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Development of an Engineering Design Process-Based Digital IPAS Module to Enhance Students' Creative Thinking

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Abstract: This study aims to develop an integrated IPAS digital module based on the Engineering Design Process (EDP) for the topic of light and to evaluate its feasibility and effectiveness in improving the creative thinking skills of fifth-grade elementary school students. This research employed a Research and Development (R&D) approach using the ADDIE development model. The module was developed using Canva Edu and transformed into an interactive flipbook through the Heyzine platform. The feasibility of the developed module was assessed through evaluations by practitioners, media experts, and subject matter experts using a 4-point Likert scale. The validation results indicated that the module obtained an overall average score of 92%, which was categorized as "highly feasible." To examine its effectiveness, the creative thinking skills of the experimental group (n = 22) were compared with those of the control group (n = 33). The pretest and posttest data were analyzed using the nonparametric Mann–Whitney U test, resulting in an asymptotic significance value (2-tailed) of 0.006 ($p < 0.05$). This finding indicates a statistically significant difference in creative thinking skills between the two groups. The experimental group that received the EDP-based IPAS digital module achieved a higher mean score (35.25) than the control group (23.17). Therefore, the EDP-based IPAS digital module is considered highly feasible for classroom implementation and has been statistically proven to enhance fifth-grade students' creative thinking skills in learning the concept of light.

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Introduction

Creative thinking is one of the six 21st-century skills that plays a very important role, as it is viewed as a skill that can permeate all other skills (Fullan et al., 2018). According to Wasahua, (2021), creative thinking is the process of thinking continuously to generate new and original ideas that meet specific needs. This aligns with the view of Nur'aini & Indrapangastuti, (2025), who state that through creative thinking, students can generate innovative ideas to solve problems they face. Based on this, fostering creative thinking in students is essential and must be developed through the learning process. The IPAS subject is one that has the potential to shape and hone students' creative thinking. This aligns with the IPAS learning outcomes outlined in the BSKAP, (2022), which implicitly encourage the development of students' creative thinking. This learning environment requires each individual not only to understand theoretical concepts but also to apply their insights to take action, form judgments, and solve everyday problems. These learning outcomes align with the steps in the creative thinking process, namely connecting various concepts, generating alternative solutions, and adapting decisions to diverse problem contexts.

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However, the reality in the field of learning in IPAS is often not in accordance with the idealism of learning. Several previous studies have shown that social studies learning in elementary schools is still mostly carried out with conventional methods that are centered on teachers using lecture methods only, so that students are easily bored (Marfilinda et al., 2025). This is supported by the results of interviews with students in grade V who complained of boredom and did not really like science subjects, due to the lack of variation in the use of learning methods and media used. This statement is also stronger as evidenced by the results of interviews with teachers who only rely on teacher books and student books. Furthermore, Marfilinda et al., (2025) also said that the use of learning resources that only rely on teacher books and student books as well as LKS is a real problem in science subjects in elementary schools. Science material for grade V of elementary school is also often considered difficult, because of its abstract concepts, one of which is light material (Anggraini et al., 2026).

Based on these problems, it shows that it is necessary to develop a media that not only varies in methodology, but is also relevant to the characteristics of today's students and is able to answer the abstraction of concepts in the material. Digital modules are one of the alternative technology-based learning media that can be developed and utilized. According to Sari & Siregar, (2022), digital modules are teaching materials that contain text, images, videos and audio that can be accessed through laptops, computers, or other digital devices. The use of digital modules in learning can make students stay active (Ismanto & Fitri, 2022).

Optimizing the role of digital modules in improving students' creative thinking skills also needs to be supported by a structured and appropriate learning model to improve these abilities and overcome students' difficulties in understanding abstract concepts in light materials. One of the models that is suitable and can be used is the Engineering Design Process (EDP) model. According to Deke et al., (2022) learning by integrating engineering aspects in several studies has shown success in shaping the 21st century generation. Previous research has also shown that there is an increase in students' creative thinking skills after using digital modules (Rofikoh et al., 2024).

