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Development of Interactive Physics Learning Media based-on Nearpod for Strengthening Science Literacy and Numeracy on Renewable Energy Material

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Abstract. The low science literacy and numeracy of class X students at SMA Negeri 1 Ajibarang in physics learning, especially renewable energy material, occurs because the available learning media don't fully involve science literacy and numeracy, and optimally facilitate students' learning styles. The use of Nearpod-based interactive learning media can overcome these problems. This research aims to determine the effectiveness of the media in strengthening students' science literacy and numeracy. This research used the R&D approach with the 4-D model. The results showed that the media has the potential to improve students' science literacy by 0.15 and numeracy literacy by 0.20, especially in the "low" category. Based on these findings, the media can be used to strengthen students' science literacy and numeracy.

INTRODUCTION

The global pandemic of Coronavirus (SARS-CoV-2) has had a considerable impact on education systems worldwide. A significant adaptation made by educational institutions has been the rapid transition from conventional learning (face-to-face) to online learning (Giday & Perumal, 2024). This shift has catalyzed a substantial advancement in digital technology within the educational sector during the pandemic (Palumbo, 2022). Conventionally, numerous activities within the teaching-learning process have now been digitized (Tiwari et al., 2021).

The strategy of implementing online learning during the pandemic has not been able to provide optimal understanding to students, with Alzahrani (2022) stating that students' performance in online learning should be better than in conventional learning. However, Khoirunnisa & Adirakasiwi (2023) stated that the numeracy literacy skills of seventh grade junior high school students in the Merdeka belajar era were in the low category at 37%. A similar observation was made by Mukharomah et al. (2021), who noted that the physics science literacy skills of students during the pandemic in the competency domain remained in the low category at 57.50%.

Recent interviews with physics teachers from SMA Negeri 1 Ajibarang have revealed that a significant proportion of grade X students in the 2021/2022 academic year encounter challenges in mathematics, namely the analysis, presentation and interpretation of data, along with the formulation of answers to questions that demand concise responses, without providing substantiating evidence, in the context of physics education, including the area of renewable energy. This suggests that students' science literacy and numeracy skills require improvement.

The challenges faced by teachers in imparting physics concepts that encompass science literacy and numeracy in the context of renewable energy materials have a discernible impact on students' deficient decision-making skills. It is imperative to recognize that nearly all aspects of life are contingent on energy, underscoring the necessity for a comprehensive understanding of renewable energy as a pivotal component in the pursuit of sustainable development (Patra, 2022). In their research, Kirana et al. (2021) observed that the creative thinking skills of students, as gauged by their performance on a pre-test on renewable energy material, were predominantly in the low category. Research by Azizah et al. (2015) also demonstrated that 32% of students encountered challenges in problem-solving and 26% experienced difficulties with the use of equations and formulas in questions on renewable energy material.

Indeed, technological advances during the pandemic have also shaped several new habits in the post-pandemic period, one of which is the learning process that depends on the use of technology and other supporting devices (Ramadhan et al., 2021). Furthermore, contemporary learners (generation Z) are growing up in a digitally connected world where instant access to information is commonplace with the help of practical and sophisticated tools such as smartphones, tablets, and laptops (Green et al., 2021). These devices have the potential to facilitate the integration of interactive platforms in classroom learning (Martín-Sómer et al., 2024). In response to this, a combination of face-to-face learning with technology as a digital-based learning medium with a science and numeracy literacy approach is recommended to facilitate students' understanding of concepts involving science and numeracy literacy.

Nearpod is a learning platform that has been found to be an effective interactive learning media. In a study conducted by Septiyanti (2023), the use of Nearpod as an interactive learning media on redox material was classified as very effective, with a percentage of 85.83%. Oktaviani & Nurhamidah (2023) also reported that Nearpod is effectively used as a learning media in Indonesian language subjects. Furthermore, Oktafiani & Mujazi (2022) posit that Nearpod positively impacts mathematics students' learning motivation. In addition, Ningsih et al. (2023) found that utilizing Nearpod in conjunction with the Problem-Based Learning (PBL) model enhances students' critical thinking skills concerning the digestive system.

