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Design And Development of Gens (Google Sites Fun Physics) Integrated with Artificial Intelligence as An Innovative Physics Learning Platform to Improve Conceptual Mastery

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Abstract: The development of the GENS (Google Sites Fun Physics) media integrated with artificial intelligence to improve concept understanding aims to develop learning media that meets the criteria of feasibility, namely valid, practical, and effective. The research was conducted at SMA Negeri 1 Tinambung with the research subjects being class X.6, comprising a sample of 32 students in the first semester of 2025/2026. Based on the analysis results, the Google Sites fun physics learning media is in the very valid category with a percentage of 90.8%, as measured by expert validator assessments. It is also in the very practical category with a cumulative percentage of 89.72%, based on student response assessments of 83.74% and teacher responses of 95.71%. The media is in the effective category with a moderate level and an N-gain value of 0.6. Therefore, it is recommended that physics teachers use the Google Sites Fun Physics learning media integrated with artificial intelligence to improve students' understanding of physics concepts.

Keywords: Artificial intelligence; Concept understanding; Google sites; Learning media; Physics

Introduction

Most students find it difficult to understand abstract physics concepts (Ekici, 2016). Due to its abstract nature, students find it difficult to understand concepts and apply formulas in everyday life. Furthermore, the average score of Indonesian students in science is 383 points, far below the OECD (Organisation for Economic Co-operation and Development) average of 485 points; only 18% of Indonesian students reach proficiency level (S., R., & A., n.d.). This indicates that there is still much work to be done in improving the understanding and application of physics concepts among Indonesian students. Further efforts are needed in developing more effective and innovative teaching methods so that students can more easily understand abstract physics concepts. In addition, the role of teachers is also very important in guiding and providing a good understanding to students so that their achievements in the field of physics can improve.

In the 21st century, teachers are required to be able to utilize new technologies (Fang, Prakob, & Timothy, 2023). With the rapid development of technology, teachers must be able to utilize various digital tools and applications that can make physics learning more engaging and interactive. With the proper use of technology, teachers can create a more enjoyable learning experience for students. Through various digital tools and applications, physics learning can become more interactive and adaptive, aligning with current technological advancements. This can help improve students' performance in physics and create a learning environment that is more relevant to the ever-evolving digital world (Ravinder, 2025). Therefore,

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teachers need to continue developing their ability to utilize new technologies to improve the quality of physics learning.

From the perspective of teaching material availability, it turns out that teachers in the teaching and learning process still use textbooks, student worksheets (LKS), and PowerPoint as their primary learning media (Endah, Mawardi, & Yari, 2025). However, to ensure more effective and engaging physics learning, teachers need to start considering the use of more advanced technologies such as computer-based physics simulations, interactive learning videos, and e-learning platforms (Muhammad, Muhammad, Muhammad, & Muhammad, 2019). By utilizing this technology, teachers can create a more enjoyable learning experience and make it easier for students to understand abstract physics concepts. Additionally, by integrating technology into physics learning, teachers can also help students develop digital skills that are highly needed in this digital age.

The teacher's teaching and learning patterns have been conventional so far, focusing on teaching materials and not yet utilizing technology in learning (Japhet & Usman, 2018), making students less interested in physics lessons, resulting in less than optimal student learning outcomes.

Google Sites is a web-based tool that allows users to create and share websites easily. It offers a variety of features, such as drag-and-drop editing, customizable templates, and integration with other Google services like Google Drive. This platform has the potential to revolutionize the way physics is taught by providing a more interactive and engaging learning experience for students. By incorporating Google Sites into the teaching process, educators can create dynamic and multimedia-rich content that caters to different learning styles and keeps students actively engaged in the learning process (Mantasiah, 2025).

AI technology has the ability to personalize learning experiences for students, providing them with individualized instruction and feedback (Oyebola, Nancy, Onyebuchi, Blessing, & Ololade, 2024) . This can help educators better understand their students' strengths and weaknesses, allowing them to tailor their teaching methods accordingly. Additionally, AI can help identify areas where students may be struggling and provide targeted support to help them improve. Overall, the integration of AI in education has the potential to greatly enhance the learning experience for students and help them reach their full potential.

