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# The Influence of RADEC-Based Learning Model Tools on Enhancing Students' Innovation Creativity in Nature-Based Elementary Schools

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**Abstract: The Influence of RADEC-Based Learning Tools on Enhancing Students' Innovation Creativity in Nature-Based Elementary Schools. Objectives:** The lack of innovative and effective learning tools presents a challenge in enhancing students' creativity, necessitating an examination of the influence of RADEC-based learning tools as an alternative solution in natural elementary schools. This study aims to examine the influence of RADEC-based learning tools on enhancing students' innovation creativity in natural elementary schools. **Methods:** The research method employed is a quantitative method with a quasi-experimental model, utilizing the One Group Pretest-Posttest Design and the Pretest-Posttest Control Group Design. The sample consists of the innovation creativity of 50 students from two natural elementary schools, with 25 students in each school. The testing technique uses open-ended test instruments based on indicators of innovation creativity. Data analysis involves descriptive statistical analysis, N-Gain, and t-tests. **Findings:** The research findings indicate: (1) the data on the creative innovation of the experimental class are in the medium category with a percentage of 80%, while the control class is at 48%; (2) the average N-Gain score for the control class is 0.17, categorized as low, while the experimental class achieves a score of 0.52, categorized as medium; and (3) the t-test shows a significance value (2-tailed) of 0.000 < 0.05 and a t-value of 5.636 > 1.677, indicating a difference in the influence of implementing RADEC-based learning tools and conventional learning tools on improving the innovation creativity of students in natural elementary schools. **Conclusion:** The conclusion of this study is that RADEC-based learning tools are effective in improving the innovation creativity of students in natural elementary schools, with better results compared to conventional learning tools.

**Keywords:** learning tools, RADEC model, innovation creativity, elementary school students, natural schools.

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## INTRODUCTION

Education has always been the foundation of a nation's development and progress. Amid the rapid changes in today's world, education plays an increasingly important role in preparing younger generations to face unprecedented challenges (Kim et al., 2019). The era of information technology and globalization has transformed the landscape of education, creating higher demands for students' skills and knowledg. The concept of 21st-century education has emerged as a relevant approach to address the complexities and dynamics of this century (Akbari & Rudiyanto, 2019; Taar & Palojoki, 2022).

21st-century education is no longer confined to knowledge acquisition but emphasizes the development of skills such as critical thinking, communication, collaboration, and innovation (Alpaydýn et al., 2022). One approach that helps clarify the principles of 21st-century education is the 6Cs framework developed by Golinkoff and Hirsh-Pasek (Golinkoff & Hirsh-Pasek, 2016). The 6Cs framework encompasses Creativity, Communication, Collaboration, Critical Thinking, Leadership, and Character (Golinkoff & Hirsh-Pasek, 2016).

One of the Cs in the 6Cs framework is creative innovation. Creative innovation is a concept introduced by Kathy Hirsh-Pasek and Roberta Michnick Golinkoff, who are prominent developmental psychologists and cognitive scientists in the study of children and education (Evans et al., 2021). This concept refers to an approach that integrates creativity and innovation in the learning process, especially during early childhood development. Creativity is defined as the ability to think outside the box, generate new ideas, and use imagination to find creative solutions to problems (Wittayakhom & Piriyasurawong, 2020) In the context of education, creativity focuses on motivating children to think freely, stimulate imagination, and encourage the exploration of different ideas. Meanwhile, innovation involves applying these creative ideas in useful or relevant contexts. Innovation is often understood as the next step after creativity, involving the conversion of creative ideas into tangible actions or innovative solutions (Adeoye & Jimoh, 2023).

