Effectiveness of Using Area Models in Differentiated Learning to Enhance Literacy and Numeracy in Early Childhood Education

Najwa, Kunzita[1]*, Setiadi, Gunawan[1], Utaminingsih, Sri[1] & Lily Muliana[2]

[1]*Universitas Muria Kudus, Kudus, Central Java 59327, INDONESIA

[2]City University, 46100 Petaling Jaya, Selangor, MALAYSIA

*Corresponding Author: kunzitanajwadipo@gmail.com

Abstract: This research aims to evaluate the effectiveness of the use of the Area Model in differentiated learning to enhance literacy and numeracy in Early Childhood Education (PAUD). The research objectives include: (1) assessing the improvement in literacy and numeracy before and after the implementation of the Area Model and differentiated learning in PAUD, (2) evaluating the impact of the use of the Area Model and differentiated learning on students' literacy and numeracy improvement, and (3) assessing the extent of the influence of the Area Model and differentiated learning in enhancing literacy and numeracy at KB As-Syifa in the Bojong district. The research method employed is quasi-experimental research with a pretest-posttest control group design. The research sample consists of 16 students from Group B of PAUD aged 5-6 years at KB As-Syifa in the Bojong district, selected through Nonprobability Sampling technique. Data were collected using tests in the form of student worksheets in the area learning model. Data analysis involved descriptive methods, gain score tests, and t-tests. The results of the research indicate that: (1) there is a difference in the improvement of literacy and numeracy mastery in the experimental class after treatment using the Area Model and differentiated learning, (2) the Area Model and differentiated learning can enhance the understanding of literacy and numeracy material by 74%, with a learning approach tailored to students' interests, creating an enjoyable learning atmosphere.

Keywords: Area model, differentiated learning, literacy, numeracy, early childhood education

1. Introduction

Early Childhood Education (PAUD) has become a crucial focus in understanding the growth and development of children. In tandem with this, attention to effective early learning stimuli or interventions has become crucial. PAUD itself focuses on six aspects of child development, including religious and moral values, physical motor skills, arts, language, cognitive development, and socio-emotional development (Singer, 2013).

The principles of PAUD learning expressed by experts, such as learning through play, integrated stimulation, and thematic approaches, form the foundation for the success of PAUD institutions in creating effective and enjoyable learning environments (Ghani, 2021). Monotonous or one-directional learning is considered a barrier for learners to express their abilities. The importance of learning models in achieving effective and enjoyable learning is emphasized. A teacher needs to master various types of learning models and choose them wisely based on student conditions, learning materials, and available facilities. Learning models are defined as patterns used by educators in implementing classroom learning, covering approaches, procedures, strategies, methods, and techniques from planning to post-learning (Isenberg & Quisenberry, 2002).

Bracken and Crawford (2010), discusses the area learning model, emphasizing its holistic approach and its potential to enhance students' understanding of various learning concepts. The Ministry of National Education (2014) has explored the importance of differentiated learning as a strategy to accommodate the diversity of students' abilities and learning styles. Learning designs that consider these differences are expected to improve teaching effectiveness.

Dick and Carey (1985) provide a detailed view of instructional design, focusing on the development of effective learning materials. Good design is expected to support the effectiveness of using the area learning model in the context of differentiated learning. Shihab (2015) considers literacy and numeracy concepts as critical aspects of learning. The

improvement of literacy and numeracy is expected to occur through the implementation of the area learning model. Zar'in and Salehcah (2021) discuss the relevance of using the area learning model in early childhood education. These studies acknowledge that this approach can provide a strong foundation for the development of literacy and numeracy at the PAUD level.

Kotob and Arnouss (2019) specifically investigates the effectiveness of using the area learning model in differentiated learning to improve literacy and numeracy. The findings from this research can significantly contribute to our understanding of how this model can be applied effectively at the PAUD level. In the context of PAUD, one of the learning models used is the area learning model. This model provides students with the freedom to choose activities based on their interests. Area learning is packaged in the form of enjoyable games, allowing students to choose learning areas that suit their interests, with the expectation that they can complete all areas prepared by the teacher.

The importance of literacy and numeracy in early childhood learning also emerges in the independent curriculum that emphasizes the use of numbers, symbols, and mathematical abilities in solving everyday problems. Numeracy literacy in PAUD includes managing numbers and data as well as the ability to evaluate statements involving mental and estimative aspects according to problems and realities (Salminen et al., 2021). The implementation of differentiated learning in PAUD is also a key factor. Differentiated learning considers the needs of students in terms of learning readiness, interests, or their learning profiles. Differentiation strategies in content, process, and product become the main pillars in ensuring that each student receives learning suitable for their needs (Aulia et al., 2024). Interview results with parents of PAUD students highlight their expectations for good literacy and numeracy learning, especially in preparing their children for further education. Therefore, it is important for teachers to add literacy and numeracy learning that aligns with the principles of enjoyable PAUD learning, such as differentiated learning.