By incorporating AI into the classroom, educators can create interactive simulations and virtual labs that allow students to explore physics principles in a hands-on way (Yang, 2025). This not only makes learning more engaging and enjoyable for students, but also helps them develop a deeper understanding of the material.

The use of AI in the learning process has been researched in recent years. Providing alternative learning access for students from diverse backgrounds can improve learning outcomes in physics (Sdenka, Kejiang, & Jun, 2022). Another researcher developed an AI-assisted teaching module that produced highly feasible teaching media suitable for use by students and teachers as support in the learning process (Malakul, 2025). Another development is creating contextual learning media, but students still struggle to connect theory to practical application (Ayu, Syifa'ul, Baiq, & Habibi, 2024).

On the other hand, AI-integrated learning systems are able to enhance students' critical and creative thinking in physics learning (Siti, Bachtiar, Vina, Eko, & Tri, 2025). However, the use of technology and technological literacy in learning is still very poorly mastered by teachers in Indonesia (Zainal, Farid, & Muhammad, 2021), while teachers must be able to implement learning tools integrated with the Era Society. 5.0. Thru the utilization of AI, it is hoped that active student participation can be increased.

To date, the development of physics learning media has successfully created text-based, image-based, video-based, and evaluation-based features. However, none of them yet provide a contextual physics experiment simulation feature. Therefore, this basic research study is proposed to develop an AI-integrated Google Sites Fun Physics learning media that presents physics concepts physically by displaying simulation videos. Thus, physical concepts can be observed directly, seen, touched, or measured, making learning more engaging and motivating students. Therefore, the purpose of this research is to develop GENS (Google sites Fun Physics) media integrated with artificial intelligence to improve valid, practical, and efficient understanding of physics concepts.

Method

This research was conducted using the Research and Development method. (R&D). Research and development is a research method used to produce a product and test its feasibility (Sagun & Ram, 2021). The development model in this R&D research uses the Four-D development model. (4D). This development research, based on the 4D model, is easier to apply in the development of learning media. Thiagarajan states that the steps of the 4D model consist of Define, Design, Development, and Dissemination (Hamsa, 2014). This can be illustrated in Figure 1.

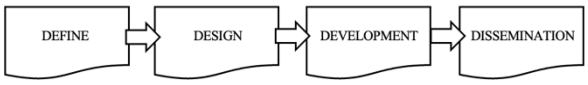

Figure 1. Research and Development Steps for the 4D Model

In the 4D model shown in the image above, there is still a breakdown of the steps for each of the four stages. As research conducted (Madhar, 2025) describes the stages of the 4D model in Figure 2.

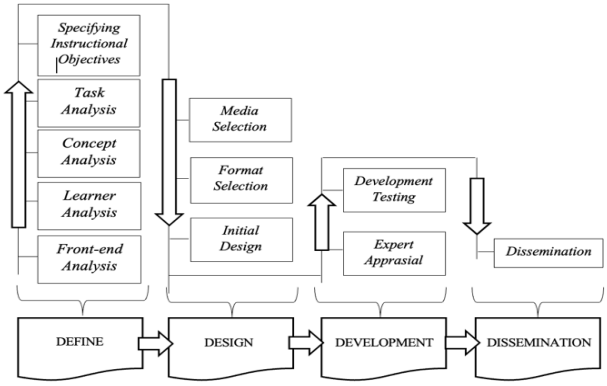

Figure 2. Research Design Diagram

Define.

Definition is the initial step in this research, involving observation at the school regarding learning conditions. At this stage, what needs to be considered are the issues in learning, such as students' low conceptual understanding due to the use of learning media that are not engaging for them. This stage consists of several steps as follows:

Front-end analysis. This first step aims to identify and establish the fundamental problems faced in the learning process, thus necessitating learning media. At this stage, observations are made to identify problems in physics learning.

Learner analysis. This stage aims to analyze the characteristics of the students. This student analysis is based on the students' cognitive abilities, individual or group skills they possess, and which can be developed to achieve the established learning objectives. At this stage, interviews were conducted with several students regarding their understanding of physics.

Concept analysis. This stage aims to identify the core concepts taught to the students (Sri, Joko, Bowo, Sri, & Chandra, 2023). At this stage, core competencies and basic competencies are analyzed as a reference for assigning tasks to students.

