the capability active Work. The same with a friend group at the time of implementation, practical, join and able to follow do practicum, and follow in data collection with good. From the implementation activity, learning and practice are said, then the student can analyze and evaluate the problem-solving process problem every individual after the implementation learning implemented. Completion value is lowest, namely in the PBL cycle "developing and presenting" results work of 80.5% or as many as 29 students. It can be stated that 29 students are capable of analyzing results of practical data, conveying results of practical work in a written and also non-written (presentation) format, and actively follow, as well as ask and answer. Students sued for can analyze data results and submit to LKPD and present in a direct way.

At the Follow-Up and Evaluation stage, students do an evaluation of the activity learning that has been done. The following is an example response to a positive and a negative student.

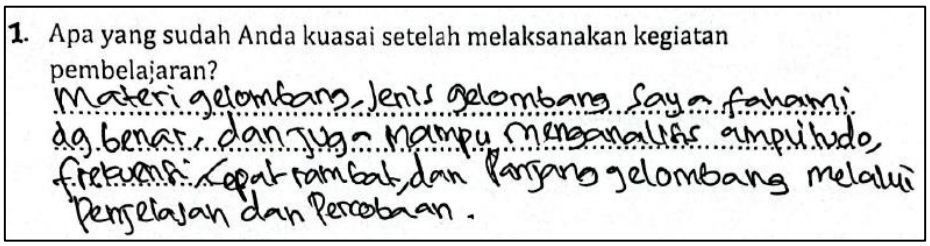
1. Apa yang sudah Anda kuasai setelah melaksanakan kegiatan pembelajaran?
Materi gelombang, jenis gelombang saya fahami dg. benar, dan juga mampu menganalisis amplitudo, frekuensi, cepat rambat, dan panjang gelombang melalui penjelasan dan Percobaan.

Figure 2. *Question 1 and its explanation answer positively at the follow-up and evaluation stage*

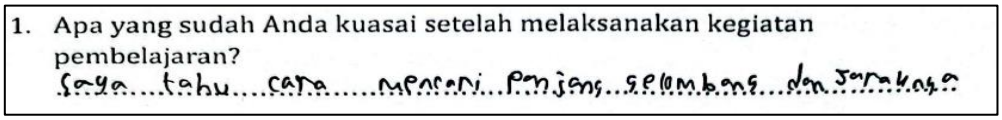
1. Apa yang sudah Anda kuasai setelah melaksanakan kegiatan pembelajaran?
saya tahu cara mencari panjang gelombang dan jarakaya

Figure 3. *Question 1 and its answer are negative at the follow-up and evaluation stage*

Based on Figure 2. Students explain the ability that has been mastered after activity learning, namely "material" wave, type wave I understand with truth, and are also capable of analyzing amplitude, frequency, speed creep, and length wave through explanation and

experiment. From the explanation student said, it is clear that the student has a good understanding of all over material explained by the teacher, and is also able to follow activity practical work with good. In picture 3, students understand searching for "long waves and their distance". From the answer, the student can state a negative answer; students understand 1 sub material only. So that still required deeper material to give understanding to students in the material presented.

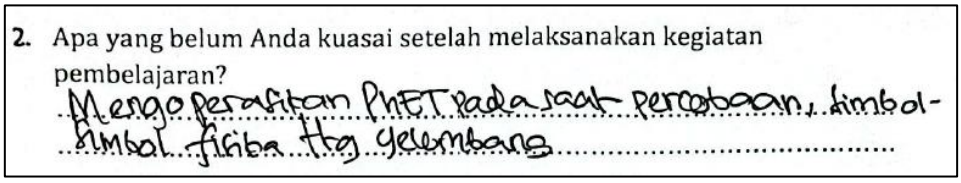
2. Apa yang belum Anda kuasai setelah melaksanakan kegiatan pembelajaran?
Mengoperasikan PhET pada saat percobaan, simbol-simbol fisika tkg gelombang

Figure 4. *Question 2 and its explanation answer positively at the follow-up and Evaluation stage*

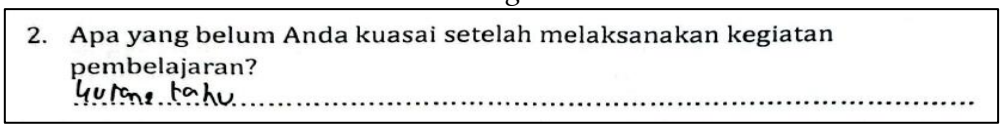
2. Apa yang belum Anda kuasai setelah melaksanakan kegiatan pembelajaran?
Gurne tahu

Figure 5. *Question 2 and its explanation answer negatively at the follow-up and evaluation stage*

After explaining the ability that is mastered, as the in Figure 4. Students explain abilities that have not been mastered, namely "operating" PhET at the time of experiments, and physics symbols about "waves". From the explanation student said, it can be known that the student previously did not know the method used application PhET, so they needed Moreover formerly before using the application PhET as a tool. Students also have not mastered physics symbols related to waves, then students must be capable of understanding and memorizing physics symbols related to waves in the form of frequency symbols, fast propagation, amplitude, length waves, etc. In Figure 5. The answer the student can be stated as a negative answer, students have not yet been evaluated on unfinished material mastered after doing the activity learning.

