JPPIPA 10(2) (2024)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Analysis of Changes in Students' Science Literacy Ability in Class V Elementary School Science Learning Using the RADEC Model

Nur Putri Ifdaniyah[1*], Wati Sukmawati[1]

[1] Elementary School Teacher Education, FKIP, Muhammadiyah University Prof. Dr. Hamka, Jakarta, Indonesia.

Received: May 20, 2023
Revised: August 24, 2023
Accepted: February 25, 2024
Published: February 29, 2024

Corresponding Author:
Nur Putri Ifdaniyah
nur_ifdaniyah@uhamka.ac.id

DOI: 10.29303/jppipa.v10i2.3952

Abstract: This study aims to analyze the literacy skills of fifth-grade elementary school students in science subjects with homogeneous and heterogeneous substances using the RADEC model (Read, Answer, Discuss, Explain, and Create). Experimental research with this type of quasi-experimental design is a quantitative study with two groups: the experimental and control classes. In the experimental class, there were 23 students in the sample, and in the control class, there were 18 students. Data sources used in this study was 16 multiple-choice questions on scientific literacy in science learning. Data were obtained from scientific literacy tests; then, analyzed using the Winstep application with Rasch modeling to obtain information about changes in scientific literacy skills in science learning. The research results were processed using the Winstep Rasch model using stacking analysis in the experimental and control classes. The experimental class, stacking analysis results, provide information that it has increased and is grouped based on the increase in logit value into the very good category 87%, 9% good, and 4% sufficient. In the control class, the logit value was very good, 61% and 39% sufficient. Based on research that has been conducted, it can be concluded that the radec learning model can improve the scientific literacy skills of grade 5 students in science learning.

Keywords: RADEC; Science learning; Science literacy; Stacking

Introduction

Natural Sciences (IPA) is literature that teaches how to acquire and use various forms of knowledge (Sheeba, 2013), according to Sopandi (2019), science principles, which include the principles of motivation, setting, memorization, learning by doing, learning by playing, and social principles. Science learning is needed in everyday life so that humans can develop curiosity, positive attitudes, and awareness of the interplay between science and learning (Lamnina et al., 2019; Lindholm, 2018). Science learning is the best way to develop qualifications (skills, maintain attitudes, and develop concepts related to everyday thinking) (Ali, 2018). With the 2013 curriculum that is applied to students, they can emphasize special skills such as those needed for critical thinking, high-level thinking, creative thinking, the ability to handle difficult situations and develop students' literacy and character (Rusydiyah et al., 2021). In addition, science learning as applied to the 2013 curriculum develops the skills and knowledge of students with good character who can overcome problems in learning science in challenging situations, and to become loyal, productive and creative (Wiratsiwi, 2020). The goal is for students to be able good and loyal citizens innovative and effective. So, the learning given to students must apply literacy skills. Literacy skills can be realized quickly through guidance that can improve teaching methods in the classroom (Guo et al., 2021). The learning that is being carried out is able to teach about literary studies because this is able to provide appropriate material to improve everyday life (Sholihin et al., 2020). As explained, science learning can teach students' literary abilities so that the skills that are honed are literacy skills so that these abilities can be applied in

How to Cite:
Ifdaniyah, N., & Sukmawati, W. (2024). Analysis of Changes in Students' Science Literacy Ability in Class V Elementary School Science Learning Using the RADEC Model. *Jurnal Penelitian Pendidikan IPA*, *10*(2), 681–688. https://doi.org/10.29303/jppipa.v10i2.3952

everyday life. Scientific literacy consists of several levels a lowest level and high level (Wen et al., 2020).

When students take science lessons at school, they should already have an initial understanding that they get from the environment. So that when studying science at school, students can relate the initial concepts to what they learn at school. That way, students who only learn to memorize become more understanding of the mastery of science concepts by understanding phenomena that occur in their environment and can improve students' scientific literacy (Sukmawati et al., 2022).