Education that focuses on creative innovation assigns students a more active role in learning. Students are taught to think independently, generate new ideas, and develop projects that promote independence and ownership (Mikhailova, 2018). Creative innovation is also considered to enhance the overall quality of education by fostering more creative teachers and more effective learning However, field observations indicate several problems related to creative innovation, including the following. Students' innovation creativity is deemed low due to a lack of supportive environments that encourage the expression of creativity (Harahap, 2020; Rati et al., 2017). Additionally, limited mastery of teaching methods focusing on lectures and student evaluations through tests hinders the development of students' creativity (Setiawan et al., 2021; Yusika & Turdjai, 2021). Based on observations and interviews, some studies also state that limited time and space for creative exploration and innovation, a lack of educational policies supporting creativity and innovation development, untrained teachers in facilitating creative activities, and perceptions of creativity as complex, challenging, and risky contribute to this issue (Auliya et al., 2021; Guslinda & Witri, 2018; Harahap, 2020; Sahippudin, 2021).

To address the issue of low student creativity, a strategic step is to implement innovative learning models. One such model capable of enhancing innovation creativity is RADEC. The RADEC model is considered capable of providing a framework that supports the development of creativity and innovation in the learning environment. RADEC stands for Read, Answer, Discuss, Explain, and Create, representing essential stages in an interactive and student-centered learning process. Furthermore, Pratama et al. (2019) and Sopandi & Handayani, (2019) argued that the RADEC learning model has several characteristics that can build not only conceptual understanding but also more complex thinking skills. The RADEC model encourages a deeper understanding of the subject matter. Students are not only asked to memorize information, but are also given the opportunity to reflect, discuss, and explain these concepts, resulting in a better and more lasting understanding (Firdaus et al., 2023). Furthermore, RADEC encourages the active and creative use of understanding. Students do not just consume information, but also create something based on their understanding, which can take the form of projects, creative solutions, or unique answers (Imran et al., 2021).

To effectively implement the RADEC model, interactive, accessible, and collaborative learning tools are required. Learning tools are media that help present information or teaching materials in formats that are easier for students to understand and access (Conceição, 2021; Sibanda, 2021). Learning tools are also defined as any media or material used to facilitate or enhance learning, such as textbooks, audiovisual materials, instructional software, and others (Piao, 2023). Based on the above background, the objective of this study is to examine the influence of RADEC-based learning tools on enhancing the innovation creativity of students in natural elementary schools. Based on the background presented earlier, the problems in this study are formulated as follows:

1. What is the depiction of innovation creativity achievement among students who receive instruction using RADEC-based learning tools?
2. Does the implementation of RADEC-based learning tools significantly influence the innovation creativity achievement of students in nature-based elementary schools?
3. Are RADEC-based learning tools effective in improving the innovation creativity of students in nature-based elementary schools?

## METHOD

### Research Design and Procedure

The research method used in this study is a quantitative method with a quasi-experimental model. For experimental research, two experimental designs were applied: the One Group Pretest-Posttest Design and the Pretest-Posttest Control Group Design. This study begins with administering a pretest to the experimental and control groups to measure the initial innovation creativity of the students. The experimental group receives instruction using RADEC-based learning tools, while the control group uses conventional methods over several sessions. After the intervention, both groups are given a posttest to assess the improvement in their innovation creativity. The data from the pretest and posttest are analyzed using statistical tests to examine the impact of RADEC tools on students' innovation creativity. This study takes place over a period of approximately 4–6 weeks, covering the stages of preparation, implementation of instruction, measurement, and data analysis. Below is the flowchart of the research design.


**Figure 1.** Research design flowchart

The hypotheses of this study are formulated as follows:

1. The innovation creativity of students who receive instruction using RADEC-based learning tools can be categorized as high.
2. RADEC-based learning tools significantly influence the innovation creativity of students in natural elementary schools.
3. There is a difference in the influence of implementing RADEC-based learning tools and conventional learning tools on improving the innovation creativity of students in natural elementary schools.