Despite Nearpod's numerous advantages for creating interactive learning materials, there is a paucity of research on its use in physics education. A review of the literature from the past decade reveals only seven articles that report the use of Nearpod in physics learning, including those on Hooke's law (Fanika et al., 2022), static fluid (Rahmani, 2022), Newton's gravity (Sudiar et al., 2023), and parabolic motion (Qiao, 2022). In addition, other studies utilized Nearpod to determine the generative thinking of grade V students in physics learning (Al-fatlawi & Al-Musawi, 2022) and the impact of video games in physics learning (Yuan et al., 2022). Research related to the utilization of Nearpod to strengthen science literacy and numeracy has not been conducted in Indonesia. Previous studies have examined the effect of Nearpod to partially measure science literacy and numeracy, including critical thinking (Rahmani, 2022), identifying, stating, explaining, calculating, and analyzing (Fanika et al., 2022), and problem-solving ability (Qiao, 2022).

The development of physics learning media assisted by Nearpod has been described as having the potential to positively influence learning outcomes and to restore students' knowledge related to science and numerical literacy, which is crucial for understanding renewable energy material. The present study aims to describe the characteristics of Nearpod-based interactive physics learning media on renewable energy material for strengthening science literacy and numeracy. The primary objective of this research endeavor is to analyze the feasibility of Nearpod-based interactive physics learning media on renewable energy materials for strengthening science literacy and numeracy. The findings of this study are expected to facilitate the diverse intelligences of students in accordance with Howard Gardner's learning theory, known as Multiple Intelligences Theory (Loveless, 2023). Furthermore, the development of media can facilitate the integration of technology as an independent learning medium.

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RESEARCH METHOD

Participant

The study focused on students in class X-1 of SMA Negeri 1 Ajibarang during the second semester of the 2023/2024 academic year. The sample was 36 students.

Design and Procedure

The research methodology employed in this study is that of Research and Development (R&D), utilizing the 4-D development model originally proposed by Thiagarajan and Semmel (Jannah & Wiyatmo, 2018). The stages in this model are defined as follows: defining, designing, developing, and disseminating.

This research procedure adheres to the stages of the 4-D development model, commencing with an analysis of the problems, characteristics of students, and potential. This was conducted through interviews with physics teachers and several grade X students at SMA Negeri 1 Ajibarang. Following this, the product design is developed and the product is created and tested. Once this stage is complete, the product is implemented with 36 students using a pre-experimental design, with a pretest-posttest to assess the product's effectiveness. Finally, the product is distributed for further evaluation.

Instrument

The methodology employed in this study comprises both test and non-test instruments. The test instrument is constituted by a pretest and a post-test, the objective of which is to measure the students' literacy and numeracy in the sciences before and after the implementation of media. The non-test instruments were in the form of questionnaires pertaining to the feasibility of the approach, in addition to responses to the media development process.

The test instruments, which included both a pretest and post-test, consisted of 12 multiple-choice questions and six essay questions. The items were organized according to the indicators of competency in science literacy and aspects or cognitive levels of numeracy literacy. The competency aspect of science literacy is indicated by the following: The competencies in question are as follows: (1) elucidating scientific phenomena (LS 1), (2) interpreting data and evidence in an epistemologically sound manner (LS 2), and (3) evaluating and designing scientific enquiries (LS 3). Regarding the cognitive aspect or level, the following indicators were identified: (1) formulating mathematical situations (LN 1), (2) utilizing mathematical concepts, facts, procedures, and reasoning (LN 2), and (3) interpreting, applying, and evaluating mathematical results. These indicators were represented by a total of five items, comprising two multiple-choice questions and one essay item (LN 3).

