

Workshop on Strengthening Deep Learning in Mathematics for Supporting Elementary School Teacher's Spasial Competences in Riau: A Preliminary Survey

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Abstrak Kurikulum pendidikan di Indonesia terus mengalami perubahan dari waktu ke waktu. Saat ini, pemerintah memfokuskan pada penguatan deep learning termasuk pada mata pelajaran matematika. Hal ini menjadikan tantangan baru bagi guru khususnya guru-guru sekolah dasar di provinsi Riau. Oleh karena itu, kegiatan Pengabdian kepada Masyarakat perlu dilaksanakan untuk memperkuat deep learning matematika untuk mendukung kemampuan spasial guru-guru tersebut. Sebanyak 25 guru-guru di provinsi Riau terlibat dalam pelaksanaan kegiatan pengabdian ini. Hasil survei awal dilakukan untuk mengukur persepsi guru tentang deep learning matematika dan kemampuan spasial mereka. Hasilnya diperoleh bahwa guru-guru tersebut memiliki persepsi yang sangat baik tentang deep learning matematika yaitu dengan skor 84 sedangkan kemampuan spasial mereka masih berada pada kategori sedang yaitu dengan skor 69.20. Oleh karena itu, Workshop penguatan deep learning matematika ini diperlukan untuk mendukung kemampuan spasial guru sekolah dasar di provinsi Riau.

Kata Kunci: deep learning matematika; guru sekolah dasar; kemampuan spasial; perubahan kurikulum

Abstract The Indonesian education curriculum continues to change over time. Currently, the government is focusing on strengthening deep learning, including in mathematics. This presents new challenges for teachers, especially elementary school teachers in Riau Province. Therefore, Community Service activities are needed to strengthen deep learning in mathematics and support the spatial abilities of these teachers. A total of 25 teachers in Riau Province were involved in the implementation of this community service activity. The results of the initial survey were conducted to measure teachers' perceptions of deep learning in mathematics and their spatial abilities. The results obtained were obtained that these teachers have a very good perception of deep learning in mathematics, with a score of 84, while their spatial abilities are still in the moderate category, with a score of 69.20. Therefore, this Workshop on strengthening deep learning in mathematics is needed to support the spatial abilities of elementary school teachers in Riau Province.

Keywords: deep learning mathematics; elementary school teachers; spatial abilities; curriculum change

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INTRODUCTION

Science and technology are developing rapidly along with this, the quality of education must also continue to improve. Striving to improve the quality of education in Indonesia, the government focuses on strengthening deep learning. No exception, deep learning reinforcement is also needed for mathematics learning. Mathematics occupies a very important position because it serves as the basis for many other sciences (Chiu, 2007; Ierna, 2022; Weng, 2017). In addition, mathematics is also a means to train students' logical, critical, analytical, and creative thinking skills (Indrapangastuti et al., 2025; Marbun, 2023). Therefore, improving the quality of mathematics learning in elementary schools needs to be a major concern.

One of the important aspects of mathematics learning is spatial competence (Hasanah et al., 2024; Medina Herrera et al., 2024). Spatial competence can be interpreted as the ability to understand, visualize, and manipulate objects in space. Spatial abilities include the ability to mentally imagine and rotate objects, identify patterns, and be able to understand how elements are interconnected in space (Revina et al., 2011; Sorby, 2007). Various studies show that students with high spatial competence tend to have better academic achievement, especially in science, technology, engineering, and mathematics (Cui & Guo, 2022; Liu et al., 2021; Porat & Ceobanu, 2024). These spatial capabilities are urgently needed to face the challenges of the 21st century. Students need to be trained as early as possible to develop their spatial abilities. Spatial skills are indispensable in facing the challenges of the 21st century. Therefore, students need to be trained early on to develop their spatial skills optimally.

