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# Workshop-Based Implementation of a Web-Based Spatial Sense Assessment Application for Elementary School Teachers

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**Abstract**

This community service program aimed to strengthen elementary school teachers' competence in assessing students' spatial sense through a web-based assessment application. Spatial sense is an important mathematical ability related to spatial reasoning and geometry learning; however, many teachers still rely on conventional assessments that do not adequately capture students' spatial abilities. This program was implemented through a workshop involving 88 elementary school teachers from the Teacher Working Group (Kelompok Kerja Guru/ KKG) Gugus Mawar in Banjarmasin Tengah. The workshop consisted of conceptual sessions on spatial sense, training on spatial sense assessment, and hands-on practice using a web-based assessment application. Data were collected through observation, interviews, and participant questionnaires. The evaluation results indicate that 89% of participants were able to operate the application independently, while 92% reported that the application was useful for conducting spatial sense assessment in classroom settings. Participants also expressed positive perceptions regarding the practicality and efficiency of the web-based system for assessment management. These findings suggest that the workshop successfully supported teachers in adopting technology-enhanced assessment practices in elementary mathematics education.

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## INTRODUCTION

The rapid development of digital technology in the 21st century has significantly transformed many aspects of human life, including the education sector. Educational institutions are increasingly encouraged to integrate digital technology not only in learning activities but also in assessment processes to improve the efficiency and accuracy of evaluating students' competencies (Mardhiyana et al., 2022). Technology-enhanced assessment enables teachers to collect, analyze, and interpret student performance more efficiently while providing faster feedback to support instructional decision-making (Pinto et al., 2023).

One important competency in elementary mathematics learning is spatial sense. Spatial sense refers to the ability to understand and reason about spatial relationships among objects, visualize geometric representations, and mentally manipulate shapes or spatial information (Martínez-Artero & Rubio, 2023). This ability plays an essential role in supporting students' understanding of geometry, measurement, and spatial reasoning (Damayati et al., 2024). Research has shown that strong spatial abilities contribute to students' mathematical development and problem-solving skills, making spatial sense an important component of early mathematics learning (Fernández & Uclés, 2025a).

Despite its importance, the assessment of spatial sense is still rarely implemented systematically in elementary school classrooms. In many cases, classroom assessment tends to focus on procedural skills, such as applying formulas or performing routine calculations, rather than evaluating students' spatial reasoning abilities (Ansori et al., 2025). As a result, teachers often find it difficult to identify students' spatial thinking profiles and provide appropriate instructional support (Nindi et al., 2023; Winarni et al., 2023). In addition, most schools still rely on traditional paper-based assessments, which limit teachers' ability to analyze student performance efficiently and provide timely feedback (Riastuti et al., 2017).

The need to strengthen students' mathematical competencies, including spatial reasoning, is also emphasized in Indonesian educational policy. Through the Merdeka Belajar framework, the Ministry of Education encourages the use of authentic assessment approaches that measure students' conceptual understanding, reasoning abilities, and higher-order thinking skills (Sudirtha, 2023). In this context, digital assessment tools can play an important role in supporting teachers to conduct more systematic and efficient evaluations of students' mathematical abilities (Indaryanti et al., 2025; Sulistyono et al., 2021).

However, teachers' readiness to implement technology-based assessment remains a challenge. Many elementary school teachers have limited experience in using digital assessment tools and rarely receive training related to technology-supported evaluation systems (Herdika et al., 2025). This situation was also identified among teachers in the Kelompok Belajar Gugus Mawar in Banjarmasin Tengah, who serve as partners in this community service program. Based on preliminary discussions with the teacher group, it was found that teachers had never received training related to spatial sense assessment using digital platforms. Most classroom assessments still relied on conventional written tests, making it difficult for teachers to identify students' spatial reasoning abilities and interpret assessment results effectively.

In addition to limited teacher training, the availability of practical and accessible assessment tools specifically designed to measure spatial sense is also limited. Teachers often lack instruments that can help them evaluate spatial reasoning indicators systematically while also providing clear assessment results that can support instructional planning (Destiani et al., 2023). Therefore, there is a need for practical solutions that not only introduce teachers to the concept of spatial sense assessment but also provide user-friendly tools that can be easily implemented in classroom settings.

