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# Mathematics Teachers' Professional Competency Development through Classroom Action Research Workshop

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**Abstract**
One of the most effective strategies to improve mathematics teachers' professional competency is providing regular professional development (PD) workshops and training sessions. This study aims to answer: (1) How to design a professional development program for mathematics teachers in Indonesia through an online workshop? (2) What areas need improvement for better future implementation? A "design research" method was adopted, analyzing the professional development process through collaborative Classroom Action Research (CAR), where teachers and researchers work together to enhance instructional practices. The study involved 24 mathematics teachers from 12 provinces. Data were collected through evaluation forms, focus group discussions, group meetings, and learning logs, then analyzed using a grounded theory approach through open, axial, and selective coding. Results showed that 51% of participants rated the workshop as very good, while 49% provided suggestions for improvement. The two main areas needing enhancement are adjusting the schedule to fit participants and addressing technical issues. Weekly evaluations revealed that teachers need more workshops on Kurikulum Merdeka, teaching media, information and communication technology (ICT) integration, and book publishing.
**Keywords:** Professional development, classroom action research

**Abstrak**
Salah satu strategi paling efektif untuk meningkatkan kompetensi profesional guru matematika adalah dengan menyediakan lokakarya dan sesi pelatihan pengembangan profesional (PD) secara berkala. Penelitian ini bertujuan untuk menjawab: (1) Bagaimana merancang program pengembangan profesional bagi guru matematika di Indonesia melalui lokakarya daring? (2) Aspek apa saja yang perlu diperbaiki agar pelaksanaan berikutnya lebih efektif? Metode design research diterapkan dalam penelitian ini, menganalisis proses pengembangan profesional melalui kolaborasi Penelitian Tindakan Kelas (PTK) di mana guru dan peneliti bekerja sama untuk meningkatkan praktik pengajaran. Studi ini melibatkan 24 guru matematika dari 12 provinsi. Data dikumpulkan melalui formulir evaluasi, diskusi kelompok terfokus, pertemuan kelompok, dan catatan pembelajaran, kemudian dianalisis menggunakan pendekatan teori dasar melalui proses open coding, axial coding, dan selective coding. Hasil penelitian menunjukkan bahwa 51% peserta menilai lokakarya ini sangat baik, sementara 49% memberikan saran perbaikan. Dua aspek utama yang perlu ditingkatkan adalah penyesuaian jadwal agar sesuai dengan peserta dan penanganan kendala teknis. Evaluasi mingguan menunjukkan bahwa guru membutuhkan lebih banyak lokakarya tentang Kurikulum Merdeka, media pembelajaran, integrasi teknologi informasi dan komunikasi (ICT), serta penerbitan buku.
**Kata Kunci:** Pengembangan profesional; penelitian tindakan kelas

## 1. INTRODUCTION

Professional competency development is gaining new skills through continuing education and career training after entering the workforce. It can help teachers boost their confidence, credibility, and career advancement (Philippakos & Voggt, 2021). Improving mathematics teachers' professional competency development can be achieved through a range of strategies (Bragg et al., 2021; Philippakos & Voggt, 2021; Yurkofsky et al., 2019). One of the most effective strategies is providing regular professional development workshops and training sessions for mathematics teachers. These workshops should be designed to provide teachers with the knowledge and skills they need to effectively teach mathematics and keep them up to date with new teaching strategies and technologies. Peer mentoring and coaching programs can also be implemented, allowing experienced teachers to work with novice teachers to provide guidance and support, share teaching strategies, and provide feedback on teaching practices (Mugirase & Ndimurugero, 2021; Wilkerson et al., 2020).

Another important strategy is to conduct regular classroom observations and provide constructive feedback to teachers on their teaching practices. This feedback should be specific and actionable in order to assist teachers in identifying areas for improvement and developing strategies to improve their teaching practices. Collaboration and networking among teachers are also necessary. Encouraging teachers to collaborate within their own school as well as across different schools and districts can result in a shared environment of resources, lesson plans, and teaching strategies, allowing for the discussion of common challenges and successes. Finally, encouraging teachers to participate in research and professional development activities such as action research, attending conferences, and participating in online forums and discussions can assist teachers in staying current with new research and teaching practices and developing their own skills and knowledge (Johar et al., 2021). By combining these strategies, it is possible to support and develop mathematics teachers' professional competency and enhance their effectiveness in the classroom.