Based on the 2018 International Student Assessment Program (PISA) reading comprehension results, Indonesia ranked 74th out of 79 countries in math and science skills assessment (Hewi et al., 2020). That way, the problem that occurs in Indonesia is the literacy skills of students who are less developed. Scientific literacy is a benchmark for the implementation of science education which is taught to all students, from elementary to tertiary education. In science education, students are trained to become knowledgeable or scientifically literate individuals (Sukmawati et al., 2023). So, to improve literacy skills for students, the action that educators must take is to apply the Read, Answer, Discuss, Explain, and Create (RADEC) teaching model, because the learning process applied to RADEC places more emphasis on the process of working together in groups to carry out a discussion so as to develop motivation, skills, and social learners in working together to carry out a discussion. The RADEC educational model is an alternative choice that has been proven to help Indonesia's educational problems (Sopandi, 2019) as well as a cognitive development perspective that builds group member interaction in developing achievement to think about processing the various information obtained (Sanjaya, 2015).

According to Pratama et al. (2020), the RADEC model is one that is used in formal education to develop the personality of students so that they have a strong character, encourage them to pursue independent learning, strengthen their communication and teamwork skills, and prepare them to engage in in-depth material analysis. RADEC as a science learning model that is contextual to the condition of students in Indonesia has high flexibility to be packaged in face-to-face learning, blended learning (Sukardi et al., 2021).

As explained, RADEC teaches students to work together in groups to solve learning problems, allowing students to interact with other group members and express their opinions. Additionally, students are taught to think critically to foster active learning, creativity, and innovation (Pratama et al., 2020). By applying the RADEC model, the learning process activities become student-centered so that the learning provided can encourage students to carry out various activities in the teaching and learning process, thereby giving students a sense of confidence, responsibility, and participation in implementing education (Zandvakili et al., 2018).

By applying the RADEC learning model to science learning, it can develop students' literacy skills through the stages of RADEC itself, namely Read, Answer, Discuss, Explain, and Create, so that it can trigger the activity and enthusiasm of students to carry out the learning process. The focus of the research question is the results of analyzing changes in the scientific abilities of students who participate in the learning process using the RADEC model affect science learning using homogeneous and heterogeneous materials was assigned.

Method

This research was conducted at an elementary school in South Tangerang with a sample of 23 students in the VA class, namely 14 girls and 9 boys, and 18 students in the VB class, 12 girls and 6 boys. The research design used was an experiment with a quantitative approach consisting of two groups, namely the experimental class and the control class. In this study, the dependent variable is literacy skills, and the independent variable is the Read, Answer, Discuss, Explain, and Create (RADEC) learning model.

The method used in this research is the Rasch measurement model. According to Boone et al. (2020), the analysis of the Rasch measuring model has advantages in improving the development and use of a test. Data analysis with the Rasch model (Sumintono, 2014), namely the analysis of fit statistics to provide information to researchers regarding the data obtained if they have high abilities, students will answer questions according to their level of difficulty. Data analysis technique used is the Rasch model stacking analysis to analyze changes in students' science literacy abilities before using the RADEC model and after using the RADEC model. Then in the class chosen to carry out this research the experimental class was given treatment in the form of science learning with homogeneous substance material and heterogeneous substances using conventional learning models.

This study took fifth-grade elementary school students. The sampling technique uses non-probability or saturated samples because all members of the population are used as samples. This instrument consists of 16 multiple-choice questions. The discourse text contained in the items includes the notion of mixed substances and the properties of homogeneous substances and heterogeneous substances. Each text

contains three multiple-choice questions. Based on the text developed, students are expected to be able to classify and interpret the functions of mixtures, examine changes in substances, describe various types of mixtures, and determine the types and properties of homogeneous and heterogeneous substances.

According to Boone et al. (2020) there is a standard deviation to find out the validation of items in the items, as follows:

Table 1. Item Validity Value

STANDARTD	
MNSQ	0.5 - 1.5
ZSTD	-2.0 - +2.0
PT CORR	0.4 – 0.85

Table 2. Validity Test Value

Question	MNSQ	ZST D	PT CORR	Valid	Follow-up
18	7.64	3.8	0.32	Invalid	No
7	0.77	-0.6	0.59	Valid	Used
3	0.81	-0.5	0.56	Valid	Used
6	0.79	-0.6	0.57	Valid	Used
20	0.50	-1.7	0.72	Valid	Used
10	0.98	0.1	0.44	Valid	Used
13	0.98	0.1	0.49	Valid	Used
14	0.60	-1.1	0.67	Valid	Used
4	0.83	-0.3	0.53	Valid	Used
5	1.19	0.6	0.29	Invalid	No
9	0.82	-0.3	0.54	Valid	Used
11	1.39	1.0	0.39	Valid	Used
15	0.87	-0.2	0.53	Valid	Used
19	0.64	-0.8	0.61	Valid	Used
8	0.85	-0.1	0.51	Valid	Used
12	2.10	1.9	0.07	Valid	Used

Based on the validity carried out, it can be seen that the questions given by students were 20 questions; there were 16 valid questions and four invalid questions.

