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THE IMPACT OF ASSISTANCE IN DEVELOPING MICROLEARNING-BASED TEACHING MATERIALS ON THE ENHANCEMENT OF PEDAGOGICAL COMPETENCE AND LITERACY-NUMERACY COMPREHENSION OF GURU PENGGERAK IN KOTA CIMAHI

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Abstract
This research explores the impact of developing microlearning-based teaching materials on enhancing the pedagogical competencies, literacy, and numeracy comprehension of Guru Penggerak in Kota Cimahi. Through a quasi-experimental design with a pre-test and post-test one-group design approach involving pre-tests, post-tests, and the creation of various microlearning formats such as videos, text/images, flashcards, games, and audio podcasts, the study evaluates the effectiveness of these materials in improving instructional practices. The research sample included 50 Guru Penggerak elementary school members from the Komunitas Guru Penggerak Kota Cimahi (KGPKC). The findings reveal significant improvements in pedagogical competencies, particularly in adapting educational materials and providing scaffolding, with an overall increase in average scores from 76.8% to 88%. Literacy and numeracy comprehension also showed positive gains, with literacy increasing from 49.8% to 55.6% and numeracy from 57% to 65%. The Wilcoxon signed-rank test further confirmed the statistical significance of these improvements. The development of microlearning-based teaching materials resulted in various formats, with participants favoring text/image and game formats for their engagement and efficiency. Despite some limitations, video, flashcards, and audio podcasts improve student understanding and material delivery. The study emphasizes the potential of microlearning to solve educational difficulties and encourages the continuing development and improvement of these teaching materials to further support educators.
Keywords: *Microlearning, Guru Penggerak, Pedagogy, Literacy, Numeracy*

Abstrak
Penelitian ini bertujuan untuk mengetahui pengaruh pengembangan bahan ajar berbasis *microlearning* terhadap peningkatan kompetensi pedagogi, pemahaman literasi, dan numerasi Guru Penggerak di Kota Cimahi. Melalui desain quasi eksperimen dengan pendekatan one-group design pre-test dan post-test yang melibatkan pre-test, post-test, dan pembuatan berbagai format microlearning seperti video, teks/gambar, flashcard, game, dan audio podcast, penelitian ini mengevaluasi efektivitas materi ini dalam meningkatkan praktik pengajaran. Sampel penelitian ini berjumlah 50 orang anggota Guru Penggerak tingkat sekolah dasar yang tergabung dalam Komunitas Mobilisasi Guru Kota Cimahi (KGPKC). Temuan ini menunjukkan peningkatan yang signifikan dalam kompetensi pedagogi, khususnya dalam mengadaptasi materi pendidikan dan menyediakan scaffolding, dengan peningkatan skor rata-rata secara keseluruhan dari 76,8% menjadi 88%. Pemahaman literasi dan numerasi juga menunjukkan peningkatan positif, dengan peningkatan literasi dari 49,8% menjadi 55,6% dan numerasi dari 57% menjadi 65%. Uji Wilcoxon Signed-Rank menunjukkan signifikansi statistik dari perbaikan ini. Pengembangan bahan ajar berbasis microlearning menghasilkan berbagai format, dimana peserta lebih menyukai format teks/gambar dan permainan karena interaksi dan efisiensinya. Meskipun ada beberapa keterbatasan, video, kartu flash, dan podcast audio lebih memudahkan peserta dalam meningkatkan pemahaman siswa dan penyampaian materi. Studi ini menekankan potensi *microlearning* untuk memecahkan kesulitan pendidikan dan mendorong pengembangan dan peningkatan berkelanjutan dari bahan ajar tersebut untuk lebih mendukung para pendidik.
Kata Kunci: *Microlearning*, Guru Penggerak, Pedagogis, Literasi, Numerasi