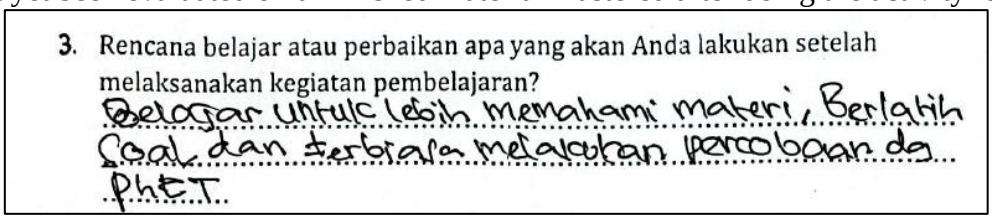
3. Rencana belajar atau perbaikan apa yang akan Anda lakukan setelah melaksanakan kegiatan pembelajaran?
Belajar untuk lebih memahami materi, Berlatih Soal dan terbiasa melakukan percobaan dg PhET

Figure 6. *Question 3 and its explanation answer positively at the follow-up and evaluation stage*

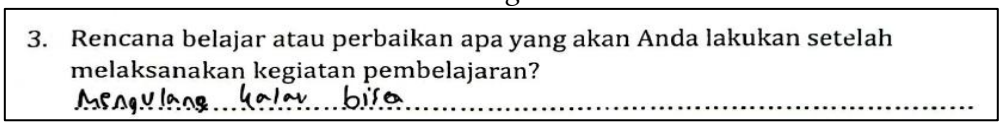
3. Rencana belajar atau perbaikan apa yang akan Anda lakukan setelah melaksanakan kegiatan pembelajaran?
Mengulang kalau bisa

Figure 7. *Question 3 and its explanation answer negatively at the Follow-Up and Evaluation stage*

In Figure 6, students convey a plan for Study or improvements that will be done after the activity learning is implemented, namely "learning to better understand material, practice about, and get used to doing tests with PhET". From the answer, then can be known that students have a sense of desire to know the high and use ability Critical Thinkingly, so students are pushed to learn, practice, and try to get results, learn more Good again. In picture 7, students answer "repeat" if they can. From the answer, the student can be considered to have given a negative answer. students want to repeat the material. However cannot yet evaluate his understanding of the improvements they will make to the material that has not been mastered.

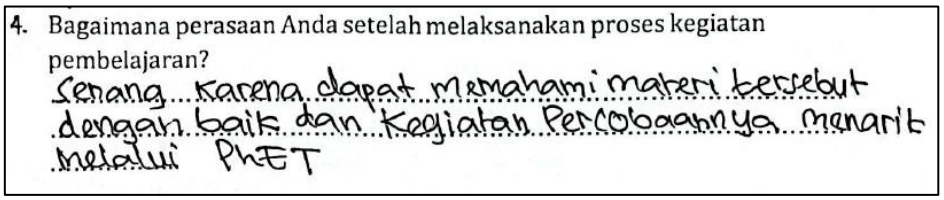
4. Bagaimana perasaan Anda setelah melaksanakan proses kegiatan pembelajaran?
Senang...karena dapat memahami materi tersebut dengan baik dan kegiatan percobaannya menarik melalui PhET

Figure 8. *Question 4 and its explanation answer positively at the Follow-Up and Evaluation stage*

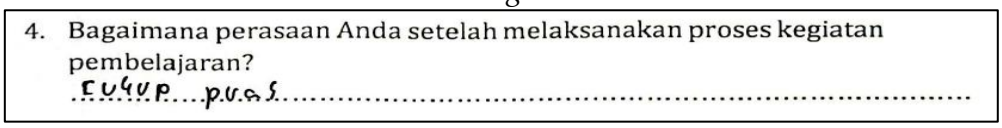
4. Bagaimana perasaan Anda setelah melaksanakan proses kegiatan pembelajaran?
cukup puas

Figure 9. *Question 4 and its explanation answer negatively at the Follow-Up and Evaluation stage*

In Figure 8, students disclose feeling self after following the activity learning, namely" happy". Because he can understand the material with good activities, his experiment is interesting through PhET. It can be known that students feel like during the activity process learning because capable understand the material wave with good, and students interested with the activity experiments conducted with the application PhET. In Figure 9, students answer "enough" satisfied". From the answer, students can state a negative answer; students feel sufficiently satisfied with the material that has not been mastered.

