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AR-ASSISTED READ, ANSWER, DISCUSS, EXPLAIN, CREATE (RADEC) LEARNING MODEL TO ENCOURAGE STUDENT'S CRITICAL THINKING SKILL

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ABSTRAK

Abstrak: Perkembangan teknologi dalam pendidikan mendorong inovasi model pembelajaran untuk mengembangkan kemampuan berpikir kritis siswa sekolah dasar. Penelitian ini bertujuan mendeskripsikan pengaruh model pembelajaran RADEC yang dikombinasikan dengan media Augmented (AR) terhadap kemampuan berpikir kritis pada siswa kelas V SD dalam mata pelajaran matematika bangun ruang kubus dan balok. Penelitian kuantitatif dengan desain kuasi eksperimen melibatkan kelompok eksperimen (N=17) dan kontrol (N=15) di SDN II dan III Teratai. Data dikumpulkan melalui pre-test dan post-test dengan soal uraian berpikir kritis. Teknik analisis data menggunakan uji non parametrik karena data tidak sepenuhnya normal dan homogen. Temuan dalam penelitian ini mengindikasikan potensi model RADEC berbantuan AR dalam mendorong kemampuan berpikir kritis siswa sekolah dasar. Hasil uji Wilcoxon mengungkapkan terdapat perbedaan signifikan kemampuan berpikir kritis sebelum dan sesudah implementasi model RADEC berbantuan AR (Asymp sig. 0.001 < 0.005). Terjadi peningkatan kemampuan berpikir kritis sebesar 70% dengan rata-rata skor post-test 84, lebih tinggi dibandingkan model PBL (rata- rata skor post-test 69). Model RADEC berbantuan AR menjadi representasi evolusi pendekatan pedagogis yang mendorong siswa berpikir kritis dan berinteraksi dengan objek virtual secara interaktif.

Abstract: *The development of technology in education encourages innovation in learning models to develop critical thinking skills in elementary school students. This study aims to describe the effect of the RADEC learning model combined with Augmented media (AR) on critical thinking skills in grade V elementary school students in the mathematics subject of cube also beam spaces. Quantitative study with a quasi-experimental design involved experimental (N=17) also control (N=15) groups at SDN II also III Teratai. Data were collected through pre-tests also post-tests with critical thinking questions. Data analysis techniques used non-parametric tests because the data were not completely normal also homogeneous. The findings in this study indicate the potential of the AR-assisted RADEC model in encouraging elementary school students' critical thinking skills. Wilcoxon test results revealed there was a significant difference in critical thinking skills before also after the implementation of the AR-assisted RADEC model (Asymp sig. 0.001<0.005). There was an increase in critical thinking skills by 70% with an average post-test score of 84, higher than the PBL model (average post-test score of 69). The AR-assisted RADEC model represents the evolution of pedagogical approaches that encourage students to think critically also interact with virtual objects interactively.*

A. BACKGROUND

Innovative learning models play an important role in improving the quality of education in the modern era. Student-centered models can develop critical thinking skills and prepare students for real-world challenges (Malik et al., 2020). This model also encourages the improvement of problem-solving skills and develops 21st century skills that are indispensable in the world of work (Rahmawati & Ertikanto, 2023).

RADEC (Read, Answer, Discuss, Explain, Create) is one of the innovative approaches that emphasizes active and student-centered learning process. This model encourages the development of critical thinking, analytical skills, and student creativity (Susanti et al., 2023). RADEC helps students comprehensively understand the material and apply it in a real context, creating a dynamic and meaningful learning environment.

The use of technology such as Augmented Reality (AR) in learning makes it easier for students to access information. AR allows integration between the real world and virtual elements, visualizing abstract material in three dimensions (Yasmin & Yoto, 2023) and creating a more engaging and interactive learning experience. In learning mathematics at the primary school level, especially abstract geometry, AR can help students visualize complex concepts (Hardiansah et al., 2024).

Learning mathematics at the elementary level is crucial for developing children's logical thinking, problem-solving skills, and critical thinking. Integrating critical thinking in math helps students understand concepts, not just memorize formulas (Najoan & Makawawa, 2023). It encourages them to question assumptions, evaluate arguments, and validate solutions, which is essential for navigating real-world complexities. This approach also strengthens logical reasoning, aiding decision-making based on data (Halimah et al., 2023). Fostering critical thinking in math prepares students for exams and equips them to be independent thinkers and effective problem solvers in a data-driven society (Tahimu, 2024).