The EDP steps used in the development of this digital module are, defining the problem, ingathering information related to the problem, generating the solution; implementing the best solution, and evaluating the solution and reflecting (Han & Shim, 2019). Through the steps in the model, students not only focus on making the final product, but there is an iterative process that is characteristic of this model. In line with the opinion of Sutisnawati et al., (2025), that EDP is a learning model that consists of a series of iterative iterative stages. So, when the initial product manufacturing is not suitable, students are required to think creatively again at the stage of evaluating the solution and reflecting. This characteristic makes EDP-based digital modules much more effective in constructing students' creative thinking skills compared to other learning models.

Based on the gaps and needs in the field, the development of products that are valid, effective, and relevant to the needs is very important. This research aims to develop a product in the form of an EDP-based IPAS digital module which is assessed for feasibility based on expert validation. In addition, it also assesses the effectiveness of EDP-based IPAS digital modules in improving the creative thinking skills of elementary school students. Through this research, it can also add new references on how to implement the EDP model in science subjects in elementary schools. In addition, in practice, this digital module can be used directly by teachers as a learning medium that can help students in deciplining abstract concepts in light materials, as well as training students' creative thinking skills.

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Research Method

Research and Development (R&D) is the type of research used in this study. R&D is a scientific process for researching, designing, creating, and testing the validity of a product (Sugiyono, 2025). By adopting the ADDIE model introduced by Branch, (2009), this methodology is structured around five sequential phases: Analysis, Design, Development, Implementation, and Evaluation. The research subjects in this study were fifth-grade elementary school students in Sukabumi City. In this study, two whole classes were selected for data collection because a Nonequivalent Control Group Design was used during the implementation stage. Sugiyono, (2025) states that in a Nonequivalent Control Group Design, the experimental and control groups are not selected randomly. The experimental class in this study was Class VB, which had 22 students at the time of implementation. Meanwhile, Class VA served as the control class, which had 33 students at the time of implementation.

The research instruments used included initial interview sheets during initial data collection, product validation questionnaires, and pre-test and post-test sheets on creative thinking. The pre-test and post-test sheets used consisted of 6 essay items, which were developed according to the indicators of creative thinking according to Torrance, (1977), namely sensitivity to problems, fluency, flexibility, originality, elaboration, and redefinition. Meanwhile, the product validation questionnaire was intended for three validators: a subject matter expert, a media expert, and a practitioner. This questionnaire was designed to assess the feasibility of the developed product. In this questionnaire, the scoring technique used was a 1-4 Likert scale, as shown in Table 1 below.

Table 1. Product Validation Sheet Scoring Method

Score	Assignment Categories
4	Excellent
3	Good
2	Fair
1	Poor

(Sugiyono, 2025)

The results obtained from each validator's score will be summed up, then the percentage of eligibility will be calculated using the following validation percentage formula.

Figure 1. Eligibility Percentage Formula

$$x_i = \frac{\sum S}{S_{max}} x\ 100\ \%$$

(Afriyanti et al., 2018)

The feasibility of EDP-based IPAS digital modules that have been converted into percentages, then interpreted in accordance with the following assessment standards.

Table 2. Product Eligibility Percentage Interpretation

Score Range (%)	Interpretation
76 – 100	Very Feasible
51 – 75	Feasible
26 – 50	Less Feasible
0 – 25	Not Feasible

(Aizah & Dewi, 2025)

For further analysis, this study used the Shapiro-Wilk normality test, since the sample size was less than 50. The data were considered normally distributed if the significance value (Sig.) was > 0.05. Following the normality test, the data were then tested for homogeneity to

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assess the variance distribution of the pre-test and post-test data. The normality and homogeneity tests are prerequisites for hypothesis testing.

