



IMPROVING THE TEACHERS INSTRUCTIONAL CAPACITY THROUGH ASSISTANCE IN CREATING MICROLEARNING-BASED LEARNING MEDIA

Maisyaroh¹, Juharyanto¹, Maulana Amirul Adha², Indra Lesmana¹, Hanika Angelie¹, Isadatul Fadhila¹

¹ Universitas Negeri Malang, Indonesia

² Universitas Negeri Jakarta, Indonesia

ARTICLE INFO

Article history:

Received: 19th December 2024

Accepted: 02nd January 2025

Published: 10th January 2025

ABSTRACT

This community service activity aims to provide insight and knowledge of microlearning learning media for teachers in laboratory elementary schools. The training and mentoring approach is used in this community service activity. This community service activity is carried out through the stages of socialization, training, technology application, mentoring and evaluation, and program sustainability. At the evaluation stage, it was carried out with pre-test and post-test sheets which were then analyzed using the SPSS 24.0 program. Based on the results of post-test calculations, there was a significant improvement in the skills of participants before and after participating in training activities. Thus, it can be concluded that there is a need for regular training and mentoring activities, especially in increasing the instructional capacity of teachers in the current digital era. Through this community service activity, it is hoped that it will be able to produce a teaching module and post-activity monitoring.

Keywords:

Microlearning, instructional, learning media, laboratory school

How to cite: Maisyaroh, Juharyanto, Adha, M., A., Lesmana, I., Angelie, H., Fadhila, I. (2024). Improving the Teachers Instructional Capacity through Assistance in Creating Microlearning-Based Learning Media. *Jurnal Pemberdayaan Masyarakat Madani (JPMM)*, 8 (2), 101-114. <https://doi.org/10.21009/JPMM.008.2.10>

* Corresponding Author.
maisyaroh.fip@ac.id
(Maisyaroh)

INTRODUCTION

The rapid advancement of technology today, teachers have the opportunity to utilize technology as a tool in the learning process. As educators, the role of teachers as learning designers is crucial in creating an environment that supports students in the learning process (Maisyaroh et al., 2021). Student learning readiness, the availability of adequate learning media, and the ability of teachers to manage the learning environment through appropriate learning strategies and methods are determining factors for the success of learning (Pahlevi et al., 2020). Good collaboration between students, teachers, and learning media has a significant impact on achieving learning objectives. Learning is no longer limited to traditional classrooms, but can occur anywhere with the help of technology (Maisyaroh et al., 2024). The application of technology in learning needs to ensure that the learning experience remains interesting in order to maintain student motivation and focus on learning.

Implementing microlearning-based learning media can increase the effectiveness and efficiency of learning time for students (Demmans Epp & Phirangee, 2019). A study conducted by Nowak et al. (2023) also emphasized that the microlearning approach allows the process of constructing knowledge and experience for learners to be carried out briefly, concisely, clearly, and easily understood. By breaking down knowledge or information into small parts, microlearning makes it easier for students to digest, understand, and remember the material. The use of microlearning in learning can also increase the optimization of learning as a whole (Pölzl-Stefanec & Geißler, 2022), so it is important for teachers to develop learning media by utilizing technology.

The partner in this community service is the Elementary School Laboratory of Malang State University (UM) in Blitar City as one of the schools under the auspices of UM, and is located in a potential area in the middle of Blitar City, has the potential to become a model school in ideal technology-based learning. Of course, this technology-based learning is a challenge for principals and teachers in implementing it proportionally in the digital era like today (Juharyanto et al., 2021; Marlina et al., 2018). Elementary School Laboratory UM Blitar City has 24 teachers and education staff, serving a total of 240 students. Despite having great potential, this school still faces several problems in providing quality education. One of the main challenges faced is in terms of compiling adequate and interesting learning media for students.

In more detail based on the initial exploration conducted by the implementation team, several problems encountered were: First, there are obstacles in the use of effective and innovative learning media to improve the quality of the teaching and learning process. Most teachers tend to use monotonous learning

media such as power point, or conventional media that are less interesting and less in accordance with current developments in information technology. Furthermore, the lack of ability to create creative learning media, teachers in partner schools have extensive knowledge in the academic field, but teachers are not fully skilled in creating innovative learning media, especially those based on technology. Third, the high number of students with different learning styles, each student has a different learning style. Some students are more responsive to visual learning methods, while others prefer auditory or kinesthetic learning. The lack of variation in the presentation of materials can make students lag behind in understanding. In addition, the lack of training and professional development for teachers in dealing with developments in learning technology is also a problem that needs attention.