### Participants

The population of this study consists of the innovation creativity of all students in natural elementary schools. The sample includes the innovation creativity of 50 students from two natural elementary schools, with 25 students from each school. The sample was selected using purposive sampling and snowball sampling techniques. The considerations for selecting the sample include the following: (1) willingness of participants to be part of the research sample; (2) Familiarity with the research topic; (3) direct involvement in the educational process; (4) having been at the school for at least one year. The inclusion criteria for sample selection include students who are actively involved in learning at the nature-based school, have at least one year of experience at the school, and are willing to participate in the study. Meanwhile, the exclusion criteria include students who have joined the school for less than one year, do not fully participate in the learning process, or do not have parental or guardian consent to participate. These criteria ensure that the selected sample truly represents the population being studied and has relevant experience with the use of RADEC-based learning tools.

**Instruments**

The testing technique employed open-ended test instruments for the indicators of innovation creativity. The innovation creativity indicators analyzed in this study are: (1) Generating original and useful new ideas; (2) Using imagination to develop new and original ideas; (3) Synthesizing, analyzing, and evaluating new ideas to enhance creative efforts; (4) Communicating new ideas to others; (5) Viewing failures, obstacles, and challenges as learning opportunities; (6) Being open and responsive to diverse perspectives, inputs, and new ideas; (7) Demonstrating leadership to realize ideas in practical applications; (8) Valuing the process of producing original works and showing a variety of ideas; (9) Creating added value from original ideas.

The validity of this study includes content validity and empirical validity. Content validity assesses how comprehensively and accurately the instrument covers the concepts or domains being measured. In this study, content validity involved experts evaluating the instrument's inclusion of all relevant aspects of the measured concept. The instrument is validated by three experts in the field of education who assess the alignment of the instrument items with the concepts being measured. The instrument is considered valid if the level of agreement among the experts (Aiken's V) reaches a value of e” 0.75. Empirical validity involved collecting empirical data to validate the research instrument, tested using the determination coefficient. The instrument is tested using the coefficient of determination ($R^2$), which shows how much the independent variable (treatment) can explain the dependent variable (innovative creativity). The instrument is considered valid if $R^2 > 0.50$, meaning that more than 50% of the data variability can be explained by the model.

The reliability of the instrument was divided into two: internal reliability and external reliability. Internal reliability was tested using Cronbach's Alpha reliability test, while external reliability was tested through the test-retest method. The instrument is considered reliable if the Cronbach's Alpha value is e” 0.70, indicating good consistency among the items in measuring the same concept. The research instrument is also tested using the test-retest method, where the instrument is administered twice to the sample within a two-week interval. The results are analyzed using Pearson's correlation (r), and the instrument is deemed reliable if r e” 0.80, indicating consistency of measurement results over different time periods.

**Data Analysis**

Data analysis for the first hypothesis employed descriptive statistics to describe the main characteristics of the research sample. The second hypothesis was analyzed using N-Gain (Normalized Gain) to evaluate students' innovation creativity improvements before and after the learning intervention. N-Gain (g) is used to measure the change in student learning outcomes after the treatment. Based on the N-Gain value, the results can be grouped into three categories. If the N-Gain value (g) is greater than 0.7, the change is categorized as high. If the N-Gain value is between 0.3 and 0.7, the change is categorized as medium. If the N-Gain value is less than 0.3, the change is categorized as low. This categorization provides an overview of the effectiveness of the treatment in improving student learning outcomes (Syahfitri, 2008). Finally, the third hypothesis was tested using t-tests to evaluate significant differences between the two treatment groups in relation to the dependent variable. The t-test is deemed an effective statistical method for comparing two groups and identifying significant differences in innovation creativity between them.

## ■ RESULT AND DISCUSSION

### Data Description

This section describes the data for each class that has been processed, including the mean, median, mode, and standard deviation. Innovation creativity data were obtained at the beginning before providing the material (pretest) and at the end after providing the material (post-test) in each class. Below is a summary of the frequency distribution of innovation creativity data for the control and experimental classes.

