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Effectiveness of Interactive Multimedia Based on Project Based Learning to Enhance Student Learning Creativity

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Abstract

This research aims to determine the effectiveness of using interactive multimedia based on project-based learning on the creativity of students regarding the human respiratory system material in the 8th grade of MTs Negeri Kota Depok. The type of research used in this study is experimental research with a pre-experimental design in the form of a one group pretest posttest design, with a quantitative research approach. In this research, sampling was conducted using total sampling technique with class 8 F as the research sample. The results showed that the average score of student learning outcomes after the application of powtoon learning media was 81.5625 while before being treated was 36.015625. In addition, there was an increase in student learning outcomes after the implementation of project-based learning-based interactive multimedia by obtaining an average gain value of 0.712 which was at high criteria. As for the n-gain percent obtained 71.2, it is on the criteria of being quite effective. The results of the t-test with a paired sample t-test were obtained 0.01 which means that Ha was accepted. From the results of this study, it can be concluded that the use of interactive multimedia based on project-based learning is effective in enhancing students' creativity in the material of the human respiratory system for eighth-grade students at MTs Negeri Kota Depok.

How to Cite

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INTRODUCTION

The development of technology at this time is progressing very rapidly, affecting almost all aspects of life including education. Entering the era of digitization and technology, teachers are required to be able to use technology in learning. This aligns with the Minister of Education and Culture Regulation No. 16 of 2022, regarding the principles of learning, namely utilizing technology and communication efficiently and effectively, thus educators are required to be as imaginative as possible in their teaching and in designing technology-based learning media that can enhance students' skills in this 21st century, including critical thinking, creativity, collaboration, and communication (Maknun et al., 2018; Trisnawatai & Sari, 2019; Partono et al., 2021).

Students' skills in the 21st century can be developed by transforming the original teacher-centered learning model into student-centered learning, thus producing active, creative, and independent students (Suparsawan, 2020; Setiawan et al., 2022; Fenanlampir et al., 2023). One of the learning models that can enhance creative thinking skills and train student independence is the Project Based Learning model. The Project Based Learning model is a project-based learning model that focuses on students (Pratiwi et al., 2023; Nababan et al., 2023; Anggraeni et al., 2023). Project-based learning models are closely related to the teacher's ability to control and guide students in completing specific projects, thereby enhancing students' creative thinking skills.

Based on interviews with science teachers at Islamic Junior High School in Depok City, students only learn through the learning media provided by teachers, where the learning media used is still less interesting, interactive, and efficient, such as materials in the form of PDFs (e-books), materials obtained from the internet, simple PowerPoint slides, and educational videos adapted from PowerPoint. Learning solely through theory from supportive science textbooks will not help students grasp what they need to master specifically in science education at junior high school, especially for students with low reading interest, making it difficult for them to understand what they should learn (Fitriani et al., 2020).

This has an impact on the limited creativity and independence of students in learning. Meanwhile, according to Winardi, (2016); Suryadi, (2020); Putranadi et al., (2021) education and learning media have a very close relationship; the learning process will not run smoothly without the appropriate learning media. The effective and adequate use of learning media is expected to stimulate students' thoughts, feelings, attention, and foster creativity and independence so that the learning process can proceed in accordance with the objectives of National Education. One of the learning media that utilizes technology is interactive multimedia. Interactive multimedia is a learning medium that consists of integrated and interactive multimedia elements such as text, images, audio, video, and animations, which can make learning more enjoyable and understandable (Melianti et al., 2020; Madona et al., 2023; Rohimah et al., 2023).

Interactive multimedia is equipped with the delivery of information and materials that can be controlled and operated by the user, so that users can choose what to run first according to the available selections and instructions, with the aim of developing active, creative, and independent students in learning activities (Lailiyah & Sukartiningsih, 2018; Nata & Putra, 2021; Angraini et al., 2022). Research related to interactive multimedia in science learning has been widely conducted. Research conducted by Nadzif et al. (2022) shows that learning using interactive multimedia is effective and beneficial for students and good for long-term goals, which has an impact on better performance of students participating in the learning process due to support from better graphic displays, animations, and simulations.

