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THE EFFECTIVENESS OF H5P-ASISTED DIFFERENTIATED-INDEPENDENT LEARNING MODEL TO INCREASE LOW-ABILITY STUDENTS' SCIENTIFIC LITERACY

I. Wilujeng*[1], T. N. Ain[1], A. P. Rilianti[1], F. Hasyim[1], M. Fiqiyah[2]

[1]STKIP Al Hikmah Surabaya, Surabaya, Indonesia
[2]Universiti Pendidikan Sultan Idris, Perak, Malaysia

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ABSTRACT

Scientific literacy is a critical skill in the era of Smart Society 5.0. Recent studies show that 76.9% of students are in the lowest category, the nominal level, in terms of science literacy. This prompted the researchers to examine the effectiveness of the H5P-assisted Differentiated-Independent Learning model in enhancing the scientific literacy of low-ability students. The state of the art in this research is demonstrated through a review of previous studies that explored the implementation of innovative learning models to promote scientific literacy. However, these models either fail to integrate the use of technology with pedagogical approaches or do not specifically address students with low ability. Therefore, the novelty of this study lies in the integration of H5P learning media as a technological resource, alongside a targeted focus on lower ability students as the primary research subjects. This study employed an experimental method with a one-group pretest-posttest design, including a replication class. The study revealed that the H5P-assisted Differentiated-Independent model was effective, as indicated by an average n-gain score of 0.74, which falls within the high category. The paired t-test demonstrated a significant difference between the pretest and posttest scores across all classes. Furthermore, the independent t-test indicated a consistent increase in scientific literacy skills in all classes, with 83% of students responding very positively based on the questionnaire. In summary, the H5P-assisted Differentiated-Independent model has a positive impact on enhancing the scientific literacy skills of low-ability students.

Keywords: Differentiated-Independent Learning; H5P; scientific literacy; low-ability students

INTRODUCTION

In the Smart Society 5.0 era, humans live side by side with technology, resulting in significant changes in how people live, work, and interact (Wang et al., 2024). Smart Society 5.0 is characterized by increasingly sophisticated technology, complex problems, a high demand for innovation and creativity, and a more competitive work environment. The strategy to face the challenges of the Smart Society 5.0 era is Smart Education (Dimitrova et al., 2024). In Smart Society 5.0, traditional learning has shifted to e-learning and Smart Education. Smart Education encourages students to construct new knowledge through technological mastery, enabling them to search, analyze, and innovate (Shakhina et al., 2023). Smart Education requires the ability to understand, evaluate, and use knowledge and technology. This is known as scientific literacy. Scientific literacy skills encompass several sequential categories, starting from the most basic skills: nominal, conceptual, functional, and multidimensional (Istyadji & Sauqina, 2023).

According to Yudha et al. (2023), ninth-grade students' scientific literacy skills are adequate. On the other hand, Saraswati et al. (2021)

***Correspondence Address**
E-mail: indrawati.physics@gmail.com

found that the literacy skills of junior high school students were in the low category with a score of 75. According to the PISA results in 2018, the scientific literacy skills of Indonesian students did not improve from 2000 to 2018, with Indonesia ranked 69th out of 77 countries. In 2019, students' scientific literacy skills remained stagnant, placing them ninth from the bottom (Lestari et al., 2024). Being in the highest level of education, university students should have high scientific literacy (Berlian et al., 2021). However, 76.9% of university students are at the most basic level, or nominal category, in terms of scientific literacy (Muhajir et al., 2021). The finding of previous research revealed the low level of students' scientific literacy (Syahmani et al., 2024). Individuals with low literacy skills will encounter difficulties in processing and understanding scientific information (Yang et al., 2024).

Education is important for improving the quality of human resources to face the Smart Society 5.0 era (Kahar et al., 2021). Therefore, the learning model that has been applied needs to be improved to increase students' scientific literacy. Classroom learning can increase scientific literacy (Jihannita et al., 2024). The low scientific literacy of students, particularly among those with low abilities, is attributed to unequal access to learning opportunities. Low-ability students are defined as those who experience difficulties in identifying, analyzing, and solving problems; these students also struggle to evaluate and reflect on their actions (Theasy et al., 2017). Learning is considered inappropriate for their needs and ability levels. Therefore, this study is important as the implementation of a learning model is believed to accommodate low-ability students and enhance their scientific literacy. One learning model that can provide equitable access to all students, including those with low abilities, is the differentiated learning model (Langelaan et al., 2024).

Differentiated learning is a pedagogical-didactic approach that allows educators to choose different initial steps for each student to meet various learning needs (Smale-Jacobse et al., 2019). This approach is recommended to be applied in order to achieve learning objectives. Haelermans (2022) stated that students' performance, cognitive abilities, motivation, and self-regulation in classes that utilize differentiated learning are better than those in classes that do not. According to Nasution et al. (2023), the differentiated learning model yields a significant positive impact on improving mathematical reasoning skills.