Geometry is an abstract concept that is difficult for elementary school students to visualize. As per the results of interviews at SDN II Teratai, the teacher used the PBL model in learning the mathematics of geometry material. The PBL model is one of the innovative problem-based learning models. However, as per the observation, the problem presented by the teacher is still in the form of questions such as "Have you ever heard of cubes also blocks? What are their characteristics?". The incompatibility of learning practices with PBL principles causes students to be unable to develop critical, analytical, also creative thinking skills are usually trained through problem-solving.

In addition, the media used by teachers for teaching geometry is limited to YouTube, which, despite offering engaging visuals, tends to create a passive, one-way learning experience (Ilham, 2023). This contrasts with PBL, which emphasizes active exploration and problem-solving. The use of YouTube limits students' interaction with geometry concepts. Although the average student test score on geometry is 80, indicating most students meet the minimum passing criteria, they struggle with critical thinking questions. This may be due to their reliance on memorizing formulas rather than understanding concepts (Putra, Amalia & Fitriani, 2020). Students often find it difficult to apply formulas in new or complex situations, highlighting the need to shift from rote learning to one focused on conceptual understanding and application.

The RADEC (Read, Answer, Discuss, Explain, also Create) learning model is one of the innovative approaches that are highly relevant for developing elementary school students' 21st-century skills in today's digital era. As per Sopandi (2017) As the pioneering creator also innovator of the RADEC learning model, its primary objective is to enhance students' scientific literacy by amalgamating the most effective elements of various constructivist learning methodologies. The model comprises five distinct stages—Read, Answer, Discuss, Explain, also Create—each serving a specific pedagogical function within Sopandi's framework. In the Read stage, students independently explore diverse sources at home to gain foundational knowledge of the forthcoming material. During the Answer stage, students utilize this acquired information, structured within a worksheet, to address pre-learning questions. The Discuss stage involves collaborative group study, where students engage in deliberations to refine their answers, allowing instructors to pinpoint groups that exhibit the most innovative applications of the concepts. The Explain stage sees students presenting their findings, with the teacher ensuring their explanations are both scientifically accurate also comprehensible to their peers. In the culminating Create stage, students are encouraged to synthesize their understanding into original ideas or concepts. Through these meticulously structured stages, students not only develop conceptual knowledge but also meet curricular demands in a more dynamic, student-centered learning environment. Furthermore, Suratmi et al., (2022) In their research also explained five identical stages.

One of the important roles educators play in creating cutting-edge instructional materials is incorporating Augmented Reality (AR) into the classroom. Muhamad et al., (2022) define AR in primary schools as a platform that supports the development of 21st-century skills, such as creativity also problem-solving, through interaction with responsive digital content. AR media as a learning tool in elementary schools has several unique characteristics that make it effective also attractive. As per Astuti et al., (2021), AR is interactive also responsive, allowing students to manipulate virtual objects directly, increasing active engagement in the learning process. Meanwhile, Widodo et al, (2022) emphasize the 3D visualization properties of AR, which helps students understand complex concepts through concrete representations, especially in science also mathematics subjects. The development of interactive also engaging AR media can be a key driver in learning innovation (Zapata et al., 2024). With AR, students can engage with more vivid also dynamic content, facilitating learning anytime also anywhere. Additionally, incorporating AR into educational games enhances the learning experience by making it more enjoyable also interactive, while also encouraging students to actively participate through basic programming tasks.

Critical thinking skills are essential for developing analytical skills also solving more complex problems. The age of elementary school children is an ideal period to build the foundation of critical thinking (lham et al., 2020; Irwan et al., 2024), because it will affect the cognitive development of students Syafi'i et al., (2021). At this stage, children have high curiosity also begin to develop reasoning skills. Critical thinking helps students analyze information in depth, make better decisions, also solve problems creatively. In a collaborative learning environment, students need to think critically also contribute creative ideas to achieve a common goal (Syahputra, et al., 2023). Indicators of critical thinking skills in elementary school students reflect cognitive abilities developed as per their stage of development.