The benefits of multimedia in the learning process according to Dewi et al. (2020) are as a concrete way to reduce verbalism, increase student interest, and make learning more enjoyable so that student learning outcomes can improve, as well as compel students to interact with learning material both physically and mentally. Topano et al. (2022) state the advantages of interactive multimedia in terms of interactivity, one of which is that media can compel users to interact directly with the material, for example, users must press the keyboard or click with the mouse to navigate from one material page to another. Based on previous research, there have been no studies related to the development of interactive multimedia based on project-based learning and how this development can enhance the creativity and independent learning of junior high school students in science on the topic of human respiratory system. Therefore, the researcher is interested in conducting a study on the development of interactive multimedia based on project-based learning on the topic of human respiratory system to improve the creativity and independent learning of junior high school students in science.

The selection of interactive multimedia in

this research and development of interactive multimedia is due to its several advantages, including being easy to use and repeatable, which can enhance student creativity. In addition, with the presence of materials, animation videos, quizzes, and virtual laboratories in the project-based learning interactive multimedia, it is hoped that it can facilitate students in self-studying the material on the human respiratory system for eighth-grade junior high school in the even semester.

METHOD

This research used a quantitative methodology of the Pre-Experiment type with a One Group Pretest-Posttest design. This research design is carried out by providing treatment to one group or class that is not randomly selected (Abdullah, K. et al., 2021). The class is called an experimental class. The population of this research is the eighth-grade students of MTs Negeri Kota Depok. The sample used in this research consists of 32 students selected using purposive sampling techniques, which is a sampling technique based on specific considerations with the results of the researcher's analysis related to the problems that match real conditions in the field.

Table 1. One group pretest-posttest research design

Pretest	Treatment	Posttest
O_1	X	O_2

Explanation:

O_1 : Initial test before treatment (pretest)

X : Treatment using interactive multimedia based on project-based learning

O_2 : Final test after treatment (posttest)

Data collection was carried out through pre-tests and post-tests designed to measure students' learning creativity. The pre-test was given before the intervention, while the post-test was given after intervention (Arikunto, 2010). According to (Kusumawati et al., 2018), there are 4 indicators through which students' learning creativity can be measured, including fluency, flexibility, originality, and elaboration. Data analysis was conducted by calculating the N-Gain for each group where data collection technique used tests, with a total of 10 essay questions. N-Gain is calculated using the average N-gain formula.

$$\langle g \rangle = \frac{\langle S_f \rangle - \langle S_i \rangle}{100\% - \langle S_i \rangle}$$

Explanation:

$\langle g \rangle$: N-gain factor

$\langle S_i \rangle$: Average score of students' creativity pretest

$\langle S_f \rangle$: Average score of students' creativity posttest

The level of effectiveness of interactive multimedia based on project-based learning to increase student creativity is seen according to the criteria of the n-gain score as in the Table 2.

Table 2. N-gain scale

N-gain score	Criteria
$0.70 < g \leq 1.00$	High
$0.30 < g \leq 0.70$	Medium
$0.00 < g \leq 0.30$	Low

Table 2 shows the assessment criteria for students' learning creativity based on the N-gain scores obtained. Scores between 0.00 and 0.30 fall into the low category, indicating that the level of students' learning creativity is still limited. Scores between 0.30 and 0.70 are categorized as moderate, depicting a fairly good level of students' learning creativity, but still capable of improvement. Meanwhile, scores between 0.70 and 1.00 are classified as high, indicating a very good level of students' learning creativity and a tendency to generate more innovative and diverse ideas. The determination of these categories provides a clear picture of levels of students' learning creativity.

RESULT AND DISCUSSION

This research was conducted to determine the effectiveness of using interactive multimedia based on project-based learning on the human respiratory system material implemented in class VIII F MTs Negeri Kota Depok to enhance learning creativity. The research was carried out in one class with a total of 32 students. The instruments used were pretests and posttests containing 10 essay questions. The pretest was administered before the students engaged in learning activities, then the students participated in learning activities using interactive multimedia based on project-based learning, and afterward, the students took a posttest that contained the same questions as the pretest.