In differentiated learning, lecturers are required to accommodate the diverse learning needs of students through independent strategies (Kahmann et al., 2024). The approach to differentiated learning is divided into three components: content, process, and product (Suwandi et al., 2023). Learning that applies a differentiated learning approach provides opportunities for low-ability students to learn according to their readiness, interests, abilities, learning styles, and needs (Widarti et al, 2020; Febriana et al., 2023; Kalinowski et al., 2024). Lecturers can also adjust the difficulty level of assignments or activities to align with students' abilities.

Low-ability students also have low learning independence (Silviawati & Kurniawan, 2023). Learning independence is one of the predictors of scientific literacy skills (Doshi et al., 2024). One approach to achieving learning independence is self-regulated learning. Through this approach, students organize learning strategies in such a way as to achieve learning goals (Hemmler & Ifenthaler, 2024). Students undergo several phases: designing learning, monitoring, evaluating, and reflecting (Zimmerman & Schunk, 2011). Self-regulated learning is fully regulated by students and encompasses a learning cycle which includes planning, performance, and reflection (Järvelä & Hadwin, 2024). Learning models that use this approach are believed to increase students' learning independence. According to Arista and Kuswanto (2018), Android-based learning media can enhance students' learning independence. According to Brata et al. (2021), digital learning utilizing the discovery learning method can enhance students' learning independence. Additionally, e-learning has a significant impact on students' independence (Pramita et al., 2021). Web-based media positively affects the scientific literacy skills of students with high learning independence (Cahyana et al., 2019). One of the models that integrates differentiated learning and independent learning is the Differentiated-Independent Learning (DIL) model. The implementation of the DIL model within the scope of this study holds significant potential for achieving the Sustainable Development Goals (SDG) 4, which focuses on ensuring educational quality. By fostering equitable access to learning opportunities, the unique characteristics of each student will be developed. Furthermore, the learning model will enhance the realization of inclusive, fair, equitable, and high-caliber educational outcomes.

Students with high learning independence can learn anywhere and at any time, utilizing various learning resources, as the self-regulated learning approach is pertinent to lifelong learning (Latva-aho et al., 2024). On the other hand, educational technology also influences how well students achieve learning objectives (Weng et al., 2024). The learning independence of low-ability students can also be enhanced by utilizing technology in education through interactive media, such as H5P, which can be employed to create interactive videos. Therefore, one alternative for improving the scientific literacy of low-ability students is to develop an H5P-assisted differentiated learning model that is grounded in learning independence.

H5P is one of educational technologies in the form of interactive media that can be applied to learning for low-ability students. H5P or HTML5 Package is a website for content collaboration with open and free access (Schez-sobrino et al., 2024). H5P facilitates the creation, sharing, and reuse of interactive HTML5 content, such as videos. Interactive videos offer advantages related to flexibility and accessibility (Dreisoerner et al., 2023). Videos with specific scenarios are uploaded to H5P and are accompanied by various interactive tasks and quizzes (Soong et al., 2024; Susanti et al., 2023).

The presence of H5P as a form of digital technological integration is profoundly pertinent and relevant to the Smart Education concept. However, the use of this technology can significantly enhance both the efficiency and adaptability of the learning process, fostering a more dynamic and personalized educational experience. Unsworth and Posner (2022) utilized H5P to design and teach interactive virtual labs. The H5P media developed by Putri et al. (2024) successfully improved students' mathematics skills. Rahmi et al. (2024) stated that interactive content created with H5P in Moodle can enhance students' knowledge, skills, and satisfaction. H5P also motivates students to be active participants in their learning, as they understand that their engagement can be measured, thereby fostering independent learning and self-assessment of their abilities (Naidu et al., 2021). One of the advantages of H5P is that educators can tailor teaching materials to meet the needs of low-ability students, resulting in a more personalized learning experience (Zagulova et al., 2023). Interactive H5P media can enhance students' motivation and participation in the learning process (Bakri, 2021).

Previous studies have generally not been specifically designed for technology-assisted instructional learning models for low-ability student groups. In light of this gap, the present research aims to explore a novel approach by evaluating the effectiveness of the DIL model, supported by H5P, in enhancing the scientific literacy of low-ability students. This model is meticulously designed to address the unique needs of students, employing differentiated instructional strategies underpinned by interactive technology. Consequently, the primary focus of this study is on low-ability students, which constitutes a limitation of the scope of this research. The pivotal aim of this study is to implement a learning model that can accommodate the needs of low-ability students in order to significantly promote their scientific literacy. In summary, this study aims to describe the effectiveness of the H5P-assisted DIL model in enhancing the scientific literacy of low-ability students. The H5P-assisted DIL model is expected to improve scientific literacy skills, particularly for low-ability students, and contribute to the more effective development of technology-based learning strategies within the context of Smart Education.