Classroom action research is a valuable tool for mathematics teachers to enhance their professional competency development (Manfra, 2019). This type of research involves teachers conducting systematic investigations of their own teaching practices to identify areas of improvement and to develop solutions to problems they encounter in the classroom. A workshop focused on classroom action research can provide teachers with the knowledge and skills needed to conduct effective research projects. A workshop focused on classroom action research for mathematics teachers should begin with an introduction to the concept of classroom action research. Teachers should be guided to understand its purpose and benefits, as well as the steps involved in conducting a research project. Additionally, the workshop should help teachers identify research questions that are relevant to their classroom context and that align with their professional goals. This will help them to focus their research efforts and achieve more meaningful results (Niemi, 2018; Thurm & Barzel, 2020).

In the next stage of the workshop, teachers should be provided with an overview of various data collection and analysis techniques. This should include a discussion of surveys, observations, interviews, and document analysis. By understanding these techniques, teachers can select the most appropriate methods for their research project. The workshop should also guide teachers in developing action plans based on the findings

of their research. These action plans should be specific, measurable, achievable, relevant, and time-bound (SMART) and should be aligned with the research questions. Finally, the workshop should include opportunities for teachers to reflect on their research experiences and to share their findings with their colleagues (Niemi, 2018; Thurm & Barzel, 2020). This sharing can take the form of presentations, posters, or written reports, allowing teachers to learn from each other and apply their findings to their own classrooms.

Sum it up, a classroom action research workshop can assist mathematics teachers in becoming more effective practitioners by improving their understanding of their own classroom practices. Teachers can identify areas for improvement and develop targeted interventions to address these issues by conducting systematic research. Teachers can learn from their own and their colleagues' experiences through reflection and sharing, fostering a culture of ongoing professional development within the mathematics teaching community(Niemi, 2018).

A classroom action research workshop can be an effective way for mathematics teachers to improve their professional competency development by providing them with the knowledge and skills needed to conduct research projects that will result in improvements in their teaching practices(Tindowen et al., 2019). Classroom action research is essential for teachers because it provides numerous benefits. To begin, classroom action research assists teachers in improving their teaching practice by identifying areas of strength and weakness in their instruction, setting goals and objectives, and developing action plans to improve their teaching strategies. Second, it assists teachers in meeting the specific learning needs of individual students by collecting data on those needs and designing teaching strategies and activities to address those needs. This can result in increased student engagement, motivation, and academic achievement (Manfra, 2019).

Moreover, classroom action research enhances teachers' professional development by promoting reflection, self-evaluation, and ongoing learning. By engaging in this research, teachers can increase their job satisfaction, motivation, and a sense of professional fulfillment (Tindowen et al., 2019). Finally, classroom action research provides an opportunity for teachers to share their experiences and contribute to the knowledge base of the field of education. Teachers can present their findings at conferences, publish articles in professional journals, and share their insights with colleagues. Overall, classroom action research is vital for teachers as it helps them to improve their teaching practice, meet the needs of their students, enhance student learning, promote professional development, and contribute to the field of education.

Recognizing that CAR is an important component of teachers' continuing professional development, and that there are still many teachers who require assistance in carrying out this scheme. Many community services/organizations are interested in assisting teachers by conducting projects that focus on teachers' professional development as part of education reform policy. This paper is part of a larger ongoing study that focuses on improving the ability of Mathematics teachers to conduct Classroom Action Research (CAR) through a Professional Development (PD) program that aims to answer the following research questions: (1) How to design PD program for mathematics teachers in Indonesia through online workshop? (2) What are areas that need to be improved so that the program works as planned the next time?

## 2. METHOD

A "design research" method adopted for analyzing the process of PD program through collaboration CAR. Due to that this study using design research method forward to produce processes and tools that work well in practice with facilitator as trainer and teachers, lecturers and supervisors as targeted group so considerably the engineering research approach is the most relevant approach for the study.

**Timeline, material, experts involved**

Workshop was held in 17 weeks including 8 weeks for teachers to implement the lesson plan. Timeline of the workshop starting from participant registration till the end of the program is available in table 1.