This can be seen from the MNSQ standards, namely (0.5- 1.5), ZSTD, namely (-2.0 - + 2.0), and PT Corr, namely (0.4-0.85). If the scores on the MNSQ, ZSTD, and PT Corr are less than or exceed these standards, they are declared invalid; if appropriate, then they are declared.

Table 3. Rasch Validity results on the question

1	4.00	3.2	-0.07	Invalid	No
17	0.44	-1.0	0.64	Valid	Used
2	0.22	-0.5	0.57	Valid	Used
16	0.00	0.00	0.00	Invalid	No

The validity of the test using Rasch conducted by researchers is empirical because it is obtained by direct observation in the field with instrument references that have been validated by fit analysis (Sukmawati et al., 2022). Internal scale validity, which is also referred to as item fitness, indicates how closely the actual responses to items match the expected responses based on the Rasch model (Park et al., 2019). When the ranges of two different distributions consistently have difficulty being considered adequate (Chae et al., 2018).

The analysis for testing students' scientific literacy abilities was measured through the pretest and posttest given when carrying out the treatment to determine changes in students' scientific literacy abilities when using the RADEC learning model using conventional learning models (Tulljanah et al., 2021). The results of the pretest and posttest are seen by the logit results through the stacking analysis. Stacking is to see changes in students after being given treatment or before being given treatment to find out students' literacy abilities (Sukmawati et al., 2023). The processed data is then grouped by the logit value at the standard deviation. See more details in Table 4.

Table 4. Standard Deviation in Logit Stacking

Class	Logit (Very Good)	Log in (Good)	Logs (Enough)
Experiment	87	9	4
Control	61	-	39

Based on these logit values, it can be seen that the experimental class, which got very good logit scores was greater than the control class. In the experimental class, there were good logit scores, and in the experimental class, the moderate logit scores were lower than the control class. We found that students in the experimental class mastered scientific skills better than those in the control class.

Result and Discussion

In this study, the use of RADEC model, in an effort to improve students' scientific literacy skills, was used as a treatment that researchers carried out to achieve goals with the learning process implemented using the RADEC model, namely Read, Answer, Discuss, Explain, and Create. In this RADEC model, students are taught to carry out the stages of RADEC (Rindiana et al., 2022).

Figure 1. RADEC model stages

First, in the reading stage, students are taught to read material about mixed substances, namely

homogeneous substances and heterogeneous substances. Students carry out this stage when they are outside or inside the school environment. The material read by students is in the theme book 9 (Things Around Us) and is based on other reading books regarding the material of homogeneous substances and heterogeneous substances.

Second, in the answer stage, students answer pre-learning questions that were previously given by educators to work on at home. The questions are related to the material to be discussed.

Third, in the discussion stage, students discuss with their group mates the pre-learning questions given, then students write the results of the discussion through the LKPD provided by the educator.

Fourth, the explained stage for each group of students explains the future of the material of homogeneous substances and heterogeneous substances. And other groups pay attention to groups that are advancing to provide a response regarding the material discussed.

Fifth, in the creation stage, each group creates creativity regarding mixed substances. At this stage, students were seen making a mixture of water and soil, water and sugar, water and food coloring, water and oil, and water and salt.

From these stages it can be seen that students carry out the learning process well, besides that students carry out the RADEC learning model appropriately. So that the learning process activities carried out are fun, not only that the literacy skills of students are also well honed when carrying out science learning with the RADEC learning model.

Changes in students' scientific literacy abilities can be from the pre-test and post-test results. We can see that of students who were processed using the Rasch model with a sufficient person category reliability value, namely a reliability value of 0.74 with a separation of 1.71. In terms of item reliability value, the item is 0.71 with a separation of 1.58. These data can show that the student respondents answering the questions posed by researchers are varied. So it can be seen in more detail in Figure 2.