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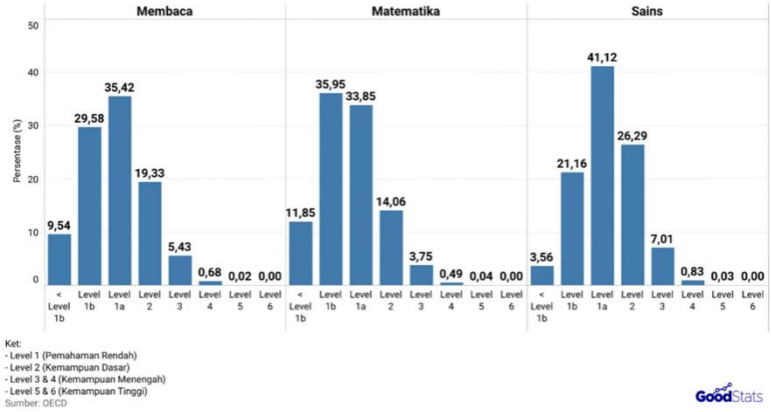
Introduction

According to PISA 2022 results, Indonesia's literacy and numeracy levels increased by five places in numeracy and six places in scientific literacy (Kemendikbudristek, 2022). However, Indonesia is still ranked 74th out of 79 countries with low literacy and numeracy skills. Based on the results of the OECD report, the percentage of Indonesian students who reached at least level 2 in reading ability was 19.33%, far below the OECD country average of 73.75%. Most of Indonesia's reading ability is still at level 1, namely at a low level of comprehension (74.54%) (OECD, 2023).This shows that Indonesian students' reading ability is still far from the minimum standard that allows them to participate actively and constructively in developing civilization (Kemendikbudristek, 2023). According to the graph below (OECD, 2023), the proportion of Indonesian students who obtained at least level 2 in mathematics was only 14.06%, the lowest of the three PISA assesment subjects.



Graph 1. Indonesian Pisa Results
Percentage of Number of Students Based on Ability Level (2022)

Lack of foundational knowledge in reading, writing, and math is one of the many issues that might contribute to this low literacy and numeracy abilities. Students have difficulty understanding complex texts, extracting information, and applying their understanding in real contexts. Only a few people know and understand the term numeracy and apply it to various mathematical problems (Maharbid, Awiria, et al., 2024). Another problem is that there is a significant gap between the quality of education in urban and rural areas. Students in urban areas have better access to educational resources, teachers, and adequate facilities compared to students in rural schools. Another obstacle is the way the educational system is oriented, emphasizing memory and subject mastery over the development of critical thinking, creativity, and problem-solving skills. Numerous variables, including a lack of resources and suitable educational facilities, a lack of parental support, and a student's absence of enthusiasm and drive to learn from themselves, might contribute to this issue (Maharbid, Gumala, et al., 2024). Apart from that, teachers, as a key aspect in improving the quality of education, still lack support in the form of training and appreciation, both in material and non-material forms. This affects their ability to teach and provide support for student development in literacy and numeracy (Kemendikbudristek, 2022)(Kemendikbudristek, 2023)(Puslitjak, 2021).

Particularly in Kota Cimahi, there are issues with numeracy and literacy. Data from Cimahikota.go.id, the Cimahi City Education Office, indicates that reading and writing are challenges for Cimahi elementary school students, especially in grades 2 and 3. More than 18% of the total 7,896 grade 2 students are not yet fluent in reading and writing. According to the

ANBK results, students in Kota Cimahi continue to have low literacy and numeracy skills. Some of the variables contributing to this include a lack of reading habits at school and at home, limited access to resources and learning facilities, a lack of teacher competency, and the implementation of effective learning models.

Low reading and numeracy skills can impede the learning process and cause delays. The absence of genuine and consistent attention given by education units in developing programs and policies to overcome this is one of the causes of Kota Cimahi's low reading and numeracy rates. Despite careful planning, program implementation has received inconsistent evaluation. Additionally, it is believed that educators would have a deeper understanding of how to help students become more proficient readers and numerators in the classroom.

Based on the results of interviews, the availability of teaching materials in Kota Cimahi so far is still in the form of teaching modules in text form developed based on the principles of an independent curriculum. This is due to limited knowledge and abilities of teachers regarding strategies for developing innovative teaching materials.