It can be stated that with Use of Self-Assessment This can used in evaluate achievement ability Critical Thinking during activity learning in progress based on PBL, according to with Rachmawati et al., (2021) in the learning process student can develop ability evaluate self and criticize the learning process they in a way independent through assessment self or Self-Assessment. Students can be effective because results collected from learning so that we can know material that has been mastered and also not yet mastered by students, able to plan Study or repair Study for students, and able to know the feeling of students during learning. From the Follow-Up and Evaluation stage, continued evaluation self with the Replication stage (Repeat).

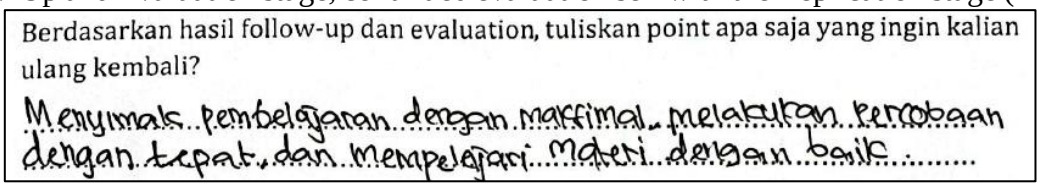
Berdasarkan hasil follow-up dan evaluation, tuliskan point apa saja yang ingin kalian ulang kembali?
Menyimak pembelajaran dengan maffimal, melakukan percobaan dengan tepat, dan mempelajari materi dengan baik

Figure 10. *Question 5 and its explanation answer positively at the Replication stage (Repeating)*

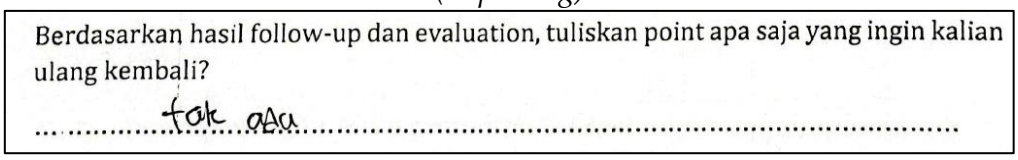
Berdasarkan hasil follow-up dan evaluation, tuliskan point apa saja yang ingin kalian ulang kembali?
tak ada

Figure 11. *Question 5 and its explanation answer Negative at the Replication stage (Repeating)*

In Figure 10. Students explain the activity, what do you want repeated again, namely listening, learning with maximum, doing tests correctly, and learn material with good. From the statement, they can know that students evaluate themselves that during the activity learning that has been done not listen and learn the material presented, and also have not yet taken the test correctly. This is due to the results Implementation stage (Implementation), students are not capable enough to convey the results practicum. In Figure 11. Students who answer "no, there is" can state that the student is Still Not yet capable of evaluating their achievement. So, from that, in the activity learning next students are required for more listen and learn material

presented by the teacher with good, do practical work in a way right, and follow the activity learning from beginning to end with maximum.

From the results of the Self-Assessment in learning based on PBL (Problem-Based Learning) material, wave Mechanics researchers can evaluate the ability of students to carry out activity lowest PBL learning activity, namely in the PBL cycle, developing and presenting results. For the highest PBL cycle, do individual and group work, and analyze and evaluate the problem-solving process. From all over the PBL cycle, with a statement of each activity on average in category finished by Luque & Medonza (2019) via stages, the results from Self-Assessment can record the assessment process self self-studying students and give feedback to come back to reach maximum results. Then you can state that the Application of Self-Assessment in learning based on PBL (Problem-Based Learning) material, wave Mechanics can be used optimally to evaluate the ability of students in carrying out PBL learning.

CONCLUSION

Self-Assessment results in learning based on PBL (Problem-Based Learning) material wave Mechanic capable used optimally in evaluating the ability student in carry out activity PBL learning can be stated that an average of 31 students follow the activity learning and practice with good results, and are capable of evaluating self in PBL learning activities with completeness. The highest student completeness is in the cycle conducting individual and group investigations and analyzing and evaluating the problem-solving process, with as many as 91.6% or 33 students. The lowest student completeness is in the cycle" developing and presenting work results," with as much as 80.5% or 29 students.

SUGGESTION

The suggestions given for further research are to carry out activity research with this learning method on various subjects. In addition, using learning media that is integrated with self-assessment as research updates and can combine this learning method with other media.

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