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Effectiveness of Differentiated Learning Approaches to Enhance Students' Literacy and Numeracy

Deny Hadi Siswanto[1]*, Arga Bagus Pratama Dyah Aan Firman Syah[2], Nurcahyo Yogyanto[3], Yarkasi[4]
[1,3]Muhammadiyah Mlati Senior High School
[2,4]Muhammadiyah 1 Sleman Vocational High School
Corresponding Author: Deny Hadi Siswanto denysiswanto11@guru.sma.belajar.id

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A B S T R A C T

This research aims to determine the effectiveness of the differentiated learning approach to improve student literacy and numeracy. The type of research used was quasi-experimental, with research subjects consisting of 60 students in class XI Multimedia A and XI Multimedia B at Muhammadiyah 1 Sleman Vocational High School. Data was collected through tests, observations and interviews. Data analysis techniques include validity and reliability tests for instrument tests as well as normality tests, homogeneity tests, and t-tests to determine the effectiveness of differentiated approaches to increase student literacy and numeracy, as well as Gain tests to determine the type of improvement. The research results showed that the data was normally distributed and homogeneous, so it was continued with the t-test. The t-test results are 0.000 < 0.05, meaning that the differentiated learning approach is effective in increasing student literacy and numeracy with an increase in the Gain test of 0.72 in the high category.

INTRODUCTION

Education serves as a vital foundation for shaping a generation capable of competing globally (Ajugo, 2024). In this modern era, literacy and numeracy are fundamental skills essential to supporting students' learning processes, especially as they face the rapid development of science and technology. According to Hirawati et al. (2021), literacy is not limited to reading and writing skills; it also encompasses critical thinking, in-depth comprehension, and critical analysis of information. Meanwhile, numeracy involves mathematical thinking, data comprehension, and the application of mathematical concepts to everyday situations. Together, these skills help students develop the competencies needed in today's digital age.

However, data indicates that the literacy and numeracy skills of students in Indonesia, including at the high school level, remain relatively low compared to other countries (Pisriwati et al., 2024; Alghiffari et al., 2024). The results of the Program for International Student Assessment (PISA) survey reveal that most Indonesian students have not yet reached adequate literacy and numeracy competency, especially in problem-solving and data interpretation key aspects in the global era. This situation affects students' critical and analytical thinking skills, which need improvement to meet international educational standards.

At Muhammadiyah 1 Sleman Vocational High School, literacy and numeracy education is also a primary focus to improve students' learning quality. In line with this goal, the currently implemented Merdeka Curriculum emphasizes the importance of teaching approaches that meet each student's learning needs (Gurion & Nasir, 2024). One such approach being applied is differentiated learning, which tailors instruction to the characteristics, interests, learning styles, and specific needs of each student. This approach is believed to support the achievement of stronger literacy and numeracy competencies in educational settings (Siswanto et al., 2024).

Differentiated learning is seen as effective in enhancing student motivation and engagement in the learning process, as it considers individual differences in learning readiness, learning styles, and learner profiles. Essentially, not all students possess the same abilities or interests in a subject. Through differentiated learning, teachers can create an inclusive learning environment that supports each student in learning according to their capacity, thus enhancing learning outcomes in literacy and numeracy (Huntington et al., 2023).

One challenge in implementing differentiated learning is how teachers can design effective lesson plans that align with each student's characteristics. This requires teachers to perform initial assessments to understand students' learning needs and readiness. At Muhammadiyah 1 Sleman Vocational High School, teachers are encouraged to understand each student's learning needs through diagnostic assessments, enabling them to determine the appropriate instructional approach. These assessments provide a foundation for understanding students' literacy and numeracy skills before designing suitable teaching methods (Dewantara et al., 2023).

Furthermore, the challenges in improving literacy and numeracy go beyond the instructional approach used; they also involve limitations in resources and support from schools and families (Astiwi et al., 2024; Pisriwati et al., 2024). Support from various parties, such as providing relevant books, technology access, and parental involvement in fostering students' interest in reading and numeracy, significantly contributes to building these foundational skills. At Muhammadiyah 1 Sleman Vocational High School, collaboration between the school and families is an essential aspect that is continually strengthened to support effective literacy and numeracy programs.