Limited instructional materials can have a big impact on students' literacy and numeracy skills. Students may lose interest in learning if the teaching materials are not relevant or fascinating to their daily lives. Many instructional materials are tedious or rely solely on one teaching technique (text without illustrations or practical activities). Consequently, the creation of teaching materials based on microlearning is required. Microlearning-based learning presents learning content in the form of particular little parts that make learning more exciting (Wayan Marti & Putu Tuti Ariani, 2023)(Kaharuddin & Dahlan, 2022). Microlearning-based instructional materials provide several advantages over traditional learning approaches. Microlearning divides learning material into little, easily digestible sections, making the learning process more effective and concentrated. This succinct and specialized material makes it easier for students to recall and grasp information, decreasing the cognitive burden associated with traditional learning. Furthermore, the flexibility of time and location allows students to study according to their schedule and convenience, improving their autonomous learning abilities. The incorporation of technology, such as mobile applications and interactive modules, makes learning more engaging and aligned with current learning patterns.

There is a lack of proper training and support for teachers to build their pedagogical competence for increasing student literacy and numeracy. The development of high-quality instructional materials requires pedagogical expertise. Teachers must be able to provide learning materials that are relevant, exciting, and appropriate to their students' needs and levels of comprehension. Teachers with strong pedagogical competence may design engaging and comprehensive learning experiences for their students that will improve their comprehension and mastery of literacy and numeracy skills. As a result, strengthening teachers' skills in designing and compiling quality teaching materials is an important step toward boosting literacy and numeracy development in the classroom. Continuous and comprehensive training in effective teaching approaches is critical for increasing classroom learning quality. Students' reading and numeracy skills are expected to improve significantly as a result of teacher training and support.

The availability of teaching materials in Kota Cimahi so far is still in the form of teaching modules in text form which were developed based on the principles of an curriculum merdeka. Existing teaching modules in text form usually use conventional methods. The material is delivered in the form of long modules or videos that are difficult to digest in a short time. This makes it difficult for participants to remember and apply the material. In addition, the lack of variety in presentation also causes a lack of participant interest and involvement. This is due to

the limited knowledge and abilities of teachers regarding strategies for developing innovative teaching materials. Implementing actual programs that are carried out by each educational unit is one attempt that can be made to solve the identified problems. It is anticipated that the creation of teaching materials based on microlearning will serve as a catalyst for enhancing the pedagogical competence of instructors and will undoubtedly influence the growth of students' reading and numeracy proficiency in Kota Cimahi.

With the foundation of the KGPKC, which currently has 136 teacher members, Kota Cimahi has a lot of potential. In order to mobilize and act as an encouragement for the start of training programs and the development of teachers' pedagogical competence, KGPKC plays a key role as a partner and stakeholder. The accomplishments of the KGPKC, which has been established via the staging of several events (training, webinars, workshops, and technical guidance) aimed at enhancing teacher competency both internally and externally, have proven the potential of this dynamic teacher community as a partner. In a broader sense, the KGPKC's role can be that of a bridge and facilitator, with the expectation that it will be able to rally all Kota Cimahi stakeholders in education.

Microlearning allows learning activities to be carried out anytime and anywhere or be flexible. And, as technology continues to develop, access to learning materials in digital form, one of which is microlearning, is becoming increasingly easier, especially in urban areas. So, this microlearning teaching material is a teaching material that has advantages in terms of time flexibility and accessibility so that it can be used in various areas. However, for remote areas there are several things that must be considered, such as technological, cultural and social limitations, human resource readiness and learning needs (Paling et al., 2024).

The novelty contained in microlearning includes that every teacher has the ability to create teaching materials that suit the characteristics of students and culture. In this way, this creates newness in every teaching material produced by the teacher. (Adilah & Rosyida, 2024) also explained there are several novelties or uniqueness offered by microlearning, including: (1) flexibility of time and place; (2) interactivity; (3) personalization; and (4) use of technology. And based on this novelty, the impact of microlearning is not only felt by teachers, but also by students and educational institutions.