One potential solution is the use of a web-based spatial sense assessment application (Indaryanti et al., 2025). This application is designed to assess several indicators of spatial sense, such as recognizing spatial relationships, interpreting visual representations, and reasoning about geometric objects (Yuliati & Lelawati, 2019). As a web-based system, the application can be accessed using various devices, including laptops and smartphones, making it flexible for classroom implementation (Moral-Sánchez & Ruiz-Rey, 2025;

Yuliati & Lelawati, 2019). In addition, the system can automatically generate assessment results, enabling teachers to analyze student performance more efficiently.

To support teachers in utilizing this technology effectively, professional development activities are necessary. Workshops can provide opportunities for teachers to understand the concept of spatial sense, learn about its assessment indicators, and practice using digital assessment tools in real classroom contexts. Through structured training and hands-on practice, teachers are expected to develop the competence and confidence needed to implement technology-enhanced assessment in mathematics learning.

Based on the needs analysis conducted with the partner group, several key issues were identified: (1) teachers have not received training on spatial sense assessment using digital tools, (2) classroom assessment still focuses mainly on procedural knowledge, and (3) teachers lack practical instruments to evaluate students' spatial reasoning abilities efficiently. In response to these challenges, this community service program implemented a workshop on the use of a web-based spatial sense assessment application for elementary school teachers. The workshop aimed to strengthen teachers' understanding of spatial sense assessment and provide practical experience in using digital assessment tools that can support classroom evaluation practices.

## METHODS

This community service program employed a Participatory Action Research (PAR) approach, which emphasizes collaborative engagement between researchers and participants in identifying problems, implementing actions, observing outcomes, and reflecting on improvements. PAR is widely used in educational and community-based programs because it encourages active participation of stakeholders in addressing practical problems while simultaneously generating knowledge and improving professional practice (Baum et al., 2006; Castro-Diaz et al., 2025; Omodan & Dastile, 2023).

The participants of this community service program were 88 elementary school teachers who are members of the Teacher Working Group (Kelompok Kerja Guru/KKG) Gugus Mawar in Banjarmasin Tengah. This program was conducted in collaboration between the Mathematics Education Department of the Faculty of Teacher Training, Universitas Lambung Mangkurat, and Gugus Mawar KKG. The implementation team consisted of four lecturers and two students who served as facilitators and technical assistants during the workshop, which was conducted offline on 9 October 2025 at one of the elementary schools in Gugus Mawar cluster. Data in this community service program were collected using several complementary instruments.

1. Observation

Observation was conducted throughout the workshop activities to document teachers' participation, engagement, and ability to operate the web-based assessment application. The observation protocol focused on several indicators, including teachers' ability to access the system, create classes, administer assessment items, and interpret assessment results.

2. Interviews

Semi-structured interviews were conducted with several participating teachers to obtain deeper insights into their experiences during the workshop and their perceptions of the web-based assessment application. The interview questions focused on teachers' prior experience with digital assessment, perceived usefulness of the application, and potential challenges in implementing the tool in classroom practice.

3. Participant Questionnaire

A questionnaire was administered at the end of the workshop to evaluate teachers' perceptions of the training and the usability of the web-based application. The

questionnaire consisted of several items measured using a five-point Likert scale, ranging from strongly disagree to strongly agree. The instrument was reviewed by experts in mathematics education to ensure its clarity and relevance before being distributed to participants.

The implementation of this program followed the Participatory Action Research cycle, consisting of four stages: planning, action, observation, and reflection (Omodan & Dastile, 2023).

