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THE TEACHINGS OF TAMANSISWA (NITENI, NIROKKE, NAMBAHI) BASED E-PBL-STEM: IS IT FEASIBLE TO IMPROVE CRITICAL THINKING SKILLS AND SCIENCE VERBAL REPRESENTATION?

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ABSTRACT

Objective: The aim of this research is to analyze the feasibility and impact of the Tri N-based E-PBL STEM learning model on students' critical thinking skills and verbal representation in science learning.

Theoretical framework: The competencies students must have in the 4.0 era are not just hard skills but more soft skills such as critical thinking and verbal representation. Learning must be able to facilitate the development of these skills while still upholding the teachings of the nation's culture. Therefore, it is necessary to develop a learning model based on problems, STEM and Tamansiswa Tri N teachings while still integrating technological advances with augmented reality.

Method: The method used is quasi experiment with a one group pre test-post test research design. This quasi experimental research uses only one experimental class without using the control class as a comparison..

Results and conclusion: The research results show that the Tri-N based EPBL-STEM model was rated "Very good" by the validator with a total score of 114, meaning it exceeds 85.5. This is reinforced by 100% implementation of the RPP and 82.4% student response, which means they really like this model and practicality results from practitioners are 87.5%. The Tri N-based E-PBL STEM model also has the impact of increasing students' critical thinking skills scores and verbal representations through the GAin test. The average gain score for each material is 0.64. Meanwhile, the average scores for critical thinking skills and verbal representation were 0.64 and 0.70 respectively. The conclusion that there is an increase in students' critical thinking skills and verbal representation in the medium category. The findings of this research show that the Tri N-based EPBL-STEM model developed is very good and very practical, so it is very suitable to be applied in learning.

Implications of the research: This research is limited to the variables of critical thinking skills and verbal representation of science as a first step to increasing students' soft skill competencies in building their own knowledge freely and comfortably.

Originality: In the developing skills for the 4.0 era towards 5.0, this research is based on problem-based learning combined with STEM and Tamansiswa Tri N teachings by integrating AR.

Keywords: Niteni-Nirokke-Nambahi, Tamansiswa, STEM, Critical Thinking, Representasi Verbal.

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OS ENSINAMENTOS DE TAMANSISWA (NITENI, NIROKKE, NAMBAHI) BASEADO EM E-PBL-STEM: É VIÁVEL MELHORAR AS HABILIDADES DE PENSAMENTO CRÍTICO E A REPRESENTAÇÃO VERBAL DA CIÊNCIA?

RESUMO

Objetivo: O objetivo desta pesquisa é analisar a viabilidade e o impacto do modelo de aprendizagem E-PBL STEM baseado em Tri N nas habilidades de pensamento crítico dos alunos e representação verbal na aprendizagem de ciências.

Estrutura teórica: As competências que os alunos devem ter na era 4.0 não são apenas habilidades duras, mas mais habilidades sociais, como o pensamento crítico e representação verbal. A aprendizagem deve ser capaz de facilitar o desenvolvimento dessas habilidades, mantendo os ensinamentos da cultura da nação. Portanto, é necessário desenvolver um modelo de aprendizagem baseado em problemas, ensinamentos de CTEM e Tamansiswa Tri N enquanto ainda integra avanços tecnológicos com realidade aumentada.

Método: O método utilizado é quase um experimento com um grupo de projeto de pesquisa pré-teste pós-teste. Esta pesquisa quase experimental utiliza apenas uma classe experimental sem utilizar a classe de controle como comparação.

Resultados e conclusão: Os resultados da pesquisa mostram que o modelo EPBL-STEM baseado em Tri-N foi classificado como "Muito bom" pelo validador com uma pontuação total de 114, o que significa que excede 85,5. Isso é reforçado pela implementação de 100% do RPP e 82,4% resposta do aluno, o que significa que eles realmente gostam desse modelo e os resultados de praticidade dos profissionais são de 87,5%. O modelo E-PBL STEM baseado em Tri N também tem o impacto de aumentar as pontuações de habilidades de pensamento crítico dos alunos e representações verbais através do teste GAin. A pontuação média de ganho para cada material é de 0,64. Enquanto isso, os escores médios para as habilidades de pensamento crítico e representação verbal foram de 0,64 e 0,70, respectivamente. A conclusão de que há um aumento nas habilidades de pensamento crítico dos alunos e representação verbal na categoria média. Os resultados desta pesquisa mostram que o modelo EPBL-STEM baseado em Tri N desenvolvido é muito bom e muito prático, por isso é muito adequado para ser aplicado na aprendizagem.