**Table 1**. Timeline of the workshop

| Number | Time |
|---|---|
| Registration | 26 June - 10 July 2022 |
| Selection of participants based on a questionnaire | 11 July - 17 July 2022 |
| Announcement of selected participants | August 17, 2022 |
| Workshop | 20 August-10 December 2022 |
| Evaluation | Every week |
| Distribution of certificates | December 31, 2022 |

There are experts that involved during the workshop. Detail about experts involved are described in Table 2

**Table 2.** Experts involved in the workshop

| Activity | Time | Material | Speaker |
|---|---|---|---|
| 1 | August 20, 2022 | The importance of CAR in the world of CAR education and technical training | Civil servant teachers and Research team |
| 2 | August 27, 2022 | Understanding of CAR and how to identify problems in CAR | Lecturer from Universitas Mataram |
| 3 | September 3, 2022 | Types of learning that can be chosen as solutions to problems in CAR | Lecturer from Universitas Mahasaraswati |
| 4 | September 10, 2022 | Cycle in CAR and preparation of lesson plans | Lecturer from Pelita Harapan University |
| 5 | September 17, 2022 | Research instruments include observation and evaluation sheets | Lecturer from Universitas Pendidikan Indonesia |
| 6 | September 24, 2022 | Research instruments include observation and evaluation sheets | Lecturer from Universitas Pendidikan Indonesia |
| 7 | October 1 - November 19, 2022 | Implementation of CAR | Research team |
| 8 | November 26, 22 | Data analysis | Academic Specialist from SEAQiM |
| 9 | December 5, 2022 | Report writing and articles publication | Lecturer from Universitas Ahmad |

| Activity | Time | Material | Speaker |
|---|---|---|---|
| 10 | December 10, 2022 | Focus Group Discussion | Dahlan<br>Research team |

In order to complete the workshop and prepare for theupcoming meeting, the teachers were asked to submitted 5 tasks during the workshop. Detail about task are available in table 3.

**Table 3**. Task to be completed by teachers during the workshop

| Task | Task details |
|---|---|
| 1 | Identifying and Selecting Problems to be Solved with CAR |
| 2 | Choosing the type of learning for CAR |
| 3 | Cycles in CAR and preparation of lesson plans |
| 4 | Research instruments include observation and evaluation sheets |
| 5 | Writing article as a final project |

**Participants**

There were 44 teachers enrolled to the workshop but online teachers who met the criteria who can join the workshop. The criteria were decided to make sure teachers could complete the final project. Teachers are selected to take part in the CAR workshop are teachers who are committed to implementing CAR as identified by the availability of a stable internet network, have sufficient time to conduct CAR, have experience implementing CAR, have a brief plan for CAR implementation, have high motivation to implement CAR and willing to provide real information that happened in their respective schools. Based on these criteria, 24 teachers were selected who were eligible to take part in the workshop. So, the participant in this study are 24 mathematics teachers from 12 provinces. The details about the provinces and number of participants are described in Table 4

**Table 4.** Provinces of the participants

| Province | Number of teachers |
|---|---|
| Aceh Darussalam | 1 |
| Bali | 2 |
| Banten | 1 |
| West Java | 2 |
| Central Java | 3 |
| East Java | 1 |
| East Kalimantan | 5 |
| Lampung | 1 |
| West Nusa Tenggara | 2 |
| West Sumatra | 3 |
| South Sumatra | 2 |
| North Sumatra | 1 |

**Data collection and data analysis**

Data in this study were collected through evaluation forms, focus group discussion, group meeting and learning logs, then the data were analyzed using grounded theory approach through the process of open, axial, and selective coding.

## 3. RESULT AND DISCUSSION

### Design of CAR workshop

The workshop including zoom meeting. Experts were invited to deliver the material in 17 weeks along with focus group discussion at the end of the meeting. Detail about the material and meeting objective in every activity is available in table 5.