Guru Penggerak is an essential component of an educational system. Guru Penggerak refers to teachers who are responsible for developing themselves and other teachers in education (Wendelinus Dasor et al., 2021). Guru Penggerak plays a significant part in raising the standard of instruction in educational institutions. In addition to teaching, they serve as mobilizers, facilitators, and motivators to increase students' enthusiasm for learning. Guru Penggerak also assists students in identifying their requirements, developing their abilities, and providing support and encouragement throughout the learning process (Imron et al., 2022). Guru Penggerak is responsible for developing long-term talents such as innovation, creativity, and critical thinking (Imron et al., 2022). This research aims to evaluate the effectiveness of the assistance program that has been implemented by measuring changes in teachers' pedagogical competence and their understanding of literacy and numeracy.

Research Methods

This research uses a quasi-experimental design with a pre-test and post-test one-group design approach to evaluate the effect of assistance in developing microlearning-based teaching materials on increasing pedagogical competence and literacy-numeracy understanding among Guru Penggerak in Kota Cimahi. The research subjects were 50 Guru Penggerak elementary

school level who are members of the Komunitas Guru Penggerak Kota Cimahi (KGPKC), who are actively involved in a series of community service activities in the form of webinars, workshops, and direct assistance.

The research procedure began with a pre-test meant to assess the baseline or initial level of instructors' pedagogical competence and literacy-numeracy comprehension. The intervention consists of multiple stages, beginning with a webinar that attempts to provide a theoretical understanding of pedagogical competency, numeracy literacy, microlearning, and how this method may be utilized to build effective teaching materials. Following that, extensive workshops and assistance were provided to teachers to help them construct microlearning-based teaching materials. Teachers create and assemble learning materials that meet the literacy-numeracy context of elementary schools and pedagogical demands with the help of direct guidance provided throughout this session. The post-test was used to assess changes or improvements in instructors' pedagogical competence and literacy-numeracy comprehension following participation in a series of activities. The post-test results are then compared to the pre-test findings to determine the effectiveness of the intervention delivered.

Data obtained from the pre-test and post-test were analyzed statistically, using the paired t-test or Wilcoxon Signed-Rank Test to test the significance of the differences between the two measurements. This analysis aims to determine whether there is a significant increase in teachers' pedagogical competency and literacy-numeracy understanding after they receive assistance in developing microlearning-based teaching materials.

Results and Discussion

The data obtained were the results of a pre-test and post-test to determine participants' understanding of the pedagogical competencies as well as literacy and numeracy of Guru Penggerak Kota Cimahi. The following are the results obtained:

The pedagogical competencies of Guru Penggerak Kota Cimahi based on the test result as presented in Table 1.

Table 1. Pre-Test & Post-Test Result of Pedagogical Competencies

No	Indicator	Pre-Test (%)	Post-Test (%)
1	Identify and analyze student learning needs, and understand individual differences (age, background, abilities, interests)	94	100
2	Create educational materials that are adaptable to students' various skills, learning styles, and interests.	84	100
3	Understand the connection of teaching materials and learning objectives.	84	100
4	Design and implement formative assessments	62	60
5	Providing incremental help (scaffolding) allows students to comprehend and master complicated content	60	80
	Mean	76,8	88

The analysis of pre-test and post-test results on pedagogical competencies reveals significant insights into the effectiveness of the training provided. The first indicator, which focuses on identifying and analyzing student learning needs and understanding individual differences, improved from 94% in the pre-test to 100% in the post-test. This indicates that the training successfully enhanced teachers' competence in recognizing and addressing diverse student needs. Similarly, the second and third indicators, related to creating adaptable

educational materials and understanding the connection between teaching materials and learning objectives, showed a substantial increase from 84% to 100%. This demonstrates that teachers have become more adept at designing instructional materials that cater to varied student abilities and ensuring alignment with learning goals.

However, the fourth indicator, which involves creating and conducting formative assessments, decreased slightly from 62% in the pre-test to 60% in the post-test. This suggests that despite the overall improvements, there is still a need for further emphasis on the importance and implementation of formative assessments. On a positive note, the fifth indicator, concerning the provision of scaffolding to help students comprehend and master complex content, saw a significant rise from 60% to 80%. This highlights the teachers' increased understanding of how to support students' learning through incremental guidance.