Based on these conditions, teachers in schools play a very important role in developing students' spatial skills (Feriana & Ulfatun, 2024; Keiler, 2018; W. Zhang, 2022). Teachers not only function as material presenters but also as facilitators who create an active, creative, and meaningful learning environment. In the context of mathematics learning, teachers are expected to be able to design strategies that emphasize deep learning so that students not only memorize concepts but also really understand their meaning and application in daily life. Thus, the success of developing students' spatial abilities is highly dependent on the competence, creativity, and readiness of teachers in managing innovative and deep understanding-oriented learning processes.

To find out the extent of the implementation of deep learning in learning, a survey was conducted among elementary school teachers in Pekanbaru to explore teachers' perceptions of the application of this approach. Furthermore, a pretest is given to measure teachers' spatial abilities as a basis for seeing their readiness and needs for competency development. The results of this initial survey will be used as a reference to map the spatial competency condition of elementary school teachers in Riau. This information is important to know the extent to which teachers have integrated spatial approaches in teaching. Through the preliminary survey, it is hoped that a comprehensive picture of the challenges and needs of teachers in the field will be obtained. The results of this activity will be a reference in designing a more comprehensive advanced training program. In the end, strengthening teacher competence is expected to have an impact on improving the quality of mathematics learning of elementary school students in Riau.

METHOD

The method used in this study is a descriptive-quantitative survey aimed at exploring teachers' perceptions of the application of deep learning in mathematics learning and measuring the spatial ability of elementary school teachers. This activity was carried out in Riau Province by involving 25 elementary school teachers as participants. The instrument used consists of two parts, namely a deep learning perception questionnaire and a spatial ability test. The questionnaire was compiled using a Likert scale with a range of 1-5. The indicators used to measure teachers' perception of deep learning can be seen in table 1.

Table 1. Deep Learning Indicators

Indicator	Aspects
Meaningful Learning	Connectedness Relevance Internalization

Mindful Learning	Full Attendance
	Reflection
	Flexibility
Joyful Learning	Motivation
	Involvement
	Positive Atmosphere

In addition to measuring teachers' perception of deep learning, measurements were also taken for their spatial thinking skills. The measurement of spatial ability is reviewed from three indicators, namely spatial relations, spatial visualisation, and spatial orientation. Indicators for measuring teachers' spatial abilities can be seen in table 2.

Table 2. Indicators of spatial thinking aspects

Indicators	Question Number
Spatial Relation	14,19,20
Spatial Visualisation	1,2,3,4,6,7,9,10,12,17
Spatial Orientation	5,8,11,13,15,16,18

Then, the criteria for the calculation of teachers' perception of deep learning can be seen in table 3.

Table 3. Deep Learning Criteria

Percentage (%)	Category
20 – 35	Very Low
36 – 51	Low
52 – 67	Enough
68 – 83	Good
84 – 100	Very Good

The teacher's spatial ability was also calculated with several criteria that were seen based on the mean value and standard deviation. The criteria are as follows.

Table 4. Criteria for Spatial Thinking Ability

Category	Criteria
Low	$S < \bar{x} - SD$
Moderate	$\bar{x} - SD \leq S \leq \bar{x} + SD$
High	$S > \bar{x} + SD$

The data that has been collected will be analyzed using quantitative descriptive techniques to obtain an overview of teachers' perceptions of deep learning and how the spatial abilities of teachers have.

RESULTS AND ACHIEVEMENT

An initial survey was conducted on 25 elementary school teachers in Riau Province with the aim of mapping teachers' perceptions of the deep learning approach in mathematics learning as well as their spatial abilities. This survey uses two main instruments, namely a perception questionnaire on deep learning mathematics and a spatial ability test. The results of the measurement of teachers' perceptions show that in general, teachers have a very good understanding and attitude towards the deep learning approach in mathematics learning. The average score obtained is 84 out of a maximum scale of 100, which is categorized as "very good". This shows that the majority of teachers understand the importance of deep understanding-based learning and show enthusiasm for the application of this approach in the teaching and learning process. The following is a picture of the results of teachers' perception of deep learning, which is reviewed from each indicator.

