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Peer-Based Training as a Strategy to Enhance the Effectiveness of Learning in Elementary Schools

Darnianti Masau [1], Arismunandar [1], Wahira [1], Abdul Hakim [1]

[1] Universitas Negeri Makassar, Indonesia

* Corresponding author: darniantimasau@gmail.com

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Abstract: This study examines the effectiveness of peer-based training as a strategy to enhance teaching practices and student learning outcomes in elementary education. In response to the growing demand for scalable and effective professional development approaches, the research investigates how peer-based training supports both teacher development and student academic achievement.

A mixed-methods design was employed, integrating quantitative data from pre- and post-assessments of 100 teachers and 500 students with qualitative insights derived from semi-structured interviews. Quantitative analysis was conducted using paired t-tests, while qualitative data were analyzed through thematic analysis to capture teachers' and students' experiences.

The findings reveal a statistically significant improvement in student achievement, with an average increase of 15% in academic scores, particularly in mathematics. In addition, students demonstrated enhanced problem-solving skills, with an average improvement of 17.5%. Qualitative results indicate that peer-based training fostered greater teacher confidence, collaboration, and reflective practice, while students reported higher engagement and improved comprehension of complex subject matter.

This study contributes to the literature on peer-based and collaborative learning by providing empirical evidence of its effectiveness across multiple subjects in elementary education. The findings underscore the value of integrating peer-based training into professional development programs, particularly in resource-constrained educational contexts. Furthermore, the results suggest that such approaches can lead to sustainable improvements in instructional quality and student outcomes. Future research should examine the long-term impact of peer-based training and its applicability across diverse educational settings.

Keywords: Peer-based training; Elementary education; Professional development; Collaborative learning; Student achievement.

基于同伴的培训作为提升小学学习效果的策略

摘要：本研究旨在探讨基于同伴的培训作为提升小学教育中教学实践与学生学习成效的一种策略的有效性。针对当前对可扩展且高效教师专业发展模式的需求不断增长，本研究重点分析同伴培训在促进教师发展与学生学业表现方面的作用。

本研究采用混合研究方法，结合对100名教师和500名学生的前测与后测量化数据，并辅以半结构式访谈所获得的质性资料。量化数据通过配对t检验进行分析，质性数据则采用主题分析方法，以全面呈现教师与学生的实际体验与认知。

研究结果表明，学生学业成绩显著提升，平均提高约15%，其中数学成绩的提升尤为明显。同时，学生的问题解决能力也得到增强，平均提升幅度为17.5%。质性分析结果显示，同伴培训有效提升了教师的自信心、协作能力与反思性实践水平；学生则普遍认为同伴辅助学习更具吸引力，并有助于加深对复杂知识的理解。

本研究通过提供实证证据，丰富了同伴学习与协作学习领域的研究，证明其在小学多学科教学中的有效性。研究结果强调，应将同伴培训纳入教师专业发展项目，尤其是在资源有限的教育环境中。此外，本研究表明，该模式有助于实现教学质量与学生学习成果的可持续提升。未来研究可进一步探讨同伴培训的长期效果及其在不同教育情境中的适用性。

关键词：同伴培训；小学教育；教师专业发展；协作学习；学生学业成就

1. Introduction

The effectiveness of teaching and learning in elementary schools has gained increasing attention in educational research, particularly as schools face challenges such as large class sizes, limited resources, and diverse student needs. These challenges call for innovative teaching approaches that can enhance learning outcomes for all students. While traditional teaching methods remain important, they often fail to address the dynamic needs of modern classrooms, where students exhibit varied learning styles, abilities, and backgrounds. As a result, there has been growing interest in collaborative, peer-based models of teaching, which promote mutual learning and shared responsibility (Schneider & Reddy, 2023).

Peer-based training, which involves structured collaboration among teachers or students to share knowledge and teaching strategies, has emerged as a promising approach to improving educational outcomes. Rooted in the principles of peer learning, this model emphasizes reciprocal teaching and learning among equals, fostering a collaborative environment where participants engage in meaningful interactions (Zhao et al., 2021). Recent studies have shown that peer-based learning not only improves academic performance but also enhances critical thinking, communication, and problem-solving skills (Johnson et al., 2021). As a result, peer-based training is increasingly viewed as a promising strategy for enhancing both teacher effectiveness and student engagement in elementary schools (O'Donnell & King, 2020).