**Table 1.** Descriptive analysis of innovation creativity data for control and experimental classes

| | Control Class | | | Experimental Class | | |
|---|---|---|---|---|---|---|
| No | Interval | Frequency | Percentage (%) | Interval | Frequency | Percentage (%) |
| 1. | 40-45 | 4 | 16 | 53-59 | 1 | 4 |
| 2. | 46-51 | 4 | 16 | 60-67 | 1 | 4 |
| 3. | 52-58 | 4 | 16 | 68-74 | 12 | 48 |
| 4. | 59-64 | 3 | 12 | 75-81 | 3 | 12 |
| 5. | 65-70 | 3 | 12 | 82-88 | 4 | 16 |
| 6. | 71-76 | 7 | 28 | 89-96 | 4 | 16 |

Based on Table 1, the following information was obtained for the control class: the highest score was 75, and the lowest score was 40. The mean was 58.84, the median was 59, the mode was 72, and the standard deviation was 11.45. Subsequently, a frequency distribution grouping for the control class was created. For the experimental class, the highest score was 94, and the lowest score was 53. The mean was 75.96, the median was 72, the mode was 69, and the standard deviation was 9.98. Similarly, a frequency distribution grouping for the experimental class was created.

Next, the data were grouped into three categories: high, medium, and low. Based on the analysis results, the creative innovation data for the control class were in the medium category, with a percentage of 48%. Additionally, the creative innovation data for the experimental class were in the medium category, with a percentage of 80%. Below is a summary of the categorization of creative innovation data for both control and experimental classes.

Based on the analysis results, it was found that the creative innovation data for the experimental class fell into the medium category

**Tabel 2.** Categorization of creative innovation data for control and experimental classes

| No | Category | Control Class | | | Experimental Class | | |
|---|---|---|---|---|---|---|---|
| | | Criteria | Frequency | Percentage (%) | Criteria | Frequency | Percentage (%) |
| 1. | Low | X < 47 | 5 | 20 | X < 66 | 1 | 4 |
| 2. | Medium | 47 ≤ X < 70 | 12 | 48 | 66 ≤ X < 86 | 20 | 80 |
| 3. | High | 70 ≥ X | 8 | 32 | 86 ≥ X | 4 | 16 |
| | **Total** | | 25 | 100 | | 25 | 100 |

with a percentage of 80%. Several factors contribute to why students' creative innovation is not yet optimal, including the following. Educational systems that often focus excessively on examinations and academic assessments can reduce incentives for students to speculate, create, and experiment with new ideas (Chen et al., 2023; Fatmawati et al., 2022; Yayuk et al., 2020). Studies also indicate that students often lack sufficient support or encouragement to develop their creativity. Teachers and schools may prioritize "correct" lessons over providing space for innovative ideas (Harahap, 2020; Ismayani, 2022).

This is in line with several viewpoints that state schools tend to focus more on developing academic skills rather than creative skills (Rati et al., 2017; Sahono, 2020). Furthermore, when answering open-ended questions, students often fear failure or worry about receiving poor grades, which can lead them to avoid risks and experimentation, thus hindering creativity (Paramita et al., 2023). Students who are accustomed to a rigid and overly structured classroom may not be given the opportunity to think outside the box or pursue projects they are interested in (Yusika & Turdjai, 2021).

## N-Gain Test

Creative innovation data obtained through the open-ended test instrument included pretest and post-test scores for both the control and experimental classes. From these scores, the significant improvement was measured by comparing the N-Gain scores of the two classes. The N-Gain values for the control and experimental classes are presented in the following table:

**Table 3.** Summary of N-Gain test results

| Class | N | Pretest Score | | Post-test Score | | N-Gain | |
|---|---|---|---|---|---|---|---|
| | | Mean | Standard Deviation | Mean | Standard Deviation | Mean | Standard Deviation |
| Control | 25 | 48.96 | 7.73 | 58.84 | 11.45 | 0.17 | 0.27 |
| Eksperimental | 25 | 48.76 | 10.15 | 75.96 | 9.98 | 0.52 | 0.19 |

Based on the data in Table 3 and Figure 2, the following information was obtained: The N-Gain score calculations show that the average N-Gain score for the control class was 0.17, which falls into the low category, while the average N-Gain score for the experimental class was 0.52, which falls into the medium category. The results of this analysis support the research hypothesis, which states that RADEC-based learning tools have a significant influence on the innovation creativity of students in natural elementary schools.

