Research Article

Improving Student Learning Outcomes with the Application of Problem Based Learning Models in Microprocessor and Microcontroller Subjects at SMK Negeri 2 Pematangsiantar

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ABSTRACT

The objectives of this Classroom Action Research were to determine: (1) increase student activity during the learning process of Microprocessors and Microcontrollers by applying the Problem Based Learning model at SMK Negeri 2 Pematangsiantar, (2) increase student learning outcomes in Microprocessor and Microcontroller learning by applying the Problem Based Learning model at SMK Negeri 2 Pematangsiantar. This research was conducted at SMK Negeri 2 Pematangsiantar for 1 month starting from August 2019. The subjects of this study were 22 students of class X1 TAV 1. The action in this study consisted of two cycles, namely Cycle I and Cycle II. Cycle I was carried out using the Problem Based Learning model. The results of the first cycle showed that 45.63% of students were active and the mean score of vocational competence students for Microprocessor and Microcontroller was still 56.82. However, these results do not meet the action indicators, namely 75% of students get a value > 75, then second cycle II is carried out. Cycle II carried out the same application. In cycle II 84.38% of students are active, and the average value of vocational competence for Microprocessors and Microcontrollers increases to 80.27. So it can be concluded that the learning process using the Problem Based Learning model can increase the activeness and ability of students in learning vocational competencies in Audio Video Engineering. The implication is that teachers must apply innovative and creative learning models. And it is suggested that Electronics Engineering teachers can improve their teaching skills to be more communicative and active in participating in various pieces of training.

Keywords: *improving student learning outcomes, microcontroller, microprocessor, problem-based learning*

Introduction

Education is a necessity as well as a major long-term investment that must be planned, implemented and evaluated, and given feedback (Brulin & Svensson, 2016). Education must be equipped with facilities and infrastructure, in this case, it can be said that material capital is quite large (Wahid & Cerya, 2022). However, if you look at it until now, Indonesia is still struggling with the classic problem, namely the quality of education. The problem, after trying to find the root of the problem, is like a circular link and it is not certain where it ends.

Concerning the quality of education, especially at the Vocational High School (SMK) level, it is still far from what is expected. When viewed from the standardization of the Final School Examination (UAS) with a value of 5.5 for each subject, all educators complained, even the parents of the students themselves, because these students could not pass. Seeing the condition of the low achievement or student learning outcomes, several attempts were made. One of these efforts is to increase student learning activity by applying various models, methods and learning strategies which are of course adapted to the characteristics of the subject matter (Suartama et al., 2020).

With the application of the right method, model, or strategy, it is hoped that students can improve their learning activities, and students who get special attention and treatment will produce better achievements (Siahaan et al., 2021). Better treatment and attention in learning at school and at home, of course, the better the mastery of competencies or concepts in the subjects being studied (Fink, 2013). Various expert opinions explain that extrinsic motivation arises as an influence from outside the individual, either because of the existence of an invitation or because of coercion from other people so that with such conditions finally willing to do something or want to learn, for example, someone wants to learn because they are told or even forced by their parents to get the first rank. Likewise, the teacher giving a problem that must be solved will force students to do it whether it is because they are told or because they are forced to, which conditions students to

learn. The condition of togetherness in learning can also form a person's interest and willingness to participate in learning.

With the application of a good learning model and following the characteristics of the material, it will be able to condition the process in the form of extrinsic motivation for students (Putri & Syahputra, 2019). Learning is not only focused on students with below-average abilities but also focused on students with average and above-average abilities. Learning should be able to facilitate all students with different abilities and can serve students according to their respective learning speeds.

Each individual is never created equal. Each has different characteristics. The response and interpretation of each student to something delivered (the same lesson in class) are very different from one student to another. This is due to the many differences in students. Some of them are differences in ability and intelligence, creativity, learning style, thinking style, thinking ability, ability to express opinions, emotional maturity, and so on.

Individual differences of students in the classroom provide insight to the teacher to determine the media, methods, models, and learning strategies that must be planned in achieving the learning objectives that have been set (Biedroń & Pawlak, 2016). The individual differences of students are found in several aspects, both physical and psychological aspects. The most dominant thing faced by teachers in formal schools is the difference in the psychological aspect. By paying attention to the individual differences of students, teachers are expected to carry out appropriate learning for students, so that students can participate in learning in a fun way because it is following the characteristics of these students.

