

The Effectiveness of Multimodel Learning on Linear Motion Topics to Practice Student's Problem Solving Skills

Aulia Agustina*, Abdul Salam M, Surya Haryandi,
Zainuddin Zainuddin, and Dewi Dewantara

Universitas Lambung Mangkurat, Banjarmasin, Indonesia

*1810121120024@mhs.ulm.ac.id

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Abstrak

Problem-solving ability is important in learning for the achievement of learning objectives. This research aims to describe the effectiveness of multimodal learning on a linear motion to practice students' problem-solving skills. This research is part of developing digital teaching materials on linear motion in a multimodel setting to practice students' problem-solving skills. Using the ADDIE development model over five stages. The subjects of the class trial were 14 students, 11 girls and 3 boys, in class X MIPA 3 of the school in Banjarmasin. The effectiveness is seen from the achievement in multimodel learning in terms of the result of the pre-test and post-test. The results of the N-gain test show that visualizing 0,40 problems in the category, presenting problems into physics concepts 0,88 in the high category, planning the completion of 0,55 in the medium category, carrying out problem-solving 0,80 in the high category, re-examining and evaluating 0,50 is categorized as high. Overall, the gain was 0,62 in the medium category. The research conclusion shows that multimodel learning is effectively used to practice students' problem-solving skills. The implications in education are creating creative and skilled resources and increasing the quality of education to support the future. Suggestions for further research are to increase the number of test subjects, to guide the process of practising problem skills, to distinguish between pre-test and post-test questions, and to carry out the maximum phases of the learning model.

Keywords: Linear Motion; Multimodel; Problem Solving Skills

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INTRODUCTION

The education progress in Indonesia is influenced by several factors, one of which is the learning objectives based on learning outcomes. Learning objectives must be achieved and fulfilled by certain sub-chapters, functioning as interest regarding student success and the requirements for the next level in the form of the next material. A person's

development is supported by several factors that can cause his thinking abilities to become wider, one of which is problem-solving to the questions given as a process of finding answers to questions accompanied by interests in order to get a solution to a problem that occurs (Hamimah, 2019). To solve the problem, of course, the stages that are regulated and the abilities in them are needed to be

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important in the learning process. Different problem-solving abilities are aligned with problem-solving, according to Heller. Among others are visualizing problems, presenting problems into physics concepts, planning solutions, problem-solving, re-checking and evaluating (Heller et al., 1998). One of the advantages of problem-solving skills is being able to think abstractly and be more developed (Wahyuddin & Nurcahaya, 2019). Based on the above, it is expected that problem-solving questions can be resolved correctly and according to the stages of problem-solving to find answers to a problem.

In life, it will be balanced if a solution and the stages of completion accompany the problem. One of the problems that students often encounter is learning Physics. The reality shows that the problems in the questions are rarely solved based on the student's abilities, but they find answers to the problems that have been presented instantly. This, of course, will impact the low problem-solving ability among students. Very few students ignore the stages of problem-solving but immediately find answers without being accompanied by the completion process. It has a negative impact if it is not trained in problem-solving to students, namely making students guess at the problem to find a solution spontaneously. In order to harmonize the solution of the problems contained in the matter of physics material on the topic of linear motion, the ability is needed in it. Therefore, problem-solving skills must be trained (Arsyad et al., 2020).

At one school in Banjarmasin, it showed that the result of the problem-solving ability test was still relatively low, especially on the topic of linear motion. This is also in line with other studies which showed low on the topic of linear motion (Febriana & Nada, 2021). The result shows that there are no students who achieve a score of 75

