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The Effect of The ROPES Learning Model with the Assistance of Crocodile Physics on Students' Critical Thinking Skills in Mechanical Waves Material

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Abstract

Based on the results of a preliminary study at SMA Negeri 2 Garut it is known that students' activeness is still lacking and students' critical thinking skills are classified as low. In addition, limited laboratory space makes learning less than optimal because it rarely does practicum. One effort that can be done to overcome this problem is to apply the ROPES learning model. Laboratory space limitations can be overcome by practicing crocodile physics. The purpose of this study was to determine the effect of the ROPES learning model assisted by crocodile physics on students' critical thinking skills in mechanical wave material in class XI MIPA SMA Negeri 2 Garut in the 2022/2023 academic year. This study used a quasi-experimental method with a nonequivalent control group research design. Instrument of students' critical thinking skills is carried out by giving tests in the form of essays with each question consisting of one indicator of critical thinking. The results of t-test at the significance level (α=0.05) show that t_count>t_table which means H_0 is rejected, so it can be concluded that the ROPES learning model assisted by crocodile physics has a significant effect on critical thinking skills in mechanical wave material.
Keywords: critical thinking, crocodile physics, mechanical waves, ROPES

Pengaruh Model Pembelajaran ROPES Berbantuan *Crocodile Physics* terhadap Keterampilan Berpikir Kritis Peserta Didik pada Materi Gelombang Mekanik

Abstrak

Berdasarkan hasil studi pendahuluan di SMA Negeri 2 Garut diketahui bahwa keaktifan peserta didik masih kurang dan keterampilan berpikir kritis peserta didik tergolong rendah. Selain itu, keterbatasan ruang laboratorium membuat pembelajaran kurang maksimal karena jarang melakukan praktikum. Salah satu upaya yang dapat dilakukan untuk mengatasi masalah tersebut adalah menerapkan model pembelajaran Review, Overview, Presentation, Exercise, Summary (ROPES). Keterbatasan ruang laboratorium dapat diatasi dengan praktikum melalui crocodile physics.

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Tujuan penelitian ini adalah untuk mengetahui pengaruh model pembelajaran Review, Overview, Presentation, Exercise, Summary (ROPES) berbantuan crocodile physics terhadap keterampilan berpikir kritis peserta didik pada materi gelombang mekanik di kelas XI MIPA SMA Negeri 2 Garut tahun ajaran 2022/2023. Penelitian ini menggunakan metode quasi experimental dengan desain penelitian nonequivalent control group. Pengukuran keterampilan berpikir kritis peserta didik dilakukan dengan memberikan tes berupa essai dengan masing-masing soal terdiri dari salah satu indikator berpikir kritis. Hasil uji t pada taraf signifikansi (α=0,05) menunjukkan bahwa t_hitung>t_tabel yang berarti H_0 ditolak, sehingga dapat disimpulkan bahwa model pembelajaran ROPES berbantuan crocodile physics berpengaruh secara signifikan terhadap keterampilan berpikir kritis pada materi gelombang mekanik.

Kata kunci: berpikir kritis, crocodile physics, gelombang mekanik, ROPES

INTRODUCTION

Education is an important process that a person goes through throughout his life. Education can be defined as a conscious and intentional effort from adults that influences the increase in the maturity of students so that they can develop their potential for provisions in people's lives (Rahmat, 2018). Education is the learning experience of students in obtaining knowledge that can be useful in solving the problems they face. Education aims to provide knowledge and improve the skills of learners (Hidayat et al., 2022). The implementation of education in Indonesia is regulated in the curriculum, one of which is the 2013 curriculum. The 2013 curriculum is a character and competency-based curriculum that aims to create productive, innovative, and creative generations of people through a series of integrated strengthening of knowledge, skills, and attitudes (Ali, 2020). The 2013 curriculum places more emphasis on the ability to reason, process, and present effectively, creatively, critically, productively, independently, collaboratively, communicatively, and selectively. This is in line with the skills in the 21st century that can be obtained after the learning process.