The results of this study were obtained from data collected through two data collection processes (pretest and posttest). In the pretest phase, students were asked to answer 10 essay questions about the human respiratory system. This was intended to determine the basic abilities of the students before receiving any treatment.

After obtaining the baseline score, students were given treatment by undergoing a learning process that implemented learning using interactive multimedia based on project-based learning.

Figure 1. Interactive multimedia display based on project based learning

In the learning process, students also prepare laboratory reports after conducting experiments on making simple breathing devices based on virtual experiments in interactive multimedia as shown in Figure 1. Then, to supplement the research data, students are given a post-test. This action is taken to see the extent of the students' understanding after learning using interactive multimedia based on project based learning. Subsequently, after all the data is collected, it is analyzed statistically using SPSS.

The results of the normality test of creativity data using the Shapiro-Wilk statistic show that the Sig. values are normally distributed. The results of the normality test on aspects of creativity indicate that the aspects of flexibility, fluency, and originality have normally distributed N-gain data. Furthermore, in the aspect of detail, the N-gain data distribution is not normally distributed. Therefore, the N-gain data for the creativity variable and the aspects of flexibility, fluency, and originality meet the normality assumption, so an independent t-test is used. Meanwhile, the aspect of detail does not meet the normality assumption, so the Mann-Whitney U test is used.

Table 3. Results of the normality test of N-gain

	Shapiro-Wilk			Description
	Statistic	Df	Sig.	
Creativity	0.957	32	0.222	Normally distributed
Flexibility	0.937	32	0.061	Normally distributed
Fluency	0.965	32	0.373	Normally distributed
Elaboration	0.827	32	0.000	Not normally distributed
Originalitiy	0.956	32	0.213	Normally distributed

Homogeneity tests were conducted on the creativity variable, as well as the aspects of fluency and originality (which met the normality assumption). For data that did not meet the normality assumption, homogeneity tests were not conducted because the difference test was performed with a non-parametric approach.

Table 4. Homogeneity Test Results

	Statistic	df_1	df_2	Sig.	Description
Creativity	14.456	1	62	0.000	Heterogen
Fluency	1.376	1	62	0.245	Homogen
Originality	0.332	1	62	0.567	Homogen

Based on Table 4, the homogeneity test for N-gain creativity obtained a Sig. value of less than 0.05, which means the variances of the data in the two groups are different or heterogeneous. Meanwhile, for the fluency and originality aspects, it obtained a Sig. value of more than 0.05, which means the variances of the data in the two groups are the same or homogeneous. Therefore, the independent sample t-test on creativity is conducted with the assumption of equal variances not being met, while the independent sample t-test is. Independent t-test with the assumption of equal variances not met presented in Table 5.

Table 5. Results of the Independent t-test Creativity

	T	Df	Sig. (2-tailed)	Description
Creativity	13.054	45.497	< 0.001	There is a significant difference

Independent t-test with the assumption of equal variances met.

Table 6. Results of the Independent t-test

	T	Df	Sig. (2-tailed)	Description
Fluency	7.095	62	< 0.001	There is a significant difference
Originality	7.964	62	< 0.001	There is a significant difference

Based on the Table 5 and 6, the results of the independent t-test obtained a Sig. value of less than 0.05, which means that there is a significant difference in the increase of creativity, as well as fluency and originality between the experimental class and the control class.

Table 7. Mann-Whitney U Test Results

	Mann-Whitney U	Z	Asymp. Sig. (2-tailed)	Description
Flexibility	290.5	-3.080	0.002	There is a significant difference
Elaboration	73.5	-5.961	< 0.001	There is a significant difference

Based on Table 7, the results of the Mann-Whitney U test obtained an Asymp. Sig. value of less than 0.05, which means there is a significant difference in the improvement of flexibility and detail aspects between the experimental class and the control class.