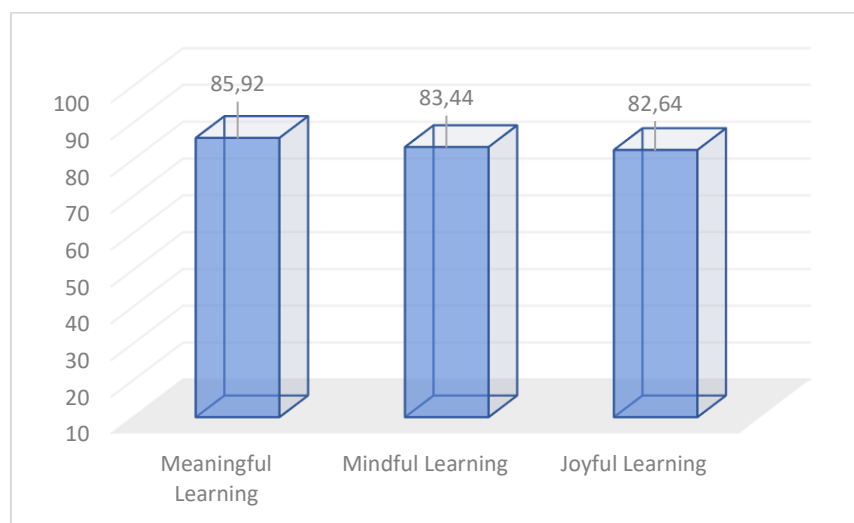


Figure 1. Results of Deep Learning Perception of Elementary School Teachers

Based on the bar chart image above, the score for teachers' perception of deep learning reviewed from the meaningful learning indicator is already in the "Very Good" category with a score of 85.92%. The results for the Mindful Learning indicator obtained a score of 83.44%, which was in the "good" category, and for the joyful learning indicator obtained a score of 82.64%, which means it is in the "good" category. The results of teachers' perceptions of deep learning can also be seen from each aspect.

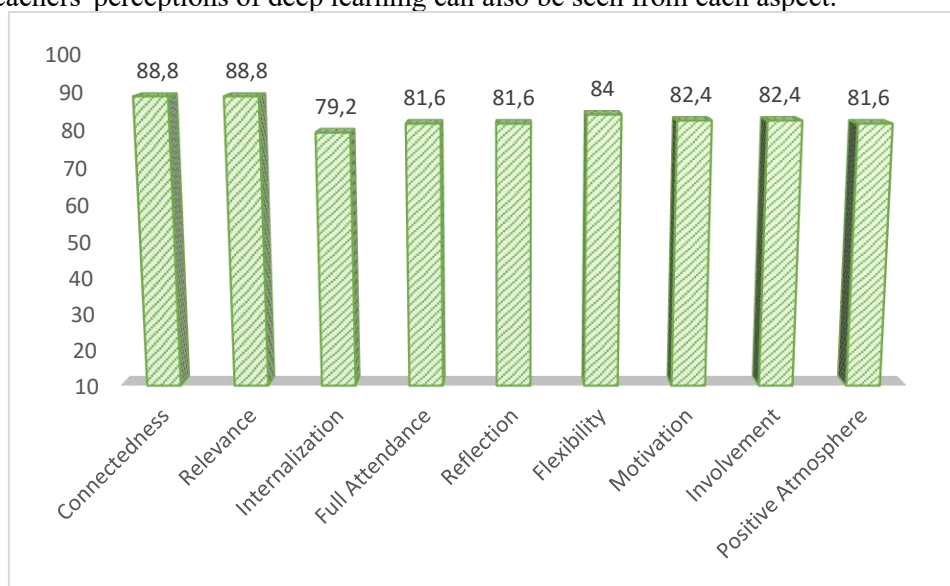


Figure 2. Teachers' Perceptions of Deep Learning in Each Aspect

Based on the bar chart in Figure 2, the results of the questionnaire of elementary school teachers' perceptions of the application of deep learning in mathematics learning are reviewed from the aspect, showing that the results show that teachers' perception of deep learning is at the criteria of good-very good. In general, the average score percentage is already above 79%. The aspect of connectedness and relevance obtained the highest percentage score of 88.8%. Then the lowest percentage was obtained in the internalization aspect with a score of 79.2%. However, this acquisition is already in the good category. Overall, the results for teachers' reception of deep learning mathematics learning obtained a score of 84%, this shows that elementary school teachers already have a very good perception of the application of deep learning in mathematics learning.