This research aims to combine the area learning model with differentiated learning to enhance literacy and numeracy in accordance with the independent curriculum guidelines. The research problem includes the extent of literacy and numeracy improvement at the PAUD level before and after being taught with the area model and differentiated learning and the extent of the influence of the area model in differentiated learning on literacy and numeracy improvement.

The research objectives include understanding the improvement in literacy and numeracy before and after the implementation of the area model and differentiated learning and its extent. The benefits of the research include theoretical and practical benefits for students, researchers, and schools. The scope of the research is focused on the effectiveness of using the area model in differentiated learning to enhance literacy and numeracy at the PAUD level at KB As-Syifa Rembul. Thus, this research is expected to contribute to the development of effective and enjoyable learning methods at the PAUD level, particularly through the implementation of the area learning model and differentiated learning.

2. Methodology

This research employs an experimental method with a One-Group Pretest-Posttest Design. The experimental method is chosen to measure the effectiveness of using the area learning model in differentiated learning to improve literacy and numeracy at the PAUD level (Knapp, 2016). This research design involves one group subjected to pretests and posttests to obtain a more accurate understanding of the treatment's impact. The research population consists of students from Group B, aged 5-6 years, at KB As-Syifa in the Bojong District, Tegal Regency. The research sample consists of 16 students selected from this population.

Data collection in this research uses a test method. The test includes student worksheets designed to measure the level of students' understanding of literacy and numeracy after receiving learning with the area model and differentiation. Research instruments encompass tests of literacy and numeracy improvement as well as the impact of using the area model and differentiation. Instrument validity is measured using the product-moment correlation, while reliability is calculated with Cronbach's alpha.

The difficulty level of the questions is identified using the difficulty index, classifying questions as difficult, moderate, or easy. The discriminant power of the questions is assessed using the discriminant power formula with classifications such as poor, fair, good, and very good. Data analysis involves prerequisite tests such as normality tests with Liliefors. The final analysis uses the Gain Score test to evaluate the improvement in student learning test results from the beginning to the end of the learning process. Additionally, the t-test is used to measure the comparison of pretest and posttest values within one group with the Paired sample t-test and between two groups with the independent sample t-test.

3. Results and Discussion

This study aimed to evaluate the effectiveness of using the area learning model in differentiated learning to improve literacy and numeracy in Early Childhood Education (PAUD). The research design employed was quasi-experimental, using a pretest-post-test method. The participants consisted of one experimental class implementing the area learning model and differentiated learning, and one control class using conventional teaching methods.

In the context of this study, research data served as a crucial foundation for measuring the effectiveness of using the area learning model in differentiated learning to enhance literacy and numeracy in PAUD. The data included the

validation process of research instruments and information regarding the improvement in literacy and numeracy measured among students. Before implementing the teaching tools and research instruments, a validation phase was conducted by expert faculty members from Muria Kudus University, significantly contributing to enhancing the quality of the instruments used. The reliability test results for literacy and numeracy question instruments showed a high level of reliability, with Cronbach's alpha values above 0.6 for all materials. This confirms that the instruments used in this study are reliable and provide consistent results, instilling confidence that the obtained data can serve as a basis for accurate analysis in measuring the impact of using the area learning model and differentiated learning on the improvement of literacy and numeracy in early childhood educuation.

Table 1. Validation and reliability test

No	Topic	Cronbach Alpha	Reliability
1	Connecting two syllables	.615	0.6
2	Connecting objects with syllables	.632	0.6
3	Sorting letters	.780	0.6
4	Connecting 3 syllables	.632	0.6
5	Calculating geometry	.650	0.6
6	Composition of pictures	.632	0.6
7	Comparison	.781	0.6
8	Figural matrices	.650	0.6

The difficulty level test (Table 2), an integral part of this research, was conducted to evaluate and measure the difficulty level of questions for each literacy and numeracy material taught. The test results depicted variations in difficulty levels, with some materials falling into the moderate and difficult categories. Through this assessment process, a clear picture emerged of the complexity of the materials faced by students during the learning process. This information is crucial in identifying the extent of challenges faced by students in understanding and mastering literacy and numeracy materials. Additionally, the results of the difficulty level test provide a deeper insight for educators to adjust their teaching strategies, ensuring that the taught materials align with the students' comprehension levels and readiness, and providing appropriate support for an effective learning process.