The next analysis assessed the effectiveness of using the EDP-based IPAS digital module in enhancing creative thinking. The Mann-Whitney U test was employed for this analysis. Hypothesis testing using the Mann-Whitney U test was conducted because one of the results from the prerequisite tests in this study did not meet the criteria for parametric statistics; therefore, hypothesis testing was performed using nonparametric statistics

Table 3. Decision Criteria for the Mann-Whitney Test

Probability (Asymp.Sig)	Explanation
≥ 0.05	H_O is accepted
< 0.05	H_O is rejected

(Mubarok et al., 2021)

Results and Discussion

Guided by the ADDIE model (Analyze, Design, Develop, Implement, Evaluate), this study systematically breaks down the development process into five structured phases.

Analyze

The analysis phase was conducted through face-to-face interviews with teachers and fifth-grade elementary school students. The analysis revealed that the majority of students in that class complained of boredom and a lack of motivation in the IPAS subject, due to a lack of variety in the teaching methods and media used. This was also confirmed by the teachers, who noted the limited use of teaching media and materials. In addition, the teacher also noted that students showed a low tendency to engage in higher-order thinking or in-depth problem-solving. Based on these findings, the development of a digital IPAS module based on EDP is necessary.

Design

Product planning at this stage involves designing the structure and components of the digital modules being developed, which explicitly integrate EDP syntax with Torrance's indicators of creative thinking in each activity. The module is designed to cover four main topics: light and its sources, the properties of light, optical instruments, and the visual system, all supplemented with images, videos, and Augmented Reality (AR) based simulation media. At this stage, assessment instruments including a validation sheet as well as pre-test and post-test questions are also designed and mapped to the six Torrance indicators of creative thinking.

Develop

The digital module development phase utilized the Canva Edu app for visual design, which was then converted into an interactive flipbook format via the Heyzine platform. The development process resulted in a digital module equipped with interactive navigation features via hyperlinks in the table of contents, pop-up video and image displays, audio cues at each activity transition, and a learning assessment integrated into a single Google Form. The EDP-based IPAS digital module, once fully developed, was then assessed for suitability through validation by subject matter experts, media specialists, and practitioners using a 1-4 Likert scale. The results of the subject matter experts' validation are presented in Table 4 below.

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Table 4. Results of Subject Matter Expert Validation

No	Assessment Indicators	Percentage	Category
1.	Content Relevance	94%	Very Feasible
2.	Content Accuracy	92%	Very Feasible
3.	EDP	95%	Very Feasible
4.	Presentation	83%	Very Feasible
Average		**91%**	**Very Feasible**

The integration of EDP syntax in the module gets the category very feasible with a percentage of 95%. This finding is scientifically relevant because EDP facilitates an iterative learning process centered on solving real-world problems. The presentation of contextual problems in everyday life helps students connect theory with practice, thereby deepening their conceptual understanding while stimulating higher-order thinking skills (Ristiani et al., 2025) The accuracy of the material is a crucial aspect in the development of instructional materials, given that misconceptions in science learning are a common problem encountered in the field and stem, in part, from inaccuracies in the instructional materials (Fariza et al., 2025). Based on expert validation results, which confirm that the material in the module is highly reliable in terms of accuracy, this module has been scientifically proven to minimize the risk of misconceptions regarding the concept of light among students.

Based on the validation results by media experts, a suitability score of 95% classified as "very feasible", indicates that the digital module meets the key characteristics of appropriate digital instructional materials. The adaptive aspect received a perfect score (5.00) from media experts, which can be scientifically linked to the current generation of students who have grown up amidst the onslaught of digital technology (digital natives), as noted by Prensky (in Dopo & Ismaniati, 2016). The "self-contained" aspect also received a perfect score, proving that students can study the module independently. This is an essential characteristic of digital instructional materials for elementary school students (Zahara et al., 2025). The results of the media validation assessment are presented in Table 5 below.