Learning in the 21st century is a series of activities that can increase the potential of students to form even better characters (Rahayu, Iskandar, & Abidin, 2022). This century's learning encourages students to practice their abilities to create and develop various skills needed for life in the future. These skills consist of critical thinking, creativity, communication, and collaboration skills. Critical thinking skills are one of

the assets that students must have to deal with the effects of globalization and increasingly developing technology (Novianti, 2020). Critical thinking skills can develop self-potential so that they are skilled in solving the problems they face. Critical thinking is a crucial need to deal with the dynamics of life amidst the flow of information (Kurniawan, Hidayah, & Rahman, 2021). Critical thinking skills are needed by students so they need to be trained because they have the potential to increase critical analytical power and learning outcomes (Susilawati, Agustinasari, Samsudin, & Siahaan, 2020). Critical thinking skills can be trained during the learning process at school. One of them is in Physics subject.

Based on the interview with one of the Physics teachers at SMA Negeri 2 Garut, it was found that the critical thinking skills of the students are still relatively low because the teacher still needs to provide a lot of stimuli to trigger critical thinking among the students. Based on classroom observations of physics learning, it was found that the teaching style is still centered around the teacher, resulting in less student engagement. Furthermore, students tend to focus more on formulas and calculations during their learning. Based on the results of preliminary study tests, it is known that students' critical thinking skills at SMA Negeri 2 Garut are still relatively low with an average percentage of 42.88%.

The low level of critical thinking skills can be addressed by employing a learner-centered instructional model, one of which is the Review, Overview, Presentation, Exercise, Summary (ROPES). The ROPES model with the assistance of Crocodile Physics is a collaborative learning approach that combines practical activities through Crocodile Physics simulations. The ROPES learning model consists of 5 syntaxes. First, review, namely students review the previous material and relate it to the material to be studied. Overview, the teacher explains the material briefly and the learning activities that will be carried out. Presentation, students do a practicum and present the results. Exercise, students work on practice questions. Summary, students conclude the learning that has been done. The ROPES instructional model is centered around fostering reasoning abilities and learner engagement through interconnected stages of learning (Man Un et al., 2020). The ROPES learning model, also known as Review, Overview, Presentation, Exercise, Summary, was developed by Hunts and used as a preparatory

plan for teaching activities (Majid, 2011). According to (Haryati, 2019) states that the ROPES learning model is a model that tries to overcome learning problems because it encourages students to think critically, be objective, and try on their own. The Review, Overview, Presentation, Exercise, Summary (ROPES) learning model focuses on the active role of students and their ability to understand a learning topic through various learning activities (Arista & Rahma, 2021). Based on this understanding, it can be said that the ROPES instructional model is student-centered, as learners play an active role in each stage of the learning process.

Mechanical waves are part of the Physics material that involves abstract concepts, well-defined principles, and laws, making it challenging for students to learn and understand (Bani, 2019). This is consistent with the research conducted by (Suganda, Parno, & Sunaryono, 2022), which states that students' understanding of wave concepts is still low due to the abstract nature of the subject. Some difficult wave concepts for students to grasp include mechanical waves, wave propagation, wave representation, and wave superposition. Abstract and challenging Physics topics can be made more comprehensible through hands-on experiments (Masril, Hidayati, & Darvina, 2018). Based on interview findings, it's revealed that practical experiments, whether conducted directly or through virtual simulations, have not been carried out for the topic of mechanical waves. Space limitations have led to the usage of the laboratory as a regular classroom, resulting in infrequent opportunities for Physics learning through practical experimentation. The limitation of laboratory space can be overcome by using Crocodile Physics simulations as a substitute for practical experiments. This study aims to determine the effect of the ROPES learning model assisted by Crocodile on critical thinking skills in mechanical wave material