Table 2. Difficulty level test results

No	Material	Test score	Description
1	Connecting two syllables	.352941176	Moderate
2	Connecting objects with syllables	.470588235	Moderate
3	Sorting letters	.058823529	Difficult
4	Connecting 3 syllables	.470588235	Moderate
5	Calculating geometry	.235294118	Difficult
6	Composition of pictures	.470588235	Moderate
7	Comparison	.117647059	Difficult
8	Figural matrices	.294117647	Difficult

In the normality test phase (Table 3), this research applied statistical analysis to evaluate the distribution of post-test scores. The research findings indicated that the distribution of post-test scores exhibited normal characteristics, as evidenced by a p-value exceeding the significance threshold of 0.05. Success in surpassing this threshold confirms that the post-test data is normal and evenly distributed. This result instill confidence in the researchers that the post-test data can be relied upon for further analysis, ensuring unbiased and consistent distribution of scores. Understanding the normality of data distribution provides a robust foundation for the interpretation of results and reliable conclusions in the context of this study.

Table 3. Normality test results

No	Test Material	Normality test
1	Connecting two syllables	.105
2	Connecting objects with syllables	.058
3	Sorting letters	.092
4	Connecting 3 syllables	.053
5	Calculating geometry	.087
6	Composition of pictures	.079
7	Comparison	.083
8	Figural matrices	.074

The t-test was conducted to examine the differences between pretest and post-test scores in the experimental group, and the results showed a significant difference, with a negative and statistically significant t-statistic (Table 4). This confirms that the implementation of the area learning model and differentiated learning has a significant positive impact on the improvement of literacy and numeracy among students. These findings reinforce the belief that integrating the area learning model with differentiated teaching approaches is effective in enhancing the quality of early childhood learning, providing a solid foundation for optimal literacy and numeracy development.

Table 4. T-test results

No	Topic	Paired t
1	Connecting two syllables	-19.214
2	Connecting objects with syllables	-15.770
3	Sorting letters	-8.357
4	Connecting 3 syllables	-22.546
5	Calculating geometry	-15.301
6	Composition of pictures	-15.301
7	Comparison	-27.019
8	Figural matrices	-22.282

The N Gain analysis, an effective method for assessing changes in student learning outcomes from the beginning to the end of the learning process, has proven to illustrate the success of the area learning model and differentiated learning in improving students' mastery of literacy and numeracy. With an average N Gain reaching 72.65%, this improvement not only reflects statistical achievement but also indicates a substantial impact on developing students' literacy and numeracy skills. This analysis provides a strong basis for implementing more effective learning strategies, particularly in the context of early childhood education.

Table 5. N Gain test results

Score				Statistic	Std. Error
N-gain Percent	**Experiment**	**Mean**		72.6512	.91780
		95% Confidence Interval for Mean	Lower Bound	70.4810	
			Upper Bound	74.8215	
		5% Trimmed mean		72.5289	
		Median		72.2916	
		Variance		6.739	
		Std. deviation		2.59594	
		Minimum		70.07	
		Maximum		77.43	
		Range		7.36	
		Interquartile range		4.10	
		Skewness		.803	.752
		Kurtosis		-.054	1.481

Based on the the research results, it is evident that the area learning model can enhance the quality of literacy and numeracy learning. By integrating the area concept, students can actively and enjoyably engage in learning, strengthening their understanding of the material. In the context of differentiated learning, this research reveals that this approach can provide a positive response to the needs and interests of students. Through N Gain analysis, it is apparent that the improvement in learning outcomes is not only statistically significant but also has practical implications for enhancing students' literacy and numeracy skills (Indrawatiningsih et al., 2024; Barham et al., 2019; Watson & Wildy, 2014).

Furthermore, the difficulty level test provides additional insights into the difficulty of the taught material. This provides a basis for educators to adjust their teaching approach according to the complexity level of the material to align with students' capabilities. In the context of early childhood education, the results of this research make a significant contribution to understanding how to integrate the area learning model and differentiated learning to achieve improvements in literacy and numeracy in early childhood (Mills et al., 2014). The findings of this research can serve as a guide for education practitioners and researchers in the field of early childhood education in designing effective and responsive learning strategies tailored to the needs of students.