Learning does not only use the brain but also uses the whole body and mind and involves all the emotions, senses, and nerves, thus if students cannot learn the way the teacher teaches, the teacher must be able to teach the way students learn. If this happens in the learning process, learning acceleration will be obtained. Overcoming the individual differences of students can be done by using a variety of learning materials and providing flexibility for independent study.

The statements above are relevant to the learning principles put forward by educational experts who pay attention to the individuality of students in the classroom. Individuality is meant to adjust learning to the ability of students. The learning process that takes place not only pays attention to students with average knowledge but also students with average and above-average abilities. With the variety of basic abilities possessed by students, teachers are required to be able to choose and use good and effective strategies, methods, and learning models, according to the characteristics of the students they are facing and the characteristics of the subject matter being taught.

Various conditions in the learning process in one class, as well as the diverse characteristics of students, require teachers to be able to develop various learning strategies and use appropriate media. García-Moya et al., (2020); Hodges et al., (2020);Kim & Asbury, (2020) say that a teacher should be able to recognize and know the characteristics of students because a good understanding of student characteristics will greatly affect the student learning process. After all, if a teacher can know the characteristics of his students, then the teacher can then adjust the learning approach used. Thus the teacher must be able to condition the class for fun learning for students (García-Moya et al., 2019).

From all the descriptions stated above, the authors are very interested in researching the effect of applying learning models on student learning outcomes and increasing student activity in the subjects of Microprocessors and Microcontrollers in the Audio Video Engineering skill package at SMK Negeri 2 Pematangsiantar.

Methods

Study this implemented in class XI TAV I SMK SMK Negeri 2 Pematangsiantar . Study this implemented During one month, that is one month of August 2019. Implementation treatment customized with timetable lesson on the school that became subject study this. Study this done gradually. Every cycle is divided into one-time meetings and then done evaluation To use measure enhancement achievement completeness n minimal student learning (Nurhasanah et al., 2020).

The end of every cycle is equipped with activity reflection and planning action next. Subject study this is all student class XI majors Audio Video Engineering SMK Negeri 2 Pematangsiantar, on eye lesson Technique Microprocessor and Microcontroller. Amount sample from the study this one total class is 22 people.

Technique Data Collection
Technique data collection used:
1. Test

    Question tests that have been made given to students and then solved by an individual. Test implemented on every beginning cycle (pretest) and end cycle (posttest) (Wijayati et al., 2019).
2. Non-Test

    Data collection in the form of non-test used is observation. Observation or observation walk together with moment implementation. Observation is done with the used sheet observation liveliness students who have prepared (Suephatthima & Faikhamta, 2018). Observation liveliness students include: pay attention lessons (visual activities), discussion (oral activities), listening the material presented (listening activities), taking notes material (writing activities), drawing (drawing activities), doing practice use application corel draw and internet (motor activities), respond problem problem in lesson nor presentation (mental activities), attitude During lessons (emotional activities).

Results
The Description Action Execution
Study implemented a total of 2 cycles. Every cycle consist of 2 encounters. Every each week class get 4 hours of lessons Microprocessor and Microcontroller. Study this use time four hours of lessons that is with allocation time 4x45 minutes because with time the more enough for To do research started _ from planning, action, observation and reflection. Theory tree used _ that is apply algorithm programming for solving problem, understand architecture (design wake up) microprocessor so that capable

explain function algorithm in solving problem and understand construction microprocessor. Competence base the solved in time 2 meetings, each meeting 4 hours of lessons.

Cycle I
Action Planning Cycle I

Planning actions in cycle I include: the teacher prepares the lesson plan by Theory operate the laptop, prepare Theory discussion group , prepare pretest and posttest questions , forming group discussion study of 22 students into 4 groups . Then the teacher explains must - have activities done at the time discussion group. Method used _ in learning is talk, ask answer, and discuss as well as work group with the Problem Based Learning model. Rating used _ is the results of pretest, posttest and activity students (Gaol & Sitepu, 2020).

