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Stacking Analysis on the Application of the RADEC Model to the Creativity of Fifth Grade Elementary School Students on Water Cycle Material

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Abstract: This study uses stacking analysis to analyze the application of the RADEC model (Read, Answer, Discuss, Explain, Create) to students' creativity in the water cycle material. The research is quantitative experimental research. The research subjects were fifth-grade elementary school students for the 2022/2023 school year, totaling 21 students. The research instrument was a creative attitude scale of 22 statements given before and after learning. The data obtained will be processed using the RASCH model through stacking analysis with the Winstep application. The results showed a change in students' creativity after the RADEC model was applied by 24% in the very good category and 76% in the fairly good category. This study's results prove that applying the RADEC model can increase students' creativity in the water cycle material.

Keywords: Creativity; RADEC; Stacking; Water cycle.

Introduction

Every elementary school student must have the provision of science learning (Aisyah et al., 2023). Based on the characteristics of science learning and the intellectual development of elementary school students, the presentation of science learning begins with something concrete to abstract, from easy to difficult, from simple to complex, and from close to far (Sopiani, 2017). In other words, science learning must start from what is around students, for example, something that is known, interesting, and needed.

Science material related to activities around students, namely the water cycle. The processes of evaporation, condensation, precipitation and infiltration make up the water cycle. The water cycle may be broken down into three different categories: short cycle, medium cycle, and long cycle. Short cycles are usually fast and generally occur at sea. In the medium cycle, the process is the same as in the short cycle, but precipitation occurs on land. Whereas in the long cycle, precipitation can be in the form of rainwater and snow ice (Fauziah & Sukmawati, 2023; Sukmawati & Wahjusaputri, 2018; Wahjusaputri et al., 2022).

In addition to the process of the water cycle, learning also discusses human activities that affect the water cycle and how to save water (Lutfiyatur, 2020). The aim is to teach this material to elementary school students so that students know and understand how to

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behave towards nature and care more about the environment (Novianti et al., 2023; Sukmawati, 2023).

The attitude that can be developed in learning science is a scientific attitude (Siregar, 2020). But because creativity is a crucial component in helping students comprehend the nation of science, it is also critical to instill these qualities in children (Siregar, 2020). According to the Department of Education (Boty & Handoyo, 2018), Creativity comes from the creative word, which means the ability to create.

Munandar revealed that the optimal development of creative thinking skills is related to teaching methods because the teacher invites students to think and express opinions, and their creative abilities will grow (Afghani & Sutama, 2020). From here, Creativity can provide breadth to students to sharpen their mindset in understanding the material provided.

According to Ryan Hargrove (Leasa et al., 2021) creativity is very useful in producing works and overcoming complex environmental problems like today. Lynn Newton and Douglas Newton (Leasa et al., 2021) argue that creative thinking is important to be able to better understand, make action plans, generate various alternative views, understand an incident, find solutions to problems and practice honesty when solving problems. The Ministry of Education has prepared a program in the 2013 Curriculum at the elementary level, where schools must develop the 4C's in the learning process which include: critical thinking, collaboration, creativity and communication (Aisyah et al., 2023; Maryana & Sukmawati, 2021; Sukmawati, Kadarohman, et al., 2021b).

Creative thinking is a type of thinking laterally. Creativity can be measured by four factors, namely fluency, flexibility, originality, and elaboration (Rahmadani, 2022). These four categories are indicators of creativity developed by Joy Paul Guilford as the father of world creativity (Leasa et al., 2021).

The creativity of students in Indonesia is quite low (Leasa et al., 2021). Florida (Leasa et al., 2021) research results show that Indonesia's creativity index is only 0.037 and is ranked 81 out of 82 countries. Interview results (Rahmadani, 2022) at one of the State Islamic Elementary Schools in Padang, information was obtained that students did not yet have the ability to develop, detail, express opinions, and teachers rarely invited students to make a product, so students lacked a place to develop their Creativity. Based on observations made by (Yanuarsi & Mayar, 2022) in the East Pariaman sub-district, it was found that the learning process for developing Creativity had not been carried out optimally, so children hesitated in creating a work (Sukmawati, 2018).