Implicações da pesquisa: Esta pesquisa é limitada às variáveis de habilidades de pensamento crítico e representação verbal da ciência como um primeiro passo para aumentar as competências de habilidades suaves dos alunos na construção de seu próprio conhecimento livre e confortavelmente.

Originalidade: No desenvolvimento de habilidades para a era 4.0 em direção a 5.0, esta pesquisa é baseada na aprendizagem baseada em problemas combinada com os ensinamentos de CTEM e Tamansiswa Tri N integrando AR.

Palavras-chave: Niteni-Nirokke-Nambahi, Tamansiswa, CTEM, Pensamento Crítico, Representasi Verbal.

LAS ENSEÑANZAS DE TAMANSISWA (NITENI, NIROKKE, NAMBAHI) BASADAS EN E-PBL-STEM: ¿ES FACTIBLE MEJORAR LAS HABILIDADES DE PENSAMIENTO CRÍTICO Y LA REPRESENTACIÓN VERBAL DE LA CIENCIA?

RESUMEN

Objetivo: El objetivo de esta investigación es analizar la viabilidad y el impacto del modelo de aprendizaje STEM E-PBL basado en Tri N en las habilidades de pensamiento crítico y representación verbal de los estudiantes en el aprendizaje de ciencias.

Marco teórico: Las competencias que los estudiantes deben tener en la era 4.0 no son solo habilidades duras, sino más habilidades blandas, como el pensamiento crítico y la representación verbal. El aprendizaje debe ser capaz de facilitar el desarrollo de estas habilidades mientras se mantienen las enseñanzas de la cultura de la nación. Por lo tanto, es necesario desarrollar un modelo de aprendizaje basado en problemas, STEM y las enseñanzas de Tamansiswa Tri N, sin dejar de integrar los avances tecnológicos con la realidad aumentada.

Método: El método utilizado es un cuasi experimento con un diseño de investigación de un grupo antes y después de la prueba. Esta investigación cuasi experimental utiliza solo una clase experimental sin usar la clase de control como comparación.

Resultados y conclusión: Los resultados de la investigación muestran que el modelo basado en Tri-N EPBL-STEM fue calificado como "Muy bueno" por el validador con una puntuación total de 114, lo que significa que supera los 85,5. Esto se ve reforzado por la implementación del 100% del RPP y la respuesta del 82,4% de los estudiantes, lo que significa que realmente les gusta este modelo y los resultados prácticos de los profesionales son del 87,5%. El modelo STEM E-PBL basado en Tri N también tiene el impacto de aumentar las calificaciones de habilidades de pensamiento crítico y las representaciones verbales de los estudiantes a través de la prueba GAin. El puntaje de ganancia promedio para cada material es 0.64. Mientras tanto, las puntuaciones promedio para las habilidades de pensamiento crítico y la representación verbal fueron de 0,64 y 0,70 respectivamente. La conclusión es que hay un aumento en las habilidades de pensamiento crítico y representación verbal de los estudiantes en la categoría media. Los hallazgos de esta investigación muestran que el modelo basado en Tri-N EPBL-STEM desarrollado es muy bueno y muy práctico, por lo que es muy adecuado para ser aplicado en el aprendizaje.

Implicaciones de la investigación: Esta investigación se limita a las variables de las habilidades de pensamiento crítico y la representación verbal de la ciencia como un primer paso para aumentar las competencias de habilidades blandas de los estudiantes en la construcción de su propio conocimiento libre y cómodamente.