Agustine & Nawawi, (2020) Their study outlined the five essential components of critical thinking: interpretation, analysis, evaluation, inference, also explanation. Interpretation refers to the ability to comprehend also convey the significance or meaning of an issue. Analysis involves identifying the underlying intentions also conclusions within statements, questions, concepts, or other forms of representation used to express opinions, judgments, experiences, or facts. Evaluation is the capacity to logically assess the relationships among assertions, descriptions, or concepts, as well as to determine the validity of statements or representations. Inference pertains to the ability to recognize also assemble the necessary elements to draw conclusions. Lastly, explanation entails the ability to provide coherent also rational justifications based on the results obtained. In line with this study, Rusmansyah et al., (2020) Their study highlighted five key components of critical thinking: interpretation, analysis, evaluation, inference, also explanation.

Several studies show the effectiveness of RADEC and AR models in developing students' critical thinking skills. The study by Rahayu & Saud2, (2022) showed that the RADEC model successfully improved the critical thinking skills of 5th grade students of SDN Sukatinggi Bandung. Research by Jumaena et al., (2024) illustrated the transformative impact of AR technology integration in geometry learning, improving students' understanding and mastery of the subject. The study of Hanggara et al., (2024) shows game-based learning with GembiAR can improve critical thinking skills. The combination of AR and RADEC learning model is expected to provide a strong foundation for future research on the application of RADEC learning model and AR technology integration in various subjects.

B. RESEARCH METHOD

This study employs a quasi-experimental methodology also a quantitative approach. The non-equivalent control group design is the study methodology employed. There are two groups in this design: the experimental group also the control group. (Abraham & Supriyati, 2022). Before therapy, a pre-test was administered to both groups. A post-test was administered to both groups following treatment in the experimental group.

All fifth-grade pupils from SDN II Teratai also SDN III Teratai in Sukoharjo, Central Java, made up the study's population. The experimental group consisted of 17 pupils apiece, while the control group consisted of 15 individuals. The experimental group employed the RADEC learning paradigm with AR media assistance, while the control group used the PBL learning model with YouTube material.

Pre-test also post-test procedures in the form of description questions were employed in this study's data-gathering approach as a means of testing critical thinking abilities. The experimental group took a pre-test before learning using the RADEC model with AR media assistance, while the control group took a pre-test before learning using the PBL paradigm with YouTube media assistance. After learning the RADEC model with AR media assistance, the experimental group took a post-test, also the control group took a post-test after learning the PBL model with Youtube media assistance.

The instrument used in this study uses indicators of critical thinking skills by Sopandi, (2017). The indicator consists of: 1) Interpretation, 2) Analysis, 3) Evaluation, 4) Inference, also 5) Explanation. The aspects also indicators of critical thinking skills can be seen in the following table:

Table 1. Indicators of critical thinking skills

Aspects of critical thinking skills	Indicator
Interpretation	The ability of students to understand also translate information or meaning presented in the form of problems or problems. Students fulfill this indicator if they can record the known also asked information correctly.
Analysis	Students' ability to break down information into small parts also shows how the parts relate to each other. Students fulfill this indicator if they can connect information to compile answers or develop appropriate mathematical models.
Evaluation	Students' ability to assess the credibility of something as per data also facts. Students fulfill this indicator if they can assess the exact strategy for solving the problem until it is completed with the correct calculation.
Inference	Students' ability to draw conclusions as per existing information. Students fulfill this indicator if they provide a logical conclusion from the problem given.
Explanation	Students' ability to provide logical reasons or justifications. Students fulfill this indicator if they can provide arguments from logical inference.

The validity of the instrument was tested on grade 6 students at SDN II Teratai. The validity test results can be seen in the table below:

Table 2. Validity Test of Critical Thinking Question Instrument

Question No.	r-count	r-table (5%)	Description
1	0,3672	0,4132	Invalid
2	0,6229	0,4132	Valid
3	0,6759	0,4132	Valid
4	0,7387	0,4132	Valid
5	0,7309	0,4132	Valid
6	0,8335	0,4132	Valid

If r count> r table, then the data is considered valid or has a significant correlation. Based on table 2 above, it is obtained that question number 1, r count < r table and question numbers 2-6, r count > r table. thus question number one is invalid while question numbers 2-6 are valid. The following reliability test results are displayed in Table 3 below:

Table 3. Reliability Test of Critical Thinking Ability Instrument

Critical Thinking Skills Instrument	
Cronbach's Alpha	N Item
0,7657	5

As per Ghozali (2018) if the Cronbach's Alpha value > 0.6 then it is said to be reliable. As per this table, it is known Cronbach's Alpha value is 0.7657, which means the question instrument used in the study falls into the reliable category.

