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Big Bergaya-Steam In Improving Scientific Reasoning Of Elementary School Students

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ABSTRACT

The scientific reasoning ability of elementary school students still needs to be improved, particularly in understanding cause-and-effect relationships, making predictions, and drawing conclusions based on observational results. This problem was identified in science learning on the topic of forces in Grade IV of SDN Taman Rahayu 04, where most students tended to memorize concepts without being able to explain phenomena logically. This study aims to develop STEAM-based Big Bergaya media as a learning medium capable of helping students understand the concept of forces while training their scientific reasoning skills. The research employed a Research and Development (R&D) method using the 4D model, consisting of the define, design, develop, and disseminate stages. The research subjects comprised 21 Grade IV students of SDN Taman Rahayu 04. Data were collected through expert validation sheets, observations, teacher and student response questionnaires, and pretest and posttest assessments. The results showed that the developed media had a very high validity level with CVR and CVI values of 1.00. The media also achieved a practicality level of 91.19%, categorized as very practical. Furthermore, the effectiveness test results indicated an N-Gain value of 0.71 in the high category and Cohen's d effect size of 1.583. These findings indicate that STEAM-based Big Bergaya media is effective in improving students' scientific reasoning ability in elementary school science learning.

1. INTRODUCTION

Science learning in elementary school plays an important role in building students' scientific thinking skills through activities of observing, experimenting, and understanding phenomena that occur in the surrounding environment. One ability that needs to be developed from an early age is scientific reasoning the ability of students to understand cause-and-effect relationships, make predictions, and draw conclusions based on empirical evidence. This ability serves as an important foundation in science learning because it helps students think logically, systematically, and solve problems scientifically (Bao et al., 2009). Furthermore, the development of scientific reasoning ability is closely related to the demands of 21st-century skills that emphasize critical thinking, creativity, and problem-solving in daily life (Osborne, 2010). However, various research findings indicate that students' scientific reasoning abilities remain relatively low. While the results of the Programme for International Student Assessment (PISA) 2022 show that Indonesian students' science literacy is still in the low category, particularly in the aspects of scientific reasoning and data interpretation (Organisation for Economic Co-operation and Development, n.d.), it is important to note that PISA measures students aged approximately 15 years. Nevertheless, this trend is consistent with findings from studies focused on elementary school students. Research by Awang (2020) found that Indonesian elementary school students also demonstrate low science learning outcomes, particularly in understanding scientific concepts and engaging in scientific inquiry. The low level of