Therefore, the teacher must be wiser in determining the learning model so that the learning process can foster student creativity. To make this happen, teachers can take advantage of the RADEC learning model provided by researchers as a solution.

The alternative learning paradigm known as RADEC has been modified to fit Indonesian educational requirements (Suryana et al., 2021). Read, Answer, Discussion, Explain, and Create make up the RADEC learning paradigm syntax (Sopandi, 2017). According to several research on the RADEC learning approach, RADEC can enhance conceptual mastery (Setiawan et al., 2020), learning outcomes (Andini & Fitria, 2021), critical thinking (Yulianti et al., 2022), higher order thinking skill (HOTS) (Tulljanah & Amini, 2021), reading comprehension skills (Nura & Hartati, 2022), and write explanatory text (Fahira, 2020).

Method

This study uses a quantitative experimental method. The subjects in the study were 21 students in Class V Elementary School for the Academic Year 2022/2023 at one of the Private Madrasah Ibtidayah in East Jakarta, with a total of 15 female students and 6 male students. This research has the dependent variable, namely Creativity and the independent variable, namely the RADEC model (Sukmawati, Kadarohman, et al., 2021a; Sukmawati & Wijiastuti, 2021; Wati Sukmawati, Asep Kadarohman, Omay Sumarna, 2021).

The instrument used is a creative attitude scale regarding the water cycle. This instrument consists of 22 statements in the form of a Likert scale. In positive statements, for the Strongly Agree (SS) category it is worth 4 with the Agree (S) category scoring three points, Disagree (TS) two, and Strongly Disagree (STS) one. In contrast, the categories of Strongly Agree (SS), Agree (S), Disagree (TS), and Strongly Disagree (STS) are given a value of 1, 2, 3, and 4, respectively, in negative assertions. Students are expected to be able to recognize their own creative progress based on the statements created.

Instrument validation was performed using the RASCH model based on Outfit Z-Standard (ZSTD) -2.0 ZSTD +2.0, Outfit Mean Square (MNSQ) 0.5 MNSQ 1.5, and Point Measure Correlation (Pt Mean Corr) 0.32 Pt-Measure Corr 0.8 (Sumintono, 2014). Validation shows that there are 22 valid statements and 3 invalid statements. The Outfit MNSQ, ZSTD, and Pt Mean Corr values that are more than or less than the standard values are the reason of this (Hassan & Osman, 2022). Even if some assertions do not satisfy one of the requirements, this does not diminish the statement's

quality (Hilala et al., 2023). The Table 1 displays the item validation findings.

Table 1. Item Validation

No	MNSQ	ZSTD	PT CORR	Valid	Follow-up
S6	1.08	0.7	-0.04	Valid	Used
S11	1.11	0.9	-0.06	Valid	Used
S24	0.65	-3.3	0.00	Valid	Used
S23	0.87	-1.1	-0.09	Valid	Used
S8	0.89	-0.9	0.27	Valid	Used
S15	0.96	-0.3	0.32	Valid	Used
S21	0.94	-0.4	0.30	Valid	Used
S7	1.81	4.5	-0.19	Invalid	Not used
S20	0.99	0.0	0.40	Valid	Used
S17	1.93	4.9	0.50	Invalid	Not used
S2	1.37	2.2	0.56	Valid	Used
S18	0.89	-0.7	-0.14	Valid	Used
S22	0.86	-0.9	0.28	Valid	Used
S16	0.99	0.0	0.31	Valid	Used
S10	1.26	1.7	0.13	Valid	Used
S1	0.80	-1.4	0.23	Valid	Used
S5	1.26	1.7	0.50	Valid	Used
S13	0.93	-0.4	0.37	Valid	Used
S14	0.68	-2.5	0.36	Invalid	Not used
S3	0.88	-0.9	0.31	Valid	Used
S9	0.59	-3.5	0.44	Valid	Used
S4	1.09	0.7	0.47	Valid	Used
S19	0.68	-2.6	0.46	Valid	Used
S25	0.81	-1.5	0.44	Valid	Used
S12	0.77	-2.0	0.43	Valid	Used