Action Implementation Cycle I

Implementation The action in cycle I was carried out on the day Thursday, 1 August 2019 and Thursday 8 August 2019 each 4 hours of lessons with allocation time 4x45 minutes specifically 7.30 – 11.15 WIB. Materials used _ is about explain principle work microprocessor minimum system and implement principle work minimum system microprocessor. Meeting First Cycle I activities study teach eye lesson Microprocessor and Microcontroller at SMK Negeri 2 Pematangsiantar started at 07.30 WIB. Learning cycle I is carried out in accordance with design research. At the meeting first done as following:

a) Initial Activities
- Master enters room and give regards to students.
- Teacher continues with attend students,
- The teacher points to one student for lead prayer.
- Teacher explains characteristics eye lesson to students.

b) Core learning activities.
- Teacher gives pretest question I for know ability student about eye lessons that will given.
- Teacher delivers Theory to students.
- Teacher form 4 groups of 22 students for discuss and resolve problems given by

the teacher about Theory lesson moment it .
- The teacher invites one group proceed to front class for present results discussion them.
- Teacher welcomes student from another group for respond presentation group that has forward.

c) Final Activities
- Teacher invites student for review new material just delivered.
- Teacher gives opportunity ask to students.
- Teacher gives give conclusion on the meeting already take place.
- Teacher gives regards closing, and leaving room room

Observation Cycle I

During implementation action in progress, observer To do observation and recording with use sheet observations that have been provided. Things observed and recorded by observation is liveliness student during the learning process eye lesson Microprocessor and Microcontroller with applying the Problem Based Learning model.

Reflection Cycle I

Based on actions in cycle I include planning and implementation action as well as results observation could done reflection. Researchers and observers discuss results implementation action. Effort for Upgrade performance learning and activity student through the application of the Problem Based Learning model is still not yet show maximum results.There are several problem faced among others:

1) Activities student in follow activity study part big still passive.
2) At meeting 1 still a number of brave student answer questions given by the teacher. 3) At meeting 1 still a number of brave student put forward opinion.
3) At meeting 1, cooperation and activities student in groupstill low. Based on results reflection in cycle I can be concluded that implementation learning in cycle I has not yet show results maximum. For that need implemented cycle advanced that is cycle

II with a number of revision based on reflection _ cycle I.

Cycle II

a. Cycle II Action Planning

As for the plan actions in cycle II include: the teacher prepares the lesson plan, the teacher prepares learning tools /media for make it easier for the teacher to explain material. Prepare pretest questions. Method used _ in learning is talk, ask answer, quiz, discussion group with the Problem Based Learning model. Rating used _ is pretest results, activity students and posttest.

b. Action Implementation Cycle II

The action in cycle II was held in 2 meetings on Thursday, August 15, 2019 and Thursday, August 22, 2019, each 4 hours of lessons with allocation time 2x4x45 minutes specifically 07.30 – 11.15 WIB. Materials used is plan application simple minimum system microprocessor. Meeting first Cycle II Learning Process Teach eye lesson Microprocessor and Microcontroller class XI at SMK Negeri 2 Pematangsiantar started 07.30 – 11.15 WIB. The learning process in the second cycle of the meeting second as following:

a). Early Activities

- Master enters room and give regards to students. Then next with attend students.
- Teacher explains characteristics eye lesson to students.
- The teacher points to one student for lead prayer.

b). Core learning activities.

Teacher gives question pretest II, for measure ability student about Theory lessons that will taught.

Teacher delivers Theory to students.

- Teacher divides group student
- Teacher welcomes each group complete good luck with method they alone.
- Teacher invite one group proceed to front class for present results discussion them .

- Teacher welcomes student from other groups respond presentation group that has come on stage

c). Final Activities

- Teacher invites student for review new material just delivered.
- Teacher gives opportunity to student for ask.
- Teacher gives reinforcement and conclusion.
- Teacher gives regards closing, and leaving room .

Observation Cycle II

During implementation action in progress, observer To do observation and recording with use sheet observations that have been provided. Things observed and recorded by observers _ _ is liveliness student during the learning process with applying the Problem Based Learning model. In this second cycle liveliness student increase fast because already link with life a day day and already very known by some big student how waves and vibrations work. Students have also start used to with the Problem Based Learning model.

Reflection Cycle II

Based on actions in cycle II include planning and implementation action as well as results observation could done results reflection. Researchers and observers discuss results implementation action. Effort for Upgrade performance study student through the Problem Based Learning strategy already enough maximum. This thing showed with part student very active in follow activity learning and results from the pretest and posttest in cycle II were satisfactory.