METHODS

The quantitative method and quasi-experimental design with replication classes were employed in this study (Fraenkel et al., 2015). The research design utilized was a pretest-posttest design. The study subjects consisted of 100 students from the Physics Education and Elementary School Teacher Education programs. The subjects were selected using purposive sampling based on their low scientific literacy skills. Low scientific literacy skills were determined based on the students' scientific literacy profiles following the initial assessment. The research process began with a preliminary study, followed by a quasi-experiment, analysis of the results from the science literacy tests, interpretation of the test results, and culminated in the formulation of conclusions and recommendations. A more detailed representation of the research stages is provided in the following figure (see Figure 1).

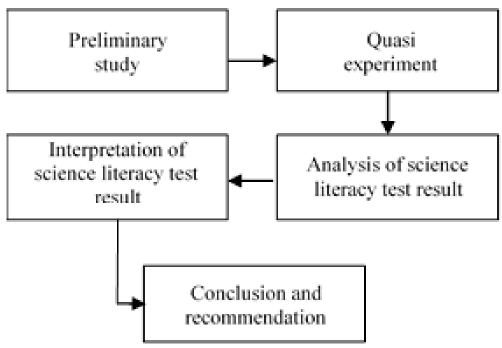

Figure 1. Research Stages

During the preliminary study stage, both field studies and a comprehensive review of relevant literature were conducted. The instruments employed included a structured interview guideline for lecturers and student questionnaires. At the quasi-experiment stage, the learning process was implemented using the DIL model, augmented by H5P. Both the model and the learning tools have been rigorously validated to ensure they are ready for use. The syntax table of the DIL model and the measured levels of scientific literacy are presented in Table 1.

Table 1. Syntax of DIL model and Science Literacy Level Measured

No.	Learning Phrase Trajectory	Science Literacy Level Measured
1.	Initial Assessment	Nominal
2.	Objective Learning Plan	Nominal
3.	Differentiated Content and Process	Conceptual
4.	Differentiated Product	Functional
5.	Presentation Result	Multidimensional
6.	Objective Learning Evaluation	Multidimensional

The research instruments utilized in this stage comprised: (1) pretest and posttest assessments of scientific literacy, (2) observation sheets, and (3) student response surveys. The subsequent stage involved a thorough analysis and interpretation of the students' scientific literacy test results. Following this, the study concluded with the formulation of recommendations in the final stage.

The effectiveness of the learning model was analyzed based on the average normalized gain (n-gain), t-test results, and student responses. The increase in students' scientific literacy was determined from the pretest and posttest scores, calculated based on the normalized gain (n-gain) (Sutinah & Ristiana, 2023). The n-gain is obtained by comparing the difference between the pretest and posttest scores with the difference between the pretest and the maximum score. The n-gain scores are then compared according to the criteria presented in Table 2.

Table 2. N-Gain Category (Hasyim et al., 2020)

N-Gain Score	N-Gain Category
0.70<N-Gain	High
0.30<N-Gain<0.70	Moderate
N-Gain<0.30	Low

The learning model effectively increases students' scientific literacy skills if the n-gain score is moderate (n-gain < 0.30). The t-test is a statistical test used to determine whether there is a significant increase in students' scientific literacy (Hasyim et al., 2020). The student response questionnaire was analyzed both quantitatively and qualitatively. Quantitative analysis was conducted by calculating the percentage comparison between the overall and highest combined scores. The results of this calculation were then compared with the criteria presented in Table 3.

Table 3. Percentage Criteria for student Responses

Percentages (%)	Assessment Criteria
81 – 100	Excellent
61 – 80	Very Good
41 – 60	Good
21- 40	Fair
0 – 20	Poor

The model is considered effective if it meets the following three criteria: (1) there is a significant increase in scientific literacy at $\alpha > 0.05$; (2) the n-gain falls within the moderate category; and (3) student responses are categorized as good (Hasyim et al., 2024).

RESULTS AND DISCUSSION

The DIL model is considered effective. To assess its effectiveness, the DIL model must meet three evaluation criteria: n-gain, t-test, and student response questionnaire. The n-gain is calculated from the pretest and posttest data obtained from the scientific literacy test instrument. The results are presented in Tables 4 and 5. Table 4 displays the n-gain for Class A.

Table 4. N-Gain of Class A

Description	Class A	
	Pretest	Posttest
Lowest Score	23	45
Highest Score	44	85
Average Score	35	74
Number of Students	41	41
Average N-Gain	0.74	
Category	High	

Table 4 shows that the average posttest score is greater than the pretest score. The n-gain for this class is 0.74, placing it in the high category. Meanwhile, the n-gain for Class B is presented in Table 5.

Table 5. N-Gain of Class B

Description	Class B	
	Pretest	Posttest
Lowest Score	23	45
Highest Score	44	85
Average Score	35	74
Number of Students	59	59
Average N-Gain	0.74	
Category	High	

Table 5 also shows that the average posttest score is greater than the pretest score. The n-gain for this class is the same as that of Class A, at 0.74, thus placing it in the high category as well.

Subsequently, a normality test was conducted using the Shapiro-Wilk test (Anwar et al., 2024) and a homogeneity test using Levene's test (Thomann et al., 2024). The data utilized were the n-gain scores from Classes A and B. This test was performed to determine whether there was a significant increase in scientific literacy skills after the implementation of the DIL learning model. The results of the normality tests are presented in Table 6.