PERSON	23 INPUT		23 MEASURED		INFIT		OUTFIT	
	TOTAL	COUNT	MEASURE	REALSE	IMNSQ	ZSTD	OMNSQ	ZSTD
MEAN	13.4	20.0	.92	.68	1.00	.0	1.39	.2
S.D.	4.3	.0	1.46	.30	.13	.4	1.67	.9
REAL RMSE	.74 TRUE SD		1.26 SEPARATION	1.71	PERSON RELIABILITY			.74
ITEM	20 INPUT		20 MEASURED		INFIT		OUTFIT	
	TOTAL	COUNT	MEASURE	REALSE	IMNSQ	ZSTD	OMNSQ	ZSTD
MEAN	15.4	23.0	-.22	.63	.98	-.1	1.39	.1
S.D.	3.6	.0	1.31	.30	.31	1.0	1.68	1.4
REAL RMSE	.70 TRUE SD		1.11 SEPARATION	1.58	ITEM RELIABILITY			.71

Figure 2. Person and item reliability value

It can be seen that with sufficient item and person reliability values, it can be ascertained that the instruments used can be used to measure the pretest and posttest. The research was done experimentally in class and in control classes, where in the experimental class, students were given treatment with the RADEC learning model, while in the control class, students were given conventional learning models. Find out the increase in students' scientific literacy skills can be seen from the results of the pretest and posttest through stacking analysis using the Rasch model.

The most widely recognized form of educational assessment is the test or examination. The test is a usual evaluation procedure performed by a teacher on the knowledge and skills of the students to know their performance by using certain instruments (Sumintono, 2018). According to Ardiyanti (2017), Rasch pays attention to several aspects (Linacre, 2021). The researcher will make pre-learning questions that are only processed based on the score of the students' answers; then, the researcher will group the answers that are easy and difficult for the students to answer. While the results of the pretest and posttest answers were processed using the Rasch model, then the data results were processed in the form of Logit values (Logarithm odd units) which were carried out for each item.

Table 5. Changes in Student Measurement Scores from the Results of the Pretest and Posttest of the Control Class

Person	Measurement		Enhancement	Category
	Pretest	Posttes		
1	-0.92	-1.26	-0.34	Enough
2	1.25	2.2	0.95	Very good
3	-1.66	-0.6	1.06	Very good
4	-0.33	1.67	1.98	Very good
5	-1.66	-0.6	1.06	Very good
6	0.89	2.2	1.31	Very good
7	-0.02	-0.02	0	Enough
8	1.67	-0.02	-1.69	Enough
9	1.67	-0.02	-1.69	Enough
10	0.57	0.89	0.32	Very good
11	-0.92	1.25	2.17	Very good
12	-0.92	2.2	3.12	Very good
13	-0.31	-0.31	0	Enough
14	-0.92	-0.92	0	Enough
15	-0.92	3.02	3.94	Very good
16	1.67	1.67	0	Enough
17	-1.26	-0.31	0.95	Very good
18	-0.92	0.57	1.49	Very good
Mean: 0.812778				
SD: 0.11363				
Very good: 61%				
Fair: 39%s				

According to Nuraeni et al. (2023), To find out changes in students' scientific literacy abilities can be seen from the changes in the measurements of students from the pretest and posttest results from the experimental class and the control class. Following are the results of students' scientific literacy abilities in the control class using conventional learning models when seen in the logit or measure results as shown in Table 5.

Table 5 shows the control class used conventional learning models for homogeneous substances and heterogeneous substances for class V Elementary School. In the Logit value of students, it can be seen from the very good category, namely, 61% of students experienced an increase in the learning process, and in the moderate category, 39% of students did not experience an increase. In general, students in the control class experienced an increase in ability. Only constants or small values were obtained. Rusdi et al. (2020) explained that the increase in the control group was not very significant, and the increase in the control class was also a natural thing because it could be influenced by various factors such as the interests of students and the characteristics of students according to what was learned.