these abilities is influenced by a teaching and learning process that remains teacher-centered and tends to emphasize concept memorization over active student participation in scientific inquiry (Awang, 2020). Similar conditions were found in Grade IV elementary school students. Based on observations and teacher interviews, most students still had difficulty explaining cause-and-effect relationships, making simple predictions, and drawing conclusions in their own words based on observational results. Science learning on the topic of forces was also still dominated by the use of textbooks, making abstract concepts difficult for students to understand concretely. One alternative that can be used to address this problem is the use of interactive and contextual learning media. Big Book media is considered capable of helping students understand concepts through large-sized visual displays, attractive illustrations, and simple language suited to the characteristics of elementary school students (Kusumawati, Palupi, & Nurjanah, 2022). Previous research has shown that the use of Big Book media can improve conceptual understanding and student learning outcomes in science (Malaikosa & Zahrotin, 2024; Harmawati & Yulistina, 2020). Additionally, the integration of the STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach in learning is able to provide more meaningful learning experiences by involving activities of exploration, problem-solving, creativity, and scientific reflection (Barkah, Awaludin, Iqbal, & Asykuri, 2024). The STEAM approach has also been proven to help students develop logical thinking skills and higher-order thinking skills through contextual and collaborative learning activities (Winata et al., 2021)**.** Nevertheless, research on the development of STEAM-based Big Book media specifically focused on improving the scientific reasoning ability of elementary school students remains limited. Previous research has generally only focused on improving learning outcomes or creative thinking skills without directly linking to scientific reasoning indicators such as the ability to observe, predict, explain cause-and-effect relationships, and draw evidence-based conclusions (Wonda et al., 2024). Thus, there is a research gap in the development of learning media that can integrate visual elements, simple experimental activities, and the STEAM approach in an integrated manner to train scientific reasoning abilities of elementary school students. The novelty of this research lies in the development of STEAM-based Big Bergaya media specifically designed to facilitate scientific reasoning indicators through observation activities, simple experiments, phenomenon analysis, and learning outcome reflection on the topic of forces in elementary school. Unlike prior studies that used digital STEAM platforms or general Big Books for reading literacy, this research uniquely integrates large-format visual storytelling with structured inquiry tasks grounded in the STEAM framework, targeting five measurable scientific reasoning indicators in a single cohesive medium for Grade IV students. This integration has not been reported in previous studies and constitutes the original contribution of this work. Based on the above description, this research focuses on how the development process of STEAM-based Big Bergaya media on the topic of forces is conducted, the level of validity and practicality of the developed media, and the effectiveness of the media in improving students' scientific reasoning ability in elementary school. To address these problems, this study uses the Research and Development (R&D) method with the 4D model consisting of the define, design, develop, and disseminate stages (Kuncoro, 2020). The media was developed in the form of an interactive Big Book equipped with contextual illustrations, simple experimental activities, and STEAM-based tasks that encourage students to actively observe, experiment, discuss, and draw conclusions based on observational results. This research aims to produce STEAM-based Big Bergaya media that is valid, practical, and effective in improving the scientific reasoning ability of Grade IV elementary school students. The research findings are expected to serve as an alternative science learning medium capable of supporting more concrete, interactive, and meaningful learning, while also helping students develop scientific thinking skills.

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2. METHODS

2.1 Research Design

This study uses the Research and Development (R&D) method with the 4D development model consisting of the define, design, develop, and disseminate stages (Kuncoro, 2020). This model was chosen because it provides a systematic development flow, from needs analysis to product implementation in learning. The define stage was conducted through an analysis of science learning needs, student characteristics, and problems identified in the topic of forces in elementary school. The design stage then focused on designing the STEAM-based Big Bergaya media along with learning tools that support the development of scientific reasoning ability. In the develop stage, the media was validated by experts, revised based on feedback, and then trialed in learning. The disseminate stage was conducted in a limited manner through media implementation in the classroom and dissemination of development results. Media implementation used a one-group pretest-posttest design to observe the improvement of students' scientific reasoning ability before and after media use. The abilities measured include: (1) identifying problems, (2) making predictions, (3) explaining cause-and-effect relationships, (4) drawing conclusions based on observational results, and (5) reflecting on problem-solving results (Zimmerman, 2000). Thus, this research not only focuses on the development of the learning media product, but also on testing the feasibility, practicality, and effectiveness of the media in supporting science learning in elementary school.

2.2 Participants

The participants in this study were all Grade IV students at one elementary school in Setu District, Bekasi Regency, for the 2025/2026 academic year, totaling 21 students. The study used total sampling technique, so all students were used as research subjects to obtain a comprehensive picture of the learning process. In addition to students, this study also involved three expert validators: one subject matter expert, one media expert, and one language expert, each with relevant academic qualifications and experience in elementary education. Each validator assessed 10 items on their respective validation sheets using a scale of 1 to 4, where a score of 3 or above was considered “essential.” The validation procedure followed the Content Validity Ratio (CVR) method proposed by Lawshe (1975), in which CVR values for each item were calculated and then averaged to obtain the Content Validity Index (CVI) for each validator. Validators also provided written feedback and suggestions for media revision prior to trial implementation.

2.3 Research Procedure

The research procedure was carried out in accordance with the 4D model stages. In the define stage, the researcher identified problems in science learning, particularly on the topic of forces, and analyzed students' needs for more concrete and interactive learning media. The design stage was conducted by drafting the STEAM-based Big Bergaya media along with the research instruments used. The develop stage included the media production process, validation by experts, product revision based on validator suggestions, and limited trials with students. After the media was declared feasible, the disseminate stage was carried out through media implementation in Grade IV science learning. Learning began with a pretest, followed by media use during the learning process, and ended with a posttest to determine the improvement in students' scientific reasoning ability after media use.