Based on the research findings, RADEC-based learning tools were proven to have a significant influence. Many learning tools include visual and interactive elements, such as images, videos, and simulations. These help students

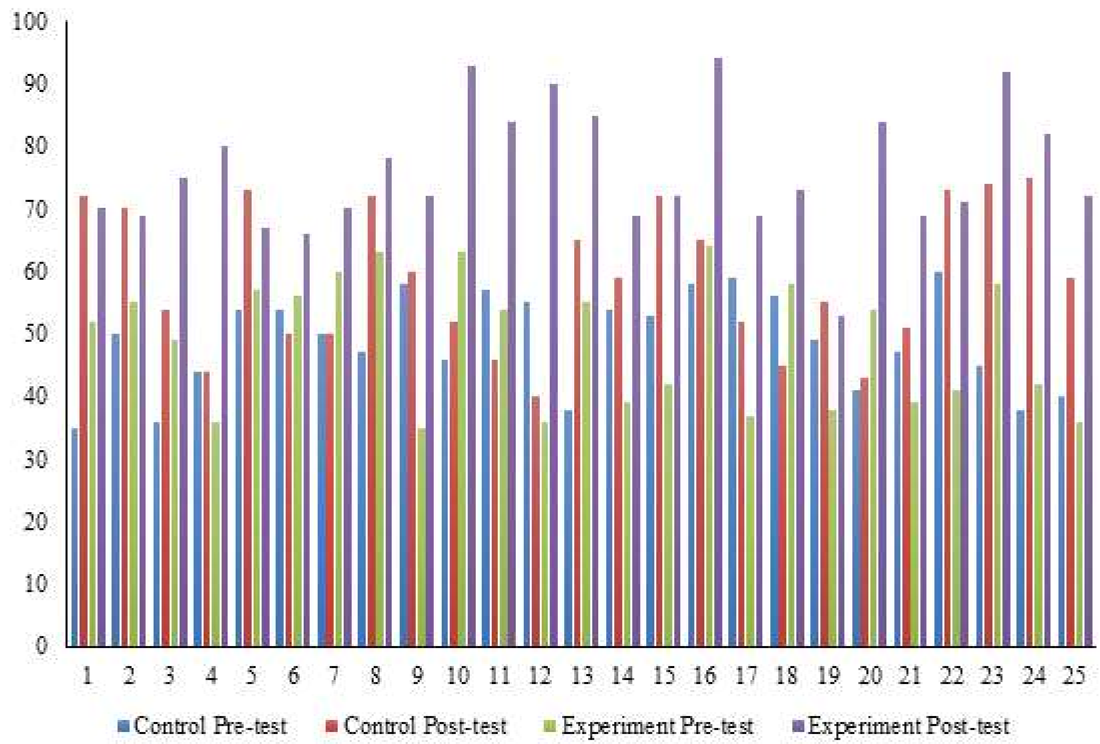


**Figure 2.** Histogram pretest-posttest

understand complex concepts in a more engaging and interactive way (Sunandar, 2020). Moreover, learning tools can be utilized by students for independent learning outside class hours, enabling them to review and reinforce the material without restrictions (Fadilah & Hayati, 2018; Mahlianurrahman, 2017). Learning tools also provide images, videos, and illustrations that help students grasp concepts more effectively (Mahlianurrahman, 2017; Sunandar, 2020). Additionally, the RADEC model encourages deeper understanding of the material. Students are not only required to memorize information, but they are also given opportunities to reflect, discuss, and explain the concepts, resulting in a better and more sustainable understanding (Firdaus et al., 2023).