Teachers have a very important role in directing the learning process and achieving learning objectives, one of which is assessing student achievement. In the era of ever-growing information technology, it is important for teachers to improve their pedagogical competence, especially in the application of technology in learning (Wang et al., 2020). Therefore, training and assistance are needed to improve teachers' pedagogical competence, where microlearning-based learning media is one of the relevant choices that can be used in partner schools (Heffernan, 2018; Nowak et al., 2023). The use of microlearning learning media has its own advantages, such as delivering interesting, effective, and efficient material. Various micromedia formats, such as videos, infographics, online quizzes, and others, can be used in learning (Adha et al., 2023; Taylor & Hung, 2022). This approach also provides flexibility for students to learn according to their individual learning pace and style. Therefore, the purpose of this community service activity is to provide assistance to the principal and educators at SD Laboratorium UM Kota Blitar in creating innovative and interactive learning media, by improving the quality of learning media, schools or teachers can facilitate students' learning independence, motivate them to learn better, and improve their academic achievement.

LITERATURE REVIEW

Media microlearning has arisen as an innovative strategy in education and training, propelled by the growing need for adaptable, engaging, and effective learning techniques (Surahman et al., 2020). The approach centers on providing educational content in concise, targeted modules across many media formats, facilitating enhanced knowledge processing and retention for learners (Taylor & Hung, 2022). This strategy is particularly pertinent in the contemporary day, as digital technology influences information availability and consumption, and attention spans are progressively diminishing. Microlearning is an approach that delivers educational content in concise, manageable segments, usually lasting between two

to five minutes (Kesiman et al., 2021). These units are provided in media including films, infographics, interactive simulations, quizzes, or podcasts. The conciseness of microlearning information is enhanced by its accessibility, interactivity, and capacity to deliver just-in-time learning experiences (Andriotis, 2018). In contrast to conventional education, which typically entails extensive and organized sessions, microlearning prioritizes addressing learners' urgent need through the provision of on-demand content.

The application of media microlearning has shown considerable advantages in multiple fields. A significant benefit is its capacity to augment learner involvement. The concise and visually engaging characteristics of microlearning content efficiently catch attention and sustain interest. Studies indicate that learners are more inclined to maintain engagement when information is delivered in digestible segments (Wang et al., 2020). This method enhances information retention, as the concentrated format of microlearning modules corresponds with the cognitive processing of the human brain. Flexibility constitutes a significant benefit of media microlearning. Students can access content at any time and from any location, rendering it an optimal choice for mobile learning. This adaptability accommodates various learning preferences and timetables, offering individualized educational experiences. Moreover, microlearning frequently proves to be more economical than conventional training approaches. The creation and dissemination of succinct modules necessitate fewer resources, and changes can be executed rapidly to maintain content relevance (Edelhauser & Dima, 2020). Organizations and educators consider this adaptability especially beneficial in dynamic situations where knowledge requirements are always changing.

Media microlearning is utilized across multiple areas, such as business training, education, language acquisition, and healthcare. Platforms such as LinkedIn Learning and Coursera have enhanced the popularity of microlearning by providing courses designed for particular work categories and sectors. Microlearning is frequently employed as an adjunct to conventional pedagogical approaches (Nowak et al., 2023; Pölzl-Stefanec & Geißler, 2022). Universities or schools include brief movies, quizzes, and interactive resources into their curricula to reinforce essential concepts and improve student comprehension. Massive Open Online Courses (MOOCs), such those provided by edX and Khan Academy, often utilize microlearning concepts by deconstructing intricate subjects into digestible courses (De Freitas et al., 2015; Kaplan & Haenlein, 2016). Microlearning has demonstrated significant efficacy in the domain of language acquisition. Applications such as Duolingo and Babbel illustrate this methodology by providing concise, interactive lessons that facilitate progressive practice of vocabulary and grammar. These systems illustrate how microlearning may render language teaching accessible and enjoyable for learners across all age groups.