**Table 5.** Meeting objectives

| Number | Material | Meeting objectives |
|---|---|---|
| 1 | The importance of CAR in the world of CAR education and technical training (week 1) | Participants understand the importance of CAR to improve the quality of learning in the classroom<br>Participants understand the importance of CAR for promotions or positions<br>Participants understand the procedure for using the CAR report for promotion<br>Participants understand the technicalities of the CAR training organized by Simejik |
| 2 | Understanding of CAR and how to identify problems in CAR (week 2) | Participants understand the definition of CAR<br>Participants understand the purpose of CAR<br>Participants are able to identify problems in class<br>Participants are able to choose the problems to be solved in the CAR |
| 3 | Types of learning that can be chosen as solutions to problems in CAR (week 3) | Participants know the types of learning that can be applied in class according to the New Normal Era<br>Participants can determine the type of learning that is implemented as an alternative solution to the chosen problem. |
| 4 | Cycle in CAR and preparation of lesson plans (week 4) | Participants understand the purpose of each component in the CAR cycle<br>Participants are able to determine the right number of cycles for the CAR that they will do<br>Participants know the components in the latest RPP<br>Participants can prepare an RPP according to the needs of the CAR that will be carried out |
| 5 | Research instruments include observation and evaluation sheets | Participants understand the types of research instruments that can be used in CAR such as observation sheets, questionnaires and evaluation instruments according to the aspects to be studied, for example critical thinking skills tests) |

| Number | Material | Meeting objectives |
|---|---|---|
| | (week 5) | |
| 6 | Research instruments include observation and evaluation sheets (week 6) | Participants can create research instruments that are appropriate to the problem to be solved. |
| 7 | Implementation of CAR (week 7-14) | Implementation of CAR |
| 8 | Data analysis (week 15) | Participants understand the data processing techniques required in CAR according to the instruments used (eg observation sheets, questionnaires and evaluation instruments according to the aspects to be studied such as tests of critical thinking skills)<br>Participants can process data according to the chosen CAR problem formulation |
| 9 | Report writing and articles publication (week 16) | Participants understand the systematics of CAR reports used for publication<br>Participants can write CAR reports that can be used for publication<br>Participants know the systematics of published articles<br>Participants can write publication articles based on the CAR that has been implemented in schools<br>Participants know the journals that can be used as a place to publish the articles they make |
| 10 | Focus Group Discussion (week 17) | Discuss about the difficulties that teachers encountered during CAR |

Each participant filled out the attendance list and an evaluation form which was sent at each zoom meeting. Participant attendance data were presented in figure 1. The total number of meetings in the workshop was 10. The topic "Research instruments include observation and evaluation sheets," which was covered over two separate meetings (Week 5 and Week 6). Since research instruments are a crucial component of Classroom Action Research (CAR), participants needed two days to fully understand the different types of instruments (e.g., observation sheets, questionnaires, and evaluation instruments for aspects like critical thinking skills) and to practice developing their own research instruments.

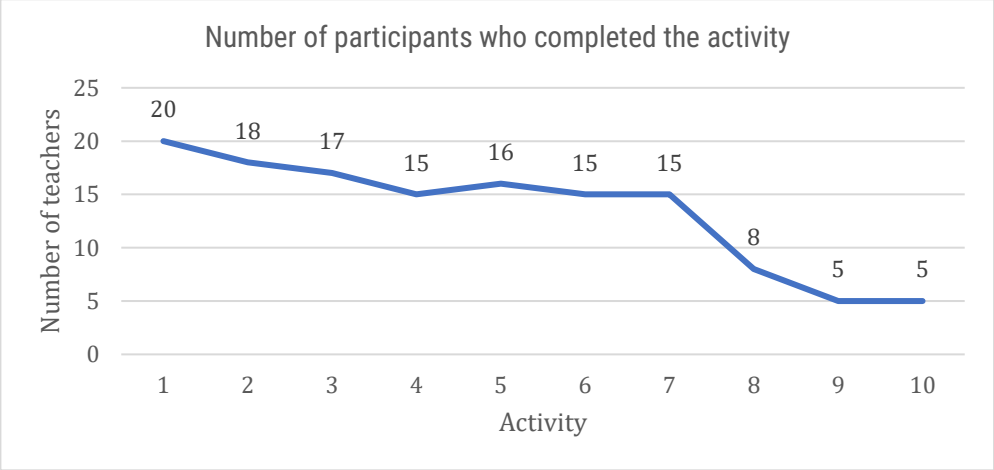


**Figure 1.** Number of participants who completed the activity

The evaluation form was distributed to obtain information on what things needed to be improved at the workshop being held. Data on the number of participants who filled out the evaluation form can be seen in figure 2.