Table 8. The results of the N-gain calculation

Aspect	Score		N-gain	
	Pre	Post	Average	Criteria
Flexibility	1.47	3.05	0.62	Medium
Fluency	1.30	2.47	0.70	High
Elaboration	1.78	3.56	0.81	High
Originalitiy	1.33	3.28	0.72	High
Creativity	1.44	3.26	0.71	High

The results of the pretest and posttest trials conducted to determine and observe student learning outcomes show that there was an improvement before and after the treatment was given, proven by the average pretest score of 36.015625 and the average posttest score of 81.5625. Based on Table 8, the experimental class that applied interactive multimedia based on project-based learning showed an increase in the average learning creativity score from 1.44 to 3.26. The average N-gain score of creativity in the experimental class is 0.71, which falls into the high criteria.

the treatment using interactive multimedia based on project-based learning in the learning process has a better impact on students' learning creativity compared to before the treatment was given. In using interactive multimedia based on project-based learning, students not only learn from theory but also from practical experience in completing projects in the form of a virtual laboratory for creating simple respiratory devices. By utilizing interactive multimedia, the learning process becomes more interactive and enjoyable, contributing to the enhancement of students' learning creativity (Berliana, S. et al., 2025; Maghfiroh, A. N. et al., 2024).

Based on the results of the analysis of the test data given to students as a whole, it shows that the 4 aspects of student learning creativity, namely fluency, flexibility, originality, and elaboration, each have different ranges of N-gain scores. Fluency is the students' ability to pose many questions, flexibility is the ability to find solutions from different perspectives, originality is the ability to generate their own ideas, and elaboration is the ability to detail the specifics of an object, idea, or situation. These indicators can be used to differentiate the levels of creativity between one student and another. In solving the problems they face, student creativity plays an important role (Ernawati et al., 2019; Adeoye, M. A., & Jimoh, H. A., 2023; Fredagsvik, M. S., 2023).

The aspect of detail has the highest average N-gain of 0.81, where students are able to seek a deeper meaning in their answers or problem-solving by following detailed steps. The aspect of detail is very effective when used to answer various questions, whether in open-ended or closed forms. Elaboration also helps students to remember and understand the material used to answer question (Wahyuni, D., & Palupi, B. S., 2022; Rahayu, P. et al., 2024; Nwokocha, G. C. 2024).

The aspect of flexibility has the lowest average N-gain of 0.62 with moderate criteria, where students are still unable to apply a concept or principle in various ways and are still lacking in considering situations different from those presented by others. Some students can generate ideas that are varied and can view problems from different perspectives, enabling them to solve existing problems. However, some other students do not understand the purpose of the problem, so they can only find one way to solve it. According to Indartiningsih, D. (2024) dan Rima, R. et al., (2024) problem-solving skills enable students to generate new ideas, answers, or questions and view problems from different perspectives.

The aspect of fluency has an average N-gain of 0.70 with high criteria, as most students can explain the problems and generate many ideas, answers, and solutions to those problems. In this case, students are able to express their ideas fluently and smoothly in solving problems. This is in line with the opinion of Sudarwati, T., (2024); Azizah, L. N., & Wulandari, F. E., (2024); Sari, D. I., & Isnawati, I., (2025) that the fluency indicator shows that students are able to quickly and accurately generate ideas, or ideas that stem from their own thoughts.

The aspect of originality has an average N-gain of 0.72 with high criteria, indicating that students are able to provide new and unique solutions to the problems presented. The ideas generated are usually innovative, creative, and of-

ten have not been thought of before; this aspect reflects the courage to think unconventionally (Irman, I. et al., 2025; adová, L. et al., 2024; Sawyer, R. K., & Henriksen, D. 2024).