Analysis of Data

The feasibility of media from a media and material perspective is determined by Aiken's V analysis, which employs the following formula (Retnawati, 2016):

$$V = \frac{\Sigma S}{n(c-1)}\ with\ S = r - lo$$

Description:

V: validity index	lo: the lowest assessment rating	c: number of rating categories
r: rating given by the assessor	n: number of raters/validators	

The Vcount result is compared with the Vtable value. If Vcount ≥ Vtable, then the media is declared valid, while if Vcount < Vtable then the media is declared invalid. The Vtable used in this research is 0.8 because this study uses 5 raters.

The efficacy of the media in enhancing students' scientific literacy and numeracy was evaluated using the n-gain test. The normality test and the t-test were conducted as preliminary analyses prior to the n-gain test. The normality test was employed to ascertain whether the pre-test and post-test data were distributed normally. The t-test employed in this study, specifically the paired sample t-test, was utilized to ascertain whether there were discernible discrepancies between the learning outcomes of the students prior to and after the utilization of the media. The normality tests and t-tests were analyzed using the Statistical Product and Service Solutions (SPSS) software. The n-gain test was calculated in accordance with the formula established by Hake (Rosidah et al., 2022).

$$\langle g \rangle = \frac{\langle Spost \rangle - \langle Spre \rangle}{max\ score - \langle Spre \rangle}$$

Description:

⟨g⟩ : the magnitude of the N-Gain value

⟨Spost⟩: average post-test score (%)

⟨Spre⟩ : average score of pre-test (%)

The results of the calculation are classified according to the category of the n-gain score as shown in Table 1 (Sembiring & Napitupulu, 2022).

TABLE 1. Categories of Interpretation of the Effectiveness of the N-gain Score

N-gain Score	Category
$\langle g \rangle > 0.7$	High
$0.3 \leq \langle g \rangle \leq 0.7$	Medium
$\langle g \rangle < 0.3$	Low

RESULT AND DISCUSSION

Define

The defining stage is undertaken to identify the issues and to examine the possibilities for development within the field. This stage is divided into five stages, namely initial analysis, learner analysis, task analysis, concept analysis, and specification of learning objectives. Based on the stages, the creation of interactive physics learning media is necessary to enhance science literacy and numeracy, while also accommodating the diverse learning styles of students according to their varying intelligences. The material presented in the media pertains to renewable energy. Furthermore, the use of smartphones owned by every learner and school Wi-Fi facilities has the potential to integrate interactive platforms into classroom learning.

Design

The design stage is the phase of the process during which the media are designed in accordance with the specifications set forth in the preceding stage. The design stage encompasses the preparation of test standards, the selection of media, the selection of formats, and the initial design. The interactive physics learning media developed with the assistance of Nearpod are modified to align with the competency aspects of science literacy and the aspects or cognitive levels of numeracy literacy, as illustrated in Table 2.

TABEL 1. Design of Nearpod-based Physics Learning Media

Nearpod Features	Description
Cover	Contains the title, subject matter, class, and identity of the author.
Objective	Contains the learning objectives to be achieved in the lesson.
Interactive video	Contains an interactive video equipped with three questions that appear in certain sections.
Slide show	Contains material and practice questions.

Fill in the blanks	Interactive quiz by putting the appropriate equation in the blank.
Draw it	Interactive quiz where learners can draw a graph as instructed.
Matching pairs	Interactive quiz where learners pair the corresponding cards.
PDF	Includes an experimental LKPD on energy changes on a roller coaster.
Nearpod Features	**Description**
PhET Simulations	Includes a digital physics simulation on energy changes where learners design their own trajectory.
Collaborative board	A place to collect the results of the analysis of the experiments that have been carried out.
Time to Climb	Loading game-based interactive quizzes.
Open-ended questions	Contains several questions for students' reflection.

Develop

The development stage is undertaken with the objective of realizing the design of Nearpod-based interactive physics learning media. The media development process makes use of Nearpod as the principal software, with the incorporation of supporting software, namely Canva, YouTube, and Kapwing AI. The media were then subjected to testing by expert validators with a view to determining the feasibility of the media. The results of the media development process are presented in Figure 1.

(a) (b)

FIGURE 1. (a) Cover view and (b) QR code of Nearpod-based interactive physics learning media.

