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# Effectiveness of Professional Learning Community in Improving Science Literacy of Madrasah Ibtidaiyah Teachers

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**Abstract:** This study aims to examine the effectiveness of professional learning community (PPP) in improving science literacy of Madrasah Ibtidaiyah (MI) teachers through a qualitative approach based on library research with integrative literature review method. Data were collected from various relevant literature sources, including national and international journals, research reports, and education policy documents. The results showed that teachers' active involvement in LTO significantly improved science literacy, including aspects of knowledge, skills and scientific attitudes. In addition, collaborative activities such as discussion, reflection and training within the community are proven to promote teachers' continuous professional transformation. Principals' leadership strategies and peer support play an important role in creating a collaborative learning culture that strengthens the quality of science learning. This study recommends the need to develop a digital-based KPP model that is adaptive to the dynamics of educational technology as well as measuring the long-term impact of KPP on student learning outcomes. The findings make an important contribution to the development of community-based education policies and practices for improving teacher quality and science learning in madrasah.

**Keywords:** Professional Learning Community, Science Literacy, Madrasah Ibtidaiyah Teachers, Integrative Review, Professional Development.

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## A. INTRODUCTION

Professional Learning Communities (PLCs) are a collaborative approach to teacher professional development that emphasizes shared reflection, sharing best practices, and improving learning quality. In the context of science education, PLCs can play a significant role in improving teachers' science literacy, which includes understanding scientific concepts, critical thinking skills, and skills in applying scientific methods in teaching (Rahmani, 2024; Supardi & Herdiana, 2024). High teacher science literacy is important to equip students with scientific thinking skills from an early age, especially at the Madrasah Ibtidaiyah (MI) level, to face the challenges of the 21st century.

Research by Rahmani (2024) shows that teachers' active participation in learning communities can improve their pedagogical competence and professionalism. Through collaboration and joint reflection, teachers can develop more effective and innovative teaching strategies. In addition, research by Supardi and Herdiana (2024) emphasized that PLCs can improve teachers' work motivation and teaching quality, although its implementation faces challenges such as time constraints and structural support. Another study by Vitriyana et al.

(2024) found that learning communities contribute to improving teachers' pedagogical and professional competencies, as well as encouraging a culture of reflection in teaching practices.

In the context of science literacy, Sukisnawati et al. (2024) highlighted the importance of developing teacher competencies through training and workshops that focus on science literacy-based learning. Teachers' mastery of technology is also a key factor in presenting e-modules and interactive multimedia that support students' science literacy. In addition, classroom programs that lead to training in creating innovative and interactive learning environments can improve students' science literacy. Research by Akbar et al. (2024) showed that teacher professionalism and school culture had a significant effect on the basic literacy skills of MI students, with effective contributions of 20.9% and 21.3%, respectively.

A study by Supardi and Herdiana (2024) emphasized that learning communities have a positive role in improving teachers' competence and work motivation. However, challenges such as lack of support from school management and limited understanding of the benefits of learning communities are still barriers to their implementation. Research by Vitriyana et al. (2024) also found that teachers' active participation in learning communities can increase awareness of the importance of collaboration in sharing knowledge, although time constraints and access to technology are challenges that need to be overcome. In addition, Sukisnawati et al. (2024) highlighted that developing teacher competence in mastering technology can support students' science literacy through the use of e-modules and interactive multimedia.

Research by Akbar et al. (2024) showed that teacher professionalism and school culture had a significant effect on MI students' basic literacy skills, with effective contributions of 20.9% and 21.3% respectively. This shows that these factors can be used as predictors of students' basic literacy skills. In addition, research by Sukisnawati et al. (2024) emphasized the importance of developing teacher competence in mastering technology to support students' science literacy through the use of e-modules and interactive multimedia. The study by Supardi and Herdiana (2024) also highlighted that learning communities have a positive role in improving teachers' competencies and work motivation, although challenges such as lack of support from school management are still an obstacle in its implementation.

Analysis of the above studies shows that professional learning communities have great potential in improving science literacy of MI teachers through collaboration, reflection and competency development. However, there is a gap in research related to the effective implementation of PLCs in the context of MI, especially in integrating technology and science literacy-based learning approaches. In addition, not many studies have specifically explored the impact of PLCs on improving science literacy of MI teachers in Indonesia. Therefore, this study aims to examine the effectiveness of professional learning communities in improving science literacy of Madrasah Ibtidaiyah teachers, with a focus on implementation strategies, challenges, and impacts on science teaching practices at the MI level.

## B. METHOD

This study uses a library research approach with an integrative literature review method to examine the effectiveness of professional learning communities in improving the science literacy of Madrasah Ibtidaiyah teachers. This approach was chosen because it is able to

combine previous research results systematically, critically and thoroughly to identify trends, key findings and research gaps in the field under review (Torraco, 2005). The integrative approach provides breadth and depth of analysis of the relevant literature, supporting theory development and stronger implications for educational practice.