From the four indicators of fluency, flexibility, originality, and elaboration, the application of interactive multimedia based on project-based learning shows an increase in student creativity with an average N-gain of student learning creativity of 0.71, which is considered high. Thus, students not only fluently express ideas and concepts in problem-solving but also they are able to elaborate on each of these ideas during problem-solving. Therefore, the implementation of interactive multimedia based on project-based learning on the material of the human respiratory system for class VIII F at MTs Negeri Kota Depok is optimally carried out to enhance student learning creativity.

In the process of learning, the application of the project-based learning model has a significant impact on students' ability to enhance their creative thinking skills, because by applying a project-based learning approach, students are highly motivated to solve problems through problem-solving (Azzahra et al., 2023). The implementation of Project Based Learning in enhancing the creativity of students and college students shows that learning using project-based learning is capable of exploring creativity and creative thinking skills Zakiah, N. E. et al., 2020; Amriani, S. D. et al., 2024; Mutia, T. et al., 2025).

According to the opinion of (Murray et al., 2020; Hidayatullah, A. S., 2025; Nikmah, S., & Widiyanti, I. S. R., 2025) Project-based learning involves the role of the teacher as a facilitator who guides students in the processes of reflection, research, and practical application of knowledge. In Project-Based Learning, students are not just involved in learning using interactive multimedia and projects designed by the teacher, such as creating a human respiratory system model, but are also given space to explore, design, and assemble their own projects. Students are also taught about responsibility for the tasks assigned and how to work cohesively in a group to complete a project. Each group member has collaborated in completing the task.

This research serves as a foundation for the development of more innovative, creative, and adaptive learning media. However, this research has several limitations, namely that the multimedia used is limited to only one main topic, which is the human respiratory system, and there is a lack of characteristics of interactive multimedia based on project-based learning. In this regard, it is hoped that there will be further research that focuses more on the characteristics of the multimedia used, similar research needs to be developed on different topics and educational levels, and it should also be linked to the development of other 21st century skills such as digital literacy, self-directed learning, and critical thinking.

CONCLUSION

Based on the results of the analysis and discussion, it can be concluded that there is a significant difference between the average scores obtained, namely the average pretest score of 36.015625 and the average posttest score of 81.5625. The n-gain test result is 0.712, which is classified as high according to the n-gain criteria, and the n-gain percentage of 71.2 is categorized as quite effective. This indicates that the use of interactive multimedia based on project-based learning is effective for the learning creativity of class VIII F MTs Negeri Kota Depok.

REFERENCES

Abdullah, K., Jannah, M., Aiman, U., Hasda, S., Fadilla, Z., Taqwin, Masita, Ardiawan, K. N., Sari, M. E. (2021). *Metodologi Penelitian Kuantitatif*. Aceh: Yayasan Penerbit Muhammad Zaini.

Adeoye, M. A., & Jimoh, H. A. (2023). Problem-solving skills among 21st-century learners toward creativity and innovation ideas. *Thinking Skills and Creativity Journal*, 6(1), 52-58.

Amriani, S. D., Uzzakah, I., Prakoso, R. A., Sabella, P. A., Surur, M., & Agusti, A. (2024). Analisis penerapan model pembelajaran project based learning (PjBL) untuk meningkatkan kreativitas siswa. *Jurnal Kajian Penelitian Pendidikan dan Kebudayaan*, 2(2), 13-25.

Anggraeni, A. R., Anugrahana, A., & Ariyanti, P. B. Y. (2023). Penerapan model pembelajaran Project Based Learning terhadap kreativitas siswa dengan menggunakan bahan alam pada kelas 1 SD Negeri Plaosan 1. *Jurnal Pendidikan Tambusai*, 7(1), 3683-3690.

Angraini, L. M., Arcat, A., & Sohibun, S. (2022). Pengaruh Bahan Ajar Berbasis Multimedia Interaktif terhadap Kemampuan Computational Thinking Matematis Mahasiswa. *JNPM (Jurnal Nasional Pendidikan Matematika)*, 6(2), 370-383.

Arikunto, S. (2010). *Prosedur Penelitian Suatu Pendekatan Praktik*. Jakarta: Rineka Cipta.