equivalent to the KKM or if represented by 0% in the very low category seen from the answers to the test results obtained, there are no students who visualize problems, 13% of students who present the problem in physics concept, 16% of students who plan solutions, there are 20% of students who carry out problem-solving, and no students who re-examine and evaluate. Other supporting data are in the form of interviews with physics teachers and student response questionnaires before carrying out learning. The average result of the questionnaire stated that it took more work for the topic of linear motion to impact understanding. This happens because the learning process at school only uses one learning model in all meetings, which impacts students, namely the lack of trained problem-solving skills (Andayani & Lathifah, 2019). Some of the latest models or innovations in the learning process are needed (Gonzalez et al., 2021). You can use two or more learning models in school to complete one material. This is meant by multimodel (Fatayah & Purwanto, 2021). The advantage of a multimodel is that it functions to be able to do settings in such a way based on the learning model that will be used (Fautin et al., 2021). There are 3 different learning models, including the direct teaching model, the guided inquiry model, and the cooperative model, so that new variations occur in learning and do not repeat themselves as a result of not with the same variety as long as the learning topic runs out of one chapter (Nida et al., 2021). Based on the statements mentioned, it is the cause of low problem-solving ability. Needs analysis shows that teachers and schools need interesting learning to support physics learning, one of which is a linear motion to practice students' problem-solving skills.

One solution to the above problems is to practice students' problem-solving

skills through multimodel learning, especially linear motion, which will be measured through student learning outcomes tests on effectiveness after participating in multimodel learning. Multimodel learning is one of the novelties of this research compared to other research. It is shown from the use of multimodel learning, which is still rarely used in the learning process, at the same time to practice students' problem-solving skills through multimodel learning.

METHOD

This research is development research, namely the mixed data (qualitative and quantitative) has the advantage of increasing problem-solving abilities more than conventional ones (Sujarwanto et al., 2014). The model used is the ADDIE model. The subject of the research trial is located in one of the schools in Banjarmasin, especially class X MIPA 3, with a total of 14 students, consisting of 11 girls and 3 boys. The test instrument was used as essay questions totalling 6 within the limits of the cognitive realm and related to everyday life (Andayani & Lathifah, 2019). The question contains an indicator of problem-solving ability, which is high-level thinking on its ability (Sujarwanto et al., 2014). The indicators of problem-solving ability are visualizing problems, presenting problems into physics concepts, planning solutions, implementing problem-solving, and re-examining and evaluating (Heller et al., 1998).

Learning is arranged in a multimodel, using more than one model, while learning on one subject (Fautin et al., 2021). The models used include direct teaching, guided inquiry, and cooperative learning. From the models used, it aims to be one of the tactics in the learning process to achieve its goals (Nida et al., 2021).

The product trial design and the pre-test and post-test results are compared when they have finished participating in multimodel learning. Through this comparison, during the learning process (Setyosari, 2013) listed in Table 1.

Table 1 Product Trial Design

<i>Pre-test</i>	<i>Treatment</i>	<i>Post-test</i>
O_1	X	O_2

(Sugiyono, 2019)

Effectiveness is monitored from the test of learning outcomes and fulfilled in the cognitive domain. The data will be calculated based on the N-gain statistical (Hake, 1998). The data will be based on the category of effectiveness, namely high, medium, and low (Ratumanan & Laurens, 2011).

RESULTS AND DISCUSSION

Effectiveness is measured if it has implemented multimodel learning. Before taking measurements, a product is needed for learning aids (Cahyani et al., 2020). Product development in digital teaching materials has gone through the validation stage by expert practitioners and academics so they can use them in learning (Rahmawati et al., 2020). The result of the validation of digital teaching materials are shown in 4,19 good categories so that they are suitable for use in learning; besides that, it is also supported by the results of student response questionnaires that function as the practicality of digital teaching materials, namely practical with the acquisition of 3,17.

The research was carried out using multimodel learning, which consisted of several models used when learning was located in one material (Tiur Maria, 2012). The model used is a direct teaching model, guided inquiry, and cooperative. There are several advantages, namely making learning more interesting because it makes learning not monotonous and fun, thanks to using several variants (Fatayah &

Purwanto, 2021). In addition, multimodal learning is comprehensive to achieve the expected learning objectives (Prasetyo & Syahmani, 2011).

In the early stages, students work on pre-test questions totalling 6 questions referring to the indicators of problem-solving abilities. Then carry out multimodal learning, after participating in multimodal learning, students work on post-test questions as a comparison before and after carrying out multimodal learning. The indicators of problem-solving ability include visualizing problems, presenting problems as physics concepts, planning solutions, problem-solving, re-checking and evaluating (Heller et al., 1998).

When the pre-test takes place, the results show that students need to visualize the problem. This happens because they are not used to it in learning; the results show that students need to describe the problem in general and do not identify a general approach to the problem in question. Students carry others out.