1. Planning
   The planning stage involved initial coordination with the leadership of the KKG Gugus Mawar to identify teachers' needs related to spatial sense assessment. Preliminary discussions revealed that teachers had limited experience in conducting spatial reasoning assessments and had never used web-based assessment tools. Based on this needs analysis, the implementation team designed a workshop program focusing on spatial sense assessment and the use of a web-based assessment application.
2. Action
   The action stage consisted of the implementation of the workshop conducted on 9 October 2025. The workshop included several sessions: introduction to spatial sense concepts, explanation of spatial sense assessment indicators, demonstration of the web-based assessment application, and guided hands-on practice in using the application.
3. Observation
   During the workshop, the implementation team conducted observations to document teachers' participation, engagement, and ability to operate the application. Teachers were also asked to complete assessment tasks using the application to demonstrate their understanding of the system's features.
4. Reflection
   The purpose of this stage was to evaluate the effectiveness of the training, identify teachers' readiness to implement the application in classroom settings, and collect suggestions for improving the application and future training activities. The PAR Cycle is shown in Figure 1.


Figure 1 PAR cycle

The web-based spatial sense assessment application was designed to measure three main indicators of spatial ability, namely spatial perception, spatial visualization, and mental rotation. Examples of assessment items corresponding to each indicator are presented in Figure 2.

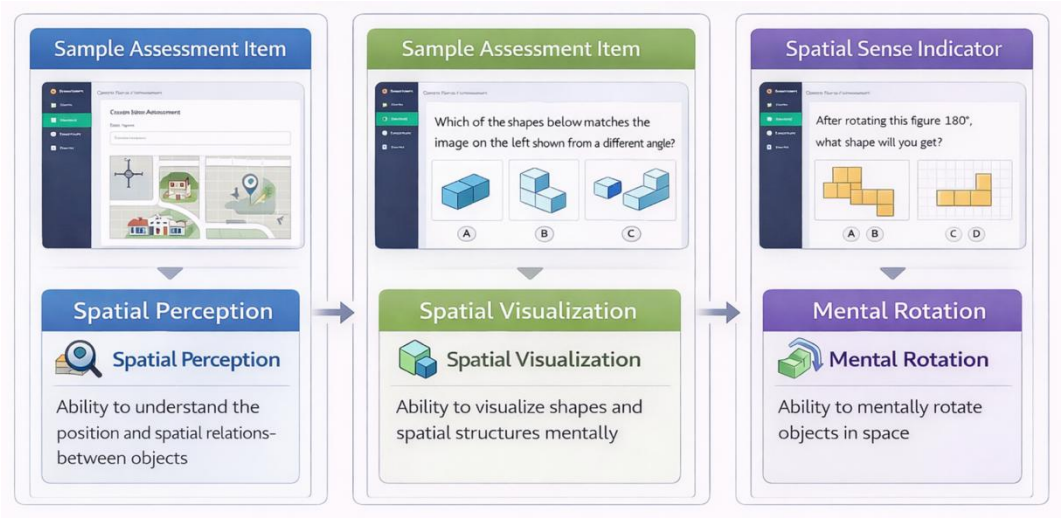


Figure 2 Sample items and indicator mapping

## RESULTS AND DISCUSSION

This community service program was conducted in collaboration with the Teacher Working Group of Gugus Mawar in Banjarmasin Tengah on 9 October 2025. A total of 88 elementary school teachers participated in the workshop. All participants attended the full training session and were involved in the hands-on practice using the web-based spatial sense assessment application.

The workshop aimed to strengthen teachers' understanding of spatial sense assessment and introduce a web-based assessment application that can support more efficient classroom evaluation practices. The training combined a conceptual explanation of spatial sense with practical activities using the digital assessment platform. During the workshop, teachers were introduced to spatial sense indicators, examples of assessment items, and the web-based spatial sense assessment system, which is illustrated in Figures 3 and 4.