Teachers agree that deep learning can help students understand mathematical concepts more comprehensively, through the application of deep learning, students are able to develop critical thinking skills, as well as increase student involvement in the learning process. Teachers also realize that this approach requires them to be more creative in developing learning strategies and media that support conceptual understanding of the mathematics material to be taught. Next, measurements were also taken for the spatial thinking ability of elementary school teachers. The spatial ability measured includes three indicators, namely spatial relation, spatial visualization, and spatial orientation. The results of measuring teachers' spatial ability, viewed from the indicators, can be seen in Figure 3.

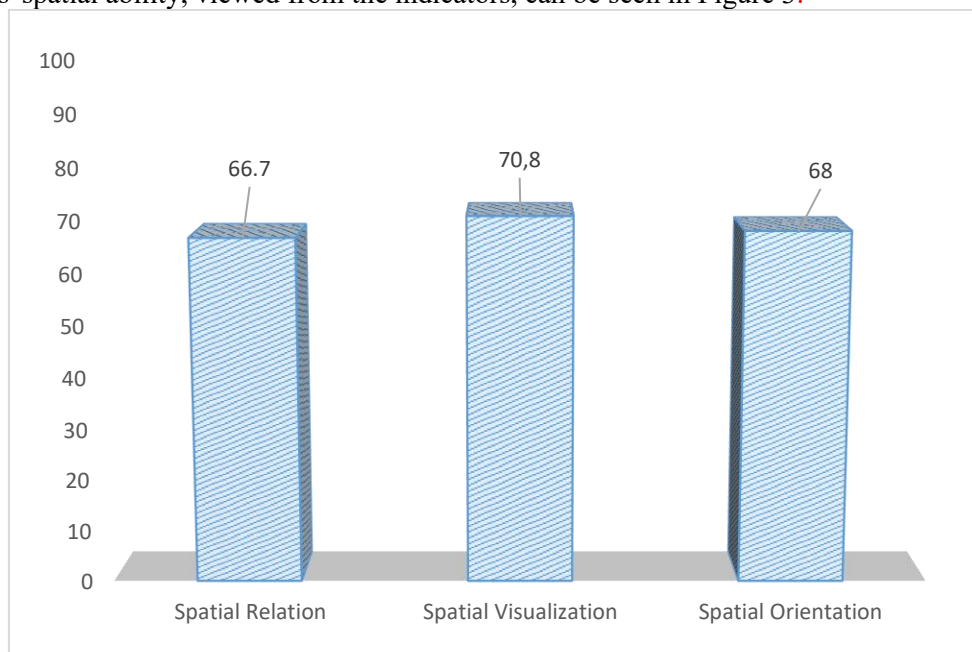


Figure 3. Results of Spatial Ability as seen from the indicator

Based on the results of the spatial thinking ability indicator in Figure 3, the results of the spatial thinking ability of 25 teachers reviewed from the spatial relationship indicator obtained a percentage of 66.7%, for the Spatial visualitation indicator, a percentage of "70.8%" was obtained, and for the spatial orientation indicator 68%, this result shows that from each of these indicators, the teacher's thinking ability is still in the "moderate" category. However, when viewed from the aspect of spatial ability, the survey results show that teachers are still in the "moderate" category. The average score obtained was 69.20, which indicates that teachers' spatial skills are not yet optimal to support visual and spatial representation-based mathematics learning. The results of teachers' spatial thinking skills can also be seen from the results of mean and standard deviation.