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2.4 Data Collection Instruments

Research instruments were used to measure the validity, practicality, and effectiveness of the STEAM-based Big Bergaya media. The instruments used include expert validation sheets, student activity observation sheets, teacher and student response questionnaires, and scientific reasoning tests in the form of pretest and posttest (Sugiyono, 2022). Validation sheets were used by subject matter experts, media experts, and language experts to assess the suitability of content, language, presentation, and media appearance. Observation sheets were used to observe student engagement during the learning process, such as activities of observing, discussing, conducting experiments, and drawing conclusions. Meanwhile, teacher and student response questionnaires were used to determine the level of ease of use, attractiveness, and usefulness of the media in science learning (Arikunto, 2019).

2.5 Data Analysis Techniques

Data analysis was conducted quantitatively and qualitatively to determine the validity, practicality, and effectiveness of the STEAM-based Big Bergaya media (Sugiyono, 2019). Quantitative data were obtained from expert validation results, response questionnaires, and pretest and posttest scores, while qualitative data were obtained through observations, interviews, and validator suggestions. Media validity was analyzed using the Content Validity Ratio (CVR) and Content Validity Index (CVI) based on Lawshe's method (1975). Media practicality was analyzed through the percentage results of teacher and student response questionnaires. Meanwhile, media effectiveness was analyzed using N-Gain calculations to determine the magnitude of improvement in students' scientific reasoning ability before and after media use (Hake, 1999). N-Gain values were interpreted as follows: N-Gain > 0.70 = high; 0.30 ≤ N-Gain ≤ 0.70 = moderate; N-Gain < 0.30 = low. To strengthen the analysis results, this study also used the paired sample t-test to determine the significant difference between pretest and posttest scores. In addition, Cohen's d effect size test was used to assess the magnitude of the media's influence on the improvement of students' scientific reasoning ability. A high effect size value indicates that the media is not only statistically significant, but also provides meaningful learning impact for students (Cohen, 1988).

2.6 Big Bergaya Media (Big Book on Learning Forces)

Big Bergaya (Big Book Belajar Gaya) is a Big Book media development designed for science learning on the topic of forces in Grade IV elementary school. This media takes the form of a large-sized book with a combination of simple text, colorful illustrations, and interactive elements that help students understand concepts more concretely and engagingly (Mufidah, 2024). The use of Big Book is considered appropriate for the characteristics of elementary school students as it can increase students' attention, engagement, and understanding through clear and communicative visualization (Wonda et al., 2024). Big Bergaya was developed based on the STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach to support students' scientific reasoning ability. The Science element is applied through activities of observing various types of forces and simple experiments. The Technology and Engineering elements are reflected in simple project activities and problem-solving involving the use of interactive media. The Arts element is seen in the use of illustrations, colors, and attractive visual designs, while the Mathematics element is applied through activities of comparing, classifying, and analyzing observational results.

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Figure 1. Card Design of STEAM-Based Big Bergaya Media

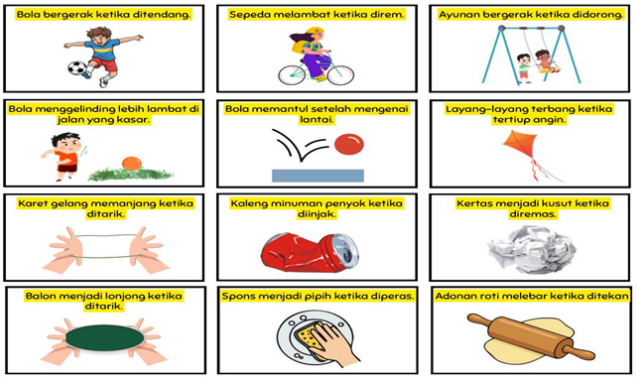

Figure 2. Design of STEAM-Based Big Bergaya Media

This media is equipped with activities of observing, predicting, experimenting, discussing, and drawing conclusions so that students are actively engaged during learning (Halimah & Pravitasari, 2024). Compared to conventional Big Books, Big Bergaya does not only function as a shared reading medium, but also as an interactive and contextual science learning medium capable of helping students develop scientific thinking skills more meaningfully (Withasari, 2019).