Table 5. Results of Media Expert Validation

No	Assessment Indicators	Percentage	Category
1.	**Self Instructional**	**94%**	**Very Feasible**
2.	**Self Contained**	**100%**	**Very Feasible**
3.	**Stand Alone**	**88%**	**Very Feasible**
4.	**Adaptive**	**100%**	**Very Feasible**
5.	**User Friendly**	**92%**	**Very Feasible**
6.	**Illustrations and Visuals**	**96%**	**Very Feasible**
Average		**95%**	**Very Feasible**

These findings were corroborated by practitioner validators, who gave a rating of "very feasible" with the highest score (100%) for the aspects of user-friendliness and visual presentation. These aspects have a significant impact on increasing students' interest in learning (Laili et al., 2019). The results of the practitioner validation are presented in Table 6 below.

Table 6. Results of Practitioner Validation

No	Assessment Indicators	Percentage	Category
1.	Self Instructional	94%	Very Feasible
2.	Self Contained	100%	Very Feasible
3.	Stand Alone	100%	Very Feasible

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4.	Adaptive	88%	Very Feasible
5.	User Friendly	100%	Very Feasible
6.	Illustrations and Visuals	100%	Very Feasible
7.	Content Relevance	75%	Feasible
8.	Content Accuracy	92%	Very Feasible
9.	EDP	90%	Very Feasible
10.	Presentation	75%	Feasible
	Average	**91%**	**Very Feasible**

Based on the product feasibility assessment conducted by the three experts, it can be concluded that the EDP-based IPAS digital module that was developed is very feasible for use, with an overall average assessment score of 92%. The overall validation results from the three validators are presented in Table 7 below.

Table 7. Overall Validation Results from the Validators

No	Validators	Percentage	Category
1.	Subject Matter Expert	91%	Very Feasible
2.	Media Expert	95%	Very Feasible
3.	Practitioner	91%	Very Feasible
	Average	**92%**	**Very Feasible**

Implementation

The study was conducted at an elementary school in the city of Sukabumi, involving two entire classes. Class VA served as the control group, consisting of 33 students, while Class VB served as the experimental group, consisting of 22 students. The students' creative thinking abilities at the beginning and end of the study were measured using pre-test and post-test instruments that had been validated by subject matter experts. The data collected from both classes were then tested for normality. The results of the normality test indicated that the pre-test and post-test data for both classes were normally distributed (Shapiro-Wilk, Sig. > 0.05). The results of the normality test are presented in Table 8 below.

Table 8. Normality Test Results

Test of Normality

		Shapiro-Wilk			
Class		**Statistic**	**df**	**Sig.**	**Description**
Pre-Test Score	Experimental Class	.915	22	.059	Normal
	Control Class	.955	33	.191	Normal
Post-Test Score	Experimental Class	.921	22	.082	Normal
	Control Class	.980	33	.777	Normal

However, the homogeneity test indicated that the variances of the post-test data were not homogeneous (Sig. = 0,010 < 0,05), so the analysis was continued using the nonparametric Mann-Whitney. The results of the homogeneity test are presented in Table 9 below.

Table 9. Homogeneity Test Results

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.	Description
Pre-Test Score	Based on Mean	1.890	1	53	.175	Homogeneous
Post-Test Score	Based on Mean	7.067	1	53	.010	Non-Homogeneous

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The Mann-Whitney test was conducted to assess the effectiveness of using the IPAS digital module. The mean rank for the experimental class was 35.25, which was significantly higher than that of the control class (23.17). The rank results of the Mann-Whitney test are presented in Table 10 below.

Table 10. Results of the Mann-Whitney Rank Test

Ranks

	Class Group	N	Mean Rank	Sum of Ranks
Creative Thinking Skills	Experimental Class	22	35.25	775.50
	Control Class	33	23.17	764.50
	Total	55		

Meanwhile, the results of the Mann-Whitney test are presented in Table 11 below.

Table 11. Results of the Mann-Whitney Test Test Statistics[a]

	Creative Thinking Skills
Mann-Whitney U	203.500
Wilcoxon W	764.500
Z	-2.753
Asymp. Sig. (2-tailed)	.006

Based on these results, the Asymp. Sig. (2-tailed) value was 0.006. Since this value is < 0.05, H_0 is rejected and H_1 is accepted. This indicates that there is a significant difference in creative thinking ability between the two classes. This significant difference can be scientifically explained by the learning mechanisms facilitated by the EDP-based IPAS digital module.