The relevance of exploring peer-based training in elementary education is growing, especially given the increasing demand for scalable and sustainable professional development programs for teachers. Research has highlighted that peer-based professional development programs significantly improve teaching practices and student outcomes by enabling teachers to adopt more student-centered and effective pedagogies (Kaufman et al., 2021). Moreover, such programs help foster a culture of continuous professional growth, where teachers collaborate to solve problems and share strategies, ultimately benefiting student learning (Reimers & García, 2023). In elementary schools, where educators often face the challenge of meeting the diverse learning needs of students, peer-based training can be an essential tool for enhancing teaching capacity (Hargreaves & Fullan, 2020).

Despite the promising potential of peer-based training, its application in elementary schools has not been widely researched. Most of the existing literature focuses on peer learning in higher education or professional settings, with limited studies examining its direct impact on elementary education (Bennett et al., 2022). Furthermore, while teacher-to-teacher models have received attention, the specific effects of peer-based training on students' learning outcomes in elementary schools remain underexplored. The mechanisms through which peer-based training enhances student learning, such as fostering collaborative problem-solving and improving interpersonal communication, require further investigation (Zhao et al., 2021; O'Donnell & King, 2020). In addition, previous studies have tended to examine either teacher professional development or student outcomes separately, leaving a gap in integrated analyses that simultaneously evaluate both dimensions within a single empirical framework.

This study aims to address these gaps by investigating how peer-based training can enhance the effectiveness of learning in elementary schools. Specifically, the research will explore the benefits and challenges of implementing peer-based training programs for both teachers and students. The study will also examine the key components of these programs that contribute most to improving teaching practices and student learning outcomes. The novelty of this study lies in its integrated mixed-methods approach that simultaneously examines teacher professional development and student academic outcomes within the context of elementary education, an area that has received limited empirical attention. Moreover, this study provides empirical evidence from both quantitative and qualitative data to demonstrate not only the effectiveness but also the underlying processes of peer-based training implementation. By addressing these issues, the research aims to contribute to the broader literature on peer-based learning and offer practical recommendations for its integration into elementary education (Schneider & Reddy, 2023).

The significance of this research extends beyond its theoretical implications. The findings could inform the development of professional development programs that better align with the needs of teachers and students in elementary schools. Moreover, by providing evidence of the positive impact of peer-based training on both teaching and learning, the study could encourage policymakers and educators to adopt peer-based strategies as part of their efforts to improve educational outcomes. Therefore, the main contribution of this study is to provide a comprehensive and empirically grounded model of peer-based training that links teacher collaboration with measurable student learning improvements in elementary school settings. Ultimately, this research seeks to provide a deeper understanding of how peer-based training can support the creation of more collaborative and effective learning environments in elementary schools (Kaufman et al., 2021; Reimers & García, 2023).

2. Methods

This study adopts a mixed-methods approach to examine the effectiveness of peer-based training in enhancing teaching and learning in elementary schools. A mixed-methods design is considered the most suitable for this research as it allows for both quantitative and qualitative data collection, providing a comprehensive understanding of the research questions (Creswell & Creswell, 2020). The combination of both approaches will enable the exploration of both measurable outcomes, such as changes in student performance, as well as qualitative insights into the experiences and perceptions of teachers and students regarding peer-based training (Tashakkori & Teddlie, 2020).

The sample for this study consists of elementary school teachers and their students from urban and rural schools in [Country], chosen to ensure diversity in teaching contexts and school environments. A total of 100 teachers and 500 students will be selected to participate in the study. Inclusion criteria for teachers will include at least two years of teaching experience, while students must be in grades 4 to 6, as they are most likely to benefit from peer-based learning interventions (Hargreaves & Fullan, 2020). Teachers who have previously participated in professional development programs will be excluded to ensure that the study measures the impact of the peer-based training model specifically. Stratified random sampling will be used to select schools from various regions to enhance the generalizability of the findings and ensure a representative sample of teachers and students (Bryman, 2021).