Media microlearning is anticipated to progress in tandem with technology improvements. Artificial intelligence (AI) is set to significantly influence individualized learning experiences that adjust to the specific demands of individual learners. Virtual and augmented reality (VR/AR) are increasingly popular, providing immersive microlearning modules that improve engagement and practical skill application (Musyaffi et al., 2024; Shahroom & Hussin, 2018). Gamification, which integrates game-like components such as incentives and leaderboards, enhances the interactivity and enjoyment of learning. Furthermore, data analytics will allow educators and businesses to monitor learner advancement, pinpoint areas for enhancement, and refine material delivery. Finally, the integration of microlearning with conventional teaching methods results in a hybrid learning approach that capitalizes on the advantages of both strategies. Media microlearning has emerged as a transformative educational approach, providing a variety of benefits that cater to the needs of contemporary learners. Although obstacles persist, its adaptability, accessibility, and compatibility with cognitive principles render it a valuable resource for a variety of professional and educational settings (Demmans Epp & Phirangee, 2019; Kesiman et al., 2021). As technology advances, media microlearning is expected to become more influential in determining the future of education.

MATERIAL AND METHOD

The implementation of community service activities is carried out with training and mentoring which aims to provide insight, guidance, and skills for elementary laboratory school teachers of the Universitas Negeri Malang (UM) related to microlearning learning media. The stages in this activity are divided into several stages, including socialization, training, technology application, mentoring and evaluation, and program sustainability. At the socialization stage itself, it aims to provide information related to the description of community service activities that will be carried out to cooperation partners. Thus, the partners will later be given the opportunity to provide input and agree on the implementation plan of the activity. Furthermore, from this process, the team compiled guidelines for the implementation of the training along with the agenda for the implementation of activities. Not only that, the team also formulated the materials that will be delivered at the activity. The next stage is training, this stage aims to provide training to teachers and other school staff on the development of microlearning-based learning media and the use of technology in the learning process. Furthermore, is the stage of technology application, where the training activities provided are expected to be able to stimulate teachers to create multimedia presentations, prepare interactive learning media, and use digital-based learning resources.

At the mentoring and evaluation stage, it will be related to guidance and assistance to teachers in implementing microlearning learning media and evaluating the progress of the program that has been trained. The evaluation was conducted using pre-test and post-test instruments to measure the improvement

of teacher skills before and after mentoring. In addition, the evaluation of the effectiveness of the training was analyzed using a quantitative approach through statistical tests, such as the Wilcoxon test, to see significant changes in teacher skills after the program was run. The final stage is, the sustainability of the program, which aims to ensure that the service program will continue to have a lasting impact even after the main activities have been carried out. In the final stage with regard to the sustainability of the program, the purpose of this stage is to ensure that the service program will continue to have a lasting impact even after the main activities have been carried out.

RESULT AND DISCUSSION

Result

The assistance for making microlearning-based learning media for teachers of the UM Laboratory Elementary School is designed systematically to ensure that teachers can improve their instructional skills, especially in the use of microlearning-based learning technology. Community service activities are carried out in several stages, the first stage is carried out initial socialization to teachers and the school. This socialization was carried out to introduce the basic concepts of microlearning, the purpose of the training, and the expected benefits. In this session, teachers were introduced to the potential of technology as a tool in the learning process, especially how technology can be used to create learning media that is more interactive and in accordance with the needs of students. This socialization was also a forum for discussion between the facilitator team and the participants to explore the specific problems and needs experienced by teachers in making learning media. Input from teachers is important to adapt training materials to the realities faced in the field.

The second stage is basic microlearning training, where teachers are trained to understand the basic concepts and principles of microlearning. The material provided includes: (a) Microlearning Concepts: Teachers learn how microlearning breaks down subject matter into small segments that are easy for students to digest. Microlearning emphasizes the presentation of information in a short format, which attracts attention and facilitates information retention; and (b) Microlearning Media Design: In this section, teachers are taught how to design engaging learning media using tools such as videos, infographics, or interactive quizzes. They learn to choose media formats that suit students' learning styles and determine the right duration for each learning segment. The training process took place interactively, where participants were given examples of microlearning media that have been used in various educational institutions. In addition, participants were also introduced to software and applications that can be used to

create technology-based learning media.