Overall, the average score across all categories climbed from 76.8% to 88%, placing it in the Very High category, indicating a general improvement in pedagogical competence following training. While the findings show significant growth in most areas, the minor decline in formative assessment practices implies that more assistance and attention may be required to properly develop this crucial part of teaching. Related research was also carried out by (Suyamto et al., 2020) and obtained data that the ability of pedagogical knowledge aspects in three schools had an average of 51.6% in the sufficient category. These results indicate that the ability to master learning pedagogy is sufficient.

Besides from that, the Wilcoxon signed-rank test was used to evaluate the collected data to test the significance of the differences pedagogical competency after they receive assistance in developing microlearning-based teaching materials. The pedagogical competencies of Guru Penggerak Kota Cimahi based on the Wilcoxon test obtained the results as presented in Table 2.

Table 2. Wilcoxon Test Results of Pedagogical Competencies

Test Statistics[a]

	Post_Pedagogi - Pre_Pedagogi
Z	-3.185[b]
Asymp. Sig. (2-tailed)	.001

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

Table 2 shows that the Sig (2-tailed) value is 0.001. Test decisions are taken based on test criteria if the Sig (2-tailed) value is <0.05, then microlearning-based teaching materials affect the teacher's pedagogical competencies. Based on the test criteria and the Sig value (2-tailed) of 0.001 < 0.05, it can be stated that the microlearning-based teaching materials utilized in the research had an impact on the pedagogical competencies of Guru Penggerak di Kota Cimahi.

The literacy comprehension of Guru Penggerak Kota Cimahi based on the test result as presented in Table 3.

Table 3. Pre-Test & Post-Test Result of Literacy Comprehension

No	Indicator	Pre-Test (%)	Post-Test (%)
1	Early Literacy Skills	68	80
2	Reading Comprehension	59	60
3	Selection of Reading Materials	46	48
4	Assessment and Reading Strategies	11	16
5	Phonics-Based Reading Instructio	76	90
6	Relationship Between Speaking Skills and Reading Fluency	74	90
7	Use of Language in Reading Instruction	48	48
	Mean	49,8	55,6

The average score across all indicators increased from 49.8% to 55.6%, reflecting an overall improvement in literacy-related competencies among the participants. However, the results highlight specific areas, such as reading comprehension, selection of reading materials, and assessment strategies, where further training and emphasis are necessary to achieve more substantial gains. The significant improvements in phonics-based instruction and understanding the relationship between speaking skills and reading fluency are positive outcomes that should be built upon in future training efforts. Based on this data, the average post-test result was 55.6% showing the literacy skills of Guru Penggerak Kota Cimahi in sufficient category.

The literacy comprehension of Guru Penggerak Kota Cimahi can be seen based on the Wilcoxon test results presented in Table 4.

Table 4. Wilcoxon Test Results of Literacy Comprehension

Test Statistics[a]

	Post_Literasi - Pre_Literasi
Z	-2.129[b]
Asymp. Sig. (2-tailed)	.033

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

Based on the test results in Table 4, shows the Sig (2-tailed) value is 0.033. The test decision is taken based on the test criteria if the Sig (2-tailed) value is <0.05, then microlearning-based teaching materials affect the teacher's literacy understanding. The Sig value (2-tailed) is 0.033 < 0.05, which means it meets the test criteria, so it concluded that the microlearning-based teaching materials used in the research influence the literacy understanding of Guru Penggerak Kota Cimahi.

The numeracy comprehension of Guru Penggerak Kota Cimahi based on the test result as presented in Table 5

Table 5. Pre-Test & Post-Test Result of Numeracy Comprehension

No	Indicator	Pre-Test (%)	Post-Test (%)
1	Basic Understanding of Numeracy Concepts	26	28
2	Application of Numeracy in Everyday Contexts	67	77
3	Differentiation Between Numeracy and Mathematics	54	76
4	Critical Thinking and Problem-Solving Through Numeracy	78	72
5	Responsibility of Numeracy Education	88	96
6	Need for Specialized Numeracy Instruction	30	42
	Mean	57	65

The pre-test and post-test results on numeracy comprehension reveal notable progress in several key areas. The average score increased from 57% in the pre-test to 65% in the post-test, indicating an overall improvement in participant' understanding of numeracy concepts. The most significant gains were observed in the differentiation between numeracy and mathematics, where the score rose from 54% to 76%, and in the application of numeracy in everyday contexts, which increased from 67% to 77%. These improvements suggest that the participant have developed a better understanding of how numeracy differs from mathematics and how it is applied in real-life situations.