Azizah, L. N., & Wulandari, F. E. (2024). Pengaruh Project Based Learning Berbasis Kearifan Lokal terhadap Berpikir Kreatif Siswa Kelas VIII SMP Negeri 6 Kota Mojokerto. *Intelektualitas Jurnal Penelitian Lintas Keilmuan*, 1(1), 1-14.

Azzahra, U., Arsih, F., & Alberida, H. (2023). Penga-

ruh Model Pembelajaran Project-Based Learning (Pjbl) Terhadap Keterampilan Berpikir Kreatif Peserta Didik Pada Pembelajaran Biologi : Literature Review. *BIOCHEPHY: Journal of Science Education*, 3(1), 49–60.

Berliana, S., Ismaya, E. A., & Wijyanto, W. (2025). Media Interaktif Berbasis Digital Sebagai Peningkatan Kreativitas Peserta Pada Pembelajaran IPAS. *Jurnal Pendidikan Inovatif,* 7(2).

Adová, L., Stíbrný, J., & Sládek, P. (2024). Leadership In The Digital Age: Navigating Complexity Through Critical Thinking, Creativity, and Unconventional Approaches. *Ad Alta: Journal of Interdisciplinary Research*, 14(1).

Dewi, S. L., Asri, I. A. S., & Ganing, N. N. (2020). Pengaruh Model Pembelajaran Quantum Teaching Berbantuan Multimedia Terhadap Kompetensi Pengetahuan IPA. *Jurnal Penelitian Dan Pengembangan Pendidikan*, 4(2), 316-324.

Ernawati, M. D. W., Damris, M., Asrial, & Muhaimin. (2019). Development of Creative Thinking Skill Instruments for Chemistry Student Teachers in Indonesia. *Internasional Journal of Online and Biomedical Engineering,* 15(14), 21-30.

Fenanlampir, A., Unmehopa, W., Leasa, M., & Batlolona, J. R. (2023). Pelatihan Penyusunan Perangkat Pembelajaran Berbasis Strategi HPC dalam Mendukung Keterampilan Hidup Abad 21 di SD Negeri Negeri Lama, Kota Ambon. *AJAD: Jurnal Pengabdian kepada Masyarakat*, 3(3), 255-263.

Fitriani, A. A., Ulfa, S., & Adi, E. P. (2020). Pengembangan Video Pembelajaran Animasi Sistem Pernapasan Manusia Sebagai Upaya Mendukung Kebijakan Belajar Di Rumah Article History. *Jurnal Kajian Teknologi Pendidikan*, 3(3), 303–316.

Fredagsvik, M. S. (2023). The challenge of supporting creativity in problem-solving projects in science: a study of teachers' conversational practices with students. *Research in Science & Technological Education,* 41(1), 289-305.

Hidayatullah, A. S., Masnur, M., & Jabri, U. (2025). Pengaruh Model Pembelajaran Project Based Learning terhadap Kemampuan Berpikir Kritis Siswa pada Pembelajaran IPA di UPT SDN 8 Pinrang. *Jurnal Pelita: Jurnal Pembelajaran IPA Terpadu*, 5(1), 21-30.

Indartiningsih, D. (2024). Kemampuan Berpikir Kreatif Matematis. *Saluky (Ed.), Kemampuan Matematis*, 133-146.

Irman, I., Surahman, E., Agustian, D., Herawati, D., & Badriah, L. (2025). Profil Kemampuan Berpikir Kreatif Peserta Didik dalam Pembelajaran IPA. *Jurnal Pendidikan MIPA*, 15(1), 60-67.

Kusumawati, E. D., Yennita, & Syahril. (2018). Capability Thinking Ability Analysis Students Class XI-MIA SMA Negeri 1 Pekanbaru on Physical Latest Eye. *Jom Fkip*, 5(1), 1-13.

Lailiyah, N., & Sukartiningsih, W. (2018). Pengembangan Media Pembelajaran Interaktif Berbasis Flash Untuk Pembelajaran Keterampilan Menuliskan Kembali Cerita Siswa Kelas IV SD. *Jurnal Penelitian Pendidikan guru Sekolah Dasar,* 6(7), 1150-1159.