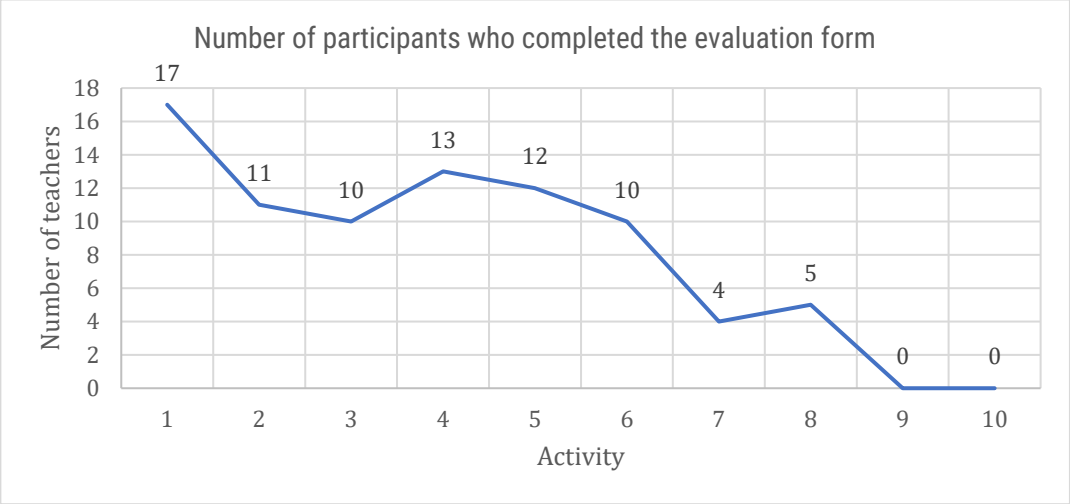


**Figure 2.** Number of participants who completed the evaluation form

Each participant worked on assignments to be able to complete the workshop. There were 5 tasks, the last task was to make articles ready for publication. Articles that had been written by teachers were expected to be used for promotion of teachers and forms of dissemination of the research process that had been carried out. Assignments from each teacher were collected in Google Classroom. Data on the number of teachers who completed the task can be seen in Figure 3.

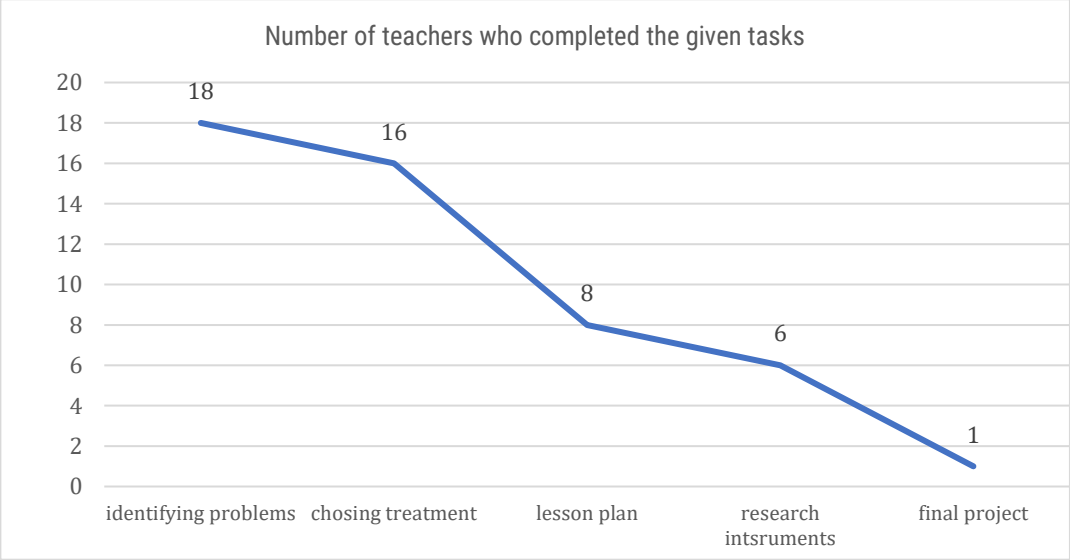


**Figure 3.** Number of teachers who completed the given tasks

**Areas for improvement**

Data about things that need to be improved to design teacher professional development workshops for teachers can be seen in figure 4.