The reliability test on the instrument obtained a personal reliability value of 0.33 with a separation value of 0.70 which was included in the bad category. This is due to the lack of sample used to fill the instrument. In comparison, the item reliability value is 0.98 with a separation of 6.74, which is included in the superior category. It can be ascertained that the instrument used can measure student creativity because it has a good item reliability value (Sumintono, 2014). The following is the result of reliability.

PERSON	96 INPUT		96 MEASURED		INFIT		OUTFIT	
	TOTAL	COUNT	MEASURE	REALSE	IMNSQ	ZSTD	OMNSQ	ZSTD
MEAN	70.6	25.0	.65	.35	1.01	-.4	1.00	-.4
S.D.	4.3	.0	.43	.07	.70	2.3	.68	2.3
REAL RMSE	.35	TRUE SD	.25	SEPARATION	.70	PERSON RELIABILITY		.33
ITEM	25 INPUT		25 MEASURED		INFIT		OUTFIT	
	TOTAL	COUNT	MEASURE	REALSE	IMNSQ	ZSTD	OMNSQ	ZSTD
MEAN	271.2	96.0	.00	.17	1.00	-.2	1.00	-.2
S.D.	49.5	.0	1.17	.02	.31	2.0	.32	2.0
REAL RMSE	.17	TRUE SD	1.15	SEPARATION	6.74	ITEM RELIABILITY		.98

Figure 1. Person and Item Reliability Value

Analysis in testing student creativity is measured through the attitude scale of creativity given before and after the application of the RADEC model. Student attitude scale scores can be seen through logit values with stacking analysis (Fauziah & Sukmawati, 2023). Stacking analysis is a study of students' conceptual changes before and after being given a treatment of learning materials (Sukmawati, 2022). Furthermore, the logit value of the results of the student attitude scale score is compared to determine student changes after the treatment is given (Sukmawati et al., 2022). The data is sorted according to the logit value at the standard deviation. The following categories of changes in log values (Sumintono, 2014):

Table 1. Guide to Categorization of Logit Value Changes Based on STDEV

Category	Mark
Very good	x > Mean
Good	Mean < x > SD
Enough	<SD

The stages of data processing are carried out based on the Rasch model of the analytical approach. The stages are (Sukmawati & Zulherman, 2023): 1). Giving scores to student answers based on students' creative abilities so that polytomous data is obtained; 2). Tabulation of data into excel and separating student answers before and after treatment; 3). Data conversion using the Winstep application becomes interval data with the same measurement scale; 4). Measuring the effectiveness of the instrument based on the value of the validity and reliability of persons and items; 5). Setting item validation via test item statistical misfit; 6). Student answers are used to test hypotheses; 7). Comparing students' creativity; 8). Comparing creativity before and after treatment.

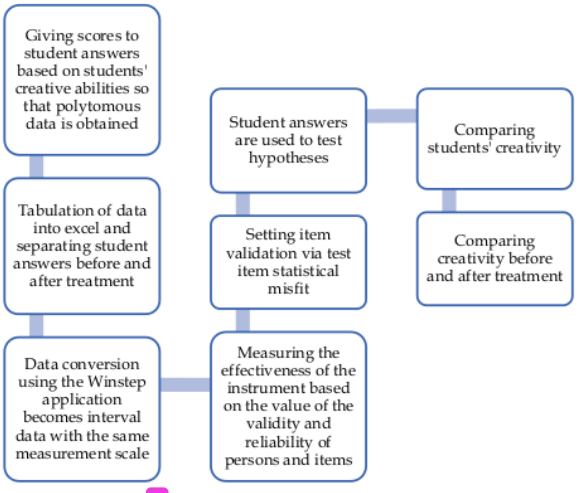

Figure 2. Stages Rasch Model Rating Analysis

Results and Discussion

This study uses the RADEC model as a treatment to analyze student creativity. The learning process carried out by students based on the RADEC model goes through several stages, namely reading, answering, discussing, explaining, and creating (Sopandi, 2017).