Based on the research Sinaga & Simamarta (2014), the results showed that the ropes learning model had a significant effect on learning outcomes in temperature and heat material compared to conventional learning. Research conducted by Dina et al., (2016) shows that the ROPES learning model can improve physics learning outcomes on optical equipment material. Haryati (2019) supports the findings of this study, indicating that the ropes learning model significantly impacts student learning outcomes in the area of motion systems. This is consistent with research that has been conducted

by Arista & Rahma (2021), the research results show that teaching and learning activities using the Ropes model with assignments get a good response from teachers and students so that it can increase activity and completeness of student learning outcomes to a higher level on the material of substances and their forms. According to Lubis (2019) previous research, the ROPES learning model can enhance student learning activities, resulting in improved learning outcomes. Research conducted by Rosmaindi et al., (2022) concluded that the ROPES learning model can improve the activity and learning outcomes of physics on newton's law of motion material. The results of research by Aini et al., (2022) state that there are significant differences in students' cognitive learning outcomes between experimental classes that apply the ROPES learning model and control classes that apply conventional learning models. Yulianti et al., (2015) research indicates that the ROPES learning model is more effective than the AIR learning model in promoting independence and improving physics learning outcomes. In addition, research conducted by Restanti et al., (2015) that the ROPES learning model with the talking stick technique had a significant effect on learning outcomes and students' science process skills on the subject of straight motion. Rivaldi et al., (2021) conducted research on the effectiveness of the ROPES learning model in reducing students' misconceptions about fluid pressure, and the results showed that the model was effective. Previous studies suggest that the ROPES learning model has an impact on learning outcomes, activeness, and students' science process skills. This research differs from previous studies in that it focuses on the ROPES model's impact on critical thinking skills, an area that has not been previously researched. Therefore, the purpose of this study is to determine the effect of the ROPES model assisted by crocodile physics on students' critical thinking skills on mechanical wave material.

RESEARCH METHOD

The study was conducted over a period of two months at SMA Negeri 2 Garut, with the subjects being students of class XI MIPA. The research method employed was quasi-experimental with a non-equivalent control group research design. The study population consisted of 324 students across nine classes of class XI MIPA at SMA Negeri 2 Garut. The research sample was selected using purposive sampling to ensure that two classes with similar initial abilities were obtained. The selection was based on

the test scores of each class. The experimental class was XI MIPA 6, and the control class was XI MIPA 8, each consisting of 36 students.

The data collection technique involved administering a critical thinking skills test based on Ennis (1985) indicators. The test consisted of 9 essay questions that were designed based on critical thinking skills indicators and underwent expert validation, validity testing, and reliability testing. The average result of expert validation was 0.82, indicating that the questions were valid and could be tested. The reliability test results, using Cronbach's Alpha, showed a value of 0.824, indicating high reliability of the questions. Based on these results, it can be concluded that the questionnaire is suitable for use in research.

The study was conducted on KD 3.8 class XI, specifically focusing on mechanical waves. The study was conducted over four meetings, each lasting 2JP (2x45 minutes). The first meeting consisted of a pretest for both classes. Learning activities were conducted during the second and third meetings. The experimental class utilized the ROPES learning model with the assistance of crocodile physics, while the control class used the direct instruction model with the assistance of crocodile physics. The final meeting consisted of a posttest for both classes.

After collecting data from the critical thinking skills test, we conducted normality, homogeneity, and hypothesis tests to analyze the data. The normality test was used to determine if the data was normally distributed, and the chi-squared statistical formula was used to calculate the normality test. The results of the normality test indicate that the data is normally distributed, as the value of $\chi^2_{count}(9{,}97) < \chi^2_{table}(12{,}8)$. The homogeneity test, which was conducted to determine whether the samples came from a population with the same variance, was calculated using Fisher's test. The results of Fisher's test show that the data is homogeneous, as the value of $F_{count}(1{,}14) < F_{table}(1{,}77)$. It was found that the data followed a normal distribution and were homogenous. Therefore, hypothesis testing was conducted using the t-test. The results of the calculation of the hypothesis test with a significance level ($\alpha = 0{,}05$) obtained $t_{count} > t_{table}$ namely $6{,}56 > 1{,}67$ so that H_0 is rejected and H_a is accepted. That is, at the 95% confidence level it can be concluded that the Review, Overview, Presentation, Exercise, Summary (ROPES) learning model assisted by crocodile physics

has a significant effect on students' critical thinking skills in mechanical wave material in class XI MIPA SMA Negeri 2 Garut academic year 2022/2023.