Each EDP syntax can facilitate all six of Torrance's indicators of creative thinking. At the stage of defining the problem, students are faced with real problems related to light phenomena to stimulate the first indicator, namely sensitivity to problems. Then, in the stage of ingathering information related to the problem, in the module material is presented in the form of reading texts, videos, and Augmented Reality (AR) that can stimulate fluency and flexibility indicators. Furthermore, the third stage of generating the solution, students pour out their ideas by arranging tools and materials as well as appropriate steps. At this stage, students are trained to hone the originality indicator. Then, the stage of implementing the best solution, which is the stage of making products that hone the elaboration indicators. Then the last stage is evaluating the solution and reflecting. At this stage, students are asked to evaluate the product that has been made and repair it if there are any discrepancies. In this case, the last stage hone students to train redefinition indicators on creative thinking. An iterative and collaborative learning process such as EDP encourages students not only to produce a single solution but also to continuously refine and develop their ideas through repeated cycles (Tipmontiane & Williams, 2022).

Evaluation

Evaluation at this stage includes formative evaluation conducted during the development process through product revisions based on validator feedback, and summative evaluation after implementation through analysis of pre-test and post-test results. Formative evaluation resulted in nine revisions from media experts and eight revisions from content experts, which collectively improved both the quality of the content and the interactivity of the module. Summative evaluation demonstrated the module's effectiveness through statistically significant results from the Mann-Whitney test.

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Although the EDP-based digital module proved statistically effective, it should be noted that the indicators of elaboration and redefinition which are dimensions of higher-order creative thinking still require further development. Scientifically, it is understood that creative thinking abilities cannot change instantly within a single learning cycle but rather require continuous and structured training (Torrance, 1977).

The findings in this study are in line with previous research conducted by Rofikoh et al., (2024), which found that the use of STEM-based electronic modules is effective in improving the creative thinking skills of elementary school students. The engineering element in STEM is closely related to the EDP model applied in this IPAS digital module, where students are trained to design solutions to a problem. Nonetheless, this study provides stronger empirical evidence than previous research. If the previous study only tested the feasibility of one group without a comparator, this study used a control class design and experiments. The results of the comparison of the two classes significantly prove that the increase in students' creative thinking skills is purely due to the intervention of EDP-based IPAS digital modules.

Conclusion

This research and development study successfully produced an Engineering Design Process (EDP)-based IPAS digital module on the topic of light for fifth-grade elementary school students. Synthesized through the ADDIE framework, the interactive flipbook effectively addresses the lack of diverse media in primary science education. Expert and practitioner validations confirm that the module is highly feasible for classroom deployment, particularly in terms of its adaptive and self-instructional features. Furthermore, empirical field testing demonstrates that the module significantly enhances students' creative thinking skills compared to conventional textbook-centered approaches. By structuring learning around design and refinement cycles, the integration of EDP provides a viable pedagogical pathway to stimulate creative capabilities among digital natives.

Recommendation

The results of this study recommend the continuous use of EDP-based IPAS digital modules by teachers on light materials. This step is very important to monitor and maximize the development of students' creative thinking skills over time. Several things should also be considered for future research. First, future studies are suggested to implement modules over a longer and continuous period so that all six indicators of creative thinking can be stimulated and measured more comprehensively.

Second, technical limitations in the system of collecting student responses still require the opening of external links, such as Google Forms. This has the potential to disrupt students' focus and continuity of their learning experience in the module. Future research can explore innovations in integrating the direct answer-entry feature into digital modules, making the completion process more efficient and the learning experience more integrated.

Third, this study directly implements modules on a full class scale without first conducting limited trials. This is one of the factors that has the potential to affect the results, because the ease of use of modules and assessment instruments by students has not been carefully assessed before implementation. Therefore, future research is recommended to include the trial phase as part of the development process to obtain more accurate usability data before testing effectiveness on a larger scale.