This media consists of 20 displays that integrate a range of features available on Nearpod, including interactive videos, drawing and writing activities, matching exercises, open-ended questions, collaborative boards, PhET simulations, and gamification (Time to Climb). These features have been adapted to align with the competencies associated with science and numeracy literacy, encompassing cognitive aspects or levels. The systematic learning activities utilizing this media are presented in Table 2.

TABLE 2. Systematization of Learning Activities

Competition	Indicator	Learning Activity
Science Literacy	Explaining phenomena scientifically	Present a video about phenomena in daily life related to the concepts of potential energy and kinetic energy. Students answer questions that appear on the Nearpod display on their respective smartphones.
Numeracy	Use mathematical concepts, facts procedures, reasoning	Presented literature materials on the understanding and equations of potential energy and kinetic energy. Students take the Fill in the Blanks quiz by putting the appropriate equation in the gap.

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Science Literacy and Numeracy	a. Use mathematical concepts, facts procedures, reasoning b. Interpret data and evidence scientifically	Students are presented with literature materials on the factors that influence and example problems of potential energy and kinetic energy. Students draw a graph of the relationship between mass and altitude with potential energy and mass, velocity, and the square of velocity with kinetic energy in the "Draw it" section.
Science Literacy	Explaining phenomena scientifically	Students pair two matching cards in the "Matching Pairs" section.
Numeracy	a. Formulate the problem mathematically	Present practice questions about potential, and kinetic energy. Students answer the questions correctly.

Competition	Indicator	Learning Activity
	b. Use mathematical concepts, facts procedures, reasoning	
Science Literacy and Numeracy	a. Evaluate and design scientific investigations b. Interpret data and evidence scientifically c. Interpret, apply and evaluate the results of a mathematical process	Presented an instruction to conduct an experiment on changes in potential energy and kinetic energy with the help of PhET Simulations presented in LKPD that has been integrated with Nearpod. Students perform simulations and analyze the energy changes that occur and the factors/variables that affect potential, kinetic, and mechanical energy.
Science Literacy and Numeracy	a. Explaining phenomena scientifically b. Evaluate and design scientific investigations c. Interpret data and evidence scientifically d. Interpret, apply and evaluate the results of a mathematical process	Students upload the results of the experiment analysis on the collaborated provided board. The results of the experiment can be presented in the form of videos, text descriptions, voice recordings, photos, or infographics. Students are also given the opportunity to present the results of the experiment on potential energy and kinetic energy in Roller Coasters to get feedback.
Numeracy	a. Formulate the problem mathematically b. Use mathematical concepts, facts procedures, reasoning	Presented literature material on the mechanical energy of roller simulations based on previously conducted coasters. Students work on mechanical energy exercises.
Science Literacy and Numeracy	All indicators of competency in science literacy aspects and processes or cognitive levels of numeracy literacy	An interactive quiz (Time to Climb) of 12 multiple choices is presented. Students answer the questions by choosing the right answer. Students can also find out the correct and incorrect answers to each question, as well as the accumulated score of everyone at the end of the quiz.

The reflection activity at the conclusion of the learning process is designed to facilitate learners' expression of their understanding, difficulties, and interest in the subject matter. Furthermore, the integration of various Nearpod features offers learners the chance to engage with content in a differentiated manner. Learners are also presented with opportunities for process differentiation (discussion and practicum) and product differentiation (track on PhET Simulations). This is designed to accommodate learners' learning styles in accordance with the diverse forms of intelligence exhibited by everyone, thereby enhancing their scientific literacy and numeracy.

Feasibility Media

A media and material feasibility test were conducted by a panel of five experts, comprising two physics lecturers and three physics teachers. The results of the test are presented in Table 3.