Table 6. Normality Test

Class	Shapiro-Wilk test			Conclusion
	Data	Statistic	Sig.	
A	N-gain	0.925	0.221	Normal
B	N-gain	0.956	0.128	Normal

Based on Table 6, the significance values for classes A and B are 0.221 and 0.128, respectively. Both classes are normally distributed because they have significance values above 0.05. The results of the homogeneity tests are presented in Tables 7.

Table 7. Homogeneity Test

Class	Levene's test		Conclusion
	Data	Sig.	
A	N-gain	0.578	Homogenous
B	N-gain	0.786	Homogenous

Based on Table 7, the significance values for classes A and B are 0.578 and 0.786, respectively. Both classes are homogeneous because they have significance values above 0.05. Since both classes are normally distributed and homogeneous, the paired t-test and independent t-test are used to test the effectiveness of the DIL model.

The paired t-test determined whether there was an increase in scientific literacy skills after implementing the DIL model. The data used were the pretest and posttest scores in classes A and B. The results of the paired t-test are displayed in Table 8.

Table 8. Paired T-test

Class	Data	Sig.	Conclusion
A	Pretest - Posttest	<0.001	There is a difference.
B	Pretest - Posttest	<0.001	There is a difference.

Based on Table 8, the significance value is <0.001 or less than 0.05. This value indicates a significant difference between the pretest and posttest in classes A and B. This finding indicates increased scientific literacy skills after the DIL model was applied.

Meanwhile, the independent t-test determined whether the DIL model consistently increased scientific literacy skills. The data used were n-gain in both classes. The results of the independent t-test are displayed in Table 9.

Table 9. Independent T-test

Class	Data	Sig.	Conclusion
A	N-gain	0.678	There is no difference.
B	N-gain	0.722	There is no difference.

Based on Table 9, the significance value is greater than 0.05. This value indicates that there is no significant difference between the average n-gain in Classes A and B. This finding suggests that the DIL model consistently enhances scientific literacy skills.

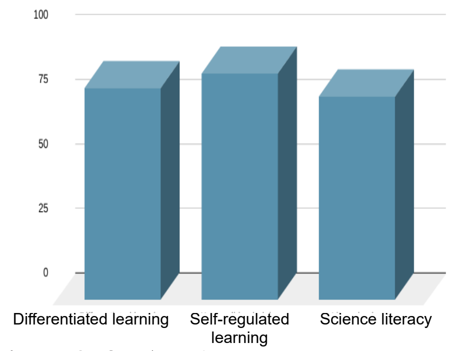

Figure 2. Students' Responses

Responses from students as research subjects also need to be identified because they impact the implementation of the DIL model. The impact can be in the form of advantages and disadvantages of implementing the model. Student responses were collected using a questionnaire at the end of the learning session. The results of the student response questionnaire are presented in Figure 2.

Based on Figure 2, students responded to several aspects, such as differentiated learning, independent learning, and scientific literacy skills. The average for each aspect reached 83% in the very good criteria. This finding indicates that students responded positively to the implementation of the DIL learning model. They felt that their learning needs were accommodated through differentiated instruction, their independent learning was fostered (Torres et al., 2024), and their scientific literacy skills were enhanced. This finding aligns with Koskinen et al. (2023), which suggests that the difficulty level of assignments must be adjusted to match students' abilities; otherwise, students' motivation to learn may decrease. This finding further supports the model's effectiveness, demonstrating that the DIL model can enhance scientific literacy skills among low-ability students.

The syntax of the DIL model consists of six phases: 1) initial assessment, 2) objective learning plan, 3) differentiated content and process, 4) differentiated products, 5) presentation results, and 6) learning objectives evaluation. The first phase, or initial assessment, is one of the characteristics of differentiated learning. The initial assessment measures students' initial readiness and understanding (Gusteti & Neviyarni, 2022). The initial assessment results are used as a basis for differentiation in learning. The second phase is objective learning plan. In this phase, students must be independent in determining the learning targets they want to achieve. This phase is also one of the indicators of self-regulated learning, which determines the learning objectives (Khotimah et al., 2023). The third phase is the differentiated content and process. In teaching and learning process, several types of content and processes are provided. The students can choose which content and processes are appropriate with their learning styles as well as their understanding levels.

The next phase is differentiated product. Differentiation of content, process, and product is a strategy employed in differentiated learning (Suwandi et al., 2023). At this phase, students can more easily understand scientific concepts both nominally and conceptually, as the content has been tailored to their level of understanding. Diverse learning processes can also assist students in developing scientific thinking skills. Furthermore, the freedom to choose products can enhance students' communication skills and demonstrate their understanding. During this phase, students learn to find evidence for scientific claims, which is essential for developing scientific literacy skills (Sarvary & Ruesch, 2023). The fifth phase is the presentation of results. Communication skills in presenting work results can also improve scientific literacy at the functional and multidimensional levels. The sixth phase is the evaluation of learning objectives. In this phase, students must re-evaluate and reflect on whether the learning objectives determined at the beginning of learning have been achieved. This phase is another indicator of self-regulated learning, the phase of evaluating the learning process and results (Khotimah et al., 2023).