Data sources in this study were obtained from several credible academic databases such as Google Scholar, Scispace, Directory of Open Access Journals (DOAJ), and Scopus. The literature reviewed included national and international journal articles relevant to the topic of professional learning communities and science literacy of primary school or madrasah Ibtidaiyah teachers. Inclusion criteria in this study included: (1) articles in Indonesian or English, (2) articles published between 2015 and 2024, and (3) articles with relevant qualitative, quantitative, or desk-based research designs. The exclusion criteria included: (1) articles that were not peer-reviewed, (2) publications that could not be accessed in full-text, and (3) articles that did not contain aspects of science literacy or teacher learning communities.

The development of research related to professional learning communities and science literacy of Madrasah Ibtidaiyah teachers shows a shift in focus from individual improvement to systemic collaboration with broad impact. In 2015-2016, research mostly highlighted efforts to improve teachers' basic pedagogical competencies through collaboration and simple school-based training. Entering 2017-2018, there was an emphasis on strengthening the quality of learning through reflection and curriculum development, emphasizing the importance of learning community-based practice. As the needs of 21st century education evolved, the 2019-2020 period began to see attention to strengthening teacher professionalism and the emergence of LTOs as a key quality improvement strategy. This trend continues into 2021-2022 with the exploration of digital and hybrid approaches in teacher training, and an emphasis on science literacy and scientific attitudes. The years 2023-2024 are marked by the emergence of strategic variables such as the digital transformation of the teacher community, contextual science literacy and long-term evaluation, demonstrating the urgency of assessing the sustainability and tangible impact of LTO programs on education quality as a whole.

The literature search process was conducted using combined keywords such as “professional learning community”, “science literacy”, “madrasah ibtidaiyah teachers”, “teacher professional development”, and “science literacy in primary Islamic education”. The search was conducted by setting filters for year of publication (2015-2024), document type (journal article), and full access. The literature selection procedure began with screening based on title and abstract, followed by full-text screening to determine topical appropriateness, theoretical contribution, and methodological quality. Articles that met the inclusion criteria were further analyzed to identify themes and categorized by subtopics.

The data analysis method used was thematic analysis, with steps including: data reduction, categorization, and interpretation of the main findings from each study. Validity in this study was maintained through a systematic selection process, triangulation between data sources, and utilization of peer-reviewed references. Reliability was maintained by recording the literature search and selection process in detail, and using checklists to ensure consistency of analysis. This strategy is in line with the PRISMA guidelines for reporting systematic reviews (Moher et al., 2009).

## C. RESULTS AND DISCUSSION

### 1. Improving Teachers' Science Literacy through Engagement in Professional Learning Communities

Improving teachers' science literacy through engagement in professional learning communities is a very relevant topic in the current educational context. Science literacy as the ability to understand, communicate and apply science knowledge in everyday life is very important in this global era (Yuliati, 2017). The goal of improving science literacy is not only focused on students, but should also include the development of teachers' abilities (Herman et al., 2022). Teacher participation in professional learning communities provides opportunities to share experiences and best practices in effective science learning. Through this collaboration, teachers can access various strategies that have been proven successful, such as problem-based learning models that can improve science literacy learning outcomes (Herman et al., 2022; (Zukmadini et al., 2021). This collaborative activity can also help teachers in designing learning based on a scientific approach that is more interactive, so that students are actively involved in the learning process (Utami & Murti, 2019).

In addition, research shows that the application of innovative learning methods contributes significantly to the improvement of science literacy. For example, the use of STEM-integrated project-based learning has been shown to be effective in building students' science literacy competencies (Amahoroe et al., 2020; (Afriana et al., 2016). Different forms of training, including workshops and seminars held in learning communities, also help teachers to gain new skills and a more thorough and targeted approach to learning in the context of improving science literacy (Zukmadini et al., 2021; Fahriani et al., 2023).

Moreover, with the increasing use of digital technology in learning, instead of ignoring this, teachers need to be taught about how to effectively integrate such technology in their learning process (Herianingtyas et al., 2023). This is important so that the learning process can be made more interesting and relevant to students, given the rapid development of the times. The appearance of teachers in this community allows teachers to support each other in overcoming the obstacles faced in creating a learning environment that supports science literacy (Fuadi et al., 2020). Thus, teachers' active involvement in professional learning communities not only improves their own science literacy but also positively impacts the improvement of students' science literacy, which is crucial in today's science education (Afriana et al., 2016; Irsan, 2021). This collaboration encourages innovation and best practices that can strengthen teachers' capacity, ultimately resulting in a more skilled and science literate generation.

### 2. The Role of Community Strategies and Activities in Promoting Teacher Professional Transformation

Teachers' professional transformation is an important aspect in improving the quality of education that has a direct impact on the effectiveness of teaching and learning. In this regard, the role of community strategies and activities is fundamental. Learning communities, as collaborative platforms, serve to support teachers in developing their professional competencies and responding to the changing demands of education.