Research Results

1. Research Results Cycle I

Data about results study student before Cycle I pretest measures were used for know mark student before implemented action cycle I and posttest I for measure how far is success after done action cycle I. As for the results could seen in table following this:

Table 1. Student Pre Test and Post Test Results Cycle I

No	Name	Mark		Note
		PreTest I	**PostTest I**	
1	Student 1	20	35	
2	Student 2	20	55	
3	Student 3	25	60	
4	Student 4	35	65	
5	Student 5	30	65	
6	Student 6	10	20	
7	student 7	35	65	
8	student 8	25	60	
9	student 9	20	50	
10	student 10	25	65	
11	Student 11	35	65	
12	student 12	35	65	
13	student 13	30	65	
14	Student 14	40	65	
15	student 15	30	65	
16	16 student	35	55	
17	17 student	40	65	
18	18 student	15	30	
19	19 student	20	55	
20	student 20	35	65	
21	Student 21	40	65	
22	22 student	20	50	
Total Value		620	1250	
Average		28,18	56.82	

From Table 1 can seen that results study student before action cycle I shows that the value of pretest I is lowest 10 and value highest 40. And results study cycle I after done action show that the lowest posttest I score was 20 and the score highest 65. The average value of the results study student cycle I of 56.82 obtained through formula average value. From the data above could determined frequency and percentage results study student cycle I divided into 5 categories that can be seen in Table 4.2 below this.

Table 2. Frequency and Percentage Category of Learning Outcomes Student Cycle I

No	Mastery Level	Category	Frequency (f)		Percentage (%)	
			Pre-Test I	**Post Test I**	**Pre-Test I**	**Post Test I**
1	0 – 20	Very Low	7	1	31.82	4.55
2	21 – 40	Low	15	2	68.18	9.09
3	41 – 60	Currently	0	7	0.00	31.82
4	61 – 80	Tall	0	12	0.00	54.55
5	81 – 100	Very High	0	0	0.00	0.00
	Amount		**22**	**22**	**100**	**100**

Based on Table 2 can obtained information that of 22 students , detailed more a little students who have mark with category very low and low . So can said that results study student class XI SMK Negeri 2 Pematangsiantar in the first cycle partially big own category high and medium . Statistics mark students in cycle I can be seen in Figure 1 below this :
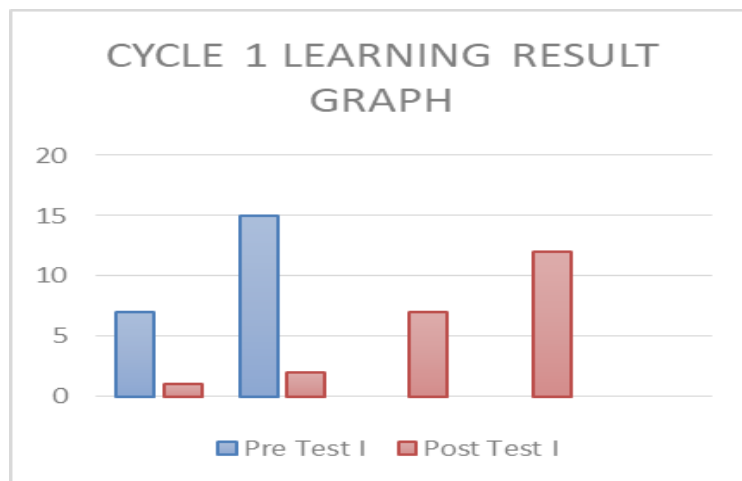

Figure 1. Chart Frequency of Learning Outcomes Students in Cycle I

Figure 1. Chart Frequency of Learning Outcomes Students in Cycle I

2. Research Results Cycle II

Data about results study student before Pretest action in cycle II is used for know ability student before implemented action cycle II and posttest cycle II were carried out for measure how far can success _ achieved after done action cycle II. The results of the pretest and posttest cycle II can be seen in table 3 below this:

Table 3 Student Pre-Test and Post-Test Results Cycle II

No	Name	Mark		Note
		PreTest II	**PostTest II**	
1	Student 1	25	73	
2	Student 2	45	76	
3	Student 3	50	77	
4	Student 4	55	78	
5	Student 5	55	80	
6	Student 6	10	60	
7	student 7	55	80	
8	student 8	50	85	
9	student 9	40	78	
10	student 10	55	80	
11	Student 11	55	92	
12	student 12	55	78	
13	student 13	55	94	
14	Student 14	55	84	
15	student 15	55	82	
16	16 student	45	80	
17	17 student	55	85	
18	18 student	35	78	

No	Name	Mark		Note
		PreTest II	PostTest II	
19	19 student	45	85	
20	student 20	55	79	
21	Student 21	55	82	
22	22 student	40	80	
	Total Value	1045	1766	
	Average	47,50	80.27	

Based on table 3 above could obtained results study student before action cycle II shows that the pretest value is lowest 10 and value highest 55. And results study after action show that lowest posttest score is 60 and the value highest is 94. The average value of the results study student cycle II of 80.27 obtained through formula average value . From the data table 4 above could determined frequency and percentage results study student cycle II divided into 5 categories that can be seen in Table 4, below:

Table 4 Frequency and Percentage Category of Learning Outcomes Student Cycle II

No	Mastery Level	Category	Frequency (f)		Percentage (%)	
			Pre-Test II	Post Test II	Pre-Test II	Post Test II
1	0 – 20	Very Low	1	0	4.55	0.00
2	21 – 40	Low	4	0	18.18	0.00
3	41 – 60	Currently	17	1	77.27	4.55
4	61 – 80	Tall	0	13	0.00	59.09
5	81 – 100	Very High	0	8	0.00	36.36
	Amount		22	22	100	100

Based on Table 4 above , we get information that of 22 students detailed no there is students who have mark with category very low and low . So can said that results study student class XI SMK Negeri 2 Pematangsiantar in cycle II partially big own category tall and very high . and can determined chart statistics as in the following figure 2 this:
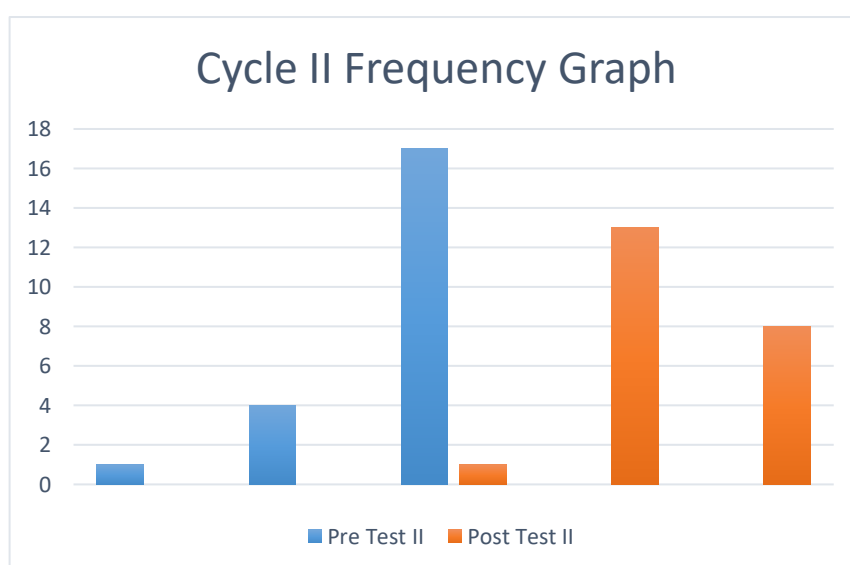

Figure 2. Graph Distribution Frequency of Learning Outcomes Student Cycle II

Analysis Activities Student

Activities student in learning eye Microprocessor and Microcontroller Engineering lessons taught _ with using the Problem Based Learning model, analyzed by descriptive percentage. Percentage liveliness increasing students _ from meeting 1 Cycle I to meeting 2 Cycle II, according to with SKM (Terms Minimum completeness) students i.e. 65, class declared has succeed or active learn it if at least 75% of students has active learn it. Enhancement liveliness student could seen in the table following this:

Table 5 Distribution Percentage Activity Student Each Cycle

No	Activity	Results Cycle I	Results Cycle II
1	Listening activities	65	92
2	Oral activities	40	80
3	Visual activities	40	85
4	Writing activities	45	85
5	Drawing activities	45	80
6	Motorcycle activities	35	80
7	Mental activities	45	85
8	Emotional activities	50	85