The implementation of a differentiated learning approach is expected to positively impact the literacy and numeracy skills of students at Muhammadiyah 1 Sleman Vocational High School. Firat et al. (2022) states that this approach can enhance students' learning outcomes, particularly in understanding the basic concepts needed for literacy and numeracy. By tailoring teaching methods to focus on individual student needs, literacy and numeracy can be taught in a way that is more engaging and aligns with students' interests.

Additionally, with the application of differentiated learning, students are expected to develop their critical and analytical thinking skills. These skills are essential for high school students as they prepare for higher education or the workforce. Differentiated learning creates opportunities for students to understand and apply literacy and numeracy concepts in everyday life, equipping them with skills they can carry into the future (Latifa et al., 2024).

This approach is also anticipated to reduce the achievement gap among students with varying abilities (Putri et al., 2024; Alam et al., 2023). At Muhammadiyah 1 Sleman Vocational High School, differentiated learning is aimed at creating equal access to learning, so each student has the same opportunity to develop their literacy and numeracy skills. With this more personalized approach, students who may initially be less interested in literacy and numeracy can become more motivated and actively engaged in learning.

Overall, the implementation of differentiated learning at Muhammadiyah 1 Sleman Vocational High School holds great potential to enhance students' literacy and numeracy skills. This research will explore how effective this approach is in influencing students' literacy and numeracy skills and the challenges encountered during its implementation. Therefore, the findings of this study are expected to provide valuable insights for educators and other stakeholders to improve the quality of literacy and numeracy education at the high school level through more innovative, student-centered teaching approaches.

LITERATURE REVIEW

Differentiated Learning

Differentiated learning is an approach that tailors the learning process to meet the individual needs, interests, and abilities of students. According to Noftariani (2023), differentiated learning aims to provide equal opportunities for every student to learn and grow optimally through varied teaching approaches adapted to each student's unique characteristics. Differentiated

learning encompasses several aspects, including differentiation in content, process, product, and learning environment, allowing students to learn in ways that align with their learning styles and levels of understanding (Gurion & Nasir, 2024). According to Fauzia & Ramadan (2023), this approach has proven effective in increasing student engagement and providing them with opportunities to develop according to their potential.

In practice, differentiated learning can be implemented through various methods, such as grouping students by ability, adjusting tasks and materials, and using diverse teaching techniques to support different learning styles. For example, a study by Smit et al. (2023) shows that differentiated learning, which accommodates individual differences among students, can enhance learning motivation, concept comprehension, and academic performance. Additionally, research indicates that this approach helps students with learning limitations or who are below average to keep up with the learning process, thereby creating an inclusive learning environment. This makes differentiated learning a relevant approach for implementation in various educational contexts.

However, implementing differentiated learning is not without challenges. The primary challenge lies in teachers' ability to design and manage teaching approaches that cater to each student, especially in large and diverse classrooms. Teachers need to have an in-depth understanding of students' characteristics and needs, as well as the skills to design flexible materials and methods. Despite these challenges, research demonstrating the positive benefits of differentiated learning has driven efforts to integrate this approach into curricula and daily teaching practices.

Student Literacy and Numeracy

Literacy and numeracy are two essential competencies in modern education, as they play a significant role in developing students' critical thinking, analytical skills, and problem-solving abilities. According to research by the OECD through the PISA, literacy involves students' ability to understand, use, evaluate, and reflect on various types of texts to achieve specific purposes in both personal and social contexts. Meanwhile, numeracy, or mathematical literacy, involves the ability to apply mathematical concepts in real life, including data interpretation, statistical analysis, and solving number-based problems. Literacy and numeracy are not merely academic skills but also foundational life skills, making them a primary focus in educational policy across many countries (Rahman, 2023; Siswanto et al., 2024).