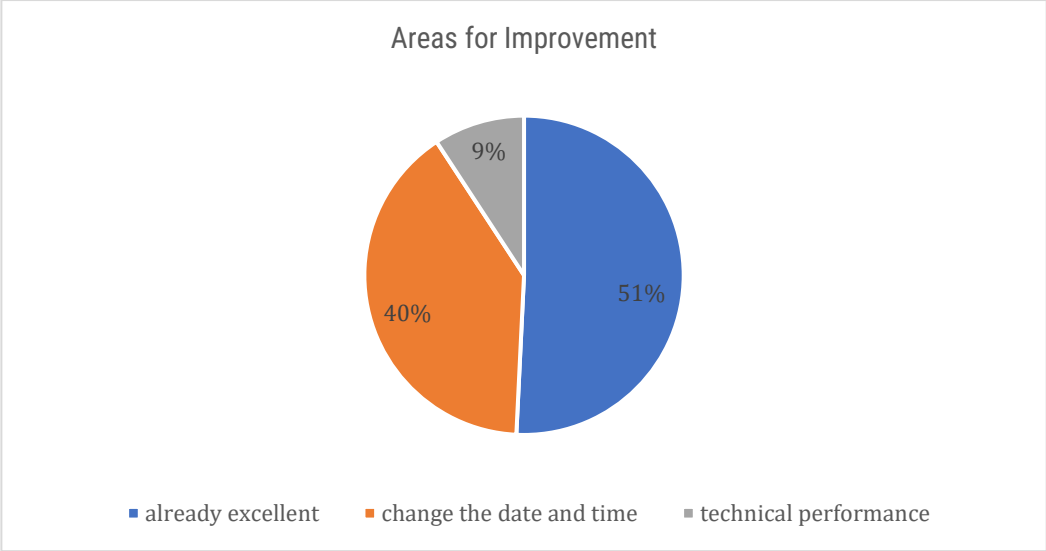


**Figure 4.** Areas for improvement

The evaluation form also asked about topics that were interesting to follow for teachers in Indonesia. The biggest percentage is 46%. Most teachers suggest kurikulum merdeka. Kurikulum merdeka is a new curriculum implemented in Indonesia. This is shown in figure 5.

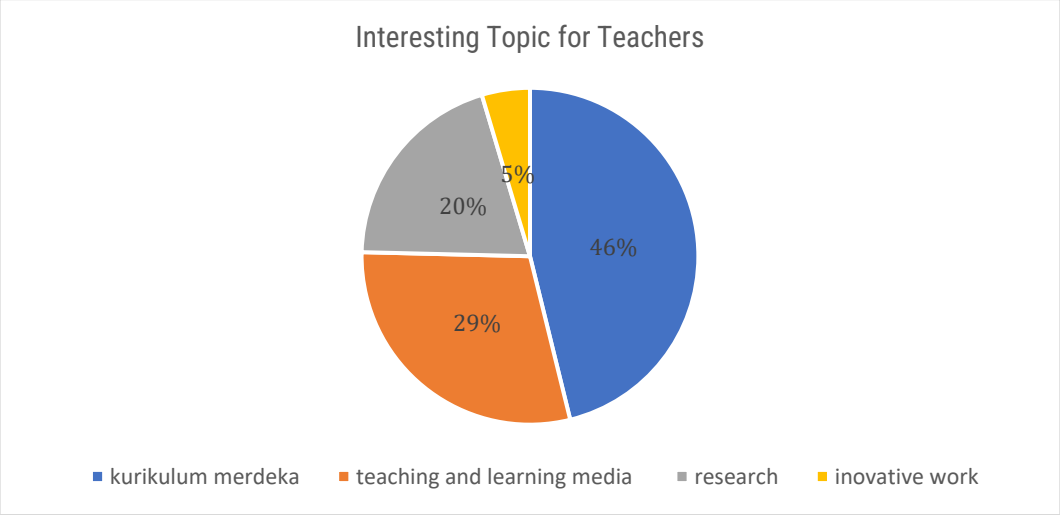


**Figure 5.** Interesting topic for teachers

Based on data on the number of participants who attended, the number of participants who filled out the evaluation form and the number of participants who completed the task. All three show a consistent decline. 51% of participants considered the workshop to be very good, but 49% provided suggestions for improvement for further implementation. The two biggest factors to improve are adjusting the time to suit the participants and considering the technical issues that teachers might face.