3. RESULTS AND DISCUSSION

RESULTS

This study produced STEAM-based Big Bergaya (Big Book Belajar Gaya) learning media for improving the scientific reasoning ability of Grade IV students on the topic of forces. Media development was conducted using the 4D model comprising the define, design, develop, and disseminate stages. Observation and interview results showed that science learning in several elementary schools in Setu District, Bekasi Regency, was still dominated by lecture methods with student books as the main source. This condition caused students to have difficulty understanding the abstract concept of forces. Furthermore, students' scientific reasoning abilities had not developed optimally, particularly in aspects of observing phenomena, making predictions, explaining cause-and-effect relationships, and drawing conclusions. Based on these conditions, a more concrete, interactive, and contextual learning medium was developed so that students could be actively engaged during the learning process. After media development was complete, the next stage was product validation by media experts, subject matter experts, and language experts using the Content Validity Ratio (CVR) and Content Validity Index (CVI) technique. The aspects assessed included

media design, function of use, attractiveness, sentence structure, readability, and suitability of content with learning objectives. This study produced STEAM-based Big Bergaya (*Big Book* Belajar Gaya) learning media for improving the scientific reasoning ability of Grade IV students on the topic of forces. Media development was conducted using the 4D model comprising the *define*, *design*, *develop*, and *disseminate* stages.

Tabel 1. CVR Calculation Results

Validator	Number of Valid Items	Average CVR Value	CVI Value	Category
Media Expert	10	1.00	1.00	Very Valid
Language Expert	10	1.00	1.00	Very Valid
Subject Matter Expert	10	1.00	1.00	Very Valid

Tabel 2. CVI Calculation Results

Validator	Assessment Aspect	Number of Essential Indicators (≥ 3)	Total Indicators	CVI
Media Expert	Media design	10	10	1.00
	Function of use	10	10	1.00
	Attractiveness	10	10	1.00
Language Expert	Sentence structure	10	10	1.00
	Readability	10	10	1.00
	Standardization of terms	10	10	1.00
Subject Matter Expert	Content suitability	10	10	1.00
	Clarity of content	10	10	1.00

Based on the data, the validation results show that all assessment aspects obtained CVR and CVI values of 1.00 in the very valid category. These findings indicate that the developed media was appropriate in terms of content, language, and appearance, and is thus suitable for use in science learning in elementary school. Furthermore, the media was assessed as capable of presenting content clearly, attractively, and in an easily understandable manner suited to the characteristics of Grade IV elementary school students. After being declared valid, the media was then tested to determine its practicality level through teacher and student response questionnaires. The assessment focused on ease of use, media attractiveness, and its usefulness in assisting the learning process.

Tabel 3. Recapitulation of Teacher and Student Responses

No.	Respondent	Practicality Percentage	Remarks
1	Teacher	95%	Very Practical
2	Students (average)	87.38%	Very Practical
	Average	91.19%	Very Practical

Based on student and teacher response results, the media achieved an average practicality level of 91.19% in the very practical category. Teachers assessed the media as easy to use and helpful in explaining the topic of forces, while students felt that learning became more engaging and easier to understand through direct observation and experimentation activities. These results indicate that

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the media can be effectively used in the classroom learning process. The effectiveness of the media was subsequently analyzed through the pretest and posttest results of students' scientific reasoning ability. Before hypothesis testing, the data were first tested for normality using the Shapiro-Wilk method, as the sample size was less than 50 students.