Changes in student creativity can be seen from the results of the attitude scale of creativity given before and after learning (Chmelárová et al., 2020). After the results are obtained, then data processing is carried out with stacking analysis using the RASCH model (Sukmawati & Zulherman, 2023). The Logit Measure value obtained two categories, namely very good at 24% and quite good at 76%, with the description in Table 3 and Figure 3 below;

Table2. Measurement of Student Values based on the Creativity Attitude Scale

Person	Measurement Pre Creativity	Post Creativity	Enhancement	Category
1	2,11	2.35	0.24	Very good
2	2,23	2,11	-0.12	Enough
3	2,11	1.67	-0.44	Enough
4	2,23	2.59	0.36	Very good
5	1.56	1.03	-0.53	Enough
6	1.67	1.56	-0.11	Enough
7	2	1.78	-0.22	Enough
8	1.78	1.89	0.11	Enough
9	2	1.35	-0.65	Enough
10	2,23	2.84	0.61	Very good
11	2,23	2	-0.23	Enough
12	1.45	1.56	0.11	Enough
13	2	1.67	-0.33	Enough
14	1.35	1.14	-0.21	Enough
15	2,11	1.67	-0.44	Enough
16	2.71	2.59	-0.12	Enough
17	1.89	2,11	0.22	Very good
11	2,23	1.24	-0.99	Enough
19	1.78	1.56	-0.22	Enough
20	1.35	1.67	0.32	Very good
21	2,11	2,23	0.12	Enough
Mean 0.12 SD 0.144873 Very Good:24%;Fair:76%				

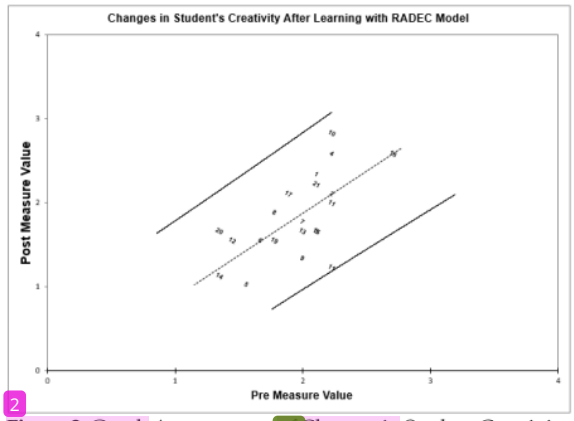

Figure 3. Graph Arrangement Changes in Student Creativity Due to the Application of the RADEC Model

As can be seen in Table 3 and the graph, it appears that all students experience changes in creativity. Students' levels of creativity change equally across the low, middle and high groups.

Students' that have the numbers 1, 4, 10, 18, and 20 exhibit highly positive changes in their inventiveness. The kids' illustrations of the water cycle helped to promote this rise. Students are able to sequence the water cycle process correctly and understand the meaning of evaporation, condensation, precipitation and infiltration, as shown in Figure 3. Students in this category can also answer questions quickly and accurately. They also explained to other students who did not understand the differences between the types of the water cycle.