The post-test results showed that students could visualize the problem because students were able to understand the meaning of the problems in general after participating in multimodal learning. Visualizing the problem serves to deliver problems from everyday life to the problems contained in the questions, that way, you can visualize the problem, which intends to describe the problem in a complex form (Fontes et al., 2011). This ability serves to see and understand the problems included in the problem by describing certain objects (Foy, 2021).

Present problems into physics concepts, namely using physical quantities identified as a form of explanation for the previous visualization (Izzati et al., 2020). Students can also determine the correct symbol for an unknown variable and the symbol for the variable to be searched. Presenting problems into physics concepts shows

that the student's pre-test questions often need to write down the problems that occur in the questions based on the physics theorem; as a result, there needs to be known information, questions, and pictures. Ended up finding an answer without a cause, as shown by the following Figure 1.

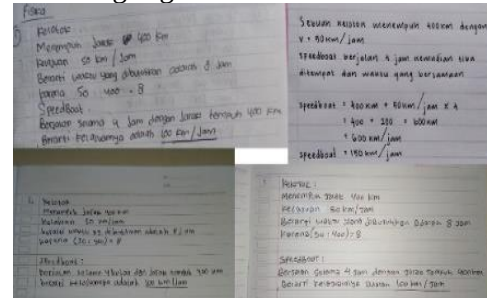


Figure 1 Pre-test Present the Problem in Physics Concept

After participating in the lesson, the post-test shows that students can present the problem in physics concepts. Marked can describe problems into physics concepts based on theorems and skills (Ratumanan & Laurens, 2011). quantities as symbols for certain variables. This is stated in the question as physical quantities as information from the visualization in symbols for certain variables. Write down the variables listed in the question, the variables asked in the question, the picture referred to by the question and other things. Presenting a problem into a concept, especially linear motion, aims to support success in finding concepts, one of which is physics (Dwi et al., 2013).

The next stage is to develop a strategy that will be used to get to the solution of the problems that have been given based on the complexity of the problem, which is entering the stage of planning a solution. The points are in the form of a formula that will be used to answer questions or a plan so that problems can be resolved, namely starting by identifying the concepts of physics in the form of equations (Kondrat'ev & Balabanov, 2017). Another thing is to systematically derive equations from

getting the right equation to solve the problem and add a description of the steps requiring certain conditions (Ramadhanti et al., 2020). The plans used may be the same, but the numbers used are different, as well as other things, namely writing 1 formula that is used, but 2 formulas are needed to find the results. The post-test shows that students can plan solutions by writing down a solution plan based on the given problem in the form of a formula to find answers based on the stages of implementation. It is proven in Figures 2 and 3.

6. Merencanakan penyelesaian - mencari percepatan $V_t^2 = V_0^2 + 2as$ $40^2 = 20^2 + 2a(60)$ $1600 = 400 + 120a$ $1200 = 120a$ $a = 10 \text{ m/s}^2$	Merencanakan penyelesaian - mencari percepatan $V_t^2 = V_0^2 + 2as$ $40^2 = 20^2 + 2a(60)$ $1600 = 400 + 120a$ $1200 = 120a$ $a = 10 \text{ m/s}^2$	Merencanakan penyelesaian - mencari percepatan $V_t^2 = V_0^2 + 2as$ $40^2 = 20^2 + 2a(60)$ $1600 = 400 + 120a$ $1200 = 120a$ $a = 10 \text{ m/s}^2$
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Figure 2 Planning a Solution

Merencanakan penyelesaian - mencari percepatan $V_t^2 = V_0^2 + 2as$ $40^2 = 20^2 + 2a(60)$ $1600 = 400 + 120a$ $1200 = 120a$ $a = 10 \text{ m/s}^2$	Merencanakan penyelesaian - mencari percepatan $V_t^2 = V_0^2 + 2as$ $40^2 = 20^2 + 2a(60)$ $1600 = 400 + 120a$ $1200 = 120a$ $a = 10 \text{ m/s}^2$	Merencanakan penyelesaian - mencari percepatan $V_t^2 = V_0^2 + 2as$ $40^2 = 20^2 + 2a(60)$ $1600 = 400 + 120a$ $1200 = 120a$ $a = 10 \text{ m/s}^2$
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Figure 3 Planning a Solution

A plan has been planned to carry out something based on the plan. Like the problem will be solved based on the solution that has been planned. At this stage, the implementation of problem-solving. This is also influenced by the previous stage in the form of a formula to be determined. If the formula used is inappropriate, the results will also not match. The post-test shows that students can carry out problem-solving achieved by substituting the values of the known variables to obtain the arithmetic solution of the searched variable, listed in Figures 4, 5, and 6.