TABLE 3. Feasibility Test Analysis Results

No.	Feasibility Aspect	Vcount	Vtable	Description
1.	Media	0.88		Valid
2.	Material	0.87	0.80	Valid
	Average	0.88		Valid

As evidenced in Table 3, the feasibility assessment conducted by five validators yielded Vcount values of 0.88 and 0.87, respectively, for the media and material aspects. The Vcount was compared with the Vtable of 0.80 with a significance level of 5%. The analysis results demonstrated that Vcount was greater than Vtable, indicating that the media was valid and suitable for use in learning. In addition to the assessment of the media and material aspects, expert validators also provided comments and suggestions related to media development, which were then utilized as improvements to the media. The comments and suggestions from expert validators, along with the improvements made, are presented in Table 4.

TABLE 4. Media-related Validator Comments

No.	Improvement Comments	Improvement Comments
1.	Video cuts to raise questions are not appropriate	Adjustment of video cuts to make statements appear
2.	Instructions for using the media are not available	Addition of instructions for using the media
3.	Explanations for doing some interactive quizzes are missing	Addition of explanations in doing some interactive quizzes

In response to the feedback provided by the validators in Table 5, improvements have been made to facilitate students in using the media independently. The media that has been deemed feasible by the expert validators has been tested on grade XI students who have taken the renewable energy material. Furthermore, preliminary trials of the test instruments were conducted. Following the identification of shortcomings in the trial, revisions were made to ensure the effectiveness and efficiency of the media before its dissemination.

Disseminate

The dissemination stage is undertaken with the objective of ensuring the widest possible distribution of the final product. This stage comprises three distinct phases: large-scale testing, intellectual property rights (IPR) registration, and media dissemination. Subsequently, the media were implemented in a large-scale test in learning class X-1, comprising two meetings. The first meeting commenced with a pretest, followed by learning with the use of media. The second meeting continued the material and concluded with a posttest. The results of the pretest and posttest were analyzed using the normality test and t-test, prior to the n-gain test being conducted to determine the effectiveness of the media.

Normality Test

The results of the normality test for pretest and posttest scores are presented in Table 5.

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TABLE 5. Normality Test Results

Test Type	Sig. Shapiro-Wilk	Criteria
Pre-test	0.052	Normally distributed
Post-test	0.088	Normally distributed

Table 5 indicates that the pretest and posttest data are normally distributed, as evidenced by a Shapiro-Wilk value exceeding 0.05. The results of the normality test are utilized as a basis for the subsequent analysis, specifically the effect test. The normality test results demonstrate that the data are then analyzed using parametric statistics, namely a paired sample t-test.

Paired t-Test

The results of the paired t-test for the pre-test and post-test values of class X-1 students indicate a significance value of 0.000, which is less than 0.005. Based on these results, it can be concluded that there are differences in the level of science literacy and numeracy of experimental class A students before and after utilizing Nearpod physics-based learning media.

N-gain Test

The N-Gain or normal gain test is a methodology employed to ascertain the impact of enhancements in science literacy and numeracy among students. The outcomes of the N-Gain test for science literacy and numeracy are delineated in Table 6.

TABLE 6. N-gain Test Results

Literacy Aspect	N-gain Score	Category
Science Literacy	0.15	Low
Numeracy	0.20	Low

The results of the n-gain test analysis indicate that class X-1 exhibited an increase of 0.15 in scientific literacy and 0.20 in numeracy literacy within the "low" category. This enhancement in science literacy (LS) and numeracy literacy (LN) is illustrated in Figure 2.