Tabel 4. Normality Test Results

Variable	Kolmogorov-Smirnov Statistic	df	Sig.	Shapiro-Wilk Statistic	df	Sig.	Remarks
Pre-test	0.18	21	0.074	0.92	21	0.089	Normal
Post-test	0.111	21	0.200*	0.963	21	0.584	Normal

The normality test results show that the significance values of both pretest and posttest are greater than 0.05. Therefore, the data are declared normally distributed, meeting the requirements for parametric statistical analysis. After the data were declared normal, analysis continued using N-Gain testing to observe the level of improvement in students' scientific reasoning ability after media use.

Tabel 5. N-Gain Test Results

Scientific Reasoning Indicator	Pretest Mean	Posttest Mean	N-Gain	Category
Observing phenomena	2.32	4.18	0.70	High
Making predictions	2.59	4.20	0.67	Moderate
Explaining cause-effect	2.49	4.31	0.73	High
Analyzing experimental results	2.51	4.37	0.75	High
Drawing evidence-based conclusions	2.60	4.15	0.65	Moderate

Based on Table 5, all scientific reasoning indicators showed improvement after the use of Big Bergaya media. The highest improvement was in the indicator of analyzing experimental results with an N-Gain value of 0.75, followed by explaining cause-and-effect at 0.73 and observing phenomena at 0.70, all classified in the high category. Meanwhile, the indicators of making predictions and drawing evidence-based conclusions obtained moderate category with values of 0.67 and 0.65, respectively. To strengthen these results, a paired sample t-test was conducted to determine the significance of the difference between students' pretest and posttest scores.

Tabel 6. Paired Sample t-Test Results

Data Pair	Mean Difference	Std. Deviation	Std. Error	CI 95% (Lower)	CI 95% (Upper)	t	df	Sig. (2-tailed)	Remarks
Pretest-Posttest	-25.429	5.801	1.266	-28.069	-22.788	-20.086	20	0.000	Significant

The test results show a significance value of 0.000 ($p < 0.05$), which means there is a significant difference between the pretest and posttest results. Thus, the use of STEAM-based Big Bergaya media has been proven to influence the improvement of students' scientific reasoning ability. The magnitude of the media's influence was then analyzed using the effect size test.

Tabel 7. Effect Size Results (Cohen's d)

Variable	Mean	Std. Deviation
Pre-test	37.4286	9.33044
Post-test	62.8571	6.73265
Combined*	-	16.06309
$d = \frac{\bar{D}}{SD_D}$	$\frac{62{,}8571 - 37{,}4286}{16{,}06309}$	1.583

Based on the effect size calculation using Cohen's d formula, a value of 1.583 was obtained, which is classified in the large effect category as it exceeds 0.80. This result indicates that the use of STEAM-based Big Bergaya media is not only statistically significant, but also has a strong influence on improving students' scientific reasoning ability. These findings show that the improvement in learning outcomes is not only reflected in the statistical difference between pretest and posttest scores, but also has a tangible impact in the learning process. Through activities of observing, experimenting, discussing, and drawing conclusions, students became more actively engaged in building their understanding of the concept of forces scientifically. Therefore, STEAM-based Big Bergaya media is considered capable of supporting more concrete, interactive, and meaningful science learning for elementary school students.

DISCUSSION

The high level of validity, practicality, and effectiveness of the STEAM-based Big Bergaya media indicates that the developed media is in line with the needs of science learning in elementary school. This suitability is reflected in the aspects of content, language, and learning design, making the media suitable for use in science learning (Rahmawati & Nurhayati, 2021). The use of visual illustrations, simple experimental activities, and contextual content presentation help students understand the concept of forces more concretely, in accordance with the cognitive development characteristics of elementary school students who are still at the concrete operational stage (Piaget, 1972). At this stage, students learn most effectively through direct manipulation of objects and observable phenomena rather than abstract instruction, which is precisely what the Big Bergaya media facilitates through hands-on experimentation and structured observation tasks. The improvement in scientific reasoning ability can be explained theoretically through the lens of inquiry-based learning and constructivism. According to Vygotsky's sociocultural theory, learning occurs most effectively when students engage in collaborative, guided problem-solving within their zone of proximal development (Vygotsky, 1978). The Big Bergaya media supports this by scaffolding students through observation, prediction, experimentation, and conclusion-drawing sequences that progressively develop their reasoning capacity. Furthermore, the STEAM framework enhances scientific reasoning by connecting Science, Technology, Engineering, Arts, and Mathematics in an integrated learning experience that requires students to think across disciplines, analyze phenomena from multiple perspectives, and apply evidence-based reasoning (Barkah et al., 2024). This interdisciplinary engagement is theorized to strengthen the neural pathways associated with logical reasoning and pattern recognition, thereby deepening students' scientific thinking skills (Osborne,