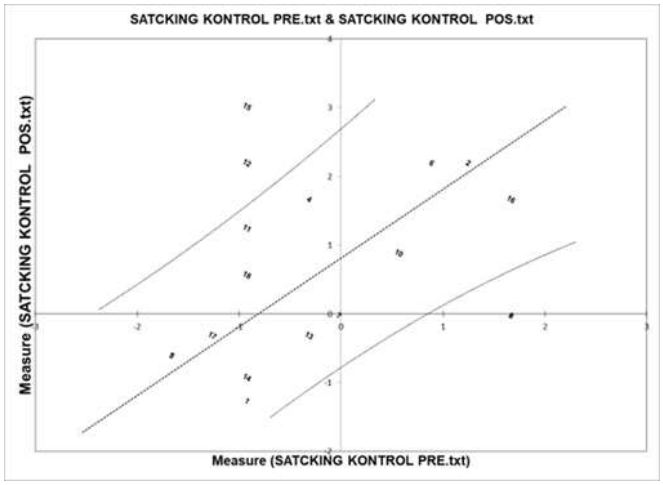

Figure 3. Compile a graph of changes in literacy ability in the control class with the conventional model

Figure 3 shows the number of small students who experienced changes in scientific literacy skills using conventional learning models. Changes in literacy skills can be seen to have increased very well in the number of students (2, 3, 4, 5, 6, 10, 11, 12, 15, 17, 18), students who experienced a significant increase in scientific literacy skills in the number of students (1, 7, 8, 9, 13, 14, 16). These changes stay the same because they use conventional learning models. These increases do not vary. Only students who are very good and sufficient can be seen that students who have experienced an increase in scientific literacy skills and students who have not experienced an increase in scientific literacy abilities in learning science. Standardized measurement of residual correlation value is to determine whether there are items that overlap (Yasin et al., 2018).

As for the results of students' scientific literacy abilities in the experimental class if given treatment using the RADEC learning model, if seen in the logit or measure results in table 6.

Table 6. Changes in Student Measurement Scores from Pretest and Posttest Results of Experimental Classes

Person	Measurement		Enhancement	Category
	Pretest	Posttest		
1	0.9	3.02	2.12	Very good
2	3.02	2.2	-0.82	Enough
3	1.67	2.2	0.53	Very good
4	-1.67	1.67	3.34	Very good
5	1.67	2.2	0.53	Very good
6	0.58	4.31	3.73	Very good
7	-0.92	2.2	3.12	Very good
8	-0.01	1.67	1.68	Very good
9	1.67	-0.02	-1.69	Enough
10	0.57	0.89	0.32	Very good
11	-0.92	1.25	2.17	Very good
12	-0.92	2.2	3.12	Very good
13	-0.31	-0.31	0	Enough
14	-0.92	-0.92	0	Enough
15	-0.92	3.02	3.94	Very good
16	1.67	1.67	0	Enough
17	-1.26	-0.31	0.95	Very good
18	-0.92	0.57	1.49	Very good
19	-0.01	3.02	3.03	Very good
20	0.28	3.02	2.74	Very good
21	0.28	2.2	1.92	Very good
22	0.28	3.02	2.74	Very good
23	1.67	3.02	1.35	Very good
Mean: 2.561739				
SD: 0.461591				
Very good: 87%				
Fair: 4%s				

Table 6 shows the experimental class used in the RADEC learning model for homogeneous and heterogeneous substances for class V Elementary School. In Logit, students are seen from a very good category, namely 87% of students experience an increase in the learning process with high standards, a good category of 9% of students who experience an increase in the learning process with reasonable standards, and a moderate category of 4% of students do not experience an increase in the learning process. Changes in students' scientific literacy abilities have improved better due to using the RADEC model in the learning process. The RADEC model can develop students' scientific literacy skills because, with this.

Based on the data in Figure 4, it can be seen that students who experience changes in scientific literacy

skills after participating in the learning process with the RADEC model can be seen that the changes experienced by students occur evenly in groups of students, low, medium, or high. Changes in scientific literacy skills have increased greatly in the number of students (1, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23) students who experienced a good increase in scientific literacy skills were seen in the number of students (3 and 5), and students who experienced an increase in the moderate category occurred in the number of students (2). Model, students are taught to read, write, think critically, and be innovative and creative. The improvements experienced varied from very good, good, and sufficient categories. This is because the RADEC learning model is by the characteristics of students. According to Laliyo et al. (2022) find out the difference in scientific literacy skills is seen from the Mean (mean size of Scientific Literacy Ability) from the results of the pretest and posttest in the experimental class and control classes. The data obtained in this study were pretest and posttest results for Students in experimental and control classes.