Originalidad: En el desarrollo de habilidades para la era 4.0 hacia la 5.0, esta investigación se basa en el aprendizaje basado en problemas combinado con las enseñanzas STEM y Tamansiswa Tri N integrando AR.

Palabras clave: Niteni-Nirokke-Nambahi, Tamansiswa, STEM, Pensamiento Crítico, Representasi Verbal.

1 INTRODUCTION

Current education must be able to provide skills to students to be able to find solutions to problems that occur in the surrounding environment (Antonio et al., 2023). The competencies that must be possessed in the 4.0 era are not just hard skills but more soft skills such as critical thinking, communication and collaboration skills (Prohimi, A. H. A., Syihabudhin, Juariyah, L., Bidin, R., Gunawan, A., & Syafruddin, A. B., 2024). The increasingly advanced era requires teachers to produce a superior young generation so that they can face various challenges in the future. Every learner should have a strong and competent spirit by mastering good skills, knowledge, and ethics (Gotama, 2018). All three can be developed when doing learning at school, for example in learning of natural sciences. This is because natural sciences contains knowledge obtained by practicum, observation, and deduction activities that produce data in the form of an explanation of symptoms that can be proven (Pratomo, W., Nadziroh, N., & Chairiyah, 2020).

Science learning should be able to improve students' critical thinking skills, one of which is through practicums. Data obtained from practicum activities at school will be analyzed

by students so that they will use logic and thought to obtain an explanation of scientific symptoms.This can happen if students apply scientific methods in analyzing data. But in reality, students' thinking skills tend to be poor (Susilowati, Sajidan, & Ramli, 2017; Dewi, Poedjiastoeti, & Prahani., 2017). This statement is in line with research conducted by Fuad, Zubaidah, Mahanal, and Suarsini (2017) which states the low achievement of the critical thinking abilities of students. The low level of students' critical thinking skills is also due to teachers not developing this competency in themselves which of course has an impact on students' competence.

The critical thinking abilities of students can be improved by using the model of Problem Based Learning (PBL). The model of Problem Based Learning (PBL) will encourage students to be active in learning so that knowledge can grow based on experience and the ability to ask questions (Kossasy, 2019; Fitri et al., 2021). Learners can create their own knowledge, develop the logic of their thinking, and achieve higher order thinking skills (Wardono et al., 2018; Temel, 2014; El-adaway, Pierrakos, & Truax, 2015; Kristiantari et al., 2022; Setiawan, 2020). This is in line with the statement of Jumadi, Perdana, & Rosana (2021) which states that Problem Based Learning makes students interpret data and explain real phenomena so that it helps them become an independent person (Husnidar & Hayati, 2021; Choden & Kijkuakul, 2020; Demirel & Dağyar, 2016).

There is a way to maximize the use of the Problem Based Learning model, namely integrating it with the STEM approach. This approach can enhance students' critical thinking abilities, along with the Problem Based Learning model in Natural Science education (Prihatin, Hariyadi, & Wicaksono, 2021; Sen, Ay, & Kiray, 2021; Farisi, hamid, & Melvina., 2017). Science, Technology, Engineering and Math (STEM) in addition to improving students' critical thinking skills also increases knowledge about how technology works and uses (Wong & Osman, 2018; Abdurrahman, 2019; Agustina, 2021; Mulyani, 2019). Integrating the Problem Based Learning (PBL) model with the STEM approach to form the E-PBL-STEM model will make it easier for students to connect science, technology, engineering, and mathematics in science learning (Avendano, L. Renteria, J., Kwon, S., & Hamdan, 2019; Anggraini & Huzaifah, 2017).

The E-PBL-STEM learning model will be more meaningful if the learning integrates teachings that can improve students' skills in the spirit of nationalism such as the Tri-N teachings. Tri N teaching is one of the Tamansiswa teachings consisting of Niteni, Nirokke, and Nambahi which can be implemented in an observation, imitation, and addition with special characteristics (Pratomo, W., Nadziroh, N., & Chairiyah, 2020; Nisa, Prasetyo, & Istiningsih.,

2019; Ernawati & Rochmiyati., 2020). E-PBL-STEM learning by applying the teachings of Tri N and the use of technology can equip students to gain knowledge that can be used in facing the times (Mustaghfiroh, 2020; Rahayu, Purnami, & Agustito, 2018; Maharani & Susanto, 2022).