Based on the explanation, the purpose of developing a model to increase students' scientific literacy is in the third, fourth, and fifth phases. The model was developed by combining the differentiation and self-regulated learning approaches. The differentiation approach is shown in phases 1, 3, and 4, while the self-regulated learning approach is displayed in phases 2, 4, 5, and 6.

What is the role of H5P in the DIL model in promoting students' scientific literacy? H5P within the DIL model assists low-performing students in enhancing their scientific literacy through interactive content and self-directed learning. Through interactive videos, virtual simulations, and adaptive quizzes, students are able to understand scientific concepts that align with their individual learning styles. The differentiation of content, process, and product allows them to become independent learners, guided by direct feedback from H5P. Furthermore, the branching scenario and formative assessment features help students identify mistakes, review course material, and gradually comprehend the content in depth. This approach is designed to enhance their critical thinking and problem-solving skills, as well as to foster their independent learning.

Which level of scientific literacy increased significantly through the implementation of the DIL model? Based on the pretest and posttest results, all levels of scientific literacy showed improvement. This finding aligns with (Taufiq et al., 2024), who state that integrating learning with technology makes the educational experience more targeted, flexible, and interactive.

At the nominal level, students begin to recognize terms and fundamental concepts through interactive quizzes and flashcards. The simulations and interactive videos assist students in understanding the relationships between scientific concepts more clearly, which is processed at the conceptual level. Meanwhile, at the functional level, students start to apply these concepts in real-world contexts through case studies and virtual experiments. At the multidimensional level, students are encouraged to integrate science with social, economic, and technological aspects through problem-based discussions and collaborative projects.

However, the most significant increase occurs at the conceptual level, as students can easily understand the relationships between concepts through H5P, which presents simulations, interactive videos, and adaptive exercises. In contrast, the smallest increase is observed at the multidimensional level. At this level, students are required to integrate their disciplinary knowledge and apply it in real-world contexts. Nevertheless, H5P continues to support this process through discussions, problem-based projects, and reflective exercises to encourage students' critical thinking. By employing appropriate learning strategies, H5P can be optimized to promote scientific literacy among students at all levels.

This finding aligns with Mutawa et al. (2023), who state that H5P is the most effective platform for students. However, interactive videos do not facilitate the functional and multidimensional levels, except through the differentiation of products and the presentation of work phases in the DIL model. This finding indicates that students must engage in independent learning, particularly at the multidimensional level, as noted by Sajidan et al. (2024).

Despite the findings, this study has several limitations. Firstly, the model applied in this study is specifically designed for low-ability students; therefore, its effectiveness for students with intermediate or high ability levels remains unexamined. Secondly, this research was conducted at only one educational institution, which means that the findings cannot be generalized to other institutions, particularly those with differing characteristics. Thirdly, the model was implemented over one semester, so the long-term impact on students' scientific literacy has yet to be adequately assessed.

The implications for future researchers are as follows: future researchers can expand the participant scope by implementing the model with students of various ability levels (higher, intermediate, and low) to assess its effectiveness more broadly. Additionally, future researchers can conduct this study across several educational institutions simultaneously over a relatively longer period to determine how this model can be adapted in different environments.

CONCLUSION

The H5P-assisted Differentiated-Independent model is effective based on an average n-gain score of 0.74, categorizing it in the high range. The paired t-test indicated a significant difference between the pretest and posttest scores across all classes, while the independent t-test demonstrated a consistent increase in scientific literacy skills among all students. Additionally, 83% of students responded very positively based on the questionnaire. The H5P-assisted Differentiated-Independent model has a positive impact on enhancing the scientific literacy skills of low-ability students.

REFERENCES

Anwar, R., Elbashir, A. M., Magdy, R., Ahmad, Z., & Al-Thani, N. J. (2024). Effectiveness of STEM based workshop for deaf education: Exploratory study. *Heliyon*, *10*(e36012), 1–12.

Arista, F. S., & Kuswanto, H. (2018). Virtual Physics Laboratory Application Based On The Android Smartphone to Improve Learning Independence and Conceptual Understanding. *International Journal of Instruction*, *11*(1), 1–16.

Bakri, R. (2021). Pengembangan Modul Digital Interaktif dalam Pembelajaran Statistika Terapan menggunakan Learning Management System Berbasis Moodle di Masa Pandemi Covid 19. *Indonesian Journal of Learning Education and Counseling*, *4*(1), 75–85.

Berlian, M., Mujtahid, I. M., Vebrianto, R., & Thahir, M. (2021). Profil Literasi Sains dalam Pembelajaran IPA di Era Covid-19: Studi Kasus di Universitas Terbuka. *Journal of Natural Science and Integration*, *4*(1), 77–84.