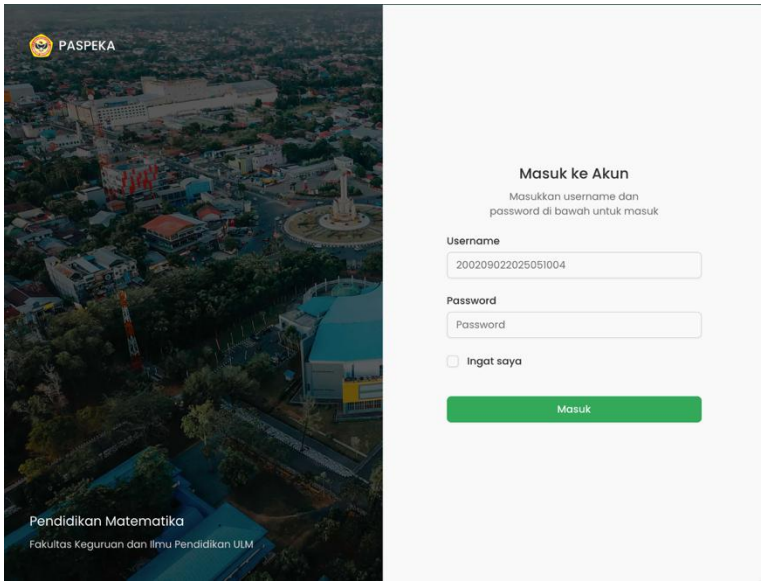


Figure 3 Screenshot of login page

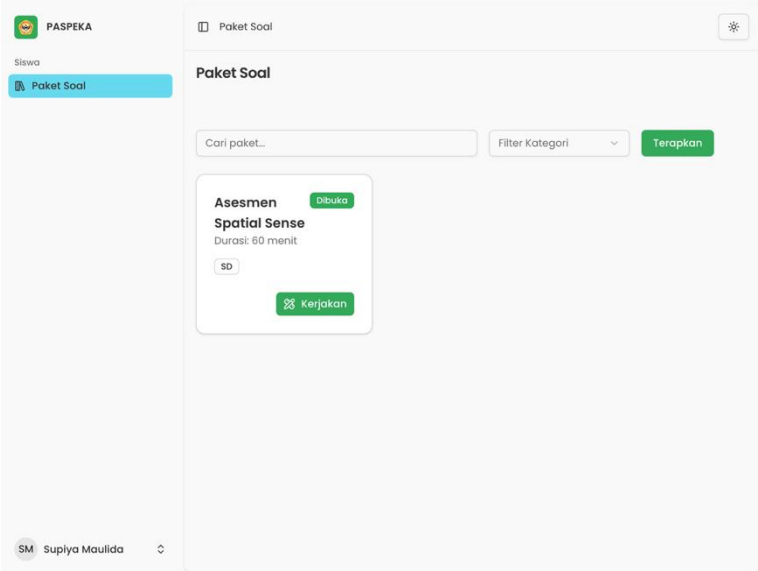


Figure 4 Screenshot of home page

The workflow of the web-based spatial sense assessment application begins with teachers creating an assessment package in the system. Students then complete the assessment items through the application interface. The system automatically scores students' responses, and the results are immediately displayed in the form of assessment reports that can be accessed by teachers for evaluation and instructional planning. The workflow is illustrated in Figure 5.


Figure 5 Assessment workflow and reporting process in the web-based spatial sense assessment application

During the practical session, participants used their personal devices to access the application and complete several operational tasks, including logging into the platform, creating assessment activities, administering spatial sense assessment items, and reviewing automatically generated results. Observation using a performance checklist was conducted to document teachers' ability to operate the application.

The results show that most teachers were able to complete the core operational tasks successfully. As presented in Table 1, 100% of participants were able to access the platform, 95% were able to create an assessment activity, 92% successfully administered spatial sense items, and 88% were able to interpret the assessment reports generated by the system.

Table 1 Teachers' competence in operating the web-based assessment application

| Competency Indicator | Percentage of Teachers |
|---|---|
| Accessing the application platform | 100% |
| Creating an assessment activity | 95% |
| Administering spatial sense assessment items | 92% |
| Interpreting assessment results | 88% |

These results indicate that most participants were able to follow the application workflow and complete the required tasks during the workshop. To evaluate participants' perceptions of the workshop implementation, teachers completed a satisfaction questionnaire consisting of 14 indicators measured using a five-point Likert scale (1 = very poor, 5 = excellent). The questionnaire evaluated several aspects, including the organization of the workshop, the quality of the training materials, and the perceived usefulness of the program for improving teachers' professional competence. The summary of questionnaire results is presented in Table 2.