2010). The structured inquiry embedded in the STEAM approach also aligns with Zimmerman's (2000) framework of scientific reasoning development, in which repeated cycles of observation, prediction testing, and reflective analysis progressively build students' causal reasoning and evidence-evaluation abilities.

The media's practicality level in the very practical category shows that Big Bergaya is easy to use by both teachers and students during the learning process. The media helps teachers explain the concept of forces more systematically while increasing student engagement through activities of observing, experimenting, discussing, and drawing conclusions (Pratiwi et al., 2023). STEAM-based learning encourages students to be actively involved in the exploration process so that learning becomes more meaningful and not only teacher-centered (Nugroho & Suyanto, 2022). Previous research tended to focus on the development of digital STEAM-based media (Riyanto et al., 2024), whereas this research integrates big books with simple experimental activities so that learning becomes more concrete, interactive, and suited to the learning characteristics of elementary school students. The effectiveness of the media is seen from the improvement in students' scientific reasoning ability across all indicators after the use of STEAM-based Big Bergaya media. The greatest improvement occurred in the ability to observe phenomena, explain cause-and-effect relationships, and analyze experimental results because students were directly involved in observation and simple experimentation activities (Hidayati et al., 2022). Investigative activities carried out during learning strengthen students' knowledge construction process through direct and exploration-based learning experiences (Wahyuni et al., 2023). Meanwhile, the ability to make predictions and draw conclusions showed a relatively moderate improvement because higher-order reasoning abilities require ongoing practice and habituation (Kusuma & Widodo, 2024). The significant difference between students' initial and final abilities confirms that STEAM-based Big Bergaya media has an influence on science learning. These findings are reinforced by the large effect size value, which indicates a strong practical impact on students' scientific reasoning ability. The large effect size indicates that media use is not only statistically effective, but also has a strong practical impact on the development of students' scientific reasoning ability. The media not only improves cognitive learning outcomes, but also supports the development of students' scientific thinking ability through processes of observation, analysis, and drawing evidence-based conclusions (Lestari et al., 2024). Thus, STEAM-based Big Bergaya media can be an innovative alternative to create more active, concrete, and meaningful science learning while supporting the development of scientific thinking skills of elementary school students (Sari & Setiawan, 2022).

4. CONCLUSION

This study successfully developed STEAM-based Big Bergaya (Big Book Belajar Gaya) media for science learning on the topic of forces for Grade IV elementary school students using the 4D development model comprising the define, design, develop, and disseminate stages. The developed media was declared very valid based on the assessment results of subject matter experts, media experts, and language experts, making it suitable for use in the learning process. Furthermore, teacher and student response results showed that the media has a very high practicality level as it is easy to use, attractive, and capable of helping students understand the concept of forces more concretely. The research results also showed that STEAM-based Big Bergaya media is effective in improving students' scientific reasoning ability. Improvement was seen across all scientific reasoning indicators, particularly in the ability to observe phenomena, explain cause-and-effect relationships, and analyze experimental results. Statistical test results showed a significant difference between pretest and posttest scores, while the effect size value in the large category indicates that the media has a strong influence on the development of students' scientific thinking ability. Therefore, STEAM-

based Big Bergaya media can be an alternative science learning medium that is more concrete, interactive, and meaningful in elementary school. The integration of STEAM elements through observation activities, simple experiments, discussions, and reflections can help students build conceptual understanding while actively training their scientific thinking ability. Future research is recommended to implement the media across a wider range of schools and to develop other science learning topics so that the effectiveness of the media can be tested more thoroughly.