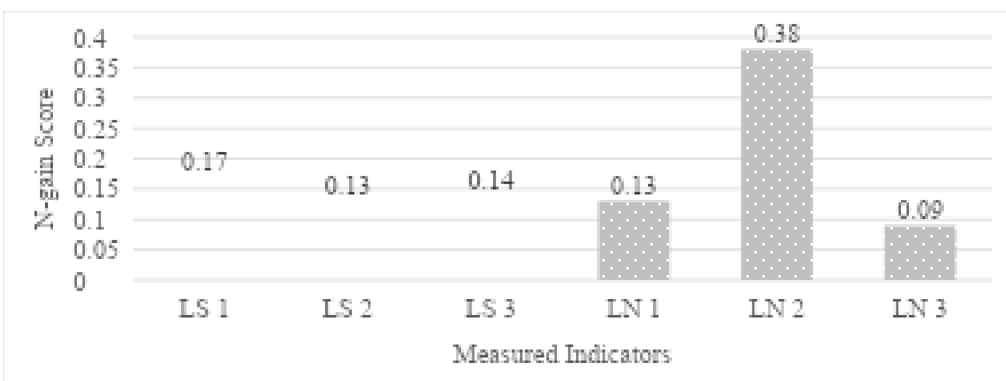

FIGURE 2. Improvement in Science Literacy and Numeracy for Each Indicator

Even though they are in the 'low' category, all the indicators of scientific literacy and numeracy skills examined have increased. This increase may occur because Nearpod provides several interactive features that can increase students' motivation to learn and support the learning process. This is in line with the research of (Hanifa & Astuti, 2022) who state that the use of interactive multimedia in learning creates enthusiasm for learning among students, which results in students easily understanding the material being taught (Hanifa & Astuti, 2022). Students are also active participants in all learning activities.

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Based on Figure 2, all indicators of scientific literacy are in the 'low' category. In addition, the increase in aspects or cognitive levels of numeracy literacy on the indicators of formulating problems mathematically (LN 1) and interpreting, applying and evaluating the results of a mathematical process (LN 3) are also in the 'low' category with n-gain values of 0.13 and 0.09 respectively. However, the indicator for using mathematical concepts, facts, procedures and reasoning (LN 2) was in the 'medium' category with an n-gain of 0.38. This may be because students have different abilities for processing, integrating new information, recalling, applying and creating new knowledge (Yaumi, 2017). The mismatch between the content of the media can also have an impact on the n-gain value of each of the indicators studied. This finding is consistent with Nur & Wathon (2018), who states that learning is considered effective when the content chosen matches the student's level of understanding. Therefore, a diagnostic test must be carried out before the research. Another factor that influences the low improvement is the short time of media implementation (6 x lesson hours), considering that the media is relatively new for the students. However, this does not exclude the possibility of a significant increase in the N-gain scores on the competency aspects of science literacy and the level or cognitive process of numeracy literacy if Nearpod-based media are used continuously in learning over a longer period of time.

CONCLUSION

The results of the research and discussion regarding the development of Nearpod-based learning media for strengthening science literacy and numeracy on renewable energy materials indicate that the characteristics of Nearpod-based interactive physics learning media are best understood by combining several features available on Nearpod. These features include interactive videos and the "Draw It" tool. These include matching pairs, open-ended questions, collaborative boards, PhET simulations, and gamification (Time to Climb), which provide opportunities for students to differentiate between content, process, and product, thereby strengthening their science literacy, especially in terms of competencies and levels or cognitive processes of numeracy literacy.

The feasibility of Nearpod-based interactive physics learning media is classified as very feasible, with a percentage of 0.88 for the media aspect and 0.87 for the material aspect. Furthermore, the media can enhance students' science literacy and numeracy by 0.15 and 0.20, respectively, in the "low" category.

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REFERENCES

Al-fatlawi, B. M., & Al-Musawi, A. M. T. (2022). The Effectiveness of the (NEARPOD) Program in Generative Thinking among Female Students of the Fifth Grade of Science in Physics. *Nasaq*, *5*(100), 88–98.

Alzahrani, M. (2022). Traditional Learning Compared to Online Learning During the COVID-19 Pandemic: Lessons Learned from Faculty's Perspectives. *SAGE Open*, *12*(2). https://doi.org/10.1177/21582440221091720

Azizah, R., Yuliati, L., & Latifah, E. (2015). Kesulitan Pemecahana Masalah Fisika pada Siswa SMA. *Jurnal Penelitian Fisika Dan Aplikasinya (JPFA)*, *5*(2), 44–50. http://journal.unesa.ac.id/index.php/jpfa

Fanika, F., Sabarrini, M. A., Rusdiana, D., & Suwarma, I. R. (2022). Pengembangan Media untuk Kegiatan Pembelajaran Berbasis E-Media Nearpod pada Materi Hukum Hooke. *Jurnal Ikatan Alumni Fisika Universitas Negeri Medan*, *8*(1), 38–43.