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E-ISSN: 2722-4627
pp. 1022-1031

References

Afriyanti, M., Sodikin, & Jadmiko, A. (2018). Pengembangan Media Pembelajaran Fisika Menggunakan Macromedia Flash Pro 8 Materi Gerak Lurus. Indonesian Journal of Science and Mathematics Education, 01(3), 197–206. https://doi.org/10.24042/ijsme.v1i3.3594

Aizah, D. R. N., & Dewi, M. (2025). Development of Game Based Learning Media MONEKO (Economic Monopoly Using QR Code) to Improve Students' Learning Outcomes. Musytari: Neraca Akuntansi Manajemen, Ekonomi, 20(11), 1–13. https://doi.org/10.2324/q4zwv142

Anggraini, S. N., Putri, K. E., & Sulistiono. (2026). Analisis Kebutuhan Pengembangan Media Etalase Pintar Berbantuan Qr Code Materi Cahaya Siswa Kelas 5 SDN Sugihwaras 7. JB&P : Jurnal Biologi Dan Pembelajarannya, 13(1), 125–134. https://doi.org/10.29407/jbp.v13i1.28591

Branch, R. M. (2009). Instructional Design: The ADDIE Approach (1st ed.). Springer New York, NY. https://doi.org/10.1007/978-0-387-09506-6

BSKAP. (2022). Capaian Pembelajaran Mata Pelajaran Ilmu Pengetahuan Alam dan Sosial (IPAS) Fase A-Fase C. Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi.

Deke, O., Jewaru, A. A. L., & Kaleka, Y. U. (2022). Engineering Design Process pada STEM melalui Authentic PBL dan Asesmen Formatif : Meninjau Desain Argumentasi Ilmiah Siswa Terkait Termodinamika. BJSME: Borneo Journal of Science and Mathematics Education, 2(3), 101–124. https://doi.org/10.21093/bjsme.v2i3.5948

Dopo, F. B., & Ismaniati, C. (2016). Persepsi Guru tentang Digital Natives, Sumber Belajar Digital dan Motivasi Memanfaatkan Sumber Belajar Digital. Jurnal Inovasi Teknologi Pendidikan, 3(1), 13–24. https://doi.org/10.21831/tp.v3i1.8280

Fariza, A., Hasibuan, A. U. H., Simamora, E. C., Ermawan, H., Siregar, N. S., Mirzah, N., & Gaol, S. I. L. (2025). Miskonsepsi Siswa Sekolah Dasar tentang Konsep IPA: Studi Kasus di kelas VI SDN 024755. Jurnal Bintang Pendidikan Indonesia, 3(2). https://doi.org/10.55606/jubpi.v3i2.3825

Fullan, M., Quinn, J., & Mceachen, J. (2018). Deep Learning: Engage the World Change the World. Corwin Press.

Han, H.-J., & Shim, K.-C. (2019). Development of an Engineering Design Process-Based Teaching and Learning Model for Scientifically Gifted Students at the Science Education Institute for the Gifted in South Korea. Asia-Pacific Science Education, 5(13), 1–18. https://doi.org/10.1186/s41029-019-0047-6

Ismanto, & Fitri, A. (2022). Pengembangan Modul Digital Interaktif Berbasis Pengalaman Siswa Untuk Menguatkan Pembelajaran Numerasi SMP Dalam Mendukung Merdeka Belajar. Jurnal Inovasi Pendidikan Matematika, 3, 61–76. https://doi.org/10.30587/postulat.v3i1.4299

Laili, I., Ganefri, & Usmeldi. (2019). Efektivitas Pengembangan E-modul Project Based Learning pada Mata Pelajaran Instalasi Motor Listrik. Jurnal Ilmiah Pendidikan Dan Pembelajaran, 3(3), 306–315. https://doi.org/10.23887/jipp.v3i3.21840

Marfilinda, R., Nissa, A., Tulljanah, R., Rossa, R., Zuleni, E., Helmi, W. M., & Al-Mawla, M. A.-W. J. (2025). Pengaruh Model Pembelajaran Inkuiri terhadap Kreativitas Belajar Peserta Didik pada Pembelajaran IPA Sekolah Dasar. Journal of Education Research, 6(1), 34–42. https://doi.org/10.37985/jer.v6i1.2247