5. REFERENCES

Actavera, A., Malaikosa, Y. M. L., & Zahrotin, A. (2024). Pengaruh Penggunaan Media Pembelajaran Big Book Untuk Meningkatkan Pemahaman Konsep Pada Mata Pelajaran IPAS Kelas IV Sekolah Dasar. *Global Education Journal*, *2*(3), 205–217. Https://Doi.Org/10.59525/Gej.V2i3.259

Awang, I. S. (2020). Kesulitan Belajar Ipa Peserta Didik Sekolah Dasar. *Doctoral Dissertation, Universitas Muhammadiyah Malang*, *6*(2), 108–122.

Bao, L., Cain, T., Koenig, K., & Fang, K. (2009). Learning And Scientific Reasoning. *SCIENCE*, *323*(5914), 586–587. Https://Doi.Org/Https://Doi.Org/10.1126/Science.1167740

Barkah, E. S., Awaludin, D., Iqbal, M., & Asykuri, E. (2024). *Implementasi Model Pembelajaran STEAM (Science , Technology , Engineering , Art And Mathematics): Strategi Peningkatan Kecakapan Abad 21*. *5*(9), 3501–3511.

C. Zimmerman. (2000). The Development Of Scientific Reasoning Skills. *Developmental Review*, *20*(1), 99–149. Https://Doi.Org/Https://Doi.Org/10.1006/Drev.1999.0497

Charles H. Lawshe. (1975). A Quantitative Approach To Content Validity. *Personnel Psychology*, *28*(4), 563–575. Https://Doi.Org/Https://Doi.Org/10.1111/J.1744-6570.1975.Tb01393.X

Dr. Pratiwi Kartika Sari, M.Pd Dendi Wijaya Saputra, M.Pd Dr. Farihen, M.Ag Dr. Widia Winata, M. P. (2021). *STEAM (Sains, Teknologi, Engineering, Art And Mathematics)*. UMJ Press.

Halimah, N., & Pravitasari, D. (2024). Pengembangan Media Pembelajaran Big Book Berbasis Qur'ani Pada Mata Pelajaran IPA. *Finger: Journal Of Elementary School*, *3*(1), 40–48.

Hidayati, N., Putra, A., & Kurniawan, D. (2022). Inquiry Activities And Students' Scientific Reasoning Skills In Elementary Science Learning. *Jurnal Basicedu*, *6*(4), 6732–6740.

J. Cohen. (1988). *Statistical Power Analysis For The Behavioral Sciences, 2nd Ed.* Hillsdale, NJ, USA: Lawrence Erlbaum Associates. Https://Doi.Org/Https://Doi.Org/10.4324/9780203771587

Kuncoro, K. S. (2020). *Four-D Model - Model Pengembangan Perangkat Pembelajaran Dari Thiagarajan, Dkk*. Unpublished Manuscript. Universitas Negeri Yogyakarta.

Kusuma, R., & Widodo, W. (2024). Improving Scientific Reasoning Through STEAM-Based Elementary Science Learning. *Jurnal Prima Edukasia*, *12*(1), 44–53.

Kusumawati, N., Palupi, W., & Nurjanah, N. E. (2022). Kemampuan Membaca Permulaan Melalui Media Big Book Pada Anak Usia 5-6 Tahun. *Jurnal Kumara Cendekia*, *10*(4), 352–363.

Lestari, R., Suryani, N., & Wibowo, A. (2024). STEAM-Based Learning In Improving Elementary Students' Critical And Scientific Thinking Skills. *Jurnal Prima Edukasia*, *12*(1), 55–56.

Mufidah, E. (2024). *Big Book Media For Teaching Growth And Development Of Living Things In Elementary School : Buku Besar Media Untuk Mengajar Pertumbuhan Dan Perkembangan Makhluk Hidup Di Sekolah Dasar*. *20*(2), 1–11. Https://Doi.Org/10.21070/Ijemd.V20i2.878

Nugroho, H., & Suyanto, S. (2022). Mplementation Of STEAM Learning To Improve Scientific Reasoning In Elementary School Students. *International Journal Of Elementary Education*, *6*(4), 589–598.