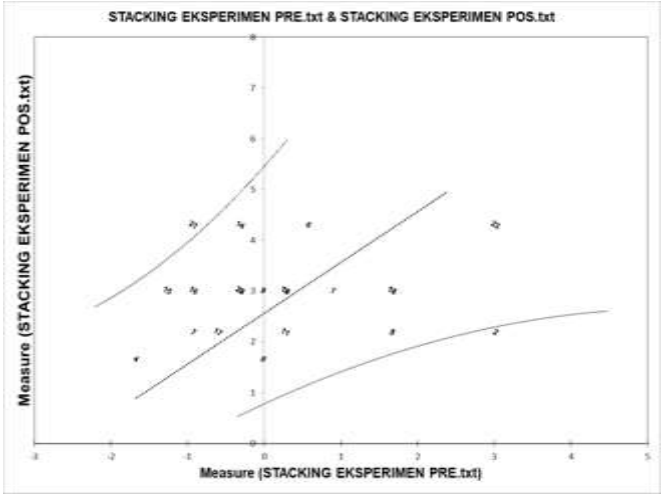

Figure 4. Compile a graph of changes in literacy ability in the experimental class with the RADEC model

Table 7. Measurement of the Average Scientific Literacy Ability

Class	Number of Items	Mean (Mean Measure of Students' Science Literacy Ability)		
		Pre-test (Logit)	Post-test (Logit)	Difference in Pre-Posttest (Logit)
Experiment (N=23)	16	0.35	2.91	2.56
Control	16	-0.16	0.64	0.812

Table 7 presents the results of the average ability measurement of changes in pre-posttest scientific literacy abilities between students in the experimental class and the control class. This data is processed based on the results of the person statistics test: Entry Order. Noted that:

First, in the experimental class, the mean posttest item size (2.91 Logit) is greater than the pretest item mean size (0.35 Logit). Second, in the control class, the mean posttest item size (0.64 Logit) is greater than the pretest mean item size (-0.16 Logit). Third, the mean difference in pre-posttest items in the experimental class (2.56 Logit) is greater than the mean difference in pre-posttest items in the control class (0.81 Logit). Fourth, there is a difference in the mean difference between the pre-posttest items in the experimental and control classes, indicating that students who are taught with the RADEC model make changes in scientific literacy skills compared to students who are taught conventionally.

Conclusion

Based on the research that has been carried out, it can be concluded that the RADEC model, which is applied to the material of homogeneous substances and heterogeneous substances, is seen as effective for the ability of scientific literacy to be implemented. The experimental class, stacking analysis results, provide information that it has increased and is grouped based on the increase in logit value into the very good category 87%, 9% good, and 4% sufficient. In the control class, the logit value was very good, 61% and 39% sufficient. Based on research that has been conducted the difference between the two groups regarding logit values and standard deviations clearly indicate changes in students' scientific ability to learn about homogeneous and heterogeneous materials. So it can be concluded that the RADEC model, which is applied to the material of homogeneous substances and heterogeneous substances, is seen as effective for the ability of scientific literacy to be implemented.

Acknowledgments

This research was completed properly with the help of various parties. Because of that, on this occasion, the author would like to thank the principal and deputy principal of an elementary school located in the South Tangerang area, who have permitted to conduct research at the school. As well as all Elementary School Teacher Councils located in the South Tangerang area who have provided the opportunity and convenience to conduct research.

Author Contributions

Dr. Wati Sukmawati, M.Pd as supervisors the designed methodology, literature review, and provided critical feedback on the manuscript. All authors read and approved the final version of the manuscript.

Funding
This research was independently funded by the researchers involved.

Conflicts of Interest
The authors declare no conflict of interest. The funders had role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of manuscripts; or in the decision to publish the results.