Giday, D. G., & Perumal, E. (2024). Students' Perception of Attending Online Learning Sessions Post-Pandemic. *Social Sciences and Humanities Open 9*, *9*, 100755–100755. https://doi.org/10.1016/j.ssaho.2023.100755

Green, T. D., Besser, E. D., & Donovan, L. C. (2021). More than Amplifying Voice and Providing Choice: Educator Perceptions of Flipgrid Use in the Classroom. *TechTrends*, *65*(5), 785–795. https://doi.org/10.1007/s11528-021-00635-3

Hanifa, I., & Astuti, F. (2022). Perbedaan Hasil Belajar Seni Tari Menggunakan Multimedia Interaktif Dengan Media Konvensional pada Siswa di SMP N 1 Talamau. *Jurnal Sendratasik*, *11*(3), 391–401. https://doi.org/10.24036/js.v11i3.117813

Jannah, M. M., & Wiyatmo, Y. (2018). Pengembangan Media Pembelajaran Permainan Ludo untuk Meningkatkan Penguasaan Materi dan Minat Belajar Fisika Peserta didik SMA. *Jurnal Pendidikan Fisika*, 240–249.

Khoirunnisa, S., & Adirakasiwi, A. G. (2023). Analisis Kemampuan Literasi Numerasi Siswa SMP pada Era Merdeka Belajar. *Jurnal Pembelajaran Matematika Inovatif*, *6*(3), 925–936. https://doi.org/10.22460/jpmi.v6i3.17393

Kirana, N. C., Anggraeni, S., & Diana, S. (2021). Pengaruh Penerapan Community of Inquiry Menggunakan LINE terhadap Keterampilan Berpikir Kreatif Siswa SMA pada Materi Energi Terbarukan. *Assimilation: Indonesian Journal of Biology Education*, *4*(1), 24–31. https://doi.org/10.17509/aijbe.v4i1.34822

Loveless, B. (2023). *15 Learning Theories in Education*.

Martín-Sómer, M., Casado, C., & Gómez-Pozuelo, G. (2024). Utilising Interactive Applications as Educational Tools in Higher Education: Perspectives from Teachers and Students, and an Analysis of Academic Outcomes. *Education for Chemical Engineers*, *46*, 1–9. https://doi.org/10.1016/j.ece.2023.10.001

Mukharomah, F., Wiyanto, W., & Darma Putra, N. M. (2021). Analisis Kemampuan Literasi Sains Fisika Siswa Sma Pada Materi Kinematika Gerak Lurus Di Masa Pandemi Covid-19. *Journal of Teaching and Learning Physics*, *6*(1), 11–21. https://doi.org/10.15575/jotalp.v6i1.10391

Ningsih, K., Panjaitan, R. G. P., & Pinawadhani, R. K. (2023). Kelayakan Media Interaktif Berbasis Nearpod pada Materi Sistem Ekskresi di Kelas XI SMA. *Bioscientist : Jurnal Ilmiah Biologi*, *11*(2), 1980–1994.

Nur, L., & Wathon, A. (2018). Peran Media Pembelajaran Speaker Terhadap Minat Belajar Siswa. *Sistim Informasi Manajemen*, *1*(1), 48-63.