Several studies indicate that Indonesian students' literacy and numeracy skills still require improvement. Based on PISA reports, the average literacy and numeracy scores of Indonesian students are below international standards, highlighting challenges in mastering these competencies in schools. One contributing factor is the one-directional learning approach, which tends to lack active student engagement in the learning process (Listyanti et al., 2024; Tarso et al., 2024). On the other hand, collaborative and contextual learning approaches, such as problem-based learning and differentiated learning, are considered more effective in fostering literacy and numeracy. Studies have

found that students involved in more student-centered learning tend to have a better understanding of literacy and numeracy.

In this context, differentiated learning is increasingly being implemented in various schools, including those in Indonesia, to improve students' literacy and numeracy skills. This approach seeks to adapt teaching methods to the individual learning characteristics and needs of students, providing a more effective and personalized learning experience. A study conducted by Langelaan et al. (2024) found that differentiated learning can help students understand material better because it takes into account factors such as students' interests, learning styles, and levels of readiness. With this flexible approach, literacy and numeracy are not only taught mechanically but are also understood as applicable and relevant skills for everyday life.

METHODOLOGY

This research uses a quasi-experiment method with a non-equivalent control group design. In this design, the class that applies a differentiated learning approach is referred to as the experimental class, while the class that uses conventional learning is referred to as the control class. These two groups were given a pretest and posttest to measure the results of implementing differentiated learning and assess the significance of the influence of the independent variable (differentiated learning) on the dependent variable (literacy and numeracy). This research design is illustrated in the following table.

Table 1. Research Design

Class	Pretest	Treatment	Posttest
Experiment	E_1	X	E_2
Control	K_1	-	K_2

(Sugiyono, 2019)

Based on the table above, the research design involves two class groups, namely the experimental class and the control class, each undergoing pretest and posttest measurements to evaluate the effect of the treatment. In the experimental class, which serves as the treatment group, a pretest, denoted as E_1, was conducted. Following this, the experimental class received a specific treatment (indicated by X) in the form of the application of a differentiated learning approach. After the treatment, the experimental class was measured again through a posttest, denoted as E_2, to assess changes and the effect of implementing this approach. Meanwhile, the control class underwent a pretest, denoted as K_1, without receiving any special treatment. The final measurement or posttest in the control class, denoted as K_2, was conducted to compare the results with the experimental class.

This study uses both primary and secondary data as its main sources. The sample was selected using a purposive sampling technique, consisting of 30 students from Class XI Multimedia A as the experimental group using the differentiated learning approach and 30 students from Class XI Multimedia B as the control group using conventional learning. The instruments include literacy

and numeracy tests in the form of pretests and posttests, each consisting of 3 literacy questions and 3 numeracy questions. Assessment was conducted by calculating the total score and adjusting it to a scale of 100.

Additionally, a questionnaire was given to teachers to gather information on the differentiated learning approach, teaching experience, and perceptions of students' literacy and numeracy skills. Observations were conducted using questionnaires for teachers and students, as well as interviews to further explore the implementation of the differentiated learning approach. The data collection process began with the selection of experimental and control classes, validity testing of the instruments, and data analysis using an independent sample t-test to test the research hypothesis, as well as a Gain test to measure the improvement in students' literacy and numeracy.

RESEARCH RESULT

Based on interviews with teachers, it was revealed that they hold a positive view of this method; they feel more motivated and confident in teaching literacy and numeracy according to students' abilities. The literacy and numeracy test data collected from the posttest after applying this method reflect students' learning outcomes after participating in four sessions with the differentiated instruction approach. Before conducting the pretest and posttest, the test instruments were piloted in a class that had already covered the material, which was class XII Multimedia. Subsequently, validity testing was carried out using SPSS-25 software, as follows.