Table 2 Summary of workshop evaluation results

| Evaluation Indicator | Mean Score | Interpretation |
|---|---|---|
| Suitability of activity schedule | 4.4 | Very Good |
| Punctuality of workshop implementation | 4.3 | Very Good |
| Comfort of venue and facilities | 4.6 | Excellent |
| Quality of supporting materials | 4.6 | Excellent |
| Relevance of materials to workshop theme | 4.7 | Excellent |
| Clarity of presenters' explanations | 4.6 | Excellent |
| Relevance of materials to teachers' needs | 4.5 | Very Good |
| Interaction between presenters and participants | 4.6 | Excellent |
| Responsiveness of the organizing committee | 4.7 | Excellent |
| Organization of workshop activities | 4.6 | Excellent |
| The workshop increased knowledge and skills | 4.7 | Excellent |
| The workshop contributes to teacher professionalism | 4.6 | Excellent |
| Motivation to apply workshop outcomes | 4.5 | Very Good |
| Relevance to elementary school learning | 4.5 | Very Good |

The questionnaire results indicate that most indicators obtained mean scores above 4, suggesting that participants responded very positively to the workshop implementation. Indicators related to the relevance of the materials, the clarity of presenters, and the usefulness of the program for improving teachers' professional competence received the highest scores.

At the end of the workshop, participants completed a questionnaire to evaluate their experiences and perceptions of the training program. The results indicate that the majority of participants responded positively to the workshop and the web-based assessment application. Approximately 90% of participants reported that they were able to operate the application independently, while 92% stated that the application was useful for conducting spatial sense assessment in classroom settings. In addition, 94% of teachers expressed interest in using the application to support classroom assessment in the future.

Participants also provided qualitative feedback regarding the workshop and the digital assessment application. Several teachers stated that the workshop helped them gain new knowledge about spatial reasoning and digital assessment tools. For example, one

participant noted that *"the application can help teachers conduct assessments more easily and efficiently."* Another participant suggested that *"more varied assessment items should be added so that the application can better accommodate different grade levels in elementary schools."*

Observation data also indicated high levels of participation during the workshop activities. Most participants were actively involved in the discussion sessions and hands-on practice. Teachers demonstrated the ability to complete the main operational tasks of the application, including accessing the platform, navigating assessment items, and reviewing assessment results generated by the system.

Feedback obtained from the discussion session and interviews revealed several important themes. Teachers appreciated the practicality of the web-based application, particularly its automatic scoring feature and the ability to generate assessment reports quickly. Participants also suggested further development of the application, such as expanding the database of spatial sense assessment items and adding options to export assessment results for documentation purposes.

Overall, the implementation of this community service program shows that workshop-based training can support teachers in adopting technology-enhanced assessment tools in elementary mathematics learning. The combination of conceptual training and hands-on practice enabled teachers to understand spatial sense assessment and gain practical experience in using digital assessment applications. The implementation of the workshop provided participating teachers with meaningful learning experiences related to spatial sense assessment and the use of digital assessment tools. The high level of teacher participation during the training sessions and hands-on activities suggests that the workshop addressed practical needs related to classroom assessment, particularly in the context of integrating technology into mathematics education.

The workshop also contributed to increasing teachers' awareness of the importance of spatial sense in elementary mathematics learning. Spatial ability has been widely recognized as a fundamental component of mathematical cognition, as it supports students' ability to visualize, manipulate, and reason about geometric objects and spatial relationships (Fernández & Uclés, 2025b). These abilities play an important role in learning topics such as geometry and measurement, and are closely related to students' mathematical problem-solving skills (Ansori et al., 2022; Murtiyasa et al., 2019). By introducing spatial sense assessment indicators and providing practical examples of assessment tasks, the program helped teachers better understand how spatial reasoning can be evaluated within elementary mathematics instruction. This finding is consistent with previous studies emphasizing the importance of teacher professional development in improving teachers' understanding of mathematical concepts and assessment practices (Ansori et al., 2025).