The data is examined using the Shapiro-Wilk test to see if it is regularly distributed. The Levene test is used in the homogeneity test, however. The study's hypothesis is the application of the RADEC learning paradigm with AR media has an impact on fifth-grade elementary school pupils' critical thinking abilities. It is clear from the normality also homogeneity test findings the data is neither entirely homogeneous (Table 6) nor normal (Table 5). Statistical tests are not parametric and are thus used in data analysis. Additionally, the N-Gain test was employed for hypothesis testing with a significance level of 0.05 to assess the learning model's efficacy. To calculate the statistical analysis, SPSS version 25 was used.

1. Mann Whitney Test

When comparing two unrelated groups, the Mann-Whitney test is utilized. This test can be performed in the event the data is neither homogeneous nor normally distributed. Thus, the present study satisfies the prerequisites for testing the hypothesis on the post-test data of the experimental group also control group using the Mann-Whitney test.

2. Wilcoxon Test

The significance of the increase from the experimental group's pre-test to post-test was assessed using the Wilcoxon test. Therefore, this test shows how students' critical thinking abilities changed before also after using the RADEC learning paradigm with AR media on the constructing cubes also beams material in grade 5 elementary school.

3. N-Gain Test

The N-Gain test is used to measure the magnitude of the increase in critical thinking skills. The N-Gain score can be calculated using the formula as per Hake (V. P. Coletta, 2023).

$$\text{N gain}=\frac{(Skor\ Posttest - Skor\ Pretest)}{(Skor\ Maksimal - Skor\ Pretest)}$$

Gain criteria:

$g \geq 0.7$ = high effectiveness

$0.3 \leq g < 0.7$ = medium effectiveness

$g < 0.3$ = low effectiveness

Table 4. Interpretation of N Gain

Percentage	Interpretation
< 40	Ineffective
40 – 56	Effective
56 – 75	Effective enough
>76	Very effective

C. RESULT AND DISCUSSION

RADEC learning activities with Augmented Reality on geometry for grade 5 students consist of three main phases: introduction, core activities, and closing. Each phase is carefully designed to create a meaningful learning experience.

In the introduction phase, teachers set up the digital learning environment using the Assembler Edu platform. The teacher ensures students have their devices ready, connected to the platform, and able to scan the AR code smoothly. The teacher builds students' interest by asking questions about cubes and blocks found in the surrounding environment, as well as conveying the learning objectives.

The core activities apply the RADEC model thoroughly. Starting with the Read syntax, students watch a learning video about the concept of cubes and blocks. Then in the Answer syntax, students solve contextual problems that require in-depth understanding of the characteristics of building spaces.

In the Discuss syntax, students get into groups and explore the shapes interactively using AR media, which allows them to see, rotate, and examine various aspects of the shapes in three dimensions.

Figure 1. Activity using AR media

This stage deepens understanding and teaches students to respect the opinions of others, which is an indicator of critical thinking skills. Through this syntax, students improve their understanding of the material and their communication skills (Halim, 2022). Discussion teaches students to respect the arguments of others (Afandi et al., 2024) and test and evaluate arguments. The collaboration aspect in the RADEC model received particular attention in Du & Dewitt's (2024) study, which showed group discussions with augmented reality improved critical thinking skills and communication collaboration. This medium can be accessed through 3D visualization, scanning of AR markers, or placement in a room using electronic devices, allowing students to quickly understand mathematical topics through 3D visual displays (Rozi et al., 2021; Angraini et al.,2023).

Additionally, experiments are carried out by students also their groups to enhance their conceptual comprehension. Students can develop conceptual understanding by direct experience, discovery, also independent knowledge production through simple experimental activities, which are a mathematical investigation process.

Figure 2. Experiment Activity

The Explain syntax allows each group to present their findings in front of the class, explaining how they solved the problem using AR media. The teacher acts as a facilitator, directing the discussion and providing clarification.

The last syntax, Create, encourages students to produce a real product as a solution to the problem-solving task posed in the Answer stage, such as designing a product by considering the volume of cubes and blocks.

Figure 3. Product Making Activity

In the closing phase, the teacher helps students reflect on their learning. Together, they summarize key concepts, relate the material to real-world situations, and discuss practical applications of geometry knowledge. A thorough evaluation is conducted by considering the originality of the product, group project, presentation skills, and students' thinking process.