Correlations

		Item_1	Item_2	Item_3	Item_4	Item_5	Item_6	Total
Item_1	Pearson Correlation	1	-.071	.056	.267	.178	.111	.420*
	Sig. (2-tailed)		.710	.770	.153	.347	.558	.021
	N	30	30	30	30	30	30	30
Item_2	Pearson Correlation	-.071	1	.287	.045	.311	.128	.491**
	Sig. (2-tailed)	.710		.124	.812	.095	.501	.006
	N	30	30	30	30	30	30	30
Item_3	Pearson Correlation	.056	.287	1	-.042	-.145	.120	.381*
	Sig. (2-tailed)	.770	.124		.827	.444	.527	.038
	N	30	30	30	30	30	30	30
Item_4	Pearson Correlation	.267	.045	-.042	1	.607**	.226	.649**
	Sig. (2-tailed)	.153	.812	.827		.000	.229	.000
	N	30	30	30	30	30	30	30
Item_5	Pearson Correlation	.178	.311	-.145	.607**	1	.390*	.734**
	Sig. (2-tailed)	.347	.095	.444	.000		.033	.000
	N	30	30	30	30	30	30	30
Item_6	Pearson Correlation	.111	.128	.120	.226	.390*	1	.623**
	Sig. (2-tailed)	.558	.501	.527	.229	.033		.000
	N	30	30	30	30	30	30	30
Total	Pearson Correlation	.420*	.491**	.381*	.649**	.734**	.623**	1
	Sig. (2-tailed)	.021	.006	.038	.000	.000	.000	
	N	30	30	30	30	30	30	30

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 1. Validity Test Results

Based on the picture above, it can be seen that there are 6 test question items, where all the question items can be seen to have a Pearson Correlation value > t_{table} (2,048) and all the question items are categorized as valid. Based on this, the next test can be tested, namely the reliability test. To test reliability, use the Cronbach's Alpha test as follows.

Reliability Statistics

Cronbach's Alpha	N of Items
.551	6

Figure 2. Reliability Test Results

Based on the picture above, it can be seen that the Chronbach's Alpha value of 0,551 is greater than α (0,05). So it can be said that the data is reliable. After carrying out validity and reliability tests and the results show that the data has a valid and reliable distribution, a pretest can then be carried out in the experimental class and research control class to find out whether the initial data is normal and homogeneous. The following are the results of the pretest data normality test.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
K_1	.159	30	.051	.960	30	.318
E_1	.131	30	.200*	.935	30	.068

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Figure 3. Normality Test Results

Based on the picture above, it can be seen that the Shapiro-Wilk test shows a value of 0,318 in the control class and 0.068 in the experimental class where this value is greater than the α value (0,05). So it can be said that the two data in this class are normally distributed. Next, the data was tested for homogeneity using the Levene Statistics test assisted by SPSS-25 as follows.

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Value	Based on Mean	.001	1	58	.981
	Based on Median	.014	1	58	.906
	Based on Median and with adjusted df	.014	1	57.872	.906
	Based on trimmed mean	.005	1	58	.943

Figure 4. Homogeneity Test Results

Based on the picture above, it can be seen that the significance value in the Levene Statistics is 0,001, which is smaller than the α value (0,05). So it can be said that the two data in this class have a homogeneous distribution. After the

two classes were said to be normal and homogeneous, learning was then carried out according to the research design, where the experimental class was given learning using a differentiated approach and the control class used conventional teacher learning. After learning is carried out, a posttest is given to both classes. The results of this posttest will be tested finally using the t test, namely as follows.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Value	Equal variances assumed	6.713	.012	5.853	58	.000	1900.03333	324.65152	1250.17272	2549.89395
	Equal variances not assumed			5.853	48.141	.000	1900.03333	324.65152	1247.32715	2552.73951

Figure 5. T test results

Based on the picture above, it can be seen that the significance value of the Independent Sample Test is 0,000, which is smaller than the α value (0,05). This shows that the differentiated learning approach is effective in increasing the literacy and numeracy of class XI Multimedia A students at Muhammadiyah 1 Sleman Vocational High School. This improvement can be seen through the results of students' pretest and posttest in learning mathematics by using the differentiated learning approach as seen in the following figure.