Dask analysis. At this stage, the aim is to identify the key skills that will be examined by the researcher. In this case, in order for students to achieve the minimum competency set, educators must analyze the core tasks that students need to master (Michael & Bimal, 2017).

Specifying instructional objectives. In this step, the research objectives are formulated to summarize the results of the previous analysis . This collection of summaries serves as the basis for developing learning media that can be used as a solution to overcome physics problems (Nur, Nasruddin, Andri, & Agus, 2023).

Design.

In the design stage or the second stage, the researcher begins to design the learning media by following the following steps:

Media selection. At this stage, media is selected based on the problems that have occurred. Based on the observation results, it shows that the lack of use of engaging learning media for students leads to poor concept understanding among students (Madhar, 2025). This multimedia learning development is expected to be able to overcome these problems.

Format selection. The selection of format in the development of learning materials is intended to design or create learning (Nurrohmatul. & gogical, 2023) . At this stage, the researcher has learned that in the learning process, students need interesting and technology-based learning media. Therefore, learning media using Google Sites was developed. Google Sites was chosen as a physics learning medium because it is easy to use and engaging for students, and also because it is easy for teachers to develop. The developed Google Sites will be integrated with artificial intelligence and will consist of text, image, video, animation formats, the Quizizz platform, and Google Forms for attendance.

In the learning media developed, the google sites fun physics will consist of several menus, namely the main page, learning identity, attendance, materials, assessments, and practicum. These menus will be on different pages, making them more organized and easier for users to access according to their needs. (1) Main page: displays an image carousel that briefly explains the features of the learning media and encourages learning using Google Sites Fun Physics. The website's menu buttons are visible with a GIF animation, and when clicked, users are directed to the page corresponding to their selection. On this main menu, two characters who will accompany the students in learning using the website will also be introduced. The characters are Azam and Firah, and finally, on the main page, there is a button that will direct you to the usage instructions page. (2) Usage instructions: designed to display parts of Google Sites to make it easier for students and teachers to use Google Sites. It also includes a description of each section to clarify the function and use of the parts available on Google Sites. (3) Learning Identity: Consists of Core Competencies (KI) and learning objectives. (4) Attendance: Students can take attendance thru Google Forms at each meeting.

(5) Learning Material: Measurement material is displayed, with each subtopic divided into several pages for better organization. Each discussion will be accompanied by learning videos and animated videos. (6) Virtual laboratory menu: students can access an online laboratory, which is an Olabs simulation integrated with artificial intelligence. This menu will also include practical work instructions and student worksheets to make it easier for students to conduct practical activities. (7) Learning assessment: presented with tasks to be completed. Two tasks will be presented, separated into two different pages that can be selected by clicking the buttons displayed on this page.

Initial design. At this stage, the researcher begins designing physics learning multimedia using Google Sites, which will serve as the product of this research. The designed multimedia was made as engaging and easy to understand as possible, thus meeting the criteria for feasibility.

Development.

The development stage is the stage for producing a product thru revisions based on expert validation feedback and product testing. The steps in this stage are as follows:

Expert appraisal. This stage aims to identify the shortcomings of the designed product (Michael, Jeffrey, & Jack, 2017). The product validity test was conducted using a questionnaire provided by the researcher and completed by a team of media experts consisting of two lecturers from the Physics Education Study Program, Faculty of Teacher Training and Education, West Sulawesi University, and one teacher.

Developmental testing. At this stage, field testing is conducted on the students after revisions have been made (Ardian, 2021). The purpose of this field trial is to identify product shortcomings for revision before widespread distribution. Revisions come from student responses, reactions, and comments. This aims to analyze the feasibility of the product produced.

Dissemination.

At this stage, the multimedia learning materials are widely disseminated, which involves sharing this GENS (Google Sites Fun Physics) learning media with several high school teachers. (SMA). Beside being distributed to physics teachers, the learning multimedia was also distributed to students in the Physics Learning Media course within the Physics Education Study Program, Class of 2024, at West Sulawesi University.

This research will be conducted at SMA Negeri 1 Tinambung. The research will be conducted in the first semester of the 2025/2026 academic year. The subjects of this research are the students of class X.6. The selection of class X.6 as the research subject was due to the initial observations being conducted to adjust to the class. Research instruments are tools used in data collection. It is said that media meets its eligibility when it fulfills three criteria: it is valid, practical, and effective (Aprilia & Tri, 2024) . To measure validity, a questionnaire for media expert validation was used as an instrument, which was filled out by a team of media experts. To measure practicality using a practicality questionnaire filled out by students and teachers. Meanwhile, to measure effectiveness, a physics concept understanding test is used.