Table 5. Results of Teachers' Spatial Thinking Skills

No.	Indicators	Mean	SD	Category
1	Spatial Relation	66.66	47.45	Moderate
2	Spatial Visualitation	70.80	45.55	Moderate
3	Spatial Orientation	68.00	56.78	Moderate

The results of the analysis of teachers' spatial thinking skills reviewed from the mean value and standard deviation can be seen in Table 5. Based on the mean value and standard deviation, it was obtained that the Spatial Relation indicator had an average of 66.66 with a standard deviation of 47.45, which was included in the moderate category. In the Spatial Visualization indicator, the average obtained was 70.80 with a standard deviation of 45.55 and was also in the moderate category. Meanwhile, the Spatial Orientation indicator shows an average of 68.00 with a standard deviation of 56.78, which is also in the

moderate category. Thus, these results show that students' abilities in the three spatial indicators, both relation, visualization, and orientation, are at a moderate level so that improvement is still needed through the right learning strategies. The spatial learning test scores of 25 elementary school teachers can be seen in the picture 4.

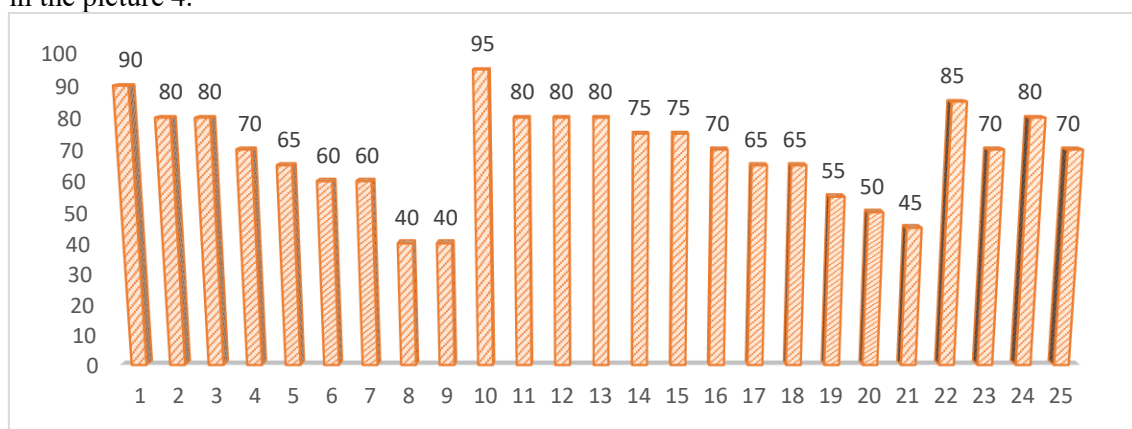


Figure 4. Spatial Ability Results of 25 Elementary School Teachers

Based on the bar diagram in figure 4, as many as 14 teachers still got a score below 75, and 2 teachers got a score of 75. Then only 9 teachers obtained a score above 75. This shows that the spatial ability of some teachers is still in the low category, and the overall average obtained a result of 66.96, which is in the "moderate" category. The gap between teachers' very good perceptions of deep learning and limited spatial skills is an important finding in this study. Although teachers have high conceptual readiness, limitations in spatial abilities can hinder the effective implementation of deep learning, especially in mathematics learning that demands visualization and manipulation of objects in space. Spatial ability is very important because many mathematical concepts are abstract and require visual representations to be understood in depth. As in the topic of geometry, teachers need to accurately explain the shape, size, and position of the building space so that students can build a correct understanding. Without adequate spatial skills, the delivery of material will be difficult to do concretely and contextually.