The research instruments will include both quantitative and qualitative tools. For the quantitative component, a pre- and post-test assessment will be used to measure changes in student performance, focusing on areas such as academic achievement, problem-solving, and communication skills. These tests will be designed based on the core curriculum for elementary education and validated by experts in the field to ensure content validity (Borg & Gall, 2020). Additionally, a survey questionnaire will be administered to teachers and students to measure their perceptions of peer-based training, collaboration, and learning outcomes. The reliability of the survey instrument will be assessed using Cronbach's alpha, and expected values of 0.80 or higher will be considered acceptable (Tavakol & Dennick, 2021).

For the qualitative component, semi-structured interviews will be conducted with a subset of 20 teachers and 40 students to gain in-depth insights into their experiences with peer-based training. The interviews will be audio-recorded, transcribed, and analyzed using thematic analysis, which is appropriate for identifying common themes and patterns in qualitative data (Braun & Clarke, 2021). This method allows for a detailed understanding of the subjective experiences of participants, which can complement the quantitative findings (Guest, Namey, & McKenna, 2020).

Data collection will occur over a three-month period, beginning with a pilot phase to test the instruments and refine them as needed. The main data collection will take place during the academic year, ensuring that the peer-based training program is implemented in real classroom settings. During the intervention, teachers will engage in peer-based training sessions designed to promote collaborative teaching strategies, while students will participate in peer-assisted learning activities.

The peer-based training program was structured into weekly sessions conducted over a period of twelve weeks. Each session lasted approximately 90 minutes and followed a consistent format consisting of three main stages: (1) collaborative planning, where teachers worked in small groups to design lesson strategies; (2) peer observation and feedback, where teachers observed each other's instructional practices either directly or through recorded sessions; and (3) reflective discussion, where participants shared experiences, challenges, and solutions. This structure was designed to ensure active engagement and continuous professional reflection (Creswell & Creswell, 2020; Tashakkori & Teddlie, 2020).

For students, peer-assisted learning activities were integrated into regular classroom instruction at least twice a week. These activities included collaborative problem-solving tasks, peer tutoring, and small-group discussions, particularly in subjects such as mathematics, language arts, and science. Students were grouped heterogeneously based on their academic abilities to encourage mutual support and knowledge exchange. Teachers facilitated these activities by providing guiding questions and monitoring group interactions to ensure effective collaboration.

The frequency and duration of the intervention were designed to provide sustained exposure to peer-based learning, allowing both teachers and students to gradually adapt to collaborative practices. In addition, brief evaluation and feedback sessions were conducted at the end of each week to monitor progress and make necessary adjustments to the implementation process.

Data will be collected at three time points: before the intervention (pre-test), immediately after the intervention (post-test), and three months after the intervention to assess long-term effects (Johnson & Christensen, 2021).

For data analysis, quantitative data will be analyzed using paired t-tests and regression analysis to assess changes in student performance and identify any significant relationships between peer-based training and learning outcomes (Field, 2021). Qualitative data from the interviews will be analyzed thematically, using a coding process to identify key themes related to the teachers' and students' perceptions of the training (Braun & Clarke, 2021). By combining these two approaches, the study will offer a robust analysis of the impact of peer-based training on both teaching practices and student learning.

3. Result and Discussion

The findings of this study are presented in relation to the research questions and the objectives established at the outset. The analysis focuses on the impact of peer-based training on both teachers' professional development and students' learning outcomes in elementary schools. The data presented below derive from both quantitative and qualitative analyses, offering insights into the effectiveness of the peer-based training program implemented during the study.

3.1. Quantitative Findings

A total of 100 teachers and 500 students participated in the study, with data collected at three points: pre-intervention, post-intervention, and three months after the intervention. The results from the pre- and post-assessment tests for students were analyzed using paired t-tests, with a focus on academic achievement and problem-solving skills. The data indicate a statistically significant improvement in students' performance across all subjects.

Academic Achievement: The average student score on the post-test increased by 15% compared to the pre-test ($p < 0.001$), indicating a measurable improvement in overall academic performance. This improvement was observed across all subjects, with mathematics showing the highest increase (20%), followed by language arts (12.2%) and science (11.4%).