Brata, W. W. W., Wibowo, F. C., & Rahmadina, N. (2021). Implementation of Discovery Learning in A Digital Class and Its Effect on Student Learning Outcomes and Learning Independence Level. *F1000Research*, *10*(386), 1–15.

Cahyana, U., Supatmi, S., Erdawati, & Rahmawati, Y. (2019). The Influence of Web-Based Learning and Learning Independence Toward Student's Scientific Literacy in Chemistry Course. *International Journal of Instruction*, *12*(4), 655–668.

Dimitrova, V., Nikolov, N., & Gospodinov, T. (2024). Education in The Era of Smart Cities: Transformation and Opportunities. *Environment. Technology. Resources. Rezekne, Latvia Proceedings of the 15th International Scientific and Practical Conference*, *2*, 352–357.

Doshi, A., Weinert, S., & Attig, M. (2024). Self-Regulatory Abilities as Predictors of Scientific Literacy Among Children in Preschool and

Primary School Years. *Learning and Individual Differences*, *114*(102515), 1–12.

Dreisoerner, A., Ferrandina, C., Schulz, P., Nater, U. M., & Junker, N. M. (2023). Using Group-Based Interactive Video Teleconferencing to Make Self-Compassion More Accessible: A Randomized Controlled Trial. *Journal of Contextual Behavioral Science*, *29*, 230–239.

Febriana, R., Sugiman, S., & Ariyadi Wijaya. (2023). Analysis of the Implementation of Differentiated Learning in the Implementation of the Independent Curriculum in Middle School Mathematics Lessons. *International Journal Of Humanities Education and Social Sciences (IJHESS)*, *3*(2), 640–650.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2015). *How to Design and Evaluate Research in Education 8th Edition*. Mc Graw Hill.

Gusteti, M. U., & Neviyarni. (2022). Pembelajaran Berdiferensiasi pada Pembelajaran Matematika di Kurikulum Merdeka. *Jurnal Lebesgue: Jurnal Ilmiah Pendidikan Matematika, Matematika Dan Statistika*, *3*(3), 636–646.

Haelermans, C. (2022). The Effects of Group Differentiation By Students' Learning Strategies. *Instructional Science*, *50*(2), 223–250.

Hasyim, F., Prastowo, T., & Jatmiko, B. (2020). The Use of Android-Based PhET Simulation as an Effort to Improve Students' Critical Thinking Skills during the Covid-19 Pandemic. *International Journal of Interactive Mobile Technologies*, *14*(19), 31–41.

Hasyim, F., Prastowo, T., & Jatmiko, B. (2024). Critical Thinking-Independent Learning: A Model of Learning to Improve Students' Critical Thinking Skills. *European Journal of Educational Research*, *13*(2), 747–762.

Hemmler, Y. M., & Ifenthaler, D. (2024). Self-Regulated Learning Strategies in Continuing Education: A Systematic Review and Meta-Analysis. *Educational Research Review*, *45*(100629), 1–25.

Istyadji, M., & Sauqina. (2023). Conception of Scientific Literacy in The Development of Scientific Literacy Assessment Tools: A Systematic Theoretical Review. *Journal of Turkish Science Education*, *20*(2), 281–308.

Järvelä, S., & Hadwin, A. (2024). Triggers for Self-Regulated Learning: A Conceptual Framework for Advancing Multimodal Research about SRL. *Learning and Individual Differences*, *115*(102526), 1–12.

Jihannita, J., Fadly, W., Ekapti, R. F., Luthfiana, D., & Widowati, A. (2024). The Development of Science Module Integrated with Ethnoscience of Singo Barong Mask to Improve Scientific Literacy and Cultural Preservation Attitudes. *Journal of Innovation in Educational and Cultural Research*, *5*(2), 356–363.

Kahar, M. I., Cika, H., Nur Afni, & Nur Eka Wahyuningsih. (2021). Pendidikan Era Revolusi Industri 4.0 Menuju Era Society 5.0 Di Masa Pandemi Covid 19. *Moderasi: Jurnal Studi Ilmu Pengetahuan Sosial*, *2*(1), 58–78.

Kahmann, R., Droop, M., & Lazonder, A. W. (2024). Dutch Elementary School Teachers' Differentiation Practices During Science and Technology Lessons. *Teaching and Teacher Education*, *145*(104626), 1–10.

Kalinowski, E., Westphal, A., Jurczok, A., & Vock, M. (2024). The Essential Role of Teacher Self-Efficacy and Enthusiasm for Differentiated Instruction. *Teaching and Teacher Education*, *148*(104663), 1–18.

Khotimah, K., Retnawati, L., Jannah, M., & Rahmasari, D. (2023). Literature Review of Self Regulated Learning: Study for Student Learning in School. *Jurnal Imliah Pendidikan Dasar*, *8*(3), 5767–5779.

Koskinen, A., McMullen, J., Hannula-Sormunen, M., Ninaus, M., & Kiili, K. (2023). The Strength and Direction of The Difficulty Adaptation Affect Situational Interest in Game-Based Learning. *Computers and Education*, *194*(104694), 1–17.