The advancement of the times allows students and teachers to use technology in learning. Teachers must also be able to create effective, creative, innovative, and fun learning (Istiqomah, 2018). Thus, students will learn while mastering the digital technology that is developing today. One technology that can be used is augmented reality (AR) based technology. Teachers can use this technology by integrating it with the Tri N-based E-PBL-STEM learning model. The aim of this research is to explain the impact of the Tri N-based EPBL-STEM learning model on students' critical thinking skills and verbal representation in science learning. The end result is that graduates can adapt to a sociocultural environment that continues to develop and move dynamically, requiring critical and creative thinking from within. students (Linh, C. T. T., Huong, H. T., & Tien, N. D., 2023). Therefore, learning is needed that combines cultural teaching contexts with modern educational models so that students can maintain the cultural character of their nation by continuing to develop the knowledge they have (Gonzales-Sánchez, A. del C., et al., 2023).

2 THEORETICAL FRAMEWORK

Natural science is the understanding gained from using experimental data, observation, and deduction to formulate reliable explanations of phenomena (Pratomo, W., Nadziroh, N., & Chairiyah, 2020). Natural Science learning at school is expected to be a means for students to learn about themselves and the natural world. Students are given the opportunity to develop themselves further by applying the knowledge and skills they acquire in everyday life, which is based on the scientific method. Therefore, a learning model is needed that can facilitate students' self-development, especially in science subjects.

A learning model is a conceptual framework that describes systematic procedures in organizing learning experiences to achieve specific learning objectives. The model serves as a guideline for learning designers and teachers in designing and implementing the learning process (Trianto, 2007). The era of the industrial revolution has brought innovation in the learning model, turning it into a digital or electronic-based using the internet known as e-learning. The e-learning learning model is the delivery of learning, training, or education programs through electronic media (Husain & Basri, 2021).

One of the learning models that can be implemented in internet-based learning is the Problem Based Learning (PBL) model. Problem Based Learning helps teachers in linking the subject matter with its application in daily life (Demirel & Dağyar, 2016; Argaw et al., 2016; Hoogerheide et al., 2019; Saputra et al., 2019; Malmia et al., 2019). In addition, Problem Based Learning can also advance the skills needed in 21st century education by developing higher order thinking skills such as critical thinking skills, problem solving, discovery and use of learning resources, independent learning, development of cooperation skills, lifelong learning, and improvement of learners' metacognitive abilities.

The Problem Based Learning (E-PBL) internet-based learning model can be optimized by integrating the STEM approach and the Tri N principle in its implementation. The STEM (Science, Technology, Engineering, and Mathematics) approach is very relevant in science learning because it helps students in solving problems and integrating technology in the learning process (Anggraini & Huzaifah, 2017). Meanwhile, the Tri N principle (Niteni, Nirokke, Nambahi) can be integrated into the learning model to strengthen the achievement of learning outcomes as well as students' critical thinking and verbal representation skills (Kuncoro, K. S., & Arigiyati, 2020). The application of information technology in learning activities also supports strengthening students in facing the era of the industrial revolution 4.0. Therefore, this learning model is called E-PBL-STEM based on Tri N.

3 METHODOLOGY

3.1 TYPES OF RESEARCH

The method used is quasi experiment with a one group pre test-post test research design. This quasi experimental research uses only one experimental class without using the control class as a comparison (Creswell, 2009). This quasi experiment research was conducted in a class that was randomly selected without a test of student characteristics in the class used to receive treatment. The results of research using the post test one group test design through measuring the pre -test results before being given treatment and post tests are carried out in each series/ learning theme. This aims to eliminate data bias from the results of research that has been done. This research design scheme is shown by Table 1.