Jawab: $V_t^2 = V_0^2 + 2as$ $40^2 = 20^2 + 2a(60)$ $1600 = 400 + 120a$ $1200 = 120a$ $a = 10 \text{ m/s}^2$	Merencanakan pemecahan masalah - Percepatan mobil $V_t^2 = V_0^2 + 2as$ $40^2 = 20^2 + 2a(60)$ $1600 = 400 + 120a$ $1200 = 120a$ $a = 10 \text{ m/s}^2$	- Waktu tempuh mobil $V_t = V_0 + a \cdot t$ $40 = 20 + 10 \cdot t$ $10t = 40 - 20$ $10t = 20$ $t = 2 \text{ s}$
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Figure 4 Carry Out Problem Solving

Merencanakan Pemecahan masalah Percepatan mobil $V_t^2 = V_0^2 + 2as$ $40^2 = 20^2 + 2a(60)$ $1600 = 400 + 120a$ $1200 = 120a$ $a = 10 \text{ m/s}^2$	Waktu tempuh mobil $V_t = V_0 + a \cdot t$ $40 = 20 + 10 \cdot t$ $10t = 40 - 20$ $10t = 20$ $t = 2 \text{ s}$	Merencanakan pemecahan masalah Percepatan mobil $V_t^2 = V_0^2 + 2as$ $40^2 = 20^2 + 2a(60)$ $1600 = 400 + 120a$ $1200 = 120a$ $a = 10 \text{ m/s}^2$
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Figure 5 Carry Out Problem Solving

Merencanakan pemecahan masalah Percepatan mobil $V_t^2 = V_0^2 + 2as$ $40^2 = 20^2 + 2a(60)$ $1600 = 400 + 120a$ $1200 = 120a$ $a = 10 \text{ m/s}^2$	Waktu tempuh mobil $V_t = V_0 + a \cdot t$ $40 = 20 + 10 \cdot t$ $10t = 40 - 20$ $10t = 20$ $t = 2 \text{ s}$	Merencanakan pemecahan masalah Percepatan mobil $V_t^2 = V_0^2 + 2as$ $40^2 = 20^2 + 2a(60)$ $1600 = 400 + 120a$ $1200 = 120a$ $a = 10 \text{ m/s}^2$
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Figure 6 Carry Out Problem Solving

A problem will be solved based on solving the problem. It contains skills, knowledge, and creative thinking power (Hamimah, 2019).

The answer has been found, and it does not stop there. Instead, it is necessary to re-examine the answers, namely utilizing re-examination and evaluation, which is the last stage in problem-solving abilities. Check whether the solution is complete, whether the answers are correct and whether the units are correct, and evaluate whether the answers' results make sense. Post-test students have examined in the form of checking answers by reversing the formula so that it is comparable to the result, as well as an evaluation of the units used and whether they fit the units used, listed in Figures 7, 8, 9, and 10.

e. mengecek kembali dan evaluasi

- Dengan memasukkan satuan

$$m/s^2 = m/s \cdot s$$

$$m/s^2 = m/s^2 \text{ (terbukti)}$$

- Pada waktu tempuh

$$s = m/s \cdot s$$

$$s = \frac{m}{s} \cdot s$$

$$s = s \text{ (terbukti)}$$

f. Dengan memasukkan nilai

$$t = \frac{v_t - v_0}{a} = \frac{40 - 20}{10} = \frac{20}{10}$$

$$t = 2 \text{ m/s}^2 \text{ (sesuai)}$$

Jadi, Percepatan dan waktu tempuh mobil adalah sebesar 2 m/s^2 dan 2 s .