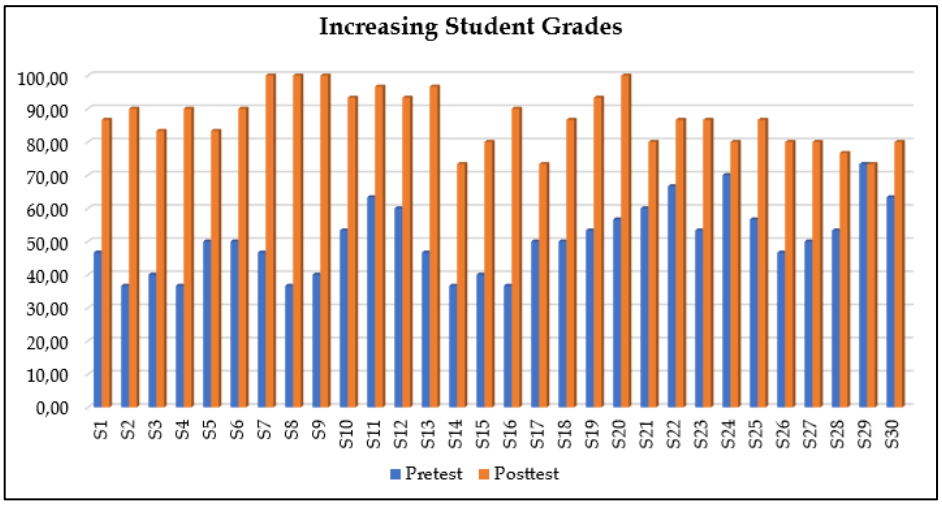

Figure 6. Pretest and Posttest Results

The image above shows that students' literacy and numeracy increased between the pretest and posttest. In the pretest data, the lowest score was 36,67, the highest score was 73,33, and the average score was 51,33. In contrast, in the posttest data, the lowest score was 80,00, the highest score was 100, and the average score was 8,44. Thus, the pretest and posttest scores were different and increased by 56,11%. To determine the increase in student literacy and numeracy, the Gain test can be carried out with the following calculation results.

$$\langle g \rangle = \frac{S_{post} - S_{pre}}{SMI - S_{pre}} = \frac{86{,}44 - 51{,}33}{100 - 51{,}33} = \frac{35{,}11}{48{,}67} = 0{,}72$$

Based on the analysis carried out, the gain figure of 0,72 shows that the effectiveness of the differentiated learning approach on literacy and numeracy for class.

DISCUSSION

This research aims to measure the effectiveness of a differentiated instruction approach in enhancing students' literacy and numeracy skills. To ensure the validity and reliability of the assessment tools, the researcher conducted validity and reliability tests on the literacy and numeracy questions with the XII Multimedia class at Muhammadiyah 1 Sleman Vocational High School, selected as a preliminary test sample before the main study was conducted. These questions were then applied to both the experimental and control classes. Both classes underwent a pretest and posttest to evaluate literacy and numeracy development. Data was collected through observations, interviews, and tests, encompassing a range of student backgrounds.

Prior to further analysis, prerequisite tests, including normality and homogeneity tests, were conducted to ensure the data suitability from both the experimental and control classes. Only after the data met these prerequisites was advanced analysis performed, allowing for a deeper understanding of the impact of differentiated instruction.

Interviews with teachers revealed that this approach positively affected their motivation and confidence in teaching. Teachers felt more capable of providing instruction tailored to each student's abilities, indicating that this method not only impacted student achievement but also improved teachers' attitudes toward the learning process. Increased motivation and confidence among teachers became a key factor in implementing a more adaptive and effective learning environment (Putri, 2024; Yogyanto et al., 2024).

In the experimental class, differentiation was implemented through variations in content, process, product, and learning environment, adapted to students' needs and abilities. This study showed that students in the differentiated instruction group experienced significant improvements in literacy and numeracy skills compared to students in the control group, who followed conventional instruction, which primarily involved lectures, simple discussions, and independent tasks, leading to more passive student engagement.

The significance value of the t-test was 0,000 < 0,05, indicating that the differentiated instruction approach was effective in enhancing the literacy and numeracy skills of the XI Multimedia A class at Muhammadiyah 1 Sleman Vocational High School. The improvement is evident from the average pretest score of 51,33 to a posttest score of 86,44, an increase of 56,11%. According to the analysis, the gain score of 0,72 indicates the approach's high effectiveness and significance in improving literacy and numeracy in the eleventh-grade A class at Muhammadiyah 1 Sleman Vocational High School, aligning with research findings (Astiwi, 2024; Siswanto & Andriyani, 2024).