However, the data also shows that some areas require further attention. For instance, the indicator related to critical thinking and problem-solving through numeracy saw a slight decline from 78% to 72%, indicating a potential need for enhanced instruction in higher-order thinking skills within numeracy education. Additionally, while there was some improvement in the need for specialized numeracy instruction (from 30% to 42%), the relatively low scores suggest that this area still requires significant emphasis. Overall, the results reflect progress and highlight areas where additional support and targeted interventions may be needed to fully develop students' numeracy comprehension. Based on this data, the average post-test result was 65% so the numeracy comprehension of Guru Penggerak Kota Cimahi were categorized as high.

The numeracy comprehension of Guru Penggerak Kota Cimahi can be seen based on the Wilcoxon test results presented in Table 6

Table 6. Wilcoxon Test Results of Numeracy Comprehension

Test Statistics[a]

	Post_Numerasi - Pre_Numerasi
Z	-2.565[b]
Asymp. Sig. (2-tailed)	.010

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

Based on the results in Table 6, showed that the results of teachers' understanding of numeracy through the Sig (2-tailed) value obtained is 0.010. The test decision is taken based on the test criteria if the Sig (2-tailed) value is <0.05, then microlearning-based teaching materials affect the teacher's understanding of numeracy. The Sig value (2-tailed) is 0.033 < 0.05, which

means it meets the test criteria, so it concluded that the microlearning-based teaching materials used in the research influence the numeracy comprehension of Guru Penggerak Kota Cimahi.

The assistance provided in the development of microlearning instructional materials has been converted into a variety of microlearning formats, including video, text/images, flashcards, games, and audio podcasts. Based on the results of the assistance that has been carried out, the following is the percentage of products produced by participants in microlearning development based on format:

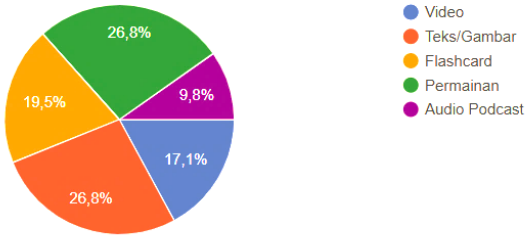


Figure 1. Microlearning-Based Teaching Material Formats

Figure 1 shows that 17.1% of participants generated video format, 26.8% produced text/image format, 19.5% produced flashcard format, 26.8% produced game format, and 9.8% produced audio podcast format. Based on these data, the highest interest of participants (26.8%) in making microlearning teaching materials is in text/image and game formats have the same percentage. Text/image and game formats are more engaging and efficient. Apart from that, the creation process is also simpler compared to other microlearning formats. The following is an example of microlearning produced by participants:

Figure 2. Microlearning-Based Teaching Material in Video Format

First, the microlearning-based teaching materials produced in this activity are videos, the information or concepts presented in the videos are usually packaged with visuals and audio. Nine participants, or 17.1% of the total, selected video format of microlearning-based teaching materials. Based on the explanation of one of the participants, microlearning-based video

learning is suitable for learning because it can increase students' understanding of learning and improve their learning outcomes. This is supported by the findings of (Hendrayani et al., 2023) found that microlearning-based learning videos can help students learn and understand the material better because they include audio images, text, material, and animation, which can attract students' attention and motivate them to learn. (Haslih et al., 2024) also explained that microlearning-based learning videos has several significant advantages, including: (1) Visualization of Material: Video allows the delivery of information in a more interesting and easy-to-understand way through visual elements, such as graphics, animations and demonstrations; (2) Fast and Efficient Delivery: Video material is usually delivered in a short time, so that participants can get information quickly without having to get bogged down in long material; (3) Emotional Engagement: Videos can evoke emotions and increase learner engagement, making learning more impressive and enjoyable; (4) Accessibility: Videos can be accessed on various devices (smartphones, tablets, laptops), allowing participants to learn anywhere and at any time; and (5) Story-Based Learning: Videos allow the use of narration or stories, which can help participants relate the information to their experiences, increasing retention. The resulting learning videos average around 4-5 minutes.