Figure 7 Check Back and Evaluate

Memeriksa kembali dan evaluasi

- Dengan memasukkan satuan pada percepatan

$$m/s^2 = m/s \cdot s$$

$$m/s^2 = m/s^2 \text{ (terbukti)}$$

- Dengan memasukkan nilai

$$t = \frac{v_t - v_0}{a}$$

$$t = \frac{40 - 20}{10}$$

$$t = 2 \text{ m/s}^2 \text{ (sesuai)}$$

Jadi, Percepatan mobil tersebut adalah 2 m/s^2 dan waktu tempuhnya adalah 2 s .

Figure 8 Check Back and Evaluate

Memeriksa kembali dan evaluasi

- Dengan memasukkan satuan pada percepatan

$$m/s^2 = m/s \cdot s$$

$$m/s^2 = m/s^2 \text{ (terbukti)}$$

- Dengan memasukkan nilai

$$t = \frac{v_t - v_0}{a}$$

$$t = \frac{40 - 20}{10}$$

$$t = 2 \text{ m/s}^2 \text{ (sesuai)}$$

Jadi, percepatan mobil tersebut 2 m/s^2 dan waktu tempuhnya 2 s .

Figure 9 Check Back and Evaluate

Memeriksa kembali dan evaluasi

- Dengan memasukkan satuan pada percepatan

$$m/s^2 = m/s \cdot s$$

$$m/s^2 = m/s^2 \text{ (terbukti)}$$

- Dengan memasukkan nilai

$$t = \frac{v_t - v_0}{a}$$

$$t = \frac{40 - 20}{10}$$

$$t = 2 \text{ m/s}^2 \text{ (sesuai)}$$

Jadi, Percepatan mobil tersebut 2 m/s^2 dan waktu tempuhnya 2 s .

Figure 10 Check Back and Evaluate

This is shown based on the data obtained, listed in Figure 11.