References

Ali, L. U. (2018). Pengelolaan Pembelajaran IPA Ditinjau Dari Hakikat Sains Pada SMP Di Kabupaten Lombok Timur. *Prisma Sains : Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, *6*(2), 103. https://doi.org/10.33394/j-ps.v6i2.1020

Ardiyanti, D. (2017). Aplikasi Model Rasch pada Pengembangan Skala Efikasi Diri dalam Pengambilan Keputusan Karir Siswa. *Jurnal Psikologi*, *43*(3), 248. https://doi.org/10.22146/jpsi.17801

Boone, W. J., & Staver, J. R. (2020). *Advances in Rasch Analyses in the Human Sciences* (3rd ed.). Springer International Publishing. https://doi.org/10.1007/978-3-030-43420-5

Chae, S., Park, E.-Y., & Choi, Y.-I. (2018). The psychometric properties of the Childhood Health Assessment Questionnaire (CHAQ) in children with cerebral palsy. *BMC Neurology*, *18*(1), 151. https://doi.org/10.1186/s12883-018-1154-9

Guo, J., & Huang, J. (2021). Information literacy education during the pandemic: The cases of academic libraries in Chinese top universities. *The Journal of Academic Librarianship*, *47*(4), 102363. https://doi.org/10.1016/j.acalib.2021.102363

Hewi, L., & Shaleh, M. (2020). Refleksi Hasil PISA (The Programme For International Student Assesment): Upaya Perbaikan Bertumpu Pada Pendidikan Anak Usia Dini). *Jurnal Golden Age*, *4*(1), 30–41. https://doi.org/10.29408/jga.v4i01.2018

Laliyo, L. A. R., Sumintono, B., & Panigoro, C. (2022). Measuring changes in hydrolysis concept of students taught by inquiry model: stacking and racking analysis techniques in Rasch model. *Heliyon*, *8*(3), e09126. https://doi.org/10.1016/j.heliyon.2022.e09126

Lamnina, M., & Chase, C. C. (2019). Developing a thirst for knowledge: How uncertainty in the classroom influences curiosity, affect, learning, and transfer. *Contemporary Educational Psychology*, *59*, 101785. https://doi.org/10.1016/j.cedpsych.2019.101785

Linacre, J. M. (2021). *A User's guide to WINSTEPS MINISTEP rasch-model computerprograms (3.91. 0)(2006)*. Rasch-Model Computer Programs.

Lindholm, M. (2018). Promoting Curiosity? *Science & Education*, *27*(9–10), 987–1002. https://doi.org/10.1007/s11191-018-0015-7

Nuraeni, A., Sugiharto, F., Anna, A., Sari, E., Mirwanti, R., Trisyani, Y., & Emaliyawati, E. (2023). Self-Efficacy in Self-Care and Its Related Factors Among Patients with Coronary Heart Disease in Indonesia: A Rasch Analysis. *Vascular Health and Risk Management*, *Volume 19*(01), 583–593. https://doi.org/10.2147/VHRM.S427488

Park, J.-Y., & Park, E.-Y. (2019). The Rasch Analysis of Rosenberg Self-Esteem Scale in Individuals With Intellectual Disabilities. *Frontiers in Psychology*, *10*(September), 1–10. https://doi.org/10.3389/fpsyg.2019.01992

Pratama, Y. A., Sopandi, W., Hidayah, Y., & Trihatusti, M. (2020). Pengaruh model pembelajaran RADEC terhadap keterampilan berpikir tingkat tinggi siswa sekolah dasar. *JINoP (Jurnal Inovasi Pembelajaran)*, *6*(2), 191–203. https://doi.org/10.22219/jinop.v6i2.12653

Rindiana, T., Arifin, M. H., & Wahyuningsih, Y. (2022). Model Pembelajaran Radec untuk Meningkatkan Higher Order Thingking Skill Dalam Pembelajaran IPS di Sekolah Dasar. *Autentik : Jurnal Pengembangan Pendidikan Dasar*, *6*(1), 89–100. https://doi.org/10.36379/autentik.v6i1.186

Rusdi, A. I., Wibowo, E. W., & Mastoah, I. (2020). The Effectiveness of Using Matrix Book Media (Strimin) in an Objective Test of Student Writing Skills (Quasi Experiment at SDN Manis Jaya. *Journal of Basic Education*, *7*(2), 89–104. Retrieved from http://jurnal.uinbanten.ac.id/index.php/ibtidai/

Rusydiyah, E. F., Indarwati, D., Jazil, S., Susilawati, S., & Gusniwati, G. (2021). STEM Learning Environment: Perceptions and Implementation Skills in Prospective Science Teachers. *Jurnal Pendidikan IPA Indonesia*, *10*(1), 138–148. https://doi.org/10.15294/jpii.v10i1.28303

Sanjaya, W. (2015). *Perencanaan dan Desain Sistem Pembelajaran*. Kencana Prenadamedia Group.