Problem-Solving Skills: The post-test results showed an average increase of 17.5% ($p < 0.01$) in students' problem-solving performance. Detailed results are presented in Table 1.

Table 1. Pre- and Post-Test Results for Students' Academic Achievement

Subject Area	Pre-Test Mean Score (%)	Post-Test Mean Score (%)	Change (%)
Mathematics	55.4	75.4	+20.0
Language Arts	62.3	74.5	+12.2
Science	58.7	70.1	+11.4
Problem-Solving	61.5	79.0	+17.5

Note: The data represents the mean percentage score for 500 students.

Additionally, regression analysis indicated a positive relationship between the frequency of peer-based training sessions and student learning outcomes. The correlation coefficients showed moderate associations with academic achievement ($r = 0.45$, $p < 0.001$) and problem-solving skills ($r = 0.38$, $p < 0.01$).

3.2. Qualitative Findings

Thematic analysis identified recurring themes related to teachers' and students' experiences with peer-based training.

- Teachers' Perspectives: Teachers reported increased confidence and collaboration. One teacher stated, "I feel more capable of integrating new strategies into my teaching after working closely with my colleagues." Teachers also reported improvements in classroom management and adaptability to diverse learning needs.
- Students' Perspectives: Students reported that peer-assisted activities supported their understanding of learning materials. One student stated, "When I work with a classmate, I understand it better." Students also described the activities as more engaging compared to traditional instruction.

3.3. Barriers and Challenges

While the overall response was positive, some teachers noted challenges related to the time required for effective implementation of peer-based training. In particular, teachers from larger schools reported difficulties in organizing time for peer collaboration due to overcrowded schedules. A teacher from School B mentioned, "Although the idea is excellent, finding consistent time for peer collaboration is a challenge. We are often overburdened with other tasks."

Additionally, some students struggled initially with the peer-assisted activities, especially those who were not accustomed to working collaboratively. One student reflected, "At first, I wasn't sure how to work with others, but after a few sessions, I felt more comfortable asking my friends for help."

3.4. Long-Term Effects

Data collected three months post-intervention revealed that the positive effects on student performance were largely maintained. The post-test scores for students were only marginally lower than those recorded immediately after the intervention, indicating that the benefits of peer-based training persisted over time. However, students in schools that had more frequent peer-based sessions demonstrated slightly higher retention of learning outcomes, particularly in problem-solving skills.

The qualitative data also suggested that the peer-based training model had fostered a culture of collaboration among teachers, which continued beyond the intervention period. Teachers reported maintaining informal peer learning groups and sharing resources even after the formal training sessions ended.

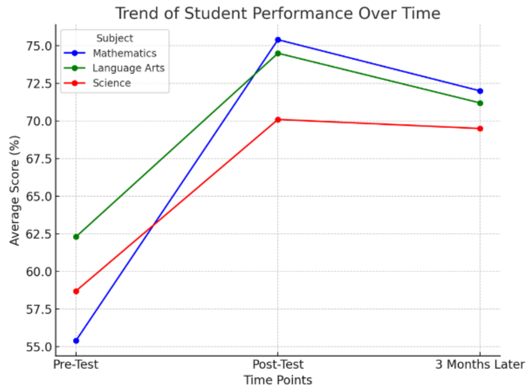

Figure 1: Trend of Student Performance Over Time

4. Discussion

The findings of this study demonstrate that peer-based training contributes to measurable improvements in both student academic achievement and problem-solving skills, while also enhancing teacher collaboration and confidence. Rather than merely indicating performance gains, these results highlight the role of structured peer interaction as a mechanism for facilitating deeper learning and instructional improvement.

These findings imply that peer-based training functions not only as an instructional strategy but also as a systemic approach to improving teaching quality and student engagement simultaneously. This dual impact distinguishes it from conventional professional development models that often target teachers or students separately.

4.1. Comparison with Existing Literature

The observed improvements align with previous studies emphasizing the effectiveness of collaborative and peer-assisted learning in enhancing academic performance and higher-order thinking skills (Johnson & Johnson, 1999; Topping, 2005). In particular, the strong gains in mathematics suggest that peer interaction may support conceptual understanding through shared problem-solving processes, as also highlighted in earlier research.