Madona, A. S., Pebriyenni, P., Dasfitri, E., Yuza, A., & Rosyid, F. E. (2023). Penggunaan Media Pembelajaran Keragaman Budaya Nasional Berbasis Multimedia Interaktif: Respon Guru dan Siswa Sekolah Dasar Islam Terpadu pada Implementasi Kurikulum Merdeka. *Jurnal Pendidikan Agama Islam Al-Thariqah,* 8(2), 329-347.

Maghfiroh, A. N., Daksana, M. F. E. H., & Salma, S. N. (2024). Efektivitas penggunaan media pembelajaran interaktif dalam pembelajaran matematika di sekolah dasar. *Griya Journal of Mathematics Education and Application*, 4(1), 55-64.

Maknun, D., Genisa, M. U., Pamungkas, T., Hernawati, K., Purnomo, J., Khikmawati, M. N., & Tamimuddin, M. (2018). *Sukses Mendidik Anak Di Abad 21*. Yogyakarta: Samudra Biru.

Melianti, E., Risdianto, E., & Swistoro, E. (2020). Pengembangan media pembelajaran berbasis multimedia interaktif menggunakan macromedia director pada materi usaha dan energi kelas X. *Jurnal Kumparan Fisika*, 3(1 April), 1-10.

Murray, L., Giralt, M., & Benini, S. (2020). Extending digital literacies: Proposing an agentive literacy to tackle the problems of distractive technologies in language learning. *ReCALL*, 1-22.

Mutia, T., Suharto, Y., Sahrina, A., Wahyudi, A., Atmaja, M. A. R., & Aprilia, R. (2025). Efektivitas E-Modul Interaktif Berbasis Project Based Learning Terhadap Kemampuan Berfikir Kreatif Siswa. *Geodika: Jurnal Kajian Ilmu dan Pendidikan Geografi*, 9(1), 42-51.

Nababan, D., Marpaung, A. K., & Koresy, A. (2023). Strategi pembelajaran project based learning (PJBL). *Jurnal Pendidikan Sosial dan Humaniora,* 2(2), 706-719.

Nadzif, M., Irhasyuarna, Y., & Sauqina, S. (2022). Pengembangan Media Pembelajaran Interaktif IPA Berbasis Articulate Storyline Pada Materi Sistem Tata Surya SMP. *Jupeis: Jurnal Pendidikan Dan Ilmu Sosial*, 1(3), 17-27.

Nata, I. K. W., & Putra, D. K. N. S. (2021). Media Pembelajaran Multimedia Interaktif pada Muatan IPA Kelas V Sekolah Dasar. *Jurnal Ilmiah Pendidikan Dan Pembelajaran*, 5(2), 227-237.

Nikmah, S., & Widiyanti, I. S. R. (2025). Efektifitas Model Project Based Learning Berbantuan Video Pembelajaran Terhadap Hasil Belajar IPAS Materi Organ Pernapasan Manusia dan Fungsinya Kelas 5 Sekolah Dasar Negeri Watupecah Rembang. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, 10(02), 409-424.

Nwokocha, G. C. (2024). The influence of fieldtrip as a practical skill acquisition technique in biology education. *Asian Journal of Education and Social Studies*, 50(6), 269-279.

Partono, P., Wardhani, H. N., Setyowati, N. I., Tsalitsa, A., & Putri, S. N. (2021). Strategi meningkatkan kompetensi 4C (critical thinking, creativity,

communication, & collaborative). *Jurnal Penelitian Ilmu Pendidikan*, 14(1), 41-52.

Pratiwi, T. A., Wardana, M. Y. S., & Purnamasari, I. (2023). Keefektifan Model Project Based Learning Berbantu Media Replika Sistem Pencernaan Manusia Terhadap High Order Thinking Skills Siswa Kelas V SD Negeri 1 Ngasem Jepara. *Pena Edukasia*, 1(2), 135-144.