Langelaan, B. N., Gaikhorst, L., Smets, W., & Oostdam, R. J. (2024). Differentiating Instruction : Understanding The Key Elements for Successful Teacher Preparation and Development Differentiating Instruction : Understanding The Key Elements for Successful Teacher Preparation and Development. *Teaching and Teacher Education*, *140*(104464), 1–15.

Latva-aho, J., Näykki, P., Pyykkönen, S., Laitinen-Väänänen, S., Hirsto, L., & Veermans, M. (2024). Pre-Service Teachers' Ways of Understanding, Observing, and Supporting Self-Regulated Learning. *Teaching and Teacher Education*, *149*(104719), 1–11.

Lestari, D. P., Paidi, P., & Suwarjo, S. (2024). Effect of The Inquiry-Based Nature of Science Argumentation Instructional Model in Scientific Literacy Skills. *Journal of Education and Learning*, *18*(3), 734–744.

Muhajir, S. N., Masara, A., & Ramdani, G. (2021). Tingkatan Literasi Sains Mahasiswa Calon Guru Fisika. *Jurnal Pendidikan Universitas Garut*, *15*(1), 378–384.

Mutawa, A. M., Al Muttawa, J. A. K., & Sruthi, S. (2023). The Effectiveness of Using H5P for Undergraduate Students in the Asynchronous Distance Learning Environment. *Applied Sciences*, *13*(4983), 1–15.

Naidu, V. R., Singh, B., Agarwal, A., Al Farei, K., Al ismaily, K., Al Harrasi, R., & Vaidhyanathan, N. (2021). Html5 Based E-Learning Authoring To Facilitate Interactive Learning During Covid-19 Pandemic: a Review. *IJAEDU- International E-Journal of Advances in Education*, 122–130.

Nasution, A. W., Hendriana, H., Kurniawan, R., & Yuliani, A. (2023). The Implementation of Google Site-Assisted Differentiation Learning Model to Improve Mathematical Reasoning of Class X Senior High School. *(Jiml) Journal of Innovative Mathematics Learning*, *6*(2), 132–140.

Pramita, M., Sukmawati, R. A., Purba, H. S., Wiranda, N., Kusnendar, J., & Sajat, M. S. (2021). Student Acceptance of E-learning to Improve Learning Independence in the Department of Computer Education. *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, *4*(1), 34–44.

Putri, I. N., Arif Abdul Haqq, & Saluky, S. (2024). Development of H5P Course Presentation to Improve Student Mathematics Learning Outcomes. *Journal of Mathematics Instruction, Social Research and Opinion*, *3*(3), 265–274.

Rahmi, U., Fajri, B. R., & Azrul, A. (2024). Effectiveness of Interactive Content with H5P for Moodle-Learning Management System in Blended Learning. *Journal of Learning for Development*, *11*(1), 66–81.

Sajidan, Atmojo, I. R. W., Ardiansyah, R., Saputri, D. Y., Roslan, R. M., & Halim, L. (2024). the Effectiveness of the Think-Pair-Project-Share (TP2S) Model in Facilitating Self-Directedness of Prospective Science Teachers. *Jurnal Pendidikan IPA Indonesia*, *13*(2), 325–338.

Saraswati, Y., Sifak Indana, & Elok Sudibyo. (2021). Science Literacy Profile of Junior High School Students Based on Knowledge, Competence, Cognitive, and Context Aspects. *IJORER : International Journal of Recent Educational Research*, *2*(3), 329–341.

Sarvary, M. A., & Ruesch, J. M. (2023). A Multistep Science Literacy Training Framework in an Introductory Biology Classroom: Teaching How to Find, Evaluate, Comprehend, and Cite Scientific Evidence. *Journal of Microbiology & Biology Education*, *24*(1), 1–4.

Schez-sobrino, S., Vallejo, D., Herrera, V., Glez-morcillo, C., Castro-schez, J. J., & Albusac, J. (2024). Softwarex Interactive Video Application : A Web-Based Open-Source Framework to Build Interactive Videos. *SoftwareX*, *27*(101772), 1–8.

Shakhina, I., Podzygun, O., Petrova, A., & Gordiichuk, G. (2023). Smart Education in the Transformation Digital Society. *Modern Information Technologies and Innovation Methodologies of Education in Professional Training Methodology Theory Experience Problems*, *67*(1), 51–64.

Silviawati, I., & Kurniawan, R. Y. (2023). Pengaruh Kemandirian Belajar, Lingkungan Keluarga, dan Motivasi Belajar Terhadap Hasil Belajar : Systematic Literature Review. *Eklektik : Jurnal Pendidikan Ekonomi Dan Kewirausahaan*, *6*(1), 99–113.

Smale-Jacobse, A. E., Meijer, A., Helms-Lorenz, M., & Maulana, R. (2019). Differentiated Instruction in Secondary Education: A Systematic Review of Research Evidence. *Frontiers in Psychology*, *10*(2366), 1–23.