Table 1

Scheme Of One Group Pre Test-Post Test Design

Pre Test	Treatment	Post Test
T_1	X (model pembelajaran)	T_2

Source: (Creswell, 2009)
T_1: Initial test is carried out before treatment is given
X : Treatment is given to students using the Tri N-based E-PBL –STEM Learning Model
T_2: The final test is carried out after the treatment is completed

This research was carried out in two subjects, namely pressure of substances and its application in everyday life, and the respiratory system in humans. Each material session begins with a pre-test and a post-test at the end of the meeting. The treatment effect is the average difference between the pre-test and post-test of the two learning materials. This scheme can be described as shown in Table 2 as follows.

Table 2

Pre Test Post Test Design Scheme

Pre Test	Treatment	Post Test
T_1. T_2	X	T_3. T_4

Source: (Creswell, 2009)
T_1 : Initial test on learning with substance pressure material and its application in everyday life
T_2 : Initial test on learning with material on the human respiratory system
X : Treatment for students using the E_PBL STEM learning model based on Tri N
T_3 : Final test on material pressure and its application in everyday life
T_4 : Final test on human respiratory system material.

The scores obtained are then analyzed using normalized gain. Normalized gain, introduced by (Hake, 1999) as a rough measure of the effect of product application in increasing a variable, is formulated as follows formula 1.

$$g = \frac{(post-pre)}{(100-pre)}$$.... Formula 1 (Hake, 1999)

The score results entered are the class average for the pre-test and the average of the post-test results. The criteria for the effectiveness of using the Tri N-based E-PBL STEM learning model on students' critical thinking skills and verbal representation are based on criteria (1) high if $g \geq 0.7$; (2) moderate, if $0.7 > g \geq 0.3$; and (3) low, if $g < 0.3$ (Hake, 1999).

3.2 RESEARCH SUBJECT

This research was conducted at one of the private Junior High School in Yogyakarta, which is located on the island of Java, Indonesia. This school is under the auspices of the Tamansiswa foundation which was founded by the internationally renowned father of national education, Ki Hajar Dewantara. The research population was all students in class VIII JHS in the even semester of the 2022/2023 academic year from January to August 2023. The sample in this study was taken using a purposive random sampling technique with the consideration that the selected class had lower critical thinking abilities in their opinion. Teacher. So it is hoped that the results of this research will provide real benefits to the problems faced by teachers and schools.

3.3 DATA COLLECTION INSTRUMENT

Data collection used a expert validation sheets, pretest-posttest questions, and student response questionnaires. Data analysis uses quantitative techniques with gain tests and percentage results. The gain test is to analyze changes that occur in students' critical thinking skills and verbal representation variables before and after using the Tri N-based E-PBL STEM model. The percentage of results is used to analyze the feasibility of the model based on expert assessment and analyze the percentage of student responses to the model developed. This research took place in the even semester of the 2022/2023 academic year.

3.4 DATA ANALYSIS TECHNIQUE

Research data analysis uses quantitative techniques and gain tests. Quantitative techniques for calculating expert validation results, practicality questionnaire score percentages, lesson plan implementation observation results, and student response questionnaires, are then described in the form of descriptions. Meanwhile, the gain test is used to analyze changes in students' critical thinking skills and verbal representations after and before the activity. Apart from validity, the learning model must also be suitable to be applied in the teaching and learning process in the classroom.

The validity data was analyzed using descriptive statistical analysis techniques by calculating the percentage using formula 2 (Sugiyono, 2011).

$$\boldsymbol{P} = \frac{\sum \boldsymbol{x}}{\sum \boldsymbol{xi}} \times \mathbf{100}\% \qquad \text{.... Formula 2 (Sugiyono, 2011)}$$

P represents the percentage of practicality of the learning model. X shows the total number of respondents' answers, while xi reflects the total number of ideal scores in one item. The constant 100 is used to convert the calculation results to a percentage.