Figure 1. Presentation of Material by Resource Person

After gaining a theoretical understanding, the teachers carried out hands-on practice in making microlearning media. They are divided into small groups and guided by facilitators in making learning media according to the subjects they are taught. Each participant is given the task of creating at least one type of learning media, either in the form of short videos, infographics, or online quizzes. At this stage, some of the skills developed include: (a) Use of Apps and Software: Teachers are trained using various applications such as Canva, PowerPoint, and short video maker apps to develop engaging microlearning materials; (b) Visual Design and Interactivity: Focus is also given on visual design aspects so that the material looks visually attractive, as well as adding interactive elements that can attract students' interest; and (c) Utilization of Learning Platforms: Teachers are taught how to upload the materials they create to learning platforms such as Google Classroom or LMS (Learning Management System) used by schools.

After creating microlearning media, teachers are given guidance and opportunities to try to integrate the media into classroom learning. They were accompanied by a team of facilitators in implementing technology in the classroom. At this stage, teachers practice how to use the digital media they have created to support the teaching and learning process in the classroom. Teachers are also given the opportunity to reflect on their experiences and share the challenges they face during the implementation of microlearning-based learning media. The facilitator team provides suggestions and solutions for improvement, as well as

ensuring that teachers are able to use technology with confidence.

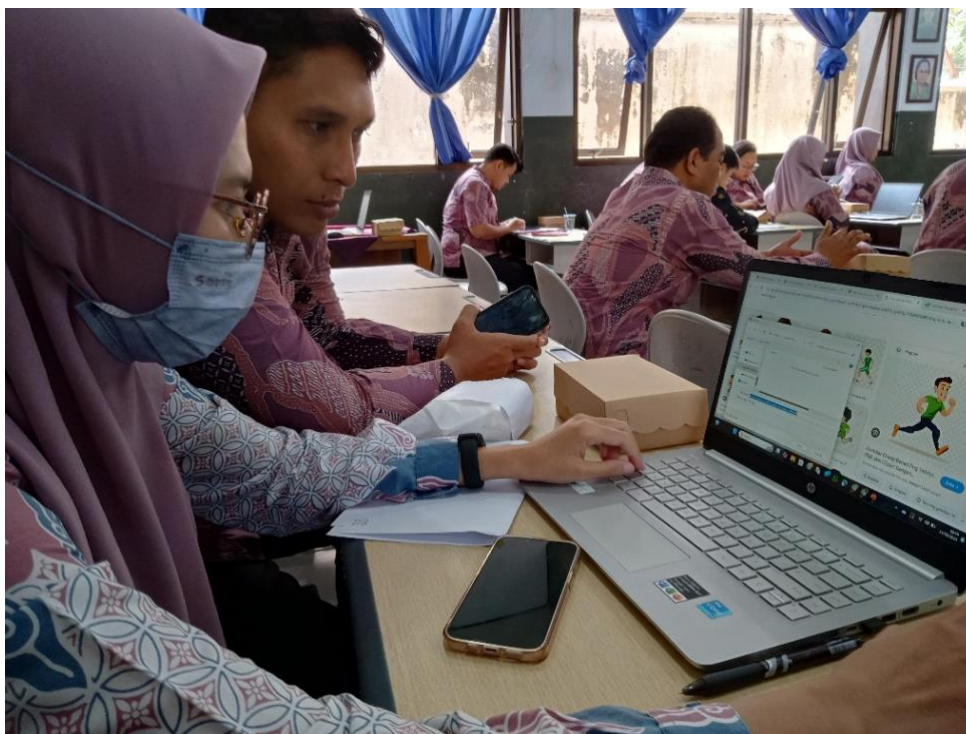


Figure 2. Enthusiasm of Community Service Participants

After the assistance activity, assistance was carried out to monitor the teacher's progress in applying microlearning. During this mentoring process, teachers continue to be guided in developing new learning media and improving their work based on feedback from students and peers. To evaluate the effectiveness of training, a final test (post-test) is carried out that measures teachers' skills after receiving training. In addition, observations were made on the application of learning media in the classroom. Before the training, the participants were given a pre-test to measure their instructional capacity, and after the training, they underwent a post-test to measure the improvement in skills after the intervention. Based on the results of the analysis as stated in Table 1, the average score of the participants' pre-test was 60.17, which was included in the good category according to the set score interval. However, even though most of the participants had good scores, there were still some participants with scores in the poor category, namely 3 people. In contrast, the post-test results showed a significant improvement in participants' skills. The average post-test score reached 91.67, which is included in the very good category. Almost all of the trainees experienced a significant improvement in skills, where only one participant was still in the good category, while the other 23 participants were in the very good category.