From the data presented in table seen that liveliness students at each category increase. This thing caused because student already could adapt with Problem Based Learning method. From the data in Table 5 above could determined chart liveliness student as following:
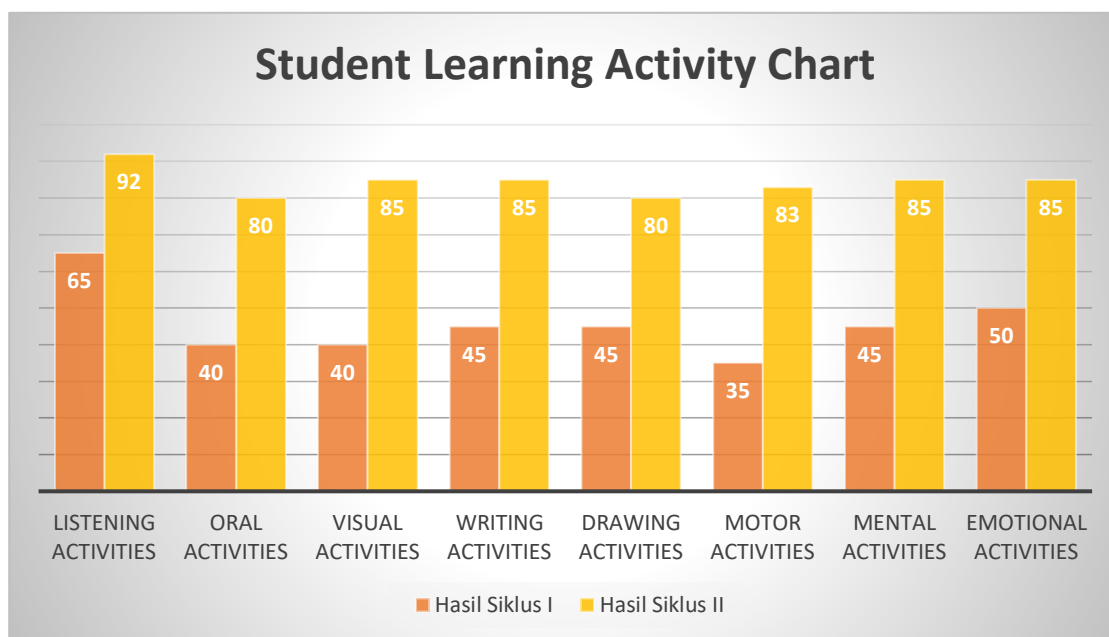

Figure 3 Chart Percentage Activity Learn Students in Cycle I and Cycle II

Discussion

Based on description research and results research that has been served before, can said that the average yield study student class XI TAV SMK Negeri 2 Pematangsiantar 2019/2020 Academic Year from cycle I to cycle II experienced upgrade , Upgrade class average _ from cycle I to cycle II increases by 11.82% i.e. from 70.43 to 83.30. Increase the average value caused by students easy absorb Theory with

the Problem Based Learning model. Where can the Problem Based Learning model be? stimulate open thought student as well as push they for To do more learning _ critical and active. The Problem Based Learning model also provides challenge to students so that they can get satisfaction with find knowledge new for himself.

Based on results observation activity student obtained information that existence enhancement in activity *listening, oral, emotional, visual, writing, motor, mental*, and *visual*. the thing show that student start give positive response _ to the lessons he followed. Well in listen and pay attention Theory learning delivered, or _ in ask about unfinished material _ understand as well as in put forward opinion. With using the Problem Based Learning model, students Becomes more easy understand Theory because they invited study through the problems that arise and how method complete problem that. View from results, the Problem Based Learning model can be help Upgrade results study and activity student in learning in eye lesson Microprocessor and Microcontroller at SMK Negeri 2 Pematangsiantar .