Result and Discussion

Development of the GENS (Google Sites Fun Physics) media integrated with artificial intelligence to improve understanding of physics concepts at SMA Negeri 1 Tinambung using the 4D model, which consists of Define, Design, Development, and Dissemination.

Define.

At this stage, the following 5 steps are taken. Front-end analysis revealed that during the learning process, only conventional learning media such as blackboards and printed books were used. Additionally, it was found that conceptual understanding had implications for physics learning outcomes, which tended to be low.

Learner analysis, at this stage, the results of the interviews with the students. Based on the students' responses, it was concluded that the majority of them do not enjoy learning physics due to the difficulty and boredom in the learning process.

Concept analysis. The researcher selects the measurement material. Core Competencies are determined. 3.2, applying the principles of physical quantity measurement, accuracy, precision, and significant figures, as well as scientific notation and core competencies 4.2, presenting the results of measuring the following physical quantities and their accuracy using appropriate equipment and techniques, and following the rules of significant figures for a scientific investigation.

Task analysis prepared 2 online practical activities using the Olabs simulation platform, namely measuring length using a vernier caliper and a screw micrometer. Specifying instructional objectives, formulating learning objectives includes: students being able to analyze the use of length measuring tools, mass measuring tools, and time measuring tools; determining the value read on the measuring tool according to significant figures; presenting the results of physical quantity measurements following the rules of significant figures; conducting experiments to measure several objects using measuring instruments; and drawing conclusions

from data interpretation in a written report of the work done.

Design.

This stage aims to design the GENS (Google Sites Fun Physics Integrated with Artificial Intelligence) media. This stage consists of three steps as follows:
Media selection. Researchers decided to develop media using Google Sites integrated with artificial intelligence. Google Sites facilitates media development by incorporating text, images, videos, animations, the Quizizz platform, YouTube, and the Olabs platform as a virtual laboratory.
Format selection, at this stage, the researcher compiles the developed learning multimedia. The multimedia learning developed in this study is in the form of a website that can be accessed thru laptop, tablet, or mobile devices. Researchers simply share the access link with students for them to access on their respective devices.
Initial design, at this stage, the GENS learning media is ready to be tested for validity by media experts. The multimedia learning designed is still in its early stages and has not yet been tested on students. After receiving validation from media expert validators, the learning multimedia was tested on students. The parts of instructional multimedia are explained as follows:
Homepage. On the main page display, an animated menu representing the features of the GENS learning media is shown, along with an invitation to learn using the developed website. In this main menu, two characters who accompany the students in their learning are also introduced using the media, namely azam and firah. On each page, you will find interactive buttons to direct users to the next page or return to the previous page.

Figure 3. Homepage GENS

Media Usage. In the media usage section, it is designed to display the GENS menu section to make it easier for students and teachers to use the media. It also includes a description of each part to clarify the function and use of the components found in GENS.

Figure 4. Media Usage GENS

Material. The material menu is designed to display measurement materials, with each subtopic divided into several pages for better organization. Each discussion is accompanied by learning videos, images, and animations to make it easier for students to understand the material. Next, there is a virtual laboratory menu displaying two experiments: one using a vernier caliper and the other using a screw micrometer, complete with student worksheets.

Figure 5. Material menu page design

Development, at this stage, there are two steps, Expert appraisal of Multimedia Learning Validation and Developmental testing. The designed multimedia learning materials were then validated by two lecturers from the Physics Education Study Program at the Faculty of Teacher Training and Education at West Sulawesi University (FKIP Unsulbar) and one teacher. This GENS learning media was used in field trials at SMA Negeri 1 Tinambung. The aspects observed on the learning multimedia validation sheet are as follows: Presentation of Feasibility Media Completeness Design Media Overall Display. The percentages provided by each validator are shown in Table 1.