Soong, R., Wolff, W., Pellizzari, J., Downey, K., Chen, S., Biswas, R. G., Bastawrous, M., Goerling, B., Busse, V., Busse, F., Elliott, C., Haber, A., Belguise, A., Simpson, M., & Simpson, A. (2024). Water Suppression 101 for Benchtop NMR–An Accessible Guide snd Primer Including Fully Interactive Training Videos. *Journal of Magnetic Resonance Open*, *19*(100150), 1–12.

Susanti, I., Suyatna, A., & Herlina, K. (2023). Development of H5P Moodle-Based Interactive STEM-Loaded Videos to Grow Performance Skills as an Effort to Overcome Learning Loss in Electrical Measuring Materials. *Jurnal Penelitian Pendidikan IPA*, *9*(9), 6974–6984.

Sutinah, C., & Ristiana, M. G. (2023). The Development of Assisted Worksheets Differentiation Learning Based on Learning Style : How Great It Can Help Students ' Mathematical Understanding Ability? *Jurnal Cakrawala Pendas*, *9*(2), 205–214.

Suwandi, F. P. E., Rahmanigrum, K. K., Mulyosari, E. T., Mulyantoro, P., Sari, Y. I., & Khosiyono, B. H. C. (2023). Strategi Pembelajaran Diferensiasi Konten Terhadap Minat Belajar Siswa dalam Penerapan Kurikulum Merdeka. *Prosiding Seminar Nasional Pendidikan Dasar*, *1*(1), 57–66.

Syahmani, Iriani, R., Kusasi, M., Prasetyo, Y. D., Norhasanah, H., & Rahman, F. A. (2024). Culturally Wetland Responsive Teaching to Improve Science Literacy and Wasaka Character. *Journal of Innovation in Educational and Cultural Research*, *5*(2), 196–206.

Taufiq, M., Kaniawati, I., Liliasari, L., Nugultham, K., & Park, H. Y. (2024). the Readiness and Constraints of Technological Integration in Implementing the Case Method and Team-Based Projects in the Mechanics Course. *Jurnal Pendidikan IPA Indonesia*, *13*(3), 377–390.

Theasy, Y., Wiyanto, & Sujarwata. (2017). Identifikasi Kesulitan Belajar Fisika Berdasarkan Kemampuan Multirepresentasi. *Physics Communication*, *1*(2), 1–5.

Thomann, H., Zimmermann, J., & Deutscher, V. (2024). How Effective is Immersive VR for Vocational Education? Analyzing Knowledge Gains and Motivational Effects. *Computers and Education*, *220*(105127), 1–13.

Torres, A. C., Duarte, M., Pinto, D., & Mouraz, A. (2024). Self-Regulated Learning in Secondary School: Students' Self-Feedback in A Peer Observation Programme. *Studies in Educational Evaluation*, *83*(101407), 1–13.

Unsworth, A. J., & Posner, M. G. (2022). Using H5P to Design and Deliver Interactive Laboratory Practicals. *Essay in Biochemistry*, *66*(1), 19–27.

Wang, X., Wang, X., Wang, X., & Wang, X. (2024). Prescriptive Manufacturing in Society 5.0: Human Autonomous Organizations and "On-Demand" Smart Services. *IFAC PapersOnLine*, *58*(3), 139–144.

Weng, X., Xia, Q., Ahmad, Z., & Chiu, T. K. F. (2024). Computers and Education : Artificial Intelligence Personality Traits for Self-Regulated Learning with Generative Artificial Intelligence : The Case of ChatGPT. *Computers and Education: Artificial Intelligence*, *7*(100315), 1–8.

Widarti, H. R., Rokhim, D. A., & Syafruddin, A. B.

(2020). The development of electrolysis cell teaching material based on stem-pjbl approach assisted by learning video: A need analysis. *Jurnal Pendidikan IPA Indonesia*, *9*(3), 309-318.

Yang, S., Brossard, D., Li, N., & Barolo, L. (2024). Bridging Gaps in COVID-19 Vaccine Knowledge : Effects of Multimodal Narratives on Message Elaboration and Recall Across Science Literacy Levels. *Clinical Epidemiology and Global Health*, *28*(101681), 1–7.

Yudha, S., Simorangkir, M., & Nurfajriani, N. (2023). Analysis of Science Literacy of XI Class Students In Buffer Solution Materials. *Journal of Learning Improvement and Lesson Study*, *3*(2), 1–6.

Zagulova, D., Prokofyeva, N., Yulia, K., Ziborova, V., Katalnikova, S., & Popova, Y. (2023). Personalization of Distance Learning: Using PLS-SEM for Analyzing the Possibility of Differentiating Students with the Felder-Silverman Learning Style Model. *Procedia Computer Science*, *225*, 3077–3085.

Zimmerman, B. J., & Schunk, D. H. (2011). Self-Regulated of Learning and Performance An Introduction and an Overview. In *Handbook of Self-Regulation of Learning and Performance*.