Figure 3. Microlearning-Based Teaching Material in Teks/Image Format

Second, the microlearning-based teaching materials produced in this activity are text/images. Several participants, 26.8% or 14 participants, created text/image microlearning in the form of infographics which contained information in the form of text and visuals. This infographic can be created via applications such as Canva. When presenting the results of the infographic, one of the participants said that infographics could increase students' knowledge and were a practical medium. The explanation given by (Nugraha et al., 2021) supported that infographics have the potential to have a wider impact on increasing students knowledge.

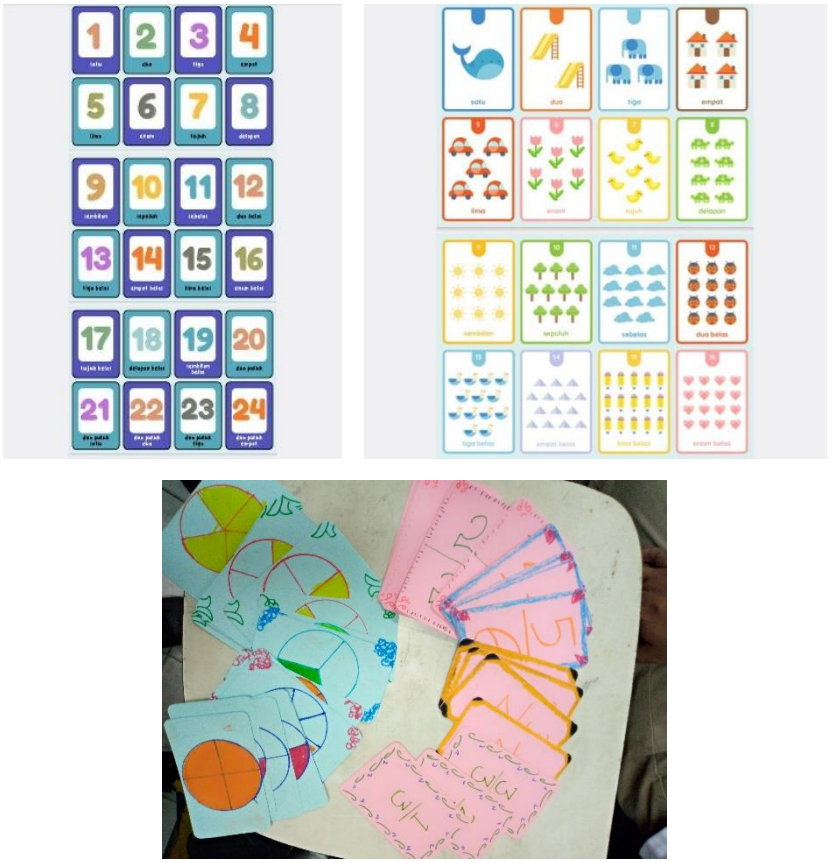


Figure 4. Microlearning-Based Teaching Material in Flashcard Format

Third, the microlearning-based teaching materials produced in this activity are Flashcards. Ten participants used the Canva program to create flashcards, while some people constructed them by hand using little colored pieces of paper with text and images on them. The participants produced numeration-based flashcards that present fractional material. During the product presentation, participants explained how flashcards may help teachers transmit concepts to students more effectively. Supporting this is the claim (Rahman & Haryanto, 2014) that flashcards are picture cards customized to the lesson content, which helps teachers more easily communicate the lesson's content. In this case, the content may also be related to reading skills, in which letter and word cards also general knowledge problems may be used. However, participants also expressed concerns about the limitations of flashcard media, such as the time it takes to locate the necessary photos. The disadvantage of flashcard media is that it is only appropriate for small groups of students, and students can only know and understand the words and images on flashcard media, requiring them to spend a significant amount of time looking for visuals (Rahman & Haryanto, 2014).