Differentiated instruction allowed teachers to tailor the learning process to students' learning styles auditory, visual, and kinesthetic-creating a more personalized learning experience that increased student motivation and engagement. This aligns with Erbil (2020), as activities like active group discussions enabled students in the experimental class to work collaboratively to deepen their understanding, in line with Lev Vygotsky's theory, which emphasizes the importance of collaboration in learning.

This study demonstrates that differentiated teaching effectively supports the improvement of students' literacy and numeracy skills by considering their respective cognitive development stages, as outlined in Jean Piaget's cognitive development theory. According to Piaget, individuals progress through various cognitive development stages, such as the sensorimotor, pre-operational, concrete operational, and formal operational stages. Each stage influences how students understand and process information, requiring teaching approaches to be adapted to the cognitive development stage students are currently experiencing (Wahyuni et al., 2024; Abuhassna et al., 2020).

By understanding the unique characteristics and needs of each developmental stage, teachers can design and create inclusive, adaptive, and responsive learning environments that cater to individual differences among students (Syah et al., 2024). This approach allows each student to develop optimally according to their potential. It not only helps students achieve learning objectives in literacy and numeracy but also fosters critical thinking and problem-solving skills that align with their cognitive abilities.

By taking cognitive development and social interaction into account, differentiated instruction fosters a more meaningful learning environment. Learning experiences that are relevant to individual needs enable students to develop creativity and gain a deeper understanding of the material. The results of this study indicate that differentiated instruction significantly enhances students' literacy and numeracy skills, impacting both their academic abilities and social skills.

CONCLUSIONS AND RECOMMENDATIONS

This research aims to analyze the effectiveness of the differentiated learning approach on literacy and numeracy for class XI Multimedia A students at Muhammadiyah 1 Sleman Vocational High School. The results showed that there was a significant increase in literacy and numeracy scores for students in the experimental group compared to the control group. These findings emphasize the importance of learning approaches that consider individual student needs to improve learning outcomes, especially in student literacy and numeracy. By providing learning experiences that suit students' cognitive development and social interactions, this approach helps create an inclusive and supportive learning environment for all students, resulting in meaningful learning.

ADVANCED RESEARCH

This study is limited to the eleventh-grade level and focuses on students' literacy and numeracy skills. It is hoped that future researchers will explore differentiated instruction approaches at other educational levels and in relation to other skills.

REFERENCES

Abuhassna, H., Al-rahmi, W. M., Yahya, N., Aman, M., & Megat, Z. (2020). Development of a new model on utilizing online learning platforms to improve students ' academic achievements and satisfaction. *International Journal of Educational Technology in Higher Education*, *17*(38), 1–23. https://doi.org/https://doi.org/10.1186/s41239-020-00216-z

Ajugo, M. U. (2024). Clinical Supervision for Quality Education Delivery in Public Schools in Nigeria. *European Journal of Arts, Humanities and Social Sciences*, *1*(2), 47–60. https://doi.org/10.59324/ejahss.2024.1(2).05

Alam, R., Suparman, Samsinar, Siswanto, D. H., & Maretha, D. G. A. (2023). Kajian Bibliometrik untuk Menemukan Kebaruan dalam Penelitian Mengenai Berpikir Kritis. *PELITA: Jurnal Penelitian Dan Karya Ilmiah Volume*, *21*(1), 49–60. https://doi.org/10.33592/pelita.v23i1.2960

Astiwi, W., & Siswanto, D. H. (2024). Pengembangan e-LKPD pada Materi Relasi dan Fungsi dengan Model PAKEM untuk Meningkatkan Kemampuan Berpikir Kreatif. *Jurnal Praktik Baik Pembelajaran Sekolah Dan Pesantren*, *3*(03), 118–132. https://doi.org/https://doi.org/10.56741/pbpsp.v3i03.684

Astiwi, W., Siswanto, D. H., & Suryatama, H. (2024). Description Regarding the Influence of Teacher Qualifications and Competence on Early Childhood Learning Achievement. *Asian Journal of Applied Education (AJAE)*, *3*(3), 347–358. https://doi.org/https://doi.org/10.55927/ajae.v3i3.10360