The findings from the homogeneity also normality tests of the study tools, pre-test, also post-test methods using SPSS are as follows:

Table 5. Normality Test

Test	Class	Significance value	α
Pre test	Experiment	0,974	0,05
	Control	0,113	
Post test	Experiment	0,002	0,05
	Control	0,220	

Data is said to be normal if the significance value is greater than the α value and vice versa. The sig. value of the experimental and control group pre-test and the control group post-test is greater than 0.05, while the experimental group post-test is smaller than 0.05. Only the post-test of the experimental group did not meet the assumption of normality. Thus, the data is not completely normally distributed.

Table 6. Homogeneity Test

Data 1	Data 2	Nilai signifikansi	α
Experiment Class Pre Test	Control Class Pre Test	0,115	0,05
Experiment Class Post Test	Control Class Post Test	< 0,001	0,05
Experiment Class Pre Test	Control Class Post Test	0,061	0,05

In Levene's test, data is considered homogeneous if the significance value is greater than 0.05. The experimental group pre-test and control group post-test results are both greater than 0.05, indicating homogeneous data. However, the experimental group's post-test data is less than 0.05 indicating the data is not homogeneous. Therefore, the pre-test data is homogeneous, but the post-test data is not homogeneous.

Table 7. Mann Whitney Test for Post-Test Data

Asymp Sig. (2-tailed)	Significance value (α)	Status
0,761	0,05	H0 accepted

Obtained an asymptotic sig value. (2-tailed) 0.761 > 0.05 therefore H0 is accepted. Hence, there is no significant difference in the critical thinking skills of fifth grade students using the RADEC learning model with AR media compared to the PBL approach with YouTube media on cube and block material.

Table 8. Wilcoxon Test for Pre-Test also Post-Test Data

Asymp Sig. (2-tailed)	Significance value (α)	Status
<0,001	0,05	H0 rejected

Table 8's Wilcoxon test findings indicate if asymptotic significance (2-tailed) is less than 0.05, then H0 is rejected. H1 is accepted since H0 is refused. Therefore, there is a notable difference between the critical thinking abilities of fifth-grade elementary school kids before also after they used the RADEC learning model with AR media on the building cubes beams content.

The N-Gain test is then performed because of the disparity. The next table then displays the results of the N-Gain calculation.

Table 9. N-Gain (Post-test for Experimental also Control groups)

Number of students	Group	Average post-test score	N-gain	Category
17	Experiment	84	0,7	High
15	Control	69	0,4	Medium

The experimental group (RADEC model with AR media) had an average N-Gain score of 0.7, or 70%, in the moderately effective category, as per the table. In contrast, the control group's (PBL model with YouTube media) average N-Gain score is 0.4, or 40%, falling into the effective category. Therefore, it can be concluded using the RADEC learning paradigm with AR media helps fifth-grade students' critical thinking abilities in mathematics classes involving the construction of space. Grade 5 elementary school pupils' critical thinking abilities in the mathematics topic of geometry are effectively enhanced by the application of the PBL learning approach with the help of YouTube videos.

Table 10. Mann Whitney Test of Critical Thinking Ability Aspects

Aspects of Critical Thinking Ability	Average post-test score (experimental)	Average post-test score (Control)	Asymp Sig. (2-tailed)	Status
Interpretation	9,41	9,47	0,758	H0 accepted
Analysis	8,23	6,8	0,014	H0 rejected
Evaluation	7,94	5,74	<0,001	H0 rejected
Inference	8,23	5,67	<0,001	H0 rejected
Explanation	8,4	6,6	<0,001	H0 rejected

As per Table 10's interpretation aspect, the null hypothesis is accepted with an Asymp Sig. (2-tailed) value of 0.758>0.05. Consequently, there is no discernible difference between the experimental also control groups in terms of interpretation. The analysis aspect's Asymp Sig. (2-tailed) value is 0.014<0.05, indicating the alternative hypothesis is accepted also the null hypothesis is rejected. This suggests the experimental group also the control group differ significantly in the analysis aspect. Additionally, the Asymp Sig. (2-tailed) <0.001 for the assessment, inference, also explanation components suggests less than 0.05. Consequently, the alternative hypothesis is accepted also the null hypothesis is rejected. As a result, the experimental group also the control group differ significantly in terms of appraisal, inference, also explanation.