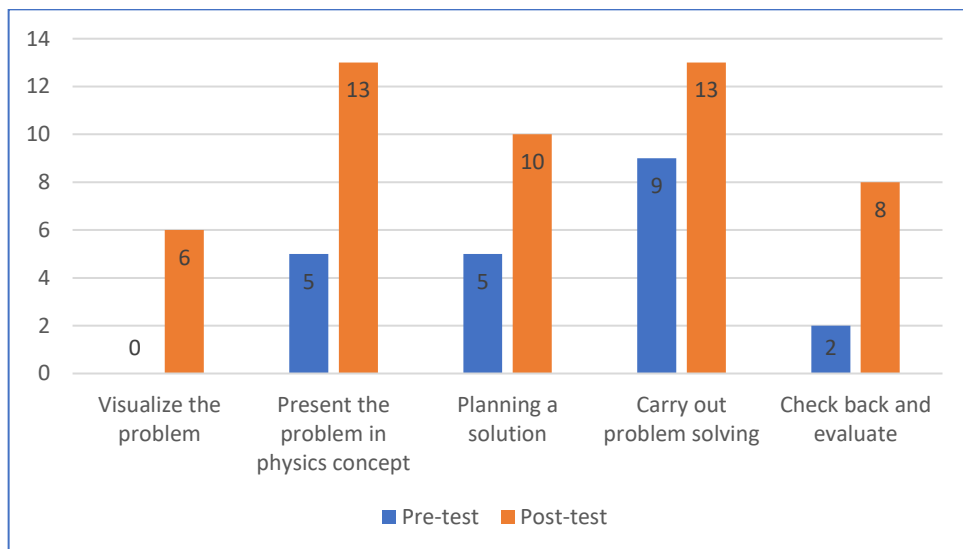


Figure 11 Pre-test and Post-test

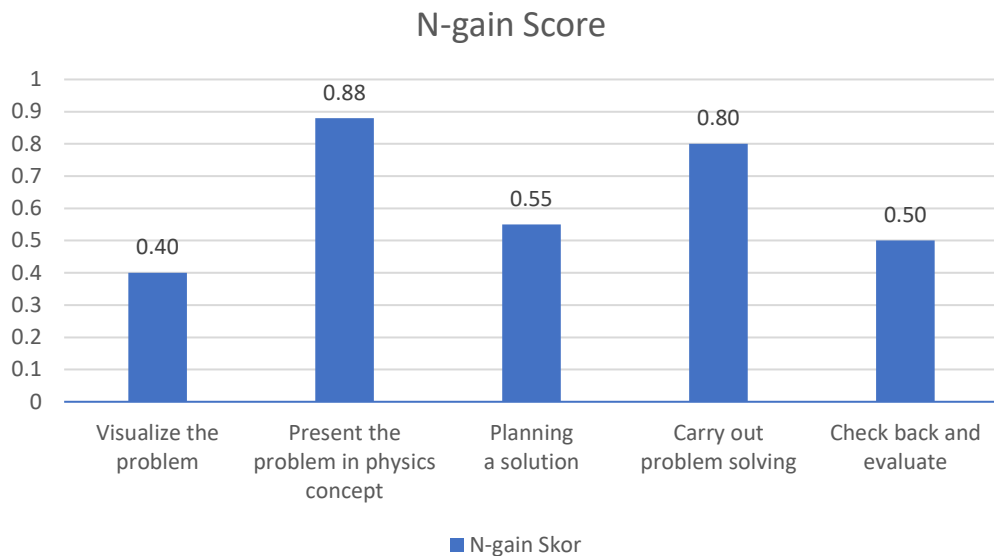


Figure 12 Result of N-gain Problem Solving Score Per Aspect

Table 2 N-gain Score Result

Average of Pre-test	Average of Post-test	$\langle g \rangle$	Category
10,40	64,86	0,61	Sedang

This research aligns with other relevant research, plus the support learning theory. There is feedback in the form of improving learning outcomes through predetermined stages so that they are effective, in line with research Lailis et al. (2021). There is an increase because the use of digital can add value to independence to make more use of time to study at home and have an impact on increasing so that it is effective. In research Khamidah & Mustikasari, (2019); Yulisa & Lia (2020), there is an increase in learning achievement because there is an influence on the learning process in the form of new media used with interactive updates.

This happens because problem-solving skills can be trained through multimodel learning, including direct teaching, guided inquiry, and cooperative models. According to research, Hartono (2020) shows the implementation of the problem-solving stages carried out in the learning process, namely multimodel training at each meeting; other research

on research Malinda (2020) states that problem-solving can be trained when using multimodel-based electron teaching materials. The support from the learning models used, namely the direct teaching model, can train problem-solving skills equivalent to research Abrory (2011), guided inquiry model alongside research Sinta (2019) able to improve understanding of learning because it is directly involved in the learning process, this is closely related to the characteristics of the material used Fathurrohman (2015) is innovative learning, from the advantages of the model used to add value to the multimodel learning function.

Multimodel learning requires support from products that are still relevant for implementing learning. The product used is the result of development, and the relevant result is shown because they have gone through a process of validation and practicality Noviyani (2021); Intan & Krisnadwipayana (2020); Rajabi et al. (2015), Riefani (2020). Can be called

worthy if it has gone through the stages of validation, practicality, and effectiveness by theory (Alfianika, 2018). Digital teaching materials are also made based on the latest curriculum, revised 2013 curriculum, and, most importantly, adjustments to the learning objectives to be achieved (Nitriani et al., 2018; Sugiarto et al., 2020).

CONCLUSION

Based on the research that has been carried out, it shows that the N-gain on problem-solving ability is visualizing the 0,40 problem in the medium category, presenting problems into physics concepts 0,88 high category, planning completion of 0,55 medium category, carrying out problem-solving 0,80 high category, re-examine and evaluate 0,50 high category. The highest indicator presents the problem in the high category of physics concepts, and the lowest indicator visualizes the problem in the medium category. The overall increase in the moderate category at the acquisition of 0,62, it can be concluded that multimodel learning is effectively used to train problem-solving skills. The following are suggestions for further research to improve it: 1) The trial subjects were quite minimal, so more test subjects were needed. 2) Guiding students while practising problem-solving skills is rarely used to work on problems using the previous problem-solving stages. 3) Students' problem-solving ability is increased because the questions are the same, so we need to differentiate between pre-test and post-test. 4) Carry out the phases of the learning model to the fullest, even though it is only carried out online.

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