The critical thinking skills of students were analyzed by calculating the proportion of the final score for each indicator. The method for calculating the overall score of critical thinking skills according to Melcin et al., (2021) is as follows.

$$P = \frac{x}{x_i} \times 100\%$$

Information:

$P =$ percentage of the final score of critical thinking skills

$x =$ score obtained for one indicator

$x_i =$ maximum score for one indicator

The values obtained are then listed according to each indicator in Table 1.

Table 1. Critical Thinking Skills Category

Persentase (%)	Category
81,25< x ≤100	Very High
71,50< x ≤81,25	High
62,50< x ≤71,50	Enough
43,75< x ≤62,50	Low
0,00< x ≤43,75	Very Low

Source: (Purwanti, Hujjatusnaini, Septiana, Amin, & Jasiah, 2022)

The results of the post-test data obtained were then analyzed for the category of critical thinking skills for each indicator. This category is obtained by first calculating the percentage obtained for each indicator and categorizing based on the percentage. Critical thinking skills are categorized as sufficient if the percentage is greater than 62.50%.

RESULTS AND DISCUSSION

The research was conducted in two classes with a total of 4 meetings and 2 of them were pretest and posttest. In the experimental class, the initial data for critical thinking skills was taken before learning using the Review, Overview, Presentation, Exercise, Summary (ROPES) model assisted by crocodile physics, while in the control class, the initial data for critical thinking skills was taken before learning using the

Direct Instruction model assisted by crocodile physics. After the pretest, the data is shown in Table 2.

Table 2 Pretest and Posttest Statistical Data of Experiment and Control Classes

Statistical Data	Pretest		Posttest	
	Eksperiment Class	Control Class	Eksperiment Class	Control Class
N	36	36	36	36
Maximum Score	36	36	36	36
Lowest Score	6	6	26	20
Highest Score	22	22	36	30
Mean	17,39	15,89	30,22	25,50
Varians	10,85	12,21	8,62	9,86
Standard Deviation	3,29	3,49	2,94	3,14

Based on Table 2 it is known that the experimental class and the control class each have 36 students. The maximum score obtained if students answered all the pretest questions correctly was 36. The variance values in the experimental class and control class were 10.85 and 12.21, respectively. The variance of the control class is slightly larger than that of the experimental class, which means that the control class has more varied data than the experimental class. The standard deviation values for the experimental class and the control class were 3.29 and 3.49, respectively. Both classes have almost the same standard deviation values. This means that the two classes have a data distribution that is close to the average value.

After taking the pretest score data for critical thinking skills, in the experimental class learning was carried out using the ROPES model assisted by crocodile physics, and in the control class learning was carried out using the direct instruction model assisted by crocodile physics on mechanical wave material. In the final activity, a posttest was carried out in the form of 9 test items in both the experimental class and the control class to find out the score of students' critical thinking skills after the learning had been carried out.

Based on Table 2, it is known that the maximum score, if students answer all posttest critical thinking skills questions correctly, is 36. The average score of the

experimental class is different from the control class, but the variance and standard deviation values are almost the same. But judging from the numbers can still be distinguished. The experimental class has a slightly smaller variance value, which means that the data in the experimental class has less variation than the control class. While the standard deviation value of the experimental class is smaller than the control class. This means that the experimental class has a distribution of data that is closer to the average value than the control class.

The difference in the critical thinking skills of the experimental class and the control class after being given treatment can be seen from the posttest average score. More details can be seen in Figure 1.