Dewantara, A. H., Setiawati, F. A., & Saraswati, S. (2023). Towards Numeracy Literacy Development: a Single-Case Study on the Use of the Living Book Homeschooling Model. *Infinity Journal*, *12*(2), 225–242. https://doi.org/10.22460/infinity.v12i2.p225-242

Erbil, D. G. (2020). A Review of Flipped Classroom and Cooperative Learning Method Within the Context of Vygotsky Theory. *Frontiers in Psychology*, *11*(June), 1–9. https://doi.org/10.3389/fpsyg.2020.01157

Fauzia, R., & Ramadan, Z. H. (2023). Implementasi Pembelajaran Berdiferensiasi Dalam Kurikulum Merdeka. *Jurnal Educatio FKIP UNMA*, *9*(3), 1608–1617. https://doi.org/10.31949/educatio.v9i3.5323

Firat, E. E., Joshi, A., & Laramee, R. S. (2022). Interactive visualization literacy:

The state-of-the-art. *Information Visualization*, *21*(3), 285–310. https://doi.org/10.1177/14738716221081831

Gurion, S. Ben, & Nasir, N. (2024). Teacher Readiness in Implementing "the Merdeka Curriculum." *Journal of Education and Teaching (JET)*, *5*(1), 108–118. https://doi.org/10.51454/jet.v5i1.321

Hirawati, H., Sijabat, Y. P., & Giovanni, A. (2021). Financial Literacy, Risk Tolerance, and Financial Management of Micro-enterprise Actors. *Society*, *9*(1), 174–186. https://doi.org/10.33019/society.v9i1.277

Huntington, B., Goulding, J., & Pitchford, N. J. (2023). Expert perspectives on how educational technology may support autonomous learning for remote out-of-school children in low-income contexts. *International Journal of Educational Research Open*, *5*(June), 100263. https://doi.org/10.1016/j.ijedro.2023.100263

Langelaan, B. N., Gaikhorst, L., Smets, W., & Oostdam, R. J. (2024). Differentiating instruction: Understanding the key elements for successful teacher preparation and development. *Teaching and Teacher Education*, *140*, 104464. https://doi.org/10.1016/j.tate.2023.104464

Latifa, A., Ammade, S., Mandar, P., & Sulawesi, W. (2024). Improving the English Language Achievement of SMP Negeri 4 Polewali by Integrating E-modul as a Media and Differentiated Learning as the Approach. *Journal of English Language Teaching and Applied Linguistics*, *6*(1), 22–42. https://doi.org/10.32996/jeltal

Noftariani, S. (2023). Integrating Game-Based Learning of Wordwall in Teaching At the Right Level To Improve Students' Motivation (A Classroom Action Research). *UNNES-TEFLIN National Conference*, 613–617.

Pisriwati, S. A., Hardi, Y., & Siswanto, D. H. (2024). Enhancing Organizational Development through Principal Leadership to Improve Teacher and Staff Work Discipline. *Journal of Organizational and Human Resource Development Strategies*, *1*(1), 52–62. https://doi.org/10.56741/ohds.v1i01.670

Pisriwati, S. A., Siswanto, D. H., Hardi, Y., & Alghiffari, E. K. (2024). Question Making Training with LOTS , MOTS , and HOTS Cognitive Levels for High School Teachers. *Journal of Social and Community Development*, *1*(1), 9–19. https://doi.org/10.56741/jscd.v1i01.666

Putri, H. A., & Siswanto, D. H. (2024). Teaching at The Right Level (TaRL) as an Implementation of New Education Concepts in the Insights of Ki Hajar Dewantara. *Indonesian Journal of Educational Science and Technology (Nurture)*, *3*(2), 89–100.

https://doi.org/https://doi.org/10.55927/nurture.v3i2.9297

Putri, H. A., Siswanto, D. H., & Susanto, D. (2024). Developing Teachers' Skills in Designing Project-Based Learning in the Merdeka Curriculum through Assembler Edu Training. *Civitas: Jurnal Pengabdian Masyarakat*, *1*(1), 12–20. https://journal.idscipub.com/civitas/article/view/334