Organisation For Economic Co-Operation And Development. (N.D.). *PISA 2022 Results (Volume I And II)*. Country Note: Indonesia.: OECD. Retrieved From Https://Www.Oecd.Org/En/Publications/Pisa-2022-Results-Volume-I-And-Ii-Country-Notes_Ed6fbcc5-En/Indonesia_C2e1ae0e-En.Html?Utm_Source

Osborne, J. (2010). Scientific Reasoning And Argumentation: A Key Element Of Science Education. *Educational Psychologist*, *45*(3), 189–201. Retrieved From Https://Www.Tandfonline.Com/Doi/Abs/10.1080/00461520.2010.493540

Piaget, J. (1972). *Psychology And Epistemology: Towards A Theory Of Knowledge*. Penguin Books.

Pratiwi, D., Handayani, L., & Kusuma, A. (2023). STEAM Learning Media And Student Engagement In Elementary Science Learning. *Jurnal Pendidikan Dasar Indonesia*, *8*(2), 101–110.

Sugiyono. (2019). *Metode Penelitian Kuantitatif, Kualitatif Dan R&D* (M. T. Dr. Apri Nuryanto, S.Pd.,S.T., Ed.). Alfabeta, Cv.

Sugiyono. (2022). *Metode Penelitian Kuantitatif, Kualitatif, Dan R&D*. Bandung: Alfabeta.

Rahmawati, I., & Nurhayati, S. (2021). The Effectiveness Of Visual Learning Media In Elementary Science Learning. *Jurnal Pendidikan Dasar Nusantara*, *7*(2), 145–154.

Richard R. Hake. (1999). *Analyzing Change/Gain Scores*. Indiana University 24245 Hatteras Street, Woodland Hills: Dept. Of Physics.

Riyanto, A., Hartinah, S., & Purwanto, B. E. (2024). Pengembangan Media Big Book Berbasis Qr Code Untuk Meningkatkan Kemampuan Membaca Permulaan Murid Kelas Awal Sekolah Dasar. *Journal Of Education Research*, *5*(3), 3224–3232. Https://Doi.Org/10.37985/Jer.V5i3.1436

S. Arikunto. (2013). *Prosedur Penelitian: Suatu Pendekatan Praktik*. Jakarta: Rineka Cipta.

Sari, M., & Setiawan, B. (2022). Contextual Science Learning In Elementary Schools: Challenges And Opportunities. *Jurnal Basicedu*, *6*(5), 8241–8249.

Wahyuni, A., Prasetyo, Z. K., & Haryanto. (2023). STEAM Learning And Students' Scientific Reasoning Ability In Primary Education. *Jurnal Pendidikan Sains Indonesia*, *11*(2), 210–221.

Withasari, Y. (2019). Pengaruh Media Big Book Terhadap Kemampuan Mengklasifikasi Pada Anak Usia Dini. *NOURA: Jurnal Kajian Gender*, *3*(2), 21–41. Https://Doi.Org/10.32923/Nou.V3i2.1046

Wonda, H., Lehan, A. A. D., Gedalya, M., & Atty, F. (2024). *Pengembangan Media Big Book Untuk Meningkatkan Keterampilan Berpikir Kreatif Pada Pembelajaran IPA Sub Tema Zat Tunggal Dan Campuran Siswa Kelas V SDI Boking*. *4*(2), 10–19.

Vygotsky, L. S. (1978). *Mind In Society: The Development Of Higher Psychological Processes*. Harvard University Press.

Yosianti, I., Harmawati, & Yulistina, N. (2020). "Pengaruh Penggunaan Media Big Book Terhadap Hasil Belajar IPA Di Sekolah Dasar." *Indonesian Journal Of Primary …*, *1*(X), 32–44. RetrievedFromhttp://Journal.Ubpkarawang.Ac.Id/Mahasiswa/Index.Php/IJPSE/Article/Download/49/42