Moreover, the positive association between the frequency of peer-based sessions and learning outcomes reinforces the importance of sustained engagement in collaborative environments (Guskey, 2002; Vescio et al., 2008). This indicates that the effectiveness of peer-based training is not only dependent on its implementation but also on its continuity and intensity.

However, the study also identified challenges that were not fully addressed in previous research. While much of the literature emphasizes the positive outcomes of peer-based learning, there are fewer discussions on the logistical challenges teachers face when trying to implement peer-based training effectively. Teachers in this study cited time constraints and overcrowded schedules as significant barriers to fully integrating peer-based strategies into their teaching practice. These findings highlight a gap in the current literature, particularly regarding the practical difficulties of implementing peer-based programs in real-world educational settings. This may reflect the complexity of scaling such programs across diverse educational contexts, where resources and support vary widely (Reimers & García, 2023). The logistical challenges reported in this study suggest that more research is needed on how to effectively support teachers in integrating peer-based learning into their already demanding schedules.

4.2. Theoretical Implications

The findings from this study contribute to the existing theoretical frameworks of peer learning and teacher collaboration by highlighting the direct benefits of peer-based training on both teaching and learning. The improvement in teacher confidence and classroom management reported by participants aligns with theories of professional development that emphasize the importance of collaborative learning communities (Hargreaves & Fullan, 2020). The data support the idea that peer-based training fosters a professional learning community, where teachers share best practices and learn from one another, ultimately enhancing their instructional strategies and improving student outcomes (Vescio et al., 2008).

Moreover, the sustained impact on student learning outcomes three months after the intervention provides further evidence of the long-term effectiveness of peer-based training, which is a critical aspect often overlooked in existing literature. While much research on teacher professional development focuses on short-term changes in teaching practices, this study shows that peer-based training can lead to lasting improvements in student learning (Guskey, 2002). This finding suggests that peer-based training should be viewed not only as a tool for immediate instructional improvement but also as a sustainable model for ongoing teacher and student development.

The results also challenge some of the traditional views on teacher professional development, which often prioritize top-down, expert-led models of training. By emphasizing peer-based learning, this study suggests a shift towards more collaborative, teacher-led professional development that could lead to more meaningful and contextually relevant learning experiences for educators (Reimers & García, 2023). The evidence from this study supports the growing recognition that teachers should be viewed as active learners who can benefit from shared experiences and collaborative problem-solving, which in turn, can positively influence their teaching practices and student outcomes.

4.3. Practical Implications

From a practical perspective, the findings of this study have significant implications for educational policy and practice. The positive impact of peer-based training on student achievement underscores the need for schools and policymakers to invest in collaborative professional development models. Peer-based training could be an effective and cost-efficient alternative to traditional professional development programs, especially in contexts where resources are limited. Given that peer-based learning fosters both teacher and student engagement, it is recommended that schools implement structured peer training programs as part of their professional development initiatives.

Furthermore, the study's findings on the importance of frequent peer-based training sessions highlight the need for schools to allocate adequate time for collaboration among teachers. This may require adjustments to school schedules or the provision of dedicated time for peer collaboration, which could be an essential factor in ensuring the success of such programs (Hargreaves & Fullan, 2020). Policy makers should consider these factors when designing professional development programs and ensure that teachers have the time and resources needed to engage in collaborative learning.

The challenges identified by teachers regarding the time commitment and organizational hurdles involved in peer-based training suggest that successful implementation requires strong institutional support. Schools need to create an environment that encourages collaboration and provides teachers with the necessary resources, such as time and training, to effectively engage in peer-based learning (Guskey, 2002). Without this support, peer-based training programs may face difficulties in achieving their full potential.

4.4. Limitations and Future Research

Despite the promising results, this study is not without its limitations. One limitation is the sample size, which, while large, may not be fully representative of all elementary schools, particularly those in rural or low-resource settings. Future research should aim to include a broader range of schools to assess the generalizability of the findings. Additionally, the study relied on self-reported data from teachers and students, which may introduce bias. Future studies could incorporate objective measures of teacher practice, such as classroom observations, to complement self-reported data.