Rahman, A. (2023). Meningkatkan Hasil Belajar Shooting Bola Basket melalui Metode Pembelajaran Teaching at the Right Level (TaRL) pada Siswa Kelas X-3 SMAN 3 Jombang Tahun pelajaran 2022-2023. *Journal on Education*, *6*(1), 2036–2043. https://doi.org/10.31004/joe.v6i1.3186

Siswanto, D. H., Alghiffari, E. K., & Andriyani. (2024). Development of Creative Thinking Evaluation Tool Utilizing Microsoft Sway Application in the Context of Pythagorean Theorem Material. *Al Khawarizmi*, *8*(1), 33–48. https://doi.org/10.22373/jppm.v8i1.23059

Siswanto, D. H., & Andriyani. (2024). Analisis Kemampuan Berpikir Kritis dalam Penyelesaian Masalah Matriks Berkonteks Perjalanan Wisata. *Buletin Edukasi Indonesia (BEI)*, *3*(03), 93–103. https://doi.org/https://doi.org/10.56741/bei.v3i03.647

Siswanto, D. H., Kuswantara, H., & Wahyuni, N. (2024). Implementation of Problem Based Learning Approach Culturally Responsive Teaching to Enhance Engagement and Learning Outcomes in Algebraic Function Limit Material. *EDUCATUM JSMT*, *12*(1), 80–88.

Siswanto, D. H., Listyanti, F. S., Firmansyah, A. B. P. D. A., Pisriwati, S. A., & Setiawan, A. (2024). Enhancing Teachers ' Competence in Designing Computer- Based Test Questions through In House Training. *JOELI: Journal of Educational and Learning Innovation*, *1*(1), 75–84. https://doi.org/https://doi.org/10.72204/g66ex111

Siswanto, D. H., Samsinar, Alam, S. R., & Andriyani. (2024). Peran Kompetensi Guru dalam Menerapkan Kurikulum Merdeka. *Jurnal Pendidikan DIDAXEI*, *5*(1), 763–773. https://e-journal.iaknambon.ac.id/index.php/DX/article/view/1042

Smit, R., Hess, K., Taras, A., Bachmann, P., & Dober, H. (2023). The role of interactive dialogue in students' learning of mathematical reasoning: A quantitative multi-method analysis of feedback episodes. *Learning and Instruction*, *86*(March), 1–18. https://doi.org/10.1016/j.learninstruc.2023.101777

Sugiyono. (2019). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta.

Syah, A. B. P. D. A. F., Suwarta, & Siswanto, D. H. (2024). Enhancing Teacher Self-Management and Skills in Designing Teaching Materials through a Merdeka Curriculum Workshop at Muhammadiyah 1 Sleman Vocational High School. *Jurnal Pengabdian Masyarakat Bestari (JPMB)*, *3*(9), 585–598. https://doi.org/https://doi.org/10.55927/jpmb.v3i9.11587

Tarso, Fitriana, E., & Siswanto, D. H. (2024). Keefektifan Fitur-Fitur pada Aplikasi Telegram sebagai Media Pembelajaran Matematika Siswa Sekolah Menengah Kejuruan. *Papanda Journal of Mathematics and Sciences Research (PJMSR)*, *3*(2), 99–109. https://ejournal.papanda.org/index.php/pjmsr/article/view/958

Wahyuni, N., Siswanto, D. H., Alghiffari, E. K., & Alam, S. R. (2024). Esensial Literasi dalam Upaya Meningkatkan Minat Baca untuk Peserta Didik. *Adi Karsa: Jurnal Teknologi Komunikasi Pendidikan Volume*, *15*(2), 134–139. https://ejournal.btkp-diy.or.id

Yogyanto, N., Pisriwati, S. A., & Siswanto, D. H. (2024). Education on the Contextual Utilization of Information Technology Based on the IoT in the Daily Lives of Senior High School Students Nurcahyo. *Civitas : Jurnal Pengabdian Masyarakat*, *1*(1), 21–27. https://journal.idscipub.com/civitas/article/view/335