However, even though teachers have a positive motivation and attitude towards the deep learning approach, they still need reinforcement in technical aspects, especially spatial skills. Therefore, training for teachers is highly necessary (Azwanti et al., 2019). In this context, the training in question is specifically intended to improve teachers' spatial abilities. Training that focuses on developing spatial skills can improve teachers' understanding and ability to implement spatial visualization-based mathematics learning (Cheng & Mix, 2014; Lowrie & Logan, 2023). Teachers who have higher spatial skills tend to have better mastery of content & pedagogy in geometry teaching (Otumfuor & Carr, 2017). Research by Burte et al. (2020) revealed that teachers who have low spatial anxiety also have lower anxiety in teaching. This means that teachers who have higher spatial confidence will also tend to have confidence in teaching mathematics. With this belief in teaching, it will create a better pedagogy in teaching geometry.

The results of spatial tests for some teachers are still low, so it is necessary to strengthen teachers' spatial skills in mathematics learning. Through proper training, it can help teachers in improving their spatial skills. Teachers who have good spatial skills will also be able to design and use effective learning media, as well as improve the overall quality of mathematics learning (Bates et al., 2023). Research shows that spatial skills serve as a reference that allows teachers and students to model, simulate, and manipulate math problems effectively (Atit et al., 2022; Gilligan-Lee et al., 2022). These skills can also be improved through practice and experience, including the use of visualization tools such as 3D media, simulations, or virtual reality (Demetriou et al., 2025; Medina Herrera et al., 2024).

Therefore, strengthening teachers' spatial skills is an important step to bridge the gap between teachers' deep learning perceptions and their spatial abilities so that the implementation of deep learning in mathematics learning can run more optimally and support students' in-depth understanding. The workshop to strengthen deep learning mathematics will be focused on improving teachers' spatial skills through

various strategies, such as training on the use of visual media and simulation of building space through virtual camera 360 based on Malay culture. The results of this initial survey provide an idea that teachers have great potential to develop. A positive attitude towards deep learning shows that they are open to change and ready to improve the quality of learning. The right support will help teachers to improve their overall competence.

Teacher training programs need to be designed comprehensively, focusing not only on theory but also on practical skills that support curriculum implementation. Training of teachers is essential to be carried out in the sustainable development of teacher competencies (Nkundabakura et al., 2024; Y. Zhang et al., 2024). In addition, the results of these surveys can serve as a basis for more in-depth follow-up research. Further research can explore the relationship between teachers' spatial abilities and student learning outcomes, as well as the effectiveness of training in improving teachers' competence in deep learning-based mathematics learning.

Overall, the results of this initial survey show that elementary school teachers in Riau Province have a very good perception of the deep learning approach to mathematics but still need to be strengthened in the aspect of spatial ability. These findings are an important basis for the planning of community service activities that aim to improve the quality of mathematics learning at the elementary school level. With the right actions, teachers will be better prepared to face the challenges of the new curriculum and be able to create more contextual, visual, and in-depth understanding-based learning. This will ultimately have a positive impact on improving the quality of education itself. As a next step, the workshop activities are designed to be a forum for teachers to learn, share experiences, and improve their skills collectively. Collaboration between teachers will also strengthen learning communities that support the implementation of deep learning in a sustainable manner.

CONCLUSION

Based on the results of an initial survey of 25 elementary school teachers in Riau Province, it can be concluded that teachers have a very good perception of the deep learning approach in mathematics learning, with an average score of 84. This shows that conceptually, teachers have understood the importance of deep learning-based learning and demonstrated readiness to implement it. However, teachers' spatial abilities are still in the moderate category, with an average score of 69.20. This gap indicates that even if teachers are well motivated and understanding, they still need reinforcement in technical skills, particularly in the spatial aspects that are very important in mathematics learning.

The main obstacle, therefore, lies in the limited spatial competence of teachers, which may hinder their ability to present mathematical material visually, contextually, and meaningfully. As a follow-up, it is recommended to provide professional development programs that focus on enhancing spatial abilities, integrating digital tools that support visual representation, and offering continuous mentoring. By strengthening teachers' spatial competence, the implementation of deep learning in mathematics can be carried out more effectively, ultimately improving the quality of instruction and student learning outcomes.

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