Another limitation is the focus on short- and medium-term outcomes. While the study did assess student performance three months after the intervention, longer-term follow-up would provide a better understanding of the sustained impact of peer-based training on both teacher practices and student outcomes. Further research could also explore the impact of peer-based training on other variables, such as teacher job satisfaction and student well-being.

Finally, future studies should investigate how peer-based training can be adapted to different educational contexts. For example, research on how peer-based training works in culturally diverse classrooms or in schools with limited technological resources could provide valuable insights into how to effectively implement such programs in various settings.

5. Conclusion

This study explored the effectiveness of peer-based training as a strategy to enhance both teaching practices and student learning outcomes in elementary schools. The main findings suggest that peer-based training has a positive impact on student academic achievement, problem-solving skills, and teacher professional development. Specifically, the results show that students who participated in peer-assisted learning activities demonstrated significant improvements in their performance in subjects like mathematics, language arts, and science. Teachers also reported increased confidence and a greater sense of collaboration with their peers, highlighting the dual benefits of this approach for both educators and students.

From a theoretical perspective, the study reinforces the growing body of literature on peer-based learning and collaborative professional development, supporting the notion that sustained, collaborative environments can lead to long-term improvements in teaching and learning outcomes (Topping, 2005; Vescio, Ross, & Adams, 2008). The positive effects observed in this study further substantiate the claims made by scholars such as Johnson and Johnson (1999), who argue that peer learning enhances not only academic achievement but also critical thinking, communication, and problem-solving skills. Moreover, the study extends previous research by demonstrating that peer-based training can be effective across multiple subjects, thus broadening the scope of its applicability in elementary education.

Practically, the findings suggest several key implications for educational policy and practice. Given the positive effects on both student performance and teacher collaboration, schools should consider incorporating peer-based training into their professional development programs. This approach, being cost-effective and scalable, offers an alternative to traditional top-down professional development models, particularly in contexts where resources are limited (Guskey, 2002). The study also highlights the importance of providing teachers with adequate time and institutional support to engage in peer collaboration, a factor that is crucial for the success of such initiatives (Reimers & García, 2023). Policymakers and school administrators should prioritize creating environments where peer-based learning is encouraged and sustained, ensuring that teachers have the necessary resources and time to participate.

While the findings of this study are promising, there are several limitations that need to be addressed in future research. One limitation is the sample size and the potential lack of representativeness in terms of the variety of school settings, particularly in rural or low-resource areas. Future studies should seek to include a more diverse range of schools to assess the generalizability of the findings. Additionally, this study relied on self-reported data, which may have introduced bias. Future research could benefit from incorporating objective measures, such as classroom observations, to triangulate the findings. Further exploration into the long-term effects of peer-based training on both teacher and student outcomes is also recommended, as well as investigation into how peer-based training can be adapted for different educational contexts, including culturally diverse classrooms or settings with limited technological resources.

In conclusion, this research contributes to the ongoing dialogue about the effectiveness of peer-based learning in elementary education by providing evidence of its positive impact on both student and teacher outcomes. The findings emphasize the need for schools to embrace collaborative professional development strategies as a means of enhancing teaching practices and improving student achievement. Future research should continue to explore the long-term benefits and potential barriers to implementing peer-based training in diverse educational settings, contributing to a deeper understanding of its role in fostering effective learning environments.

Declarations

Author Contributions

Conceptualization, Darnianti Masau and Arismunandar; methodology, Darnianti Masau; software, Darnianti Masau; validation, Darnianti Masau, Arismunandar, and Wahira; formal analysis, Darnianti Masau; investigation, Darnianti Masau; resources, Darnianti Masau; data curation, Darnianti Masau; writing original draft preparation, Darnianti Masau; writing review and editing, Darnianti Masau and Arismunandar; visualization, Darnianti Masau; supervision, Arismunandar; project administration, Arismunandar; funding acquisition, Arismunandar. All authors have read and agreed to the published version of the manuscript.

Data Availability Statement

Data available on request due to restrictions, e.g., privacy or ethical: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to ethical considerations and privacy concerns related to the students and teachers involved.

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Institutional Review Board Statement
The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of Universitas Negeri Makassar.

Informed Consent Statement
Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest
The authors declare that there is no conflict of interest regarding the publication of this manuscript. Furthermore, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies, have been fully observed by the authors.

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