4. Conclusion

This research underscores the effectiveness of the differentiated area learning model in enhancing literacy and numeracy skills among early childhood students at the PAUD level. The positive impact observed in the experimental group highlights the model's potential as a valuable tool in early childhood education. Nevertheless, the study's limitations must be acknowledged. The time constraints during data collection, challenges related to student adaptation to new learning methods, and the potential issues with the generalization of the results due to sample selection are all factors that warrant careful consideration in future research. In light of these findings and limitations, several recommendations are proposed. Further development of the differentiated area learning model could provide deeper insights into improving early childhood literacy and numeracy. Additionally, future studies should allocate sufficient time for data collection to ensure more robust and representative results. A more detailed examination of how students adapt to new learning models and the use of a more representative sample selection technique could also enhance the generalizability of future research outcomes. Overall, this study contributes valuable knowledge to the field of early childhood education, particularly regarding the implementation of differentiated learning models. Future research can build upon these insights to further advance educational practices for young learners.

References

Aulia, Y., Dahlan, D., & Dahlan, H. M. (2024). Improving student learning outcomes through the implementation of differentiated learning in a problem-based learning model. *PEDAGOGIK: Jurnal Pendidikan*, *11*(1), 36-53. https://doi.org/10.33650/pjp.v11i1.6146

Barham, A. I., Ihmeideh, F., Al-Falasi, M., & Alabdallah, A. (2019). Assessment of first-grade students' literacy and numeracy levels and the influence of key factors. *International Journal of Learning, Teaching and Educational Research*, *18*(12), 174-195.

Bracken, B. A., & Crawford, E. (2010). Basic concepts in early childhood educational standards: A 50-state review. *Early Childhood Education Journal*, *37*, 421-430. https://doi.org/10.1007/s10643-009-0363-7

Dick, W., & Carrey, L. (1985). The Systematic Design Instruction. Secon edition. Glenview. *Illinois: Scott., Foreman and Company*.

Ghani, S. H. A. (2021). Understanding the Basic Concepts Of Early Childhood Education in Islamic Education. *Jurnal Paradigma*, *13*(2), 124-151. https://doi.org/10.53961/paradigma.v13i2.84

Indrawatiningsih, N., Qomariyah, S., Nubita, A. R., & Muarofah, L. (2024). Effectiveness of Differentiated Learning in Improving Literacy and Numeracy of Primary School Students. *Asian Journal of Education and Social Studies*, *50*(5), 8-17.

Isenberg, J. P., & Quisenberry, N. (2002). A position paper of the Association for Childhood Education International PLAY: Essential for all Children. *Childhood Education*, *79*(1), 33-39. https://doi.org/10.1080/00094056.2002.10522763

Knapp, T. R. (2016). Why is the one-group pretest–posttest design still used?. *Clinical nursing research*, *25*(5), 467-472. https://doi.org/10.1177/1054773816666280

Kotob, M., & Arnouss, D. (2019). Differentiated instruction: The effect on learner's achievement in kindergarten. *International Journal of Contemporary Education*, *2*(2), 61-92. https://doi.org/10.11114/ijce.v2i2.4479

Mills, M., Monk, S., Keddie, A., Renshaw, P., Christie, P., Geelan, D., & Gowlett, C. (2014). Differentiated learning: From policy to classroom. *Oxford review of education*, *40*(3), 331-348. https://doi.org/10.1080/03054985.2014.911725

Ministry of National Education. (2014). *Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 137 Tahun 2014 Tentang Standar Nasional Pendidikan Anak Usia Dini*.

Salminen, J., Khanolainen, D., Koponen, T., Torppa, M., & Lerkkanen, M. K. (2021, October). Development of numeracy and literacy skills in early childhood—A longitudinal study on the roles of home environment and familial risk for reading and math difficulties. In *Frontiers in Education* (Vol. 6, p. 725337). Frontiers Media SA. https://doi.org/10.3389/feduc.2021.725337

Shihab, N. (2015). *Diferensiasi: Memahami Pelajar untuk Belajar Bermakna & Menyenangkan*. Tangerang: Lentera Hati.

Singer, E. (2013). Play and playfulness, basic features of early childhood education. *European Early Childhood Education Research Journal*, *21*(2), 172-184. https://doi.org/10.1080/1350293X.2013.789198

Watson, R., & Wildy, H. (2014). Pedagogical practice of early childhood teachers: Explicit enhancement of students' literacy. *Australasian Journal of Early Childhood*, *39*(2), 82-90. https://doi.org/10.1177/183693911403900211

Zar'in, F., & Salehcah, S. (2021). Local Content Curriculum Model for Early Childhood Scientific Learning. *Jurnal Pendidikan Usia Dini*, *15*(1), 81-100.