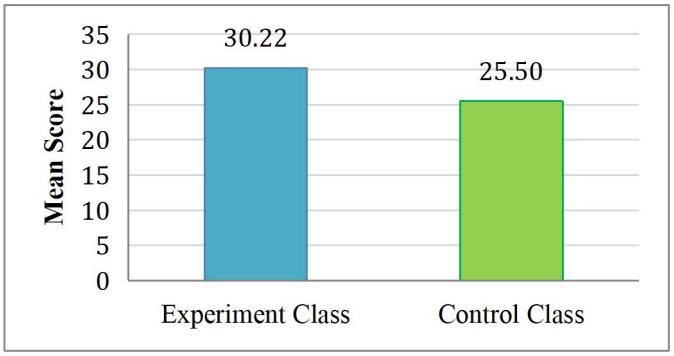

Figure 1 Posttest Mean Score of Experimental Class and Control Class

Figure 1 shows that there are differences in the mean post-test scores between the experimental class and the control class. The posttest mean score for the critical thinking skills test tested in the experimental class was 30.22, while in the control class, the average score was 25.50. These results indicate that the posttest mean score in the experimental class is greater than the control class average score. The difference in post-test scores is caused by the involvement or activeness of students during the learning process. In the experimental class, student-centered learning so that students play an active role during the learning process. In the control class, teacher-centered learning so that students are less actively involved during learning and are very dependent on the teacher. This is in line with the opinion of Hunaepi et al., (2014) which states that learning uses the direct instruction model, the teacher's role is more dominant in the learning process so the communication that is formed tends to be one-way communication. Learning using the direct instruction model makes learning centered on the teacher so that students do not have many opportunities to be actively involved and find it difficult to develop their thinking skills (Setyawan & Riadin, 2020). This direct

instruction learning model makes students very dependent on the teacher in obtaining information during learning. In addition, the experimental class has higher critical thinking skills because in the ROPES model students are directed to remember the previous material and relate it to the material to be learned through everyday phenomena. Also in the ROPES model, students collaborate with their groups to plan virtual laboratory activities to be carried out to train their critical thinking skills. This is in line with the opinion of Marbun, (2021) that one of the advantages of the ROPES model is that it encourages students to think and work on their initiative. This can be seen when students carry out virtual laboratory activities. One of the laboratory activities carried out is regarding diffraction which aims to determine the relationship between wavelength and frequency. Before carrying out these activities, students must think beforehand to determine what steps will be taken so that the objectives of the laboratory activity can be achieved.

The posttest scores for critical thinking skills in the experimental and control classes are clearly and comprehensively presented by calculating the average percentage score for each indicator. The percentage values are derived from the posttest scores, which consist of 9 essay questions, each corresponding to a critical thinking skill indicator. The obtained percentages of critical thinking skills are categorized according to the classification by Purwanti et al., (2022). These results are presented in Table 3.

Table 3 Average Posttest Scores Per Indicator of Critical Thinking Skills in Experiment Class and Control Class

No	Indicator	Eksperiment Class		Control Class	
		Persentage (%)	Category	Persentage (%)	Category
1	Basic Clarification	70,83	Enough	69,44	Enough
2	Basic Support	88,19	Very high	81,94	Very high
3	Inference	79,86	High	75,00	High
4	Advance Clarification	84,03	Very high	64,58	Enough
5	Strategy and tactics	90,28	Very high	62,50	Low
	Average	**82,64**	**Very high**	**70,69**	**Enough**

Based on Table 3, it is known that the average critical thinking skills in the experimental class are in the very high category, while those in the control class are in

the enough category. Each indicator of critical thinking skills in the experimental class has a greater percentage than the control class. This means that each indicator of critical thinking skills in the experimental class is better than the control class.

The difference in the category of critical thinking skills indicators is due to the learning activities carried out in each syntax of the ROPES model. Indicators of basic clarifiction are included in the enough category, both in the experimental class and in the control class. In the experimental class, this indicator relates to syntax review and practice. The review syntax encourages students to practice their thinking skills by recalling the material that has been studied and answering questions posed by the teacher so that they can explain related to the material to be studied. This syntax encourages students to think and remember in advance the material that has been studied before, namely about motion and vibration. After that, the teacher gives an everyday phenomenon related to waves. Based on the phenomenon given, students must explain the relationship between the phenomenon and the previous material that has been studied.