Conclusion

The conclusions from the results of Classroom Action Research using the Problem Based Learning learning model are as follows. The application of the Problem Based Learning model can help improve student learning outcomes for class XI TAV SMK Negeri 2 Pematangsiantar for the 2019/2020 academic year. The increase in the average grade from the first cycle to the second cycle increased by 23.45% from 56.82 to 80.27. Student learning outcomes reach the indicator of success from the Minimum Completeness Criteria (KKM) 65 of 95.45%. Based on the results of research on student activities, information was obtained that there was an increase in listening activity from 65% to 92%, oral from 40% to 80%, visual from 40% to 85%, writing from 450% to 85%, motor from 35% to 80 %, and mental from 50% to 85%, emotional from 50% to 85%,. The results showed that the application of the Problem Based Learning learning model could help increase the activity of class XI students at SMK

Negeri 2 Pematangsiantar. Student activity is seen from the aspect of paying attention, asking the teacher, answering questions, giving opinions, working in groups, working on questions, learning to use learning resources, and group presentations from cycle I to II, all aspects have increased.

Acknowledgement

References

Biedroń, A., & Pawlak, M. (2016). The interface between research on individual difference variables and teaching practice: The case of cognitive factors and personality. *Studies in Second Language Learning and Teaching*, *6*(3), 395–422.

Brulin, G., & Svensson, L. (2016). *Managing sustainable development programmes: A learning approach to change*. Routledge.

Fink, L. D. (2013). *Creating significant learning experiences: An integrated approach to designing college courses*. John Wiley & Sons.

Gaol, R. L., & Sitepu, A. (2020). The Influence of Used Good-Based Learning Media on the Value of Chracter Education and Student's Motivation to Study. *Budapest International Research and Critics in Linguistics and Education (BirLE) Journal*, *3*(4), 1696–1703. https://doi.org/10.33258/birle.v3i4.1299

García-Moya, I., Brooks, F., & Moreno, C. (2020). Humanizing and conducive to learning: an adolescent students' perspective on the central attributes of positive relationships with teachers. *European Journal of Psychology of Education*, *35*(1), 1–20.

García-Moya, I., Moreno, C., & Brooks, F. M. (2019). The 'balancing acts' of building positive relationships with students: Secondary school teachers' perspectives in England and Spain. *Teaching and Teacher Education*, *86*, 102883.

Hodges, C. B., Moore, S., Lockee, B. B., Trust, T., & Bond, M. A. (2020). *The difference between emergency remote teaching and online learning*.

Kim, L. E., & Asbury, K. (2020). 'Like a rug had been pulled from under you': The impact of COVID-19 on teachers in England during the first six weeks of the

UK lockdown. *British Journal of Educational Psychology*, *90*(4), 1062–1083.

Nurhasanah, F., Sukandi, U., Kuncoro, A. B., Rusilowati, A., Hastuti, W. S., & Prabowo, A. (2020). Collaborative classroom action research for mathematics and science teachers in Indonesia. *Journal of Physics: Conference Series*, *1613*(1). https://doi.org/10.1088/1742-6596/1613/1/012024

Putri, S. K., & Syahputra, E. (2019). Development of Learning Devices Based on Realistic Mathematics Education to Improve Students' Spatial Ability and Motivation. *International Electronic Journal of Mathematics Education*, *14*(2), 393–400.

Siahaan, K. W. A., Manurung, H. M., & Siahaan, M. M. (2021). Android-Based Learning Media Development Strategies During Pandemic Times To Improve Student Science Literature. *International Journal of Education and Humanities*, *1*(1), 34–42. http://i-jeh.com/index.php/ijeh/article/view/4

Suartama, I. K., Triwahyuni, E., Abbas, S., Hastuti, W. D., Subiyantoro, S., & Salehudin, M. (2020). Development of E-Learning Oriented Inquiry Learning Based on Character Education in Multimedia Course. *European Journal of Educational Research*, *9*(4), 1591–1603.

Suephatthima, B., & Faikhamta, C. (2018). Developing Students' Argument Skills Using Socioscientific Issues in a Learning Unit on the Fossil Fuel Industry and Its Products. *Science Education International*, *29*(3), 137–148. https://doi.org/10.33828/sei.v29.i3.2

Wahid, R. N., & Cerya, E. (2022). Development of Android-Based Interactive Media Learning Economics Capital Market Materials. *Economic Education Analysis Journal*, *11*(1).

Wijayati, N., Sumarni, W., & Supanti, S. (2019). Improving Student Creative Thinking Skills Through Project Based Learning. *KnE Social Sciences*, 408–421. https://doi.org/10.18502/kss.v3i18.4732