The limited trial was carried out in one class in one of the Tamansiswa junior high schools in the city of Yogyakarta. Data collection used practicality questionnaires, RPP implementation sheets, pretest-posttest, and student response questionnaires. Data analysis uses quantitative techniques to calculate the percentage of practicality questionnaire scores, the results of observing the implementation of the RPP. The limited trial was carried out in one class in one of the Tamansiswa junior high schools in the city of Yogyakarta. Data collection used practicality questionnaires, RPP implementation sheets, pretest-posttest, and student response questionnaires. Data analysis uses quantitative techniques and gain tests to calculate the percentage of practicality questionnaire scores, observation results of lesson plan implementation, pretest-posttest scores, and student response questionnaires, then described in descriptive form. This research took place in the even semester of the 2022/2023 academic year. The data collection method for assessing the implementation of the RPP and the practicality of the model is carried out using a non-test approach, while for students it is through response questionnaires, pretests and posttests.

Research data analysis uses quantitative techniques and gain tests to calculate the differences in results during the pre-test and post-test, then described in the form of a description. Apart from validity, the learning model must also be suitable to be applied in the teaching and learning process in the classroom.

Table 3

Practicality and Feasibility Assessment Criteria Learning Model

Category	Percentage (%)
Very practical	81% - 100%
Practical	61% - 80%
Moderately Practical	41% - 60%
Not Practical	21% - 40%
Very Impractical	< 20%

Source: (Arikunto, 2010)

4 RESULT AND DISCUSSION

This research developed a Problem Based Learning model combined with STEM approach and Tri N teaching (niteni, nirokke, nambahi). The implementation is assisted by a guidebook, syllabus, Learning Implementation Plan, Learner Worksheet, and student assessment instrument. The research sample was taken from one class with one teacher and 16 students. The research was conducted for 1.5 months with 12 face-to-face sessions on the material of substance pressure and the human respiratory system.

This research is one part of the stages of the ADDIE development model (Analysis, Design, Develop, Implementation, and Evaluate). At the analysis stage, information was obtained that the teacher had not used a learning model that strengthened students' verbal representations and critical thinking skills needed to be improved (Ahmad, 2021; Arief & Sudin, 2016; Arsani et al., 2020; Bakar et al., 2020; Busyairi & Zuhdi, 2020). The design stage produces a model design along with Augmented Reality (AR)-based learning tools and assessment instruments. The develop stage obtained the realization of the design that has been made, such as the design of learning implementation, Augmented Reality-based media, and teaching materials to be implemented (Cresswell, 2009). But before implementing to teachers and students, the product is consulted to expert lecturers and validated by expert judgment. The results of consultation and validation are used as product revisions to make it even better.

The TRIN-based EPBL stem learning model was assessed for its feasibility by 6 experts from state higher education who were competent in their respective fields. The expert judgment validation result from the 6 experts with number of assessment items as much 19 and number of respondents as much 6, are shown in table 4.

Table 4

Result of scores for each expert

Validator	Scores
1	19
2	19
3	19
4	19
5	19
6	19
Total Scores (X)	114

Because the value of X = 114, this value is more than 85.5. So it can be said that the model developed was rated "Very good" by the expert judgment. The instrumen use dicotomi quessioner with answer “Yes” or “Not”.

Products that have obtained assessments from validators are then applied to a limited scale test in one randomly selected school. The limited test will show the practicality of using the model. Furthermore, in the implementation stage, a broad field test is carried out on the model that has been developed. Through the observation sheet of the use of the Tri N-based E-PBL STEM learning model, it is known that teachers always teach according to the steps or syntax. This is evidenced by the use of 8 syntaxes of the E-PBL STEM learning model at each meeting, including problem oriented, visualization, investigation organizing, analyzing and interpreting data, using mathematics and computational thinking, developing and presenting the work, engaging in argument from evidence, and analyzing and evaluating the problem-solving process (Alfiana, Parno, & Yogihati, 2021). Thus, the learning implementation received a percentage of 100% with good results (Chen & Chen, 2021; Daniel, 2017).

In addition to learning implementation, the practicality assessment score of the E-PBL STEM model was also obtained and can be observed in Table 5.