Examples of phenomena given by the teacher are someone throwing stones and playing rubber. When someone throws a stone into the water it will form a wave. In a rubber/rope game, when the rope is moved a wave will form. Based on this phenomenon, students must explain that waves occur due to movement or vibration so that this wave material is a continuation of the previous material regarding motion and vibration. In this syntax, not all students carry out the activity stages optimally. Some students try to think optimally so that they can remember and connect the material that has been studied with the material that will be studied. However, some other students have not been able to connect the previous material with the material to be studied. Therefore, this basic clarification indicator is in the sufficient category. Meanwhile, in the exercise syntax, students work on problem exercises. Students can discuss with their group mates to answer practice questions. Based on the exercises provided, it can encourage students' critical thinking skills, especially on basic clarification indicators. One of the causes of this basic clarification indicator is still in the sufficient category, namely, the instrument questions for this indicator only amount to 1 while the other indicators number 2 questions. This resulted in students' critical thinking skills on basic clarification indicators depending on 1 question. If the answer is correct, students can be

said to have the ability to think critically on that indicator. If the answer is wrong, the student is declared not to have critical thinking skills on the basic clarification indicators.

The indicators for basic support are in the very high category, both in the experimental class and in the control class. In the control class, it is in a very high category even though it uses the direct instruction model. When the teacher explains the material, students are not just silent. Some students asked about the material being explained. In the experimental class, this basic skill-building indicator relates to the overview syntax. This syntax encourages students to find out more about the material that was only delivered by the teacher briefly so that they can also assess whether the material presented by the teacher and from other sources is the same or not. In this syntax, the teacher only explains the outline of the material to be studied. Furthermore, students must find information related to the material from various sources, both from books and the internet. The information obtained is used as a basis for carrying out virtual laboratory activities. Activities in the overview syntax can encourage students to actively seek information not only from the teacher but from various relevant sources.

The inference indicator is included in the high category, both in the experimental class and in the control class. In the control class, this indicator can be trained through virtual laboratory activities so that students practice making conclusions from the activities that have been carried out. In the experimental class, indicators of summarizing relate to presentation and summary syntax. Almost the same as the control class, in this presentation syntax students practice making conclusions from the virtual laboratory activities carried out. For example, in a virtual laboratory activity about reflection. After doing these activities, students can make conclusions about the process of reflection on waves. When a wave hits an impenetrable medium, a reversal of the direction of wave propagation occurs. Then, it is strengthened again in the summary syntax, namely, students practice to make overall conclusions from the learning activities that have been carried out. Conclusions are made regarding wave mechanics, the magnitude of the wave, and the characteristics of wave mechanics.

The indicators advanced clarification, including the very high category in the experimental class, whereas, in the control class, it falls under the enough category. In the control class, the enough category is attributed to the provision of independent exercises for the students to work on. In the experimental class, the very high category

is supported by the syntax exercises. These syntax exercises provide several problem-solving tasks that should be completed by the students through discussions with their groupmates, enabling them to exchange ideas. Consequently, students find it easier to address the exercises. The problems tackled by the students are present in the Distributed Student Worksheets (LKPD) that have been distributed to each group. This aligns with Rivaldi et al., (2021) viewpoint that during the exercise phase, students put into practice what they have understood by engaging in problem-solving tasks, which aim to offer a direct learning experience and enhance the significance of the outcomes achieved.

The indicators governing strategy and tactics are in a very high category in the experimental class while those in the control class are in the low category. This difference is caused by when carrying out virtual laboratory activities in the control class, students only carry out activities according to the directions already in the LKPD. Whereas in the experimental class, there is a presentation syntax that can encourage students to practice organizing strategies and tactics. Students discuss with their group mates to plan virtual laboratory activities to be carried out because in the experimental class LKPD there are no work steps but only important instructions. This makes students practice arranging what steps to take based on the instructions given. In this syntax, students discuss with their groups to determine the steps to be carried out in virtual laboratory activities using crocodile physics. After carrying out virtual laboratory activities, students process the data obtained and present it.

Laboratory activities carried out are about the characteristics of mechanical waves. One of them is about diffraction.