Sheeba, M. N. (2013). An Anatomy of Science Process Skills In The Light Of The Challenges to Realize Science Instruction Leading To Global Excellence in Education. *Educationa Confab*, *2*(4), 108–123. Retrieved from https://rb.gy/4z86lv

Sholihin, M., Sari, R. C., Yuniarti, N., & Ilyana, S. (2020). A new way of teaching business ethics: The evaluation of virtual reality-based learning media. *The International Journal of Management Education*, *18*(3), 100428. https://doi.org/10.1016/j.ijme.2020.100428

Sopandi, W. (2019). Sosialisasi dan Workshop

Implementasi Model Pembelajaran RADEC Bagi Guru-Guru Pendidikan Dasar dan Menengah. *Pedagogia: Jurnal Pendidikan*, *8*(1), 19–34. https://doi.org/10.21070/pedagogia.v8i1.1853

Sukardi, R., Sopandi, W., & Riandi, R. (2021). Repackaging RADEC learning model into the online mode in science class. *Journal of Physics: Conference Series*, *1806*(1), 012142. https://doi.org/10.1088/1742-6596/1806/1/012142

Sukmawati, W., Sari, P. M., & Yatri, I. (2022). Online Application of Science Practicum Video Based on Local Wisdom to Improve Student's Science Literacy. *Jurnal Penelitian Pendidikan IPA*, *8*(4), 2238–2244. https://doi.org/10.29303/jppipa.v8i4.1940

Sukmawati, W., & Zulherman, Z. (2023). Analysis of Changes in Students' Scientific Literacy Ability After Attending Lectures Using the RADEC Model. *Jurnal Penelitian Pendidikan IPA*, *9*(3), 1039–1044. https://doi.org/10.29303/jppipa.v9i3.2846

Sumintono, B. (2014). *Model Rasch untuk penelitian sosial kuantitatif*. Statistics Department, Institut Teknologi Sepuluh Nopember, Surabaya.

Sumintono, B. (2018). Rasch Model Measurements as Tools in Assesment for Learning. *Proceedings of the 1st International Conference on Education Innovation (ICEI 2017)*, *173*, 38–42. https://doi.org/10.2991/icei-17.2018.11

Tulljanah, R., & Amini, R. (2021). Model Pembelajaran RADEC sebagai Alternatif dalam Meningkatkan Higher Order Thinking Skill pada Pembelajaran IPA di Sekolah Dasar: Systematic Review. *Jurnal Basicedu*, *5*(6), 5508–5519. https://doi.org/10.31004/basicedu.v5i6.1680

Wen, C.-T., Liu, C.-C., Chang, H.-Y., Chang, C.-J., Chang, M.-H., Fan Chiang, S.-H., Yang, C.-W., & Hwang, F.-K. (2020). Students' guided inquiry with simulation and its relation to school science achievement and scientific literacy. *Computers & Education*, *149*(1), 103830. https://doi.org/10.1016/j.compedu.2020.103830

Wiratsiwi, W. (2020). Penerapan Gerakan Literasi Sekolah di Sekolah Dasar. *Refleksi Edukatika: Jurnal Ilmiah Kependidikan*, *10*(2), 230–238. https://doi.org/10.24176/re.v10i2.4663

Yasin, S. N. T. M., Yunus, M. F. M., & Ismail, I. (2018). The use of rasch measurement model for the validity and reliability. *Journal of Counseling and Educational Technology*, *1*(2), 22. https://doi.org/10.32698/0111

Zandvakili, E., Washington, E., Gordon, E., & Wells, C. (2018). Mastery Learning in the Classroom: Concept Maps, Critical Thinking, Collaborative Assessment (M3CA) Using Multiple Choice Items (MCIs). *Journal of Education and Learning*, *7*(6), 45. https://doi.org/10.5539/jel.v7n6p45