**Test t**

The next step was to test the difference in the influence of implementing RADEC-based learning tools and conventional learning tools on the innovation creativity of students in natural elementary schools using a t-test. This difference test aimed to determine whether there was a significant difference between the learning achievements of the control and experimental classes. The t-test results are presented in the following table:

Based on the data above, the degree of freedom (df) was 48. This value was used to determine the t-table value. With df = 48 and a 5% error level, the t-table value was found to be 2.001. With a significance value (2-tailed) of 0.000 < 0.05 and a $t_{calculated}$ value of 5.636 >

**Tabel 4.** Test results t

| Parameter | t-value | df | p-value | Results |
|---|---|---|---|---|
| Equal variances assumed | 5.636 | 48 | .000 | Significant difference ($p < 0.05$) |
| Equal variances not assumed | 5.636 | 47.125 | .000 | Significant difference ($p < 0.05$) |

$t_{table}$ of 1.677, it can be concluded that there is a difference in the influence of implementing RADEC-based learning tools and conventional learning tools on improving innovation creativity in students at natural elementary schools.

Based on the research data, the control class taught using conventional learning tools exhibited lower creative innovation compared to the experimental class taught using RADEC-based learning tools. This is because RADEC-based learning tools emphasize research and analysis steps that encourage students to understand the context of problems more deeply. This approach can stimulate critical and analytical thinking in students (Firdaus et al., 2023; Imran et al., 2021). On the other hand, conventional learning tools are more oriented toward delivering predetermined information, which does not provide students with opportunities to conduct independent research and delve deeper into problems (Indrayani et al., 2016; Yanti et al., 2019).

Furthermore, RADEC-based learning tools are designed to actively involve students in the learning process, requiring them to think critically, plan, and experiment. This can increase student engagement and motivate them to innovate (Agustin et al., 2021; Stevani, 2023). The results of this study are supported by several previous studies that show active learning models, such as RADEC, can enhance student engagement in critical thinking and experimentation (Agustin et al., 2021; Handayani et al., 2019; Nugraha & Prabawanto, 2021; Nurnaningsih et al., 2023). Additionally, students who are actively involved in the learning process tend to be more motivated to generate creative ideas (Lasari et al., 2023; Maruf et al., 2020). Other research also reveals that the RADEC-based approach improves students' ability to create innovative solutions (Pratama et al., 2020; Rani et al., 2023).

This contrasts with conventional learning tools, which tend to be more passive, with students primarily receiving information rather than creating or discussing it (Sunandar, 2020; Yanti et al., 2019). However, some studies show that in the implementation of various innovative learning models, it is often found that overly structured or rigid models can limit students' freedom to innovate (Komariah et al., 2023). Additionally, other research reveals that external factors such as lack of time or resources in the classroom can hinder innovation (Kusumaningpuri & Fauziati, 2021).

## ■ CONCLUSION

Based on the research findings and discussion, the following conclusions can be drawn: (1) the creative innovation data for the experimental class are in the medium category; (2) RADEC-based learning tools have a significant influence on the innovation creativity of students in natural elementary schools, with an N-Gain score for the experimental class, categorized as medium; (3) there is a difference in the influence of implementing RADEC-based learning tools and conventional learning tools on improving the innovation creativity of students in natural elementary schools. Thus, it can be concluded that RADEC-based learning tools are effective in improving the innovation creativity of students in natural elementary schools, with better results compared to conventional learning tools.

Based on the above conclusions, the following recommendations are provided: For readers, this study helps readers understand the creativity and innovation of students in natural elementary schools and provides inspiration for the application of RADEC-based learning tools in their environments. For practitioners and teachers, this study can assist teachers and practitioners in understanding and mastering the implementation of RADEC-based learning tools in their classrooms. For future researcher, this study can help future researchers gain a more detailed understanding of research methods, applications, and the influence of learning tools on the creativity and innovation of elementary school students. It can also inspire future researchers to expand the research sample, modify the research subjects or variables, while maintaining the same topic.

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