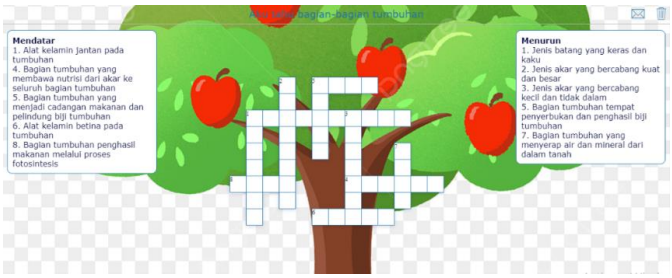


Figure 5. Microlearning-Based Teaching Material in Games Format

Fourth, this activity generated further microlearning-based instructional materials in the form of games. Most of the games made by the participants are interactive tests made with Kahoot, the Wordwall Application! And so forth, based on each teacher's unique ingenuity. Fourteen participants chose the game format for microlearning-based teaching materials. According to the participant's explanation, he created this game using the Wordwall program because, when it was implemented in the classroom, students were excited to play due to its engaging characteristics. This relates to the explanation (Yuliatun et al., 2024) that Wordwall has the advantage of having various features that make game-based learning appear more appealing. Educational games can be a useful tool for improving learning because they boost motivation to learn. Additionally, games can be utilized as teaching instruments for complex subjects (Maharbid, Herman, et al., 2024). There are several advantages of game format for microlearning-based in the learning process, including: (1) Students are actively involved; (2) Increased Retention; and (3) Student skills development is increasing. With these various advantages, game format for microlearning-based is an effective way to improve learning experiences and learning outcomes.

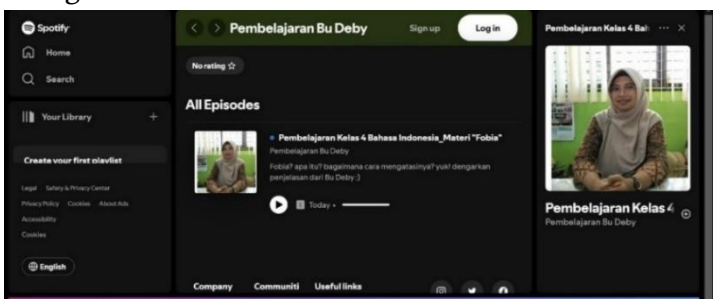


Figure 6. Microlearning-Based Teaching Material in Audio Podcast Format

Lastly, the microlearning-based teaching material produced in this activity is an audio podcast. The resulting audio podcast includes audio that explains the subject you want to convey to the student. To help students understand it, the teacher used Spotify to make this audio podcast. According to participants, this audio podcast is a type of microlearning that is quite difficult compared to other microlearning.

The assistance in developing microlearning-based teaching materials led to the creation of various formats, including text/images, games, videos, flashcards, and audio podcasts. Participants found text/image and game formats particularly effective due to their engaging and efficient nature. Videos and games were noted for their ability to enhance student understanding and motivation. Flashcards were praised for aiding in concept retention, though they have limitations, while audio podcasts were recognized as challenging to produce but valuable in delivering content in a different medium.

Conclusion

The research results demonstrate that the implementation of microlearning-based teaching materials significantly improved the pedagogical competencies, literacy comprehension, and numeracy comprehension of Guru Penggerak Kota Cimahi. The Wilcoxon signed-rank test confirmed these improvements, with p-values well below the 0.05 threshold, indicating a statistically significant impact. Notable advancements were seen in the ability to create adaptable educational materials, phonics-based literacy instruction, and understanding the distinction between numeracy and mathematics. However, areas such as formative assessment practices and higher-order numeracy skills require further attention. Overall, the study underscores the effectiveness of microlearning in enhancing teacher competencies but also highlights the need for ongoing targeted interventions in specific areas. The development of microlearning-based teaching materials resulted in various formats, with participants favoring text/image and game formats for their engagement and efficiency, while videos and games enhanced student understanding, and despite the challenges of producing audio podcasts, they offered a valuable medium for content delivery.

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