As per the indications of critical thinking skills—interpretation, analysis, evaluation, inference, also explanation—the graphic compares the experimental also control groups' average post-test scores. In terms of interpretation, the experimental group scored 9.41, whereas the control group scored 9.47, which was marginally higher. The experimental group scored 8.23 on the analysis component, greater than the control group's 6.8. Additionally, the experimental group scored higher (7.94) than the control group (5.74), in the evaluation component. The experimental group scored 8.23 on the inference component, greater than the control group's 5.67. Lastly, the experimental group outperformed the control group with a score of 8.4 on the explanation indicator, compared to 6.6 for the latter. This graphic demonstrates, except for the interpretation component, that the experimental group outperformed the control group in the majority of critical thinking skill categories.

Figure 4. Average Post Test scores as per aspects

of critical thinking skills

The Read, Answer, Discuss, Explain, Create (RADEC) learning model with augmented reality (AR) shows great potential in improving students' critical thinking skills in learning mathematics, especially geometry material. A study by Živković, (2016) highlights the value of instructional strategies that integrate constructivist methods with technology. This idea is supported by the RADEC model, in which students actively generate knowledge through a sequence of planned activities rather than merely receiving it. As per their study, this method continuously enhances higher-order cognitive abilities also the depth of conceptual knowledge.

Statistical analysis using SPSS version 25 showed significant differences with Asymp sig. (2-tailed) 0.001<0.005 on students' critical thinking skills before and after using the RADEC model with AR.

The N-Gain test results showed a 70% increase in students' critical thinking skills using this model, with an average post-test score of 84, compared to 69 using the PBL model with YouTube media.

The strength of the RADEC model lies in its ability to integrate various pedagogical strategies to encourage students to think deeply and analytically. This is revealed by Damayanti & Ghozali (2023) critical thinking is one of the higher-order cognitive abilities the RADEC model can foster. Each stage is designed to hone students' ability to analyze, evaluate, and create knowledge. In the Read stage, students get basic information from a YouTube video. The Answer stage involves problem solving that encourages critical thinking, information processing, and argument development.

The use of Augmented Reality (AR) encourages critical thinking and helps visualize concepts. AR transforms abstract concepts into meaningful interactive investigations, allowing students to quickly understand math topics through 3D visual displays. AR media is created using the Assembler Edu platform and can be accessed through 3D visualization, scanning of AR markers, or placement in the room using a laptop or smartphone. This integration of AR technology, collaborative approach, and innovative pedagogical design not only teaches mathematical concepts but also develops critical thinking skills, creativity, and digital literacy that are indispensable in the context of 21st-century education (Afriani et al., 2024; Kiska et al., 2024; Komang et al., 2024; Muthmainnah et al., 2024).

A study conducted by Nindiasari et al., (2024) revealed AR media improves problem-solving skills in students. Problem-solving ability has an interrelated relationship with critical thinking. These results are in line with a previous study that states AR media has a positive impact on students' critical thinking skills (Suhati et al., 2023; Alkhabra et al., 2023; Firdausya, 2024). Learning combines digital technology with a collaborative approach can improve critical thinking skills compared to conventional methods (Tang,2024)). The use of AR media in learning mathematics in elementary schools can facilitate students' affective also cognitive abilities including critical thinking skills (Jabar et al., 2022; Victor et al., 2024; Prasetya et al., 2024).

The main challenges of implementing models with this medium relate to technological complexity also the need for digital infrastructure. However, Haleem et al., (2022) demonstrated a staged strategy also ongoing expert assistance may help remove these obstacles. They discovered the key to successfully implementing technology-based learning models is teacher training also the development of techno-pedagogical capability.

D. CONCLUSION AND SUGGESTION

The accomplishment of preset learning objectives is one of the elements influencing the success of education. An instructor must encourage more student participation in the classroom to prevent learning failures and also make learning more than a mere transmission or transfer of information. Through the development of the RADEC learning model with the use of augmented reality, this study significantly advances the field of mathematics instruction in elementary schools. The study is unusual because it uses an integrative method to enhance students' critical thinking abilities by combining AR technology with the RADEC model. After using the AR-assisted RADEC model, students' critical thinking abilities significantly improved, as per the Wilcoxon test results, even if the Mann-Whitney test results did not significantly differ from the Youtube-assisted PBL model. With an average post-test score of 84, the 70% rise demonstrates the model's enormous potential to revolutionize the way mathematics is learned.

This research has limitations since the sample was limited to grade V students in one area. However, the use of the AR-assisted RADEC model has the possibility to influence the development of mathematics education methods in elementary schools. Teachers can utilize it to develop students' critical thinking skills and create a more engaging learning environment. The practical implication is the need for educational strategies that utilize the latest technology such as AR to increase student engagement.

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