The Wilcoxon test was carried out to compare pre-test and post-test scores to evaluate the

effectiveness of assistance activities. The results of the Wilcoxon test showed a significance value of 0.00, which means that there was a significant difference between the pre-test and post-test results. With a significance value of less than 0.05, it can be concluded that this training is effective in improving teachers' skills. In addition, the test results also showed that the positive ranks value was 24, which means that all participants experienced an improvement in post-test scores compared to their pre-test. None of the participants experienced a decrease in grades or no changes, indicating that all participants benefited from this training.

Table 1. Description of Instructional Capacity of Laboratory Elementary School Teachers through Microlearning Learning Media Creation Assistance

Value	Interval	Category	Frequency	Mean	Description
Pre-Test	0 - 25	Bad	0	60.17	Good
	26 - 50	Not Good	3		
	51 - 75	Good	21		
	76 - 100	Very Good	0		
Post-Test	0 - 25	Bad	0	91.67	Very Good
	26 - 50	Not Good	0		
	51 - 75	Good	1		
	76 - 100	Very Good	23		
N : 24					

Discusson

The community service activities that have been carried out have focused on developing the skills of UM Laboratory Elementary School teachers in creating microlearning-based learning media. The microlearning approach was chosen because it provides a great opportunity for teachers to design learning materials that are short, concise, and easy to digest by students, which are in accordance with the learning needs of today's digital era (Rubach & Lazarides, 2021; Taylor & Hung, 2022) Microlearning-based learning offers many benefits, both for teachers and students. For teachers, this method makes it easier to organize material that focuses on the core of a topic, which is then presented in an engaging and interactive format such as videos, infographics, or online quizzes (Pölzl-Stefanec & Geißler, 2022) For students, microlearning-based learning supports easier understanding of material because the material is delivered in small, focused pieces, reducing cognitive load and increasing information absorption (Demmans Epp & Phirangee, 2019) As mentioned in the results, teachers are trained to utilize various software such as Canva and PowerPoint, which are widely known and easy to use for creating visual content and short videos. With this provision, teachers are expected to be able to present more interesting material and support different learning styles of students.

This assistance process began with initial socialization, which aimed to introduce the basic concepts of microlearning and the potential of technology as a tool in the learning process. This is an important step to build an initial understanding of what microlearning means and how technology can support learning. This initial step also provides an opportunity for the service team to interact with teachers, explore their specific needs, and tailor training based on problems faced in the field. Through this interactive approach, the training becomes more relevant and beneficial for participants.

The next stage in this activity is more technical training, namely the introduction of tools and applications for the creation of microlearning-based learning media. Providing examples of learning media from various educational institutions is an important part in inspiring teachers about the forms of media they can make. The training not only covers technical aspects, but also covers pedagogical aspects, such as an understanding of the importance of engaging visual design and the creation of interactive elements to increase student interest and engagement. This is an important aspect of microlearning, where visual display and interactivity can play a big role in improving student information retention.

Based on the results obtained, it is clear that these training and assistance activities have a significant impact on improving teachers' instructional skills. Based on the Wilcoxon test conducted, there was a significant difference between the pre-test and post-test results with a significance value of 0.00, which showed that this training was effective. The increase in the average post-test score (91.67) compared to the pre-test (60.17) shows an increase in teachers' understanding and skills in creating microlearning-based learning media. This was also seen in the increase in the frequency of participants who were in the "very good" category after the training, where 23 participants managed to achieve the category, while only one participant was in the "good" category.

The effectiveness of this training is also supported by a learning method based on hands-on practice (Arnesson & Albinsson, 2017) The teachers not only received the material theoretically, but were also given the opportunity to directly practice the creation of learning media in small groups. This practice-based approach allows teachers to get direct feedback from facilitators and peers, which enriches their learning process. In addition, mentoring activities after training, where teachers are assisted in integrating the media they have created into classroom learning, is a strategic step that gives teachers more confidence in using technology in the classroom.