In addition, the hands-on practice session allowed teachers to explore the functionality of the web-based spatial sense assessment application. Most participants were able to complete the main operational steps of the application during the workshop, such as accessing the system, navigating assessment items, and reviewing automatically generated results. These experiences indicate that web-based assessment tools have the potential to support teachers in conducting classroom assessments more efficiently. Similar findings have been reported in previous studies showing that digital assessment systems can improve efficiency in scoring and reporting while helping teachers monitor students' learning progress more systematically (Hasanah et al., 2020; Novitasari et al., 2021).

The integration of digital assessment tools is also consistent with broader educational policies that emphasize the use of technology to support authentic and data-informed

assessment practices (Wahyuningsih et al., 2022). Educational frameworks increasingly encourage teachers to use digital tools that facilitate systematic evaluation and provide timely feedback for instructional improvement (Vercruyssen et al., 2023). Through guided practice during the workshop, teachers were able to gain initial experience in interpreting digital assessment results and considering how such information may support instructional decision-making in classroom contexts (Mujib & Walid, 2025).

However, the findings of this program should be interpreted with several limitations in mind. First, the evaluation relied partly on teachers' self-reported responses collected through questionnaires and discussions, which may be influenced by positive response bias. Second, the workshop was conducted in a single session, which limits the ability to examine long-term implementation of the application in classroom practice. Third, differences in teachers' access to digital devices and varying levels of technological familiarity may affect how effectively the application can be adopted in different school contexts. In addition, the positive responses observed during the workshop may partly reflect novelty effects associated with the introduction of new technology.

Despite these limitations, the program demonstrates the potential of workshop-based professional development in introducing teachers to spatial sense assessment and technology-enhanced evaluation tools. Providing teachers with opportunities to engage in both conceptual discussions and practical training may help support the gradual adoption of digital assessment practices in elementary mathematics education.

## CONCLUSION

This community service program aimed to strengthen elementary school teachers' competencies in assessing students' spatial sense through the introduction of a web-based assessment application. The results indicate that the workshop provided participating teachers with practical experience in understanding spatial sense assessment and operating a digital assessment system. Based on questionnaire responses and observation data, most participants were able to perform key operational tasks within the application, including accessing the platform, administering spatial sense assessment items, and interpreting automatically generated results. In addition, many teachers reported that the application was useful for supporting classroom assessment practices and expressed interest in applying it in their teaching activities.

These findings suggest that workshop-based professional development can serve as an initial step in introducing technology-enhanced assessment tools to elementary school teachers. By combining conceptual discussions with hands-on practice, the program enabled teachers to gain experience in implementing spatial sense assessment using a digital platform that supports automatic scoring and reporting, thereby helping teachers conduct assessments more efficiently.

However, several limitations should be acknowledged. The workshop was conducted as a single training session, which limits the ability to evaluate long-term adoption of the application in classroom practice. In addition, the evaluation relied partly on self-reported responses that may be influenced by response bias, and differences in teachers' technological familiarity may affect implementation across schools. Therefore, future programs should include extended mentoring and follow-up activities to support classroom implementation. Further development of the web-based application is also recommended, particularly in expanding the item bank and improving data analysis and reporting features based on teachers' feedback.

## CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

## AUTHOR CONTRIBUTIONS STATEMENT

Conceptualization, EK; methodology, EK and HA; formal analysis, EK and J; investigation and data collection, EK, HA, J, and MZA; application development and technical implementation, MZA; writing—original draft preparation, EK and MZA; writing—review and editing, EK, HA, and J; visualization and documentation, MS and E; supervision, EK. All authors have read and agreed to the published version of the manuscript. Authorship is limited to individuals who have made substantial contributions to the reported community service activity.

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## AI DISCLOSURE STATEMENT

Artificial intelligence tools were used to assist in language editing and in generating illustrative figures used in this manuscript. All content, interpretation of results, and conclusions were developed and verified by the authors. The authors take full responsibility for the accuracy and integrity of the manuscript.

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