Table 5

Result of Practicality Test Prosentation

No.	Aspect	Average Aspect Value (%)
1	Content Quality Aspect	81,81
2	Instructional Quality Aspect	81,25
3	Technical Quality	81,25

The assessment of the three aspects resulted in an overall average of 81.41%. However, the calculation uses a Likert scale with a score of 140 out of a maximum score of 160, then a percentage value of 87.5% is obtained. These results indicate that the Tri N-based E-PBL STEM learning model is categorized as very practical and easy to implement in the classroom. Furthermore, to test students' responses in using the Tri N-based E-PBL STEM learning model, pretests and postests were conducted. The scores from the pretest and post-test were calculated using the gain test method to obtain the results, as shown in Tables 6, 7, and 8. Table 6 shows that there was an increase in post-test scores compared to pre-test in each material. For the pressure material, the gain test score was 0.63, while for the human respiratory system material it was 0.67, so the average gain score was 0.65. This result of 0.65 is included in the medium category. The score gain results which only reach a moderate level are influenced by many

things, including the habits of teachers who teach using a full lecture method or working all day on calculations, science learning which is less fun and passive, students are used to the habit from generation to generation that science learning is not necessary. followed by let alone focus. The impact of this bad habit causes many children who initially still have old habits and don't care about learning. However, it turns out that there has been a change in the activity of students who previously did not want to listen, turned into being enthusiastic about participating in science learning from start to finish, including doing all the existing assignments.

Table 6

Result of Gain Score for Each Material

Material	Average Pretest Score	Mean Posttest Score	Pr-Po	M-Pr	Gain Score
Pressure	2,06	38,31	36,25	57,94	0,63
Human Respiratory System	3,31	41,38	38,06	56,69	0,67
Average					0,65

Table 7

Gain Result of Critical Thinking

Critical Thinking Skills	**Average Pretest Score**	**Mean Posttest Score**	**Pr-Po**	**M-Pr**	**Gain Score**
Pressure	1,38	25,06	23,69	38,63	0,61
Human Respiratory System	0,75	26,94	26,19	39,25	0,67
Average					0,64

Table 8

Gain Result of Verbal Representation

Verbal Representation	**Average Pretest Score**	**Mean Posttest Score**	**Pr-Po**	**M-Pr**	**Gain Score**
Pressure	2,19	14,44	12,25	17,81	0,69
Human Respiratory System	1,13	14,44	13,31	18,88	0,71
Average					0,70

According to the gain test results table, it is evident that the average score for the material is 0,64. While the average score of critical thinking skills and verbal representation is 0,64 and 0,70, respectively. The results in the table show an increase in scores which indicates that the ability to understand material, critical thinking skills, and verbal representation of students' science has increased after using the Tri N-based E-PBL STEM learning model (Ananda & Salamah, 2021; Apriyani, Ramalis, & Suwarma., 2019; Ardianti et al., 2020; Argaw

et al., 2016; Djohar, 2017). These results are reinforced by the questionnaire scores of students' responses to the E-PBL STEM learning model listed in table 9 below.

Table 9

Results of Student Response

No.	Aspects	Average Aspect Value (%)
1	Content Quality Aspects	82,42
2	Instructional Quality Aspects	81,95
3	Technical Quality Aspects	82,81

Based on the table of student response results, it is known that the average percentage score of all aspects is 82,4% which shows a good response from all students. The overall results show that the model is very practical and easy to use in science learning at school (Fajrina, Lufri, & Ahda, 2020). Thus, the Tri N-based E-PBL STEM learning model is feasible to be applied in science learning in the classroom and makes it easier for teachers to deliver subject matter.

5 CONCLUSION

The conclusions of this study are as follows:

1. The feasibility of the model is based on expert judgment results of 114 or more than 85.5 in the category very good or very suitable for use in science learning to enhancing critical thinking and verbal representation of students;
2. The learning steps or syntax of the Tri N-based E-PBL STEM learning model can be implemented well until a score of 100% is obtained;
3. The results of the gain test showed an increase in material understanding (score 0,64), critical thinking skills (score 0,64), and verbal representation of students (score 0,70) after using the Tri N-based E-PBL STEM learning model;
4. The use of the Tri N-based E-PBL STEM learning model received a good response from students with a percentage score of 82,4%.

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