The successful implementation of microlearning media in the classroom, as conveyed by teachers during the reflection process, also shows that this learning model is able to increase student involvement in the teaching and learning process. This is consistent with previous research that shows that the use of

technology in learning, especially through microlearning, is able to increase students' interest and motivation in learning, as well as help them understand the material delivered more effectively (Maisyaroh et al., 2021; Nowak et al., 2023) Based on the reflection of the activity, although the overall training results are positive, some challenges still need to be considered. One of the main challenges expressed by teachers is the limited time in preparing microlearning-based learning media, especially for teachers who teach several subjects at once. In addition, technological abilities among different students can also be an obstacle in the use of this medium in the classroom. Therefore, it is important for schools to continue to provide support, both in the form of advanced training and technological facilities, to ensure that teachers can continue to develop and update their skills in using microlearning media. With this skill improvement, it is hoped that teachers can continue to innovate in learning and maximize the potential of technology to create more effective and enjoyable learning.

CONCLUSION AND RECOMMENDATION

The rapid development of technology seems to demand and change the teacher's perspective in determining new learning models that are certainly more effective, innovative, and creative. The presence of training to increase the capacity of UM laboratory elementary school teachers through microlearning learning media creation assistance has succeeded in achieving the main goal, namely improving the knowledge and skills of teachers in relation to the preparation of microlearning learning media. The training and mentoring process, which includes the introduction of microlearning concepts and deepening the material through joint practice activities, has proven to be effective in measuring participants' understanding of microlearning learning media. Evaluation activities were carried out through pre-test and post-test which showed a significant improvement in the skills and understanding of participants before and after participating in the training.

Based on the evaluation of this activity, there are several suggestions submitted by the author as a form of reflection and future training plans. First, after the service activities are carried out, it is expected to continue to monitor periodically after the training activities. Second, there needs to be prior communication regarding the teaching materials taught by each participant. This is done as a preparation effort for teachers, especially as material for compiling micro learning media. Third, it is suggested that the next training can be accompanied by a teaching module in accordance with the theme being trained. Thus, it will make it easier for participants to understand, explore, and focus more on the practice of making micro learning media.

ACKNOWLEDGEMENT

This Community Service is supported by the Directorate of Research, Technology, and Community Service (DRTPM) of the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia, with Grant number 0667/E5/AL.04/2024.

REFERENCES

- Adha, M. A., Faslah, R., Ikhwan, M., Ariyanti, N. S., Mahfirah, T. F., Nurwahida, & Nurhayani. (2023). Mentoring Students in Creating Online-Based Infographics to Enhance Creativity in the Digital Age. *2023 International Conference on Electrical, Computer and Energy Technologies (ICECET)*, 1–5. <https://doi.org/10.1109/ICECET58911.2023.10389487>
- Andriotis, N. (2018). *What Is Microlearning: A Complete Guide For Beginners*. ELearning Industry.
- Arnesson, K., & Albinsson, G. (2017). Mentorship—a pedagogical method for integration of theory and practice in higher education. *Nordic Journal of Studies in Educational Policy*, 3(3), 202–217. <https://doi.org/10.1080/20020317.2017.1379346>
- De Freitas, S. I., Morgan, J., & Gibson, D. (2015). Will MOOCs transform learning and teaching in higher education? Engagement and course retention in online learning provision. *British Journal of Educational Technology*, 46(3), 455–471. <https://doi.org/10.1111/bjet.12268>
- Demmans Epp, C., & Phirangee, K. (2019). Exploring mobile tool integration: Design activities carefully or students may not learn. *Contemporary Educational Psychology*, 59, 101791. <https://doi.org/10.1016/j.cedpsych.2019.101791>
- Edelhauser, E., & Dima, L. L. (2020). Is Romania prepared for e-learning during the covid-19 pandemic? *Sustainability (Switzerland)*, 12(13), 1–29. <https://doi.org/10.3390/su12135438>
- Heffernan, A. (2018). Power and the ‘autonomous’ principal: autonomy, teacher development, and school leaders’ work. *Journal of Educational Administration and History*, 50(4), 379–396. <https://doi.org/10.1080/00220620.2018.1518318>
- Juharyanto, Sultoni, A., Nasih, A. M., Zahro, A., Priyatni, E. T., & Adha, M. A. (2021). Professional Teachers’ Capability in the Implementation of Online-Based Quality Learning in Covid 19 Pandemic Era: Analysis of Technology Infrastructure Support in Indonesia. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, 6(12), 1923–1929. <https://doi.org/10.17977/jptpp.v6i12.15171>
- Kaplan, A. M., & Haenlein, M. (2016). Higher education and the digital revolution: About MOOCs, SPOCs, social media, and the Cookie Monster. *Business Horizons*, 59(4), 441–450. <https://doi.org/10.1016/j.bushor.2016.03.008>
- Kesiman, M., Santyadiputra, G., & Darmawiguna, I. G. (2021). Pelatihan Pembuatan Media Pembelajaran