In the process of validating multimedia learning, there were no suggestions for improvement from the validator. There was only one comment from Validator 1 stating that the developed product is highly suitable for use in research. The three validators assessed that the developed learning multimedia can be used without revision. This indicates that the multimedia learning material was well-developed and met the standards set

by the validators, demonstrating its effectiveness in enhancing the learning experience for students. The positive feedback from the validators highlights the success of the development process in creating a valuable educational resource.

Table 1. Media Validation Results by the Three Validators for Each Aspect

Aspect	Percentage (%)				VC
	V 1	V 2	V 3	R	
Presentation	95.6	91.6	91.6	93.0	VV
Feasibility	87.5	87.5	86.1	87.0	VV
Media Completeness	93.0	91.6	87.5	90.7	VV
Media Design	95.6	90.8	91.6	92.7	VV
Overall View	87.5	92.2	92.2	90.6	VV
Average	91.8	90.7	89.8	90.8	

Developmental testing. In the field trial, 32 students and one physics teacher served as respondents. What was measured in this field trial was the response of students and teachers. The results of the students' and teachers' responses (practicality) can be seen in Table 2 dan Table 3:

Table 2. Results of Student Responses

Aspect	R (%)	Category
Interest in media	81.97	VP
Media Content	81.59	VP
Media Quality	87.67	VP
Average	83.74	

In the student response questionnaire, the aspects measured were interest in the media, which scored 81.97%, media content, which scored 81.59%, and media quality, which scored 87.67%. This indicates that the development of the Google Sites Fun Physics media has been able to elicit a positive response and acceptance from students, with an average score of 83.74%, placing it in the very practical category.

Table 3. Results of Teacher Respons

Aspect	R (%)	Category
Interest in media	97.50	VP
Media Content	95.97	VP
Media Quality	93.67	VP
Average	95.71	

The teacher's response to the development of the Google Sites Fun Physics media also showed positive results. The aspect of interest in the media is at 97.50%, media content at 95.97%, and media quality at 93.67%. From these results, an average of 95.71% was obtained, indicating that this media falls into the very practical category. Additionally, if the responses of both students and teachers are accumulated, the overall development of this Google Sites fun physics media falls into the very practical category for use.

To measure the increase in students' conceptual understanding, an instrument in the form of a Student Conceptual Understanding Test was used, which was administered at the beginning and end of the field trial. The results of the students' improved conceptual understanding are outlined in Figure 6 below

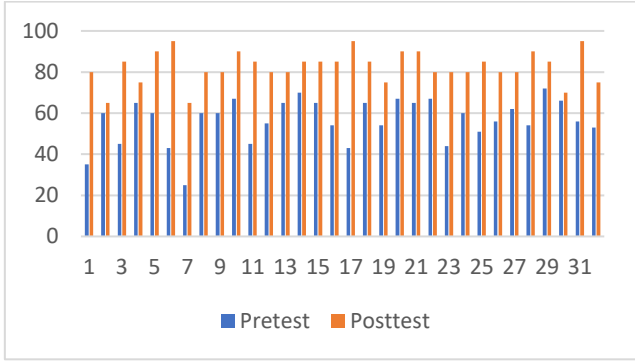

Figure 6. Data on the Improvement of Students' Conceptual Understanding

To measure the effectiveness of multimedia learning in improving students' concept mastery, a concept understanding test is used. Google Sites fun physics is said to be effective if students experience an increase in conceptual understanding after using the learning media, measured using the N-Gain test. In the initial stage of the field trial, a pretest was conducted to determine their learning outcomes before using Google Sites as a learning medium. Then, a posttest is administered after the learning process to measure the extent of the students' learning outcome improvement. Overall, an N-Gain result of 0.6% was obtained, which falls into the moderate category. Based on the N-Gain category table, it can be concluded that the Google Sites Fun Physics media falls into the moderate category and can be categorized as effective for improving students' conceptual understanding.

Google Sites Fun Physics is a learning medium developed based on the principles of multimedia learning development, such as using language that is easy for students to understand, providing an initial introduction to key concepts thru concept maps, breaking down the material into several subtopics, and also using images, videos, and practical activities. Therefore, this learning media is able to reduce cognitive load in learning and also increase students' cognitive engagement. The material presentation is also supplemented with various case studies and real-life applications, enabling students to apply their knowledge in different situations or contexts. Students are no longer passive learners, but actively participate and interact directly with the learning multimedia used.