First, the strategies implemented by school principals greatly influence the development of professional teacher competencies. Research by Arvia et al. explained that principals have a strategic role in facilitating the development of teachers' professional competencies through various programs and activities at school, which involve collaboration between teachers in it (Arvia et al., 2023). This is in line with Maya and Mahmudah's research, which emphasizes the important role of principals in creating an environment that supports teachers as learning leaders and drivers of innovation (Maya & Mahmudah, 2023). When principals encourage teachers' participation in learning communities, they function not only as managers but also as facilitators who present opportunities for teachers to share best practices and experiences (Susanto & Muhyadi, 2016).

In addition, research by Suyamti et al. shows that mobilizing teachers, who act as a learning community, are able to promote learner independence and leadership and provide training for fellow teachers (Suyamti et al., 2024). Active teacher mobilizers in the community stimulate teachers' attention and engagement in the educational process, which in turn strengthens connections between teachers and improves their professional skills. Initiatives such as Lesson Study, proposed by Bastiana et al. also demonstrate the effectiveness of learning communities in collaboratively and sustainably improving teaching practices (Bastiana et al., 2023).

From the competency point of view, research by Ananda et al. asserts that an understanding of roles and responsibilities as educators is important for creating innovative learning environments (Ananda et al., 2023). Therefore, a community that supports teachers in reflecting on their practice will contribute to improving the quality of education. On the other hand, Sukirman and Ekantiningsih emphasize the important role of training and development held within the community to explore new skills relevant to curriculum and technology developments (Sukirman & Ekantiningsih, 2023).

Thus, the strategies implemented by principals and learning community activities both play an important role in promoting teachers' professional transformation. Continuous professional development through learning communities not only improves individual teachers' skills but also creates a collaborative culture that strengthens the overall quality of education. Therefore, the support of all stakeholders in creating an inclusive and productive community is crucial to achieving the expected educational goals.

### 3. Analysis of Professional Learning Community Effectiveness Based on Perceptions and Tangible Impacts

Professional learning communities (PLCs) among educators serve as a platform to develop skills and improve teaching quality. Research on the effectiveness of LTOs shows varying results depending on the context and implementation in each institution. According to Windasari et al., effective and skillful management of educators is necessary to improve learning quality, with good leadership creating a supportive academic environment Windasari et al. (2024). This research shows that LTOs can play a significant role in improving teacher professionalism by providing continuous access to learning and sharing best practices.

Sihombing and Barus highlighted a comparison of learning effectiveness before and during the COVID-19 pandemic which showed that changes in the way of learning, from face-

to-face to courageous, affected educators' perceptions of educational effectiveness (Sihombing & Barus, 2022). The uncertainty of this transition process underscores the importance of community support for relevant teaching and learning. With the support of professional learning communities, educators can share effective strategies and tools to undergo the adaptation process in an unprecedented situation.

On the other hand, Putri asserts that technological applications, such as the use of digital platforms in learning, can improve educational effectiveness by providing media that facilitate the teaching and learning process (PUTRI, 2023). This is in line with the increased collaboration within the KPP, where members can share resources and practice innovative teaching. The LTO serves not only as a platform to share ideas, but also to teach and determine best practices in education that have a real impact on learning.

KPP members' perceptions of effectiveness are also explained through research conducted by Djajadi et al., which emphasizes that individual capacity building, collaboration among staff, and program coherence are important aspects in the success of learning communities (Djajadi et al., 2015). This research shows that active participation in LTOs can strengthen educators' expertise and in turn have a positive impact on the quality of classroom teaching. The implementation of project-based learning models devoted to improving learning outcomes has also been highlighted. Setiawati et al. observed that this method invites learners to actively engage in the learning process, which is fully supported by the facilitator of the LTO (Setiawati et al., 2024). In this context, LTOs play an important role in supporting the implementation of innovative methods and facilitating more interactive learning.

However, although LTO offers many benefits, challenges remain, especially in the application of new technologies and learning integration strategies. Kurniawan and Zarnita pointed out that the dynamics in teacher professional education in Indonesia still have obstacles that require attention, including in the aspect of implementing dare learning and systematic professionalism training (Kurniawan & Zarnita, 2020). This shows that the success of KPP is not only determined by active member participation, but also by an understanding of existing needs and challenges.

Overall, the analysis of the effectiveness of professional learning communities provides important insights into the real and accelerated impact on improving the quality of education. The results obtained from these studies emphasize that support among educators through LTOs is key to achieving more effective and sustainable learning goals. Through constructive interaction and collaboration, LTOs can overcome various challenges while generating positive impacts on the educational environment.

## D. CONCLUSIONS AND SUGGESTIONS

Teachers' active involvement in this community not only has an impact on improving their science knowledge and skills, but also contributes to improving students' science literacy. The principal's strategy and collaborative activities in KPP have proven to be able to transform teachers' professional practices in a sustainable manner, create a collaborative learning culture and strengthen the quality of education in madrasahs. In the future, research needs to be directed at exploring digital-based professional learning community models that are adaptive

to developments in educational technology. In addition, measuring the long-term impact of KPP on student learning outcomes is also an urgent study to ensure its sustainability and effectiveness in the context of 21st century learning.

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