Oktafiani, O., & Mujazi, M. (2022). Pengaruh Media Pembelajaran Nearpod terhadap Motivasi Belajar pada Mata pelajaran Matematika. *JPGI (Jurnal Penelitian Guru Indonesia)*, *7*(1), 124. https://doi.org/10.29210/022033jpgi0005

Oktaviani, R., & Nurhamidah, D. (2023). Efektivitas Penggunaan Media Pembelajaran Interaktif Nearpod pada Mata Pelajaran Bahasa Indonesia. *Jurnal Didaktika Pendidikan Dasar*, *7*(2), 717–726. https://doi.org/10.26811/didaktika.v7i2.1121

Palumbo, R. (2022). Thriving in the Post-Covid-19 Era: a New Normality for Libraries' service Offering. *Library Management*, *43*(8–9), 536–562. https://doi.org/10.1108/LM-05-2022-0051

Patra, C. A. F. (2022). Pengembangan Energi Terbarukan dalam Upaya Mewujudkan Pembangunan Berkelanjutan di PT. Pertamina. *Jurnal Green Growth Dan Manajemen Lingkungan (JGG)*, *11*(2), 113–122. https://doi.org/10.21009/jgg.112.05

Qiao, Y. (2022). K-12 Science Learning: Designing a Lesson on Nearpod to Teach Projectile Motion. *Proceedings of the 2022 8th International Conference on Humanities and Social Science Research (ICHSSR 2022)*, *664*(Ichssr), 2122–2127. https://doi.org/10.2991/assehr.k.220504.384

Rahmani, M. N. (2022). *Pengaruh Pendekatan Integrated STEM Berbantuan Nearpod terhadap*. Universitas Islam Negeri Syarif Hidayatullah.

Ramadhan, S., Sukma, E., & Indriyani, V. (2021). Online Distance Learning While the COVID-19 Pandemic: Implementation, Evaluation, and Expectations. *Proceedings of the 4th International Conference on Language, Literature, and Education (ICLLE-4 2021)*, *604*(21), 267–275. https://doi.org/10.2991/assehr.k.211201.040

Retnawati, H. (2016). Proving Content Validity of Self-Regulated Learning Scale (The Comparison of Aiken index and Expanded Gregory Index). *REID (Research and Evaluation in Education)*, *2*(2), 155–164. https://doi.org/10.21831/reid.v2i2.11029

Rosidah, Nizaar, M., Muhardini, S., Haifaturrahmah, & Mariyati, Y. (2022). Efektifitas Media Pembelajaran Game interaktif Berbasis Power Point Untuk Meningkatkan Motivasi Belajar Siswa Kelas V SD. *Seminar Nasional Paedagoria*, *2*(1), 10–16. http://journal.ummat.ac.id/index.php/fkip/article/view/9749%0Ahttp://journal.ummat.ac.id/index.php/fkip/article/download/9749/pdf

Sembiring, B. O., & Napitupulu, E. E. (2022). Development of Interactive Student's Worksheets to Improve Mathematical HOTS of Tenth Grade Students in Trigonometry Topic. *AlphaMath Journal of Mathematics Education*, *8*(2), 99–110.

Septiyanti, A. D. (2023). *Efektivitas Penggunaan Nearpod sebagai Media Pembelajaran Interaktif pada Materi Redoks*. Universitas Islam Negeri Syarif Hidayatullah.

Sudiar, S., Djudin, T., Hidayatullah, M. M. S., Silitonga, H. T. M., & Oktavianty, E. (2023). Penerapan Model Direct Instruction Berbantuan Media Audiovisual Nearpod pada Materi Gravitasi Newton. *Jurnal Ilmiah Profesi Pendidikan*, *8*(4), 2394–2402. https://doi.org/10.29303/jipp.v8i4.1617

Tiwari, P., Séraphin, H., & Chowdhary, N. R. (2021). Impacts of COVID-19 on Tourism Education: Analysis and Perspectives. *Journal of Teaching in Travel and Tourism*, *21*(4), 313–338. https://doi.org/10.1080/15313220.2020.1850392

Yaumi, M. (2017). Prinsip-prinsip Desain Pembelajaran. Kencana Prenada Media Grup. Jakarta.

Yuan, Y., Zhang, Z., & Zhao, Y. (2022). Technology and Education: A Study of the Impact of Educational Video Games on Physics Teaching. *Proceedings of the 2021 International Conference on Education, Language and Art (ICELA 2021)*, *637*(Icela 2021), 382–387. https://doi.org/10.2991/assehr.k.220131.070