Scheduling conflicts refer to situations where teachers have other commitments or responsibilities that prevent them from attending the workshop at the scheduled time. For example, a teacher may have a class or a meeting during the workshop, making it difficult for them to participate fully or consistently. Scheduling conflicts can also arise due to personal reasons, such as family obligations or medical appointments, which may take precedence over attending the workshop. When scheduling conflicts occur, it can lead to lower attendance and engagement, which can ultimately impact the effectiveness of the workshop.

Technical issues refer to any problems related to the technology used to conduct the online workshop. This can include issues with internet connectivity, audio or video problems, or difficulties navigating the online platform. Technical issues can be frustrating for teachers and can make it difficult for them to participate fully in the workshop (Bragg et al., 2021). When technical issues occur, it can lead to interruptions in the workshop, delays, or even complete cancellation, all of which can be detrimental to the overall effectiveness of the workshop. Technical issues can also lead to increased stress and frustration among teachers, which can negatively impact their engagement and motivation.

This is in line with research from several literatures which stated similar things about the obstacles experienced by participants during the workshop which caused the implementation not to go according to plan. There could be several factors that contribute to teachers' decreasing participation during an online acitivities. Some possible reasons are (Appel et al., 2022; Bragg et al., 2021; Johar et al., 2021; Kuhnley et al., 2021; Li et al., 2021; Marasi et al., 2020; Truong & Murray, 2019)

1. Scheduling Conflicts

Teachers may have other obligations or responsibilities during the scheduled time of the online workshop, which can make it difficult for them to participate fully or consistently.

2. Technical Issues
   Technical issues such as poor internet connectivity, audio or video problems, or difficulty navigating the online platform can make it difficult for teachers to participate fully in the online workshop.
3. Lack of Interaction
   Online workshops can sometimes feel less interactive than face-to-face workshops, which can lead to reduced engagement and participation from teachers. If the online workshop is mainly comprised of lectures or presentations, teachers may feel less motivated to participate actively.
4. Fatigue
   Online workshops can be mentally exhausting, especially if they require teachers to be on their computer or device for long periods of time. This can lead to a decrease in participation over time, as teachers may feel burnt out or overwhelmed.
5. Lack of Relevance
   If the content of the online workshop is not relevant to teachers' interests or needs, they may be less motivated to participate actively.

Addressing scheduling conflicts is essential to ensure that teachers can fully participate in online workshops. Here are some strategies that can be implemented to fix the problem of scheduling conflicts (Bragg et al., 2021; Edwards, 2022; Linde-Koomen & Voogt, 2019): Firstly, offering flexible scheduling is a viable solution. This approach involves providing online workshops at different times during the day or week, considering the schedules and availability of teachers. Scheduling online workshops in the evenings or on weekends may be more convenient for some teachers who have other obligations during the typical workweek. Secondly, providing recordings of the online workshops may be an effective solution for teachers who are unable to attend live sessions. The recordings can be made available to watch at a later time, allowing teachers to access the workshop content at their convenience. Thirdly, shortening the workshop duration can be considered. Breaking up the workshop into shorter, more manageable sessions can make it easier for teachers to participate and avoid exhaustion. Lastly, planning ahead and giving teachers sufficient notice of the online workshop date and time can minimize scheduling conflicts and ensure full participation. Encouraging schools and districts to prioritize attendance at online workshops and making attendance mandatory if necessary can also help teachers benefit from the professional development opportunities offered by the workshops .