- Berbasis Microlearning Untuk Ikatan Guru Indonesia Kabupaten Buleleng. *Proceeding Senadimas Undiksha* 2021, 2020, 1300–1308.
<https://conference.undiksha.ac.id/senadimas/2021/prosiding/file/177.pdf>
- Maisyaroh, Juharyanto, Wiyono, B. B., Adha, M. A., & Saputra, B. R. (2024). Hybrid Learning in Schools: Analysis of the Community's Role in ICT-Based Learning Facilities Management. In X.-S. Yang, R. S. Sherratt, N. Dey, & A. Joshi (Eds.), *Proceedings of Eighth International Congress on Information and Communication Technology. ICICT 2023* (pp. 733–743). Springer Nature Singapore. https://doi.org/10.1007/978-981-99-3043-2_60
- Maisyaroh, Ulfatin, N., Juharyanto, Prestiadi, D., Adha, M. A., Ariyanti, N. S., Saputra, B. R., & Sjaifullah, F. W. (2021). Mentoring teachers in the utilization of moodle e-learning application to optimize learning success. *2021 7th International Conference on Education and Technology (ICET)*, 19–23. <https://doi.org/10.1109/ICET53279.2021.9575083>
- Marlena, N., Dwijayanti, R., Patrikha, F. D., Parjono, & Sudarwanto, T. (2018). Penyegaran Kemampuan Guru Dalam Merancang Media Pembelajaran Melalui Aplikasi Powtoon dan Screen O Matic. *Jurnal Pemberdayaan Masyarakat Madani*, 2(2), 204–223. <https://doi.org/10.21009/JPMM.002.2.04>
- Musyaffi, A. M., Adha, M. A., Mukhibad, H., & Oli, M. C. (2024). Improving students' openness to artificial intelligence through risk awareness and digital literacy: Evidence form a developing country. *Social Sciences & Humanities Open*, 10, 101168. <https://doi.org/10.1016/j.ssaho.2024.101168>
- Nowak, G., Speed, O., & Vuk, J. (2023). Microlearning activities improve student comprehension of difficult concepts and performance in a biochemistry course. *Currents in Pharmacy Teaching and Learning*, 15(1), 69–78. <https://doi.org/10.1016/j.cptl.2023.02.010>
- Pahlevi, T., Wulandari, S. S., Suratman, B., & Ranu, M. E. (2020). Improvement Teacher Skills in Archiving Letters through Mentoring E-Archive Learning Media. *Jurnal Pemberdayaan Masyarakat Madani*, 4(1), 34–43. <https://doi.org/10.21009/JPMM.004.1.03>
- Pözl-Stefanec, E., & Geißler, C. (2022). “Micro-steps” on the route to successful online professional development for Austrian Early Childhood Educators. *International Journal of Educational Research*, 115, 102042. <https://doi.org/https://doi.org/10.1016/j.ijer.2022.102042>.
- Rubach, C., & Lazarides, R. (2021). Addressing 21st-century digital skills in schools – Development and validation of an instrument to measure teachers' basic ICT competence beliefs. *Computers in Human Behavior*, 118, 106636. <https://doi.org/https://doi.org/10.1016/j.chb.2020.106636>.
- Shahroom, A. A., & Hussin, N. (2018). Industrial Revolution 4.0 and Education. *International Journal of Academic Research in Business and Social Sciences*, 8(9), 314–319.

<https://doi.org/10.6007/ijarbss/v8-i9/4593>.

- Surahman, E., Sulthoni, S., Ulfa, S., Husna, A., Ramdiana, H., At Thaariq, Z. Z., Setiawan, A. B., & Qolbi, M. S. (2020). Pelatihan Micro Learning Object Berbasis TPACK bagi Guru-Guru SMA di Garut. *Abdimas Pedagogi: Jurnal Ilmiah Pengabdian