Putranadi, K., Wahyuni, D. S., & Agustini, K. (2021). Pengembangan Media Pembelajaran Struktur Pernapasan Dan Ekskresi Manusia Untuk Kelas Xi Ipa Di Sma Negeri 2 Singaraja. *KARMAPATI (Kumpulan Artikel Mahasiswa Pendidikan Teknik Informatika*), 10(3), 300-310.

Rahayu, P., Saridewi, N., & Herpi, A. N. (2024). Pengaruh Metode Pembelajaran Bermain Peran terhadap Kemampuan Berpikir Kreatif Siswa pada Materi Koloid. *Jurnal Pendidikan*, 25(1), 20-29.

Rima, R., Yuhana, Y., & Fathurrohman, M. (2024). Perspektif kemampuan berpikir kritis dalam pembelajaran Bahasa Inggris sebagai Bahasa Asing. *JIIP-Jurnal Ilmiah Ilmu Pendidikan*, 7(1), 754-763.

Rohimah, R., Wulandari, A. Y. R., Qomaria, N., Sutarja, M. C., & Rosidi, I. (2023). Pengembangan multimedia interaktif berbasis web pada materi pengukuran besaran dan satuan. *Natural Science Education Research (NSER*), 6(2), 103-114.

Sari, D. I., & Isnawati, I. (2025). Penerapan Model Pembelajaran Problem Based Learning Untuk Meningkatkan Keterampilan Berpikir Kreatif Siswa Kelas X SMAN 3 Pamekasan Pada Pembelajaran Biologi. *Jurnal Asimilasi Pendidikan*, 3(2), 90-99.

Sawyer, R. K., & Henriksen, D. (2024). *Explaining creativity: The science of human innovation*. Oxford university press.

Setiawan, Z., Pustikayasa, I. M., Jayanegara, I. N., Setiawan, I. N. A. F., Putra, I. N. A. S., Yasa, I. W. A. P., & Gunawan, I. G. D. (2023). *Pendidikan Multimedia: Konsep dan Aplikasi pada era revolusi industri 4.0 menuju society 5.0*. PT. Sonpedia Publishing Indonesia.

Sudarwati, T. (2024). *Analisis Kreativitas Siswa Dalam Pemecahan Masalah Matematika Berdasarkan Gaya Kognitif Siswa*. Artikel Matematika.

Suparsawan, I. K. (2020). *Kolaborasi Pendekatan Saintifik dengan Model Pembelajaran STAD Geliatkan Peserta Didik*. Tata Akbar.

Suryadi, A. (2020). *Teknologi dan media pembelajaran jilid i.* CV Jejak (Jejak Publisher).

Trisnawati, W. W., & Sari, A. K. (2019). Integrasi Keterampilan Abad 21 dalam Modul Sociolinguistics: Keterampilan 4C (Collaboration, Communication, Critical Thinking, Dan Creativity). *Jurnal Muara Pendidikan*, 4(2), 455–466.

Topano, A., Asiyah, A., & Revola, Y. (2022). Peningkatan Aktivitas Belajar Mahasiswa Melalui Media Pembelajaran IPA Berbasis Multimedia Interaktif. *Jurnal Basicedu*, 6(3), 5423-5434.

Wahyuni, D., & Palupi, B. S. (2022). Analisis kemampuan berpikir kreatif matematis siswa kelas V sekolah dasar melalui soal open-ended. *Jurnal Kiprah Pendidikan*, 1(2), 76-83.

Winardi, A. (2016). Pengembangan Media Komik Pembelajaran Matematika untuk Meningkatkan Kemampuan Menganalisis pada Materi Pecahan Siswa Kelas V SDN Tarokan 1 Ajaran 2016/2017.

Zakiah, N. E., Fatimah, A. T., & Sunaryo, Y. (2020). Implementasi Project-Based Learning Untuk Mengeksplorasi Kreativitas dan Kemampuan Berpikir Kreatif Matematis Mahasiswa. *Teorema: Teori Dan Riset Matematika*, 5(2), 286.