Mubarok, A., Sahroni, & Sunanto. (2021). Uji Mann Whitney dalam Komparasi Hasil

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E-ISSN: 2722-4627
pp. 1022-1031

Bimbingan Praktik Kewirausahaan Mahasiswa antara Dosen Laki-Laki dan Perempuan pada Fakultas Ekonomi Universitas Pamulang. Procuratio: Jurnal Ilmiah Manajemen, 9(1), 9–15. https://doi.org/10.35145/procuratio.v9i1.785

Nur'aini, A. I., & Indrapangastuti, D. (2025). Peningkatan Keterampilan Berpikir Kreatif dan Hasil Belajar IPAS Melalui Penerapan Model Scientific Reading Based Project (SRBP) Berbantuan Media Konkret. Kalam Cendekia: Jurnal Ilmiah Kependidikan, 13(3), 1704–1712. https://doi.org/10.20961/jkc.v13i3.100379

Ristiani, R., Ali, A., & Apriyanto. (2025). Konsep Dasar Pembelajaran IPA (Efitra (ed.)). PT. Sonpedia Publishing Indonesia. https://books.google.co.id/books?hl=en&lr=&id=F3Q-EQAAQBAJ&oi=fnd&pg=PA1&dq=prinsip+IPAS+yaitu+pembelajaran+yang+kontekstual&ots=6s33otG9x3&sig=O9XXvpQVucIu3oReIv-TybxBLsY&redir_esc=y#v=onepage&q&f=false

Rofikoh, S., Supeno, & Farisi, M. I. (2024). Pengembangan E-Modul Berbasis STEM untuk Meningkatkan Keterampilan Berpikir Kreatif Peserta Didik dalam Pembelajaran IPA di Sekolah Dasar. Jurnal Pendidikan MIPA, 14(4), 1132–1142. https://doi.org/10.37630/jpm.v14i4.2112

Sari, D. M., & Siregar, N. (2022). Pengembangan Modul Digital Menggunakan Desain Pembelajaran ELPSA untuk Meningkatkan Pemahaman Konsep Siswa. Jurnal Kajian Pendidikan Matematika, 2682(2), 321–336. https://doi.org/10.30998/jkpm.v7i2.13606

Sugiyono. (2025). Metode Penelitian Kuantitatif, Kualitatif, dan R&D (Sutopo (ed.)). ALFABETA.

Sutisnawati, A., Rahmawati, Y., Sumantri, M. S., & Lestari, I. (2025). A Review of Integration of Engineering Design Process (EDP) Learning Model through STEM Approach in Elementary Schools. EduBasic Journal: Jurnal Pendidikan Dasar, 7(1), 129–145. https://doi.org/10.17509/ebj.v7i1.82001

Tipmontiane, K., & Williams, P. J. (2022). The Integration of the Engineering Design Process in Biology-related STEM Activity : A Review of Thai Secondary Education. Journal of Science and Engineering Education, 1(1), 1–10. https://doi.org/10.17509/ajsee.v2i1.35097

Torrance, E. P. (1977). Creativity in the Classroom: What Research Says to the Teacher. National Education Association.

Wasahua, S. (2021). Konsep Pengembangan Berpikir Kritis dan Berpikir Kreatif Peserta Didik di Sekolah Dasar. Jurnal Horizon Pendidikan, 16(2), 72–82. https://doi.org/10.33477/hp.v16i2.2741

Zahara, M., Dwi, D. F., Silalahi, B. R., & Napitupulu, S. (2025). Pengembangan E-Modul Berbasis AR pada Pelajaran IPAS Materi Struktur Lapisan Bumi di Kelas V Sekolah Dasar. Pendas : Jurnal Ilmiah Pendidikan Dasar, 10(4), 302–312. https://doi.org/10.23969/jp.v10i04.34426