The perfect duration for a workshop meeting depends on various factors such as the topic, the audience, and the goals of the workshop (Traga Philippakos & Voggt, 2021). Typically, workshop sessions can range from a few hours to a full day, or even multiple days if the workshop covers a complex or in-depth topic. In general, it's important to consider the attention span and engagement of the audience when deciding on the duration of a workshop meeting. Shorter sessions may be more effective for maintaining focus and engagement, while longer sessions may provide more opportunities for in-depth exploration of the topic. As a rule of thumb, a workshop meeting should be long enough to achieve the intended objectives and allow for active participation and discussion, but not so long that participants become fatigued or lose interest (DePryck et al., 2022). It's

also important to build in breaks and opportunities for interaction to help keep participants engaged throughout the meeting.

The COVID-19 pandemic has resulted in a shift towards online workshops for professional development among educators. However, factors such as technical difficulties, mental fatigue, and lack of relevance can hinder participation and engagement (Vetter & Pagnucci, 2021). To address these challenges, organizers of online workshops can implement several strategies (Correnti et al., 2021; Matsumura et al., 2019; Yurkofsky et al., 2019). Firstly, clear and detailed instructions on how to use the online platform should be provided, with technical support available to help teachers navigate any issues. Interactive activities and discussions can also be incorporated into the workshop to encourage participation and engagement, increasing the sense of community and collaboration among participants. To avoid mental fatigue, the workshop can be broken up into shorter, more manageable sessions, with ample breaks in between.

Additionally, offering flexibility in scheduling or alternative times for teachers who may have conflicts during the scheduled time can also increase participation (Bragg et al., 2021). Lastly, the content of the workshop should be relevant and tailored to the needs and interests of the teachers. By addressing topics that are of importance to them and providing opportunities for personalized learning and development, educators are more likely to remain engaged and invested in the workshop. In conclusion, by implementing strategies such as clear instructions and technical support, interactive activities, flexible scheduling, and relevant content, organizers of online workshops can mitigate challenges and increase participation and engagement among educators. This can ultimately lead to a more successful and impactful professional development experience (Bragg et al., 2021).

Teachers want to join workshop related to related to the Kurikulum Merdeka implementation, teaching media, ICT integration, and book publishing. There are several reasons why teachers in Indonesia may be interested in workshops related to the Kurikulum Merdeka implementation, teaching media, ICT integration, and book publishing. Here are a few possible reasons. The Indonesian education system is undergoing significant changes with the introduction of the Kurikulum Merdeka. This new curriculum aims to equip students with 21st-century skills such as critical thinking, collaboration, and digital literacy. Teachers who want to integrate this new curriculum into their teaching may benefit from attending workshops to gain a deeper understanding of its implementation.

In addition to keeping up with changes in education, attending workshops can also help teachers improve their teaching quality. Workshops on teaching media and ICT integration can help teachers create more engaging and interactive lessons, while workshops on book publishing can aid in the development of high-quality teaching materials (Khor & Khor, 2021). By learning new strategies and techniques, teachers can enhance their teaching skills and improve learning outcomes for their students.

Furthermore, workshops provide opportunities for networking and collaboration among educators. Teachers can share ideas, best practices, and experiences with colleagues, building a supportive community of like-minded professionals. Attending workshops is an essential component of professional development for teachers, as it allows them to stay up to date with the latest trends and best practices in education, and continue to grow and develop in their careers.

## 4. CONCLUSION

51% of participants considered the workshop to be very good, but 49% provided suggestions for improvement for further implementation. The two biggest factors to improve are adjusting the time to suit the participants and considering the technical issues that teachers might face. Based on the evaluation form each week, teachers considered that that they need to join workshop related to related to the Kurikulum Merdeka implementation, teaching media, ICT integration, and book publishing. Teachers who want to integrate this new curriculum into their teaching may benefit from attending workshops to gain a deeper understanding of its implementation.

## 5. ACKNOWLEDGMENTS

The author would like to thank and acknowledge highly dedicated experts who gave presentations and facilitated discussion at each zoom meeting, as well as the core team members and volunteers of simejik. Simejik is an acronym that stands for sains dan matematika menjadi asik (science and mathematics become fun). Simejik is a nonprofit organization that actively engages in community service. Simejik has conducted research, webinars, workshops, and trainings to improve teacher skills in mathematics teaching and learning in collaboration with other passionate educational institutions. The author gratefully acknowledges all teachers and students who participated in this study.

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