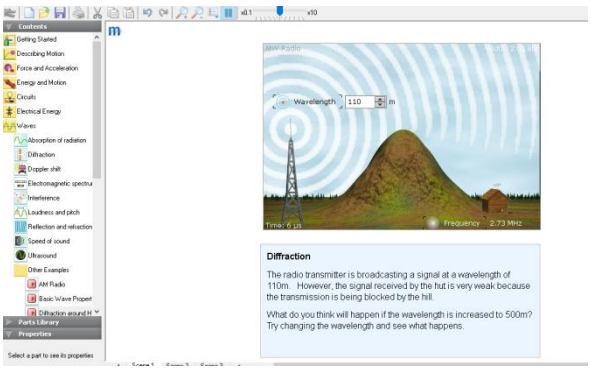

Figure 2 Display of Diffraction Crocodile Physics Virtual Laboratory Activities

Figure 2 is a diffraction laboratory activity using crocodile physics. This activity aims to determine the relationship between wavelength and frequency. The experiment was carried out by varying the wavelength value so that the frequency data was obtained. The results of the experiment, students make a graph of the relationship between wavelength and frequency. After that, students conclude from the experiments carried out. So, besides being able to train indicators to set strategies and tactics, the presentation syntax can train indicators to conclude. At this presentation stage, it is the core of learning where students carry out experiments that can train cooperation in groups to determine an action (Sinaga & Simamarta, 2014).

The ROPES learning model assisted by crocodile physics influences students' critical thinking skills in mechanical wave material. This influence is because the ROPES learning model involves students actively and directly in learning activities with the help of a virtual laboratory, namely crocodile physics. This is in line with Arista & Rahma, (2021) which states that the ROPES learning model emphasizes the active role and ability of students to understand the material. In addition, adequate critical thinking skills will make it easier for students to understand the material. Critical thinking aims to encourage students to have a deep understanding so they can make wise decisions (Amalia et al., 2023). Crocodile physics is used to help with the presentation syntax, namely doing practical work on the ROPES model. In addition, mechanical wave material also requires practicum to help students understand the material more easily, so a virtual laboratory in the form of crocodile physics is used. This mechanical wave material is material that is abstract and difficult to understand if students do not see the phenomenon directly or not through practicum activities (Dewi, Susilawati, & Kurniawan, 2020). This virtual laboratory activity trains students' critical thinking skills in planning strategies and tactics for conducting and processing practicum results data. This is in line with research conducted by Ocvianti & Sulisworo (2021) that learning with a virtual laboratory helps train students' critical thinking skills through a series of processes starting from planning, implementing, and processing data which is carried out in groups.

The Review, Overview, Presentation, Exercise, Summary (ROPES) learning model influences students' science process skills on the concept of static fluid (Setiowati, 2020). In addition, the Review, Overview, Presentation, Exercise, Summary (ROPES)

learning model influences student learning outcomes in heat and heat transfer material (Mutia, 2019). Other research states that the ROPES learning model influences the activity and learning achievement of students in Physics material (Man Un, Hudha, & Pranata, 2020). Based on previous research, it is known that the ROPES learning model influences students' learning outcomes, activeness, and science process skills. Then, in this research, research was conducted to find out the effect of the ROPES learning model assisted by crocodile physics on students' critical thinking skills. After collecting and analyzing the data, it was found that the ROPES learning model assisted by crocodile physics affected students' critical thinking skills in mechanical wave material. So, in addition to influencing learning outcomes and science process skills, it turns out that the ROPES learning model with the help of crocodile physics can also affect students' critical thinking skills.

The research has the advantage of producing a new finding that the ROPES learning model, assisted by crocodile physics, affects students' critical thinking skills on mechanical wave material. However, not all indicators of critical thinking skills are categorized as very good, so each learning syntax needs to be maximized again.

CONCLUSION

Based on the results of the research, data processing and analysis, as well as hypothesis testing, it can be concluded that the Review, Overview, Presentation, Exercise, Summary (ROPES) learning model assisted by crocodile physics has a significant effect on student's critical thinking skills in mechanical wave material in class XI MIPA even semester SMA Negeri 2 Garut for the academic year 2022/2023. The ROPES learning model is rated very high on the indicators of basic support, advance clarification, and strategy and tactics. Meanwhile, the inference indicator is categorized as high and the basic clarification indicator is categorized as sufficient. In order for any critical thinking skill indicator to be categorized as very high, it must maximize each syntax of the ROPES model. Specifically, in the review syntax, the teacher can provide a stimulus for students to practice thinking skills in recalling previous material.

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