Figure 4. Student Creativity Results in Very Good Category

Students who experienced an increase in creativity in the fairly visible category from student numbers (2, 3, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 19, and 21). In this category, students are able to sequence the water cycle process correctly. However, some students do not understand the meaning of evaporation, condensation, precipitation, and infiltration. So that some of the pictures made by students are not correct in making cycle arrows, and the stages of the water cycle have not been included, as shown in Figure 5. Some students in the category still tend to be passive and shy to express their opinions, so the teacher motivates

students to be brave in answering and active in discussions.

Figure 5. Student Creativity Results in Enough Category

The stages of the RADEC model have a major influence on increasing student creativity because these phases teach students to think critically, collaborate, and communicate while coming up with original ideas and choosing which ones should be developed, put into practice, and reported (Suryana et al., 2021). The RADEC paradigm has five stages: Reading, Answering, Discussing, Explaining and Creating.

In the Read stage, students read information from various sources. To encourage students to understand the information, students will be given 3 pre-learning questions. These questions are about the benefits of water for living things, human activities that affect the water cycle, and the stages of the water cycle in the medium and long cycles.

Furthermore, students respond to pre-learning questions in the Answer stage using the knowledge they gained in the Read stage (H. Lestari et al., 2022). Through answering activities, students can independently identify material they find easy and difficult. Answering activities can measure student creativity because it is included the creativity indicator (Suryana et al., 2021). Before the teaching and learning process begins, students engage in reading and answering exercises outside of school or at home.

The following stage is the Discussion, which is conducted by pupils at school, when they have received adequate instruction. Students discuss in small groups the water cycle material related to pre-learning questions. Then the results of the Discussion are outlined in the Student Worksheet. At this stage also, students who have mastered the water cycle material will provide guidance to other students in their group who have not mastered the water cycle (Malleus & Kikas, 2019). This stage can measure student creativity because students can express their own opinions when the Discussion takes place.

Next, the class is requested to hear from the students how their group talks turned out. This stage can assess creativity since student actions effectively portray the outcomes of group conversations, and other students might query, dispute, or supplement what students who are explaining have said (Sukmawati, 2020; Wati Sukmawati, Asep Kadaroman, Omay Suwarna, 2020).

At the Create stage, students are asked to draw a short-cycle type of water cycle using circular cardboard with a diameter of approximately 20-30 cm, then color the drawing with colored pencils or crayons. Then the teacher gives a laminated plastic sheet that has been cut according to the size of the cardboard circle. Students will make raindrops on the laminated plastic sheets with tips ex. Then the plastic laminate is plugged into the cardboard using tacks. The creation stage is expected to provoke students' creativity in applying the material they learn (Suryana et al., 2021).

Figure 6. RADEC Model Stages (Discuss, Explain, and Create)

Through the stages of the RADEC model, students are required to be active because students carry out activities to seek information independently, give different answers, express opinions, ask questions, solve problems, and create works so that their creativity increases (Suryana et al., 2021). Thus, it is proven that the application of the RADEC model is effective in increasing student creativity. If student creativity is high, because creative thinking is a component of higher-order thinking, pupils thinking will get good learning results (A. Lestari & Suhandi, 2020).

Conclusion

Based on the findings and discussion that has been presented, it can be concluded that student creativity increases after the RADEC model is applied. Student creativity has increased in the very good category by 24% and the quite good category by 76%. The increase is measured through the score of the attitude scale of creativity before and after learning. The measure logit value shows that students who originally had low creativity experienced a significant increase. The RADEC approach is used to treat pupils throughout learning, and it guides them to develop their creativity by starting with autonomous study based on the surroundings. This proves that the application of the RADEC model can increase student creativity.

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Author Contributions

Nurliana contributed to compiling research activities, data collection, processing and writing of the original draft. Wati Sukmawati contributed in accompanying and guiding research starting from writing proposals, validating instruments, processing teaching data using Rasch, and writing articles.

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Conflicts of Interest

The author hereby declares that there is no conflict of interest in the research up to the writing of this article. The authors also certify any circumstances or personal interests that could be considered to have influenced the representation or interpretation of research results reported inaccurately.

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