The use of mutually supportive words and images also helps students understand the material more easily, even complex concepts. Overall, the Google Sites Fun Physics learning media is designed to make it easier for students to learn and understand the material, thereby improving their conceptual understanding.

Conclusion

Based on the analysis of the data obtained, it can be concluded that the GENS (Google Sites Fun Physics) media integrated with artificial intelligence to improve the understanding of the concepts developed has met the eligibility criteria.

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Author Contributions

Conceptualization, M.M. and I.I.; methodology, M.M.; software, I.I.; validation, M.M. and I.I.; formal analysis, M.M.; investigation, I.I.; resources, M.M.; data curation, I.I.; writing—original draft preparation, M.M.; writing—review and editing, I.I.; visualization, M.M.; supervision, I.I.; project administration, M.M.; funding acquisition, I.I. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest

References

Amaliyah, N. (2023). Development of Technological, Pedagogical and Content Knowledge Based Learning Media. *JTP - Jurnal Teknologi Pendidikan*, *25*(1), 107–116. https://doi.org/10.21009/jtp.v25i1.34838

Astuti, M., Arifin, Z., Mutohhari, F., & Nurtanto, M. (2021). Competency of Digital Technology: The Maturity Levels of Teachers and Students in Vocational Education in Indonesia. *Journal of Education Technology*, *5*(2), 254–262. https://doi.org/10.23887/jet.v5i3.35108

Dawadi, Saraswati; Shrestha, Sagun and Giri, Ram A. (2021). Mixed-Methods Research: A Discussion on its Types, Challenges, and Criticisms. *Journal of Practical Studies in Education*, 2(2) pp. 25–36. https://doi.org/10.46809/jpse.v2i2.20

Fang, Prakob, & Timothy. (2023). *Using mobile technologies to teach 21st century learning skills: a study of teachers' acceptance in Thai secondary schools*. International Journal of Mobile Learning and OrganisationVol. 17, No. 1-2, pp 254-279 https://doi.org/10.1504/IJMLO.2023.128343

Hamsa, Akmal and Akidah, ihramsari (2014) *Development Of Model-Based Learning Visual Media Through The Model Four-D Thiagarajan For Expository Writing In Junior High School*. In: International Conference On Mathematics, Science, Technology, Education and their Applications (ICMSTEA) 2014, 20 - 21 Agustus 2014, Makassar.

Henri, M., Johnson, M.D. and Nepal, B. (2017), A Review of Competency-Based Learning: Tools, Assessments, and Recommendations. J. Eng. Educ., 106: 607-638. https://doi.org/10.1002/jee.20180

HL, N. I., Nasruddin, N., Sejati, A. E., & Sugiarto, A. (2023). Developing Teaching Material of Research Methodology and Learning with 4D Model in Facilitating Learning During the Covid-19 Pandemic to Improve Critical Thinking Skill. *Jurnal Kependidikan*, *9*(2), 541–554. https://doi.org/10.33394/jk.v9i2.7110

Iffatul Aimmah, & Madhar Amin. (2024). Thiagarajan's 4-D Learning Model: A Theoretical Study and Its Application in Learning Device Development. *Journal of Education Policy Analysis*, *1*(1), 17–24. Retrieved from http://businessandfinanceanalyst.com/index.php/JEPA/article/view/449

Kumar, V. & Kumar, R. (2025). Implementation of Information and Communication Technology (ICT) in Teaching of Physics. *Journal of Computers in Mathematics and Science Teaching, 43*(2), 93-104. Retrieved from https://www.learntechlib.org/p/222798.

Kurniawan, D., Masitoh, S., Bachri, B. S., Warman, Kamila, V. Z., Subastian, E., Sulfa, & Wahyuningsih, T. (2025). Integrating AI in digital project-based blended learning to enhance critical thinking and problem-solving skills. *Multidisciplinary Science Journal*, *7*(12), 2025552. https://doi.org/10.31893/multiscience.2025552

Lawrence, J. E., & Tar, U. A. (2018). Factors that influence teachers' adoption and integration of ICT in teaching/learning process. *Educational Media International*, *55*(1), 79–105. https://doi.org/10.1080/09523987.2018.1439712

Malakul, S. 2025. Exploring Factors Influencing Teachers' Acceptance of AI Tools for Creating Animated Educational Videos With Pedagogical Agents. *Journal of Computer Assisted Learning* 41, no. 4: e70083. https://doi.org/10.1111/jcal.70083.

Murti, Jufri, Juanda, & Mantasiah R. (2025). Digital Scaffolding for Literacy: The Effectiveness of a Google Sites-Assisted CIRC Model in Enhancing Secondary Students' Text-Based Composition Skills. *Journal of Learning and Development Studies*, *5*(2), 113-127. https://doi.org/10.32996/jlds.2025.5.2.11

Ningsih, E. R., Mawardi, M., & Dwikurnaningsih, Y. (2025). Developing Interactive Learning Worksheets (LKPD) with Google Slides for Elementary School Teachers. *Jurnal Paedagogy*, *12*(1), 154–162. https://doi.org/10.33394/jp.v12i1.13939

Onyebuchi, Nneamaka & Olusola, Ayeni & Hamad, Nancy & Osawaru, Blessing & Adewusi, Ololade. (2024). AI in education: A review of personalized learning and educational technology. GSC Advanced Research and Reviews. 18. 261-271. 10.30574/gscarr.2024.18.2.0062.

Qurat-ul-Ain, Shahid, F., Aleem, M., Islam, M. A., Iqbal, M. A., & Yousaf, M. M. (2019). A Review of Technological Tools in Teaching and Learning Computer Science. *Eurasia Journal of Mathematics, Science and Technology Education, 15*(11), em1773. https://doi.org/10.29333/ejmste/109611

Rahmawati, S. N., Hidayat, R., & Amelia, F. (2022). Modul Elektronik Fisika Berbasis Google Sites (Metrofalesi) sebagai Inovasi Pembelajaran Jarak Jauh Mata Pelajaran Fisika Kelas X SMA. *Seminar Nasional Hasil Riset Dan Pengabdian*, *4*, 498–505. Retrieved from https://snhrp.unipasby.ac.id/prosiding/index.php/snhrp/article/view/353

Rakhmatdi, R., Widoretno, S., Ariyanto, J. ., Sugiharto, B. ., Dwiastuti, S. ., & Prabowo, C. A. . (2023). Concept Map Instructional Techniques in the Deciding Stage - Project Based Learning on Students' Argumentation Skills. *Jurnal Penelitian Pendidikan IPA*, *9*(8), 6359–6367. https://doi.org/10.29303/jppipa.v9i8.3157

S., R., & A. (n.d.). *Students' thinking in solving geometric problems based on PISA levels*. Retrieved from https://iopscience.iop.org/article/10.1088/1742-6596/1320/1/012068/meta

Salas-Pilco, S. Z., Xiao, K., & Oshima, J. (2022). Artificial Intelligence and New Technologies in Inclusive Education for Minority Students: A Systematic Review. *Sustainability*, *14*(20), 13572. https://doi.org/10.3390/su142013572

Sari, A. R., Gummah, S., Syukroyanti, B. A., & Habibi, H. (2024). The Effect of Contextual Teaching and Learning Model Assisted by Video on Students' Learning Outcomes and Motivation. *Lensa: Jurnal Kependidikan Fisika*, *12*(2), 197–211. https://doi.org/10.33394/j-lkf.v12i2.13313

Sofiantari, A. R. S., & Astuti, T. (2024). Development of Android-Based Digital Teaching Materials Using Articulate Storyline 3 to Increase Student Motivation and Learning Outcomes in Natural and Social Science Subjects. *Jurnal Penelitian Pendidikan IPA*, *10*(6), 3501–3510. https://doi.org/10.29303/jppipa.v10i6.7690

Sudarman, S., & Ardian, A. (2021). The Development Of Interactive Module To Support Student Centered Learning. *Akademika*, *10*(01), 77-92. https://doi.org/10.34005/akademika.v10i01.1344

Yang, Lei. (2025). The Potential of AI in Education: Personalizing Learning. *International Journal of Artificial Intelligence for Science (IJAI4S)*, *1*(2). https://doi.org/10.63619/ijai4s.v1i2.003

Zeraatkar, D., Obeda, M., Ginsberg, J.S. *et al.* The development and validation of an instrument to measure the quality of health research reports in the lay media. *BMC Public Health* **17**, 343 (2017). https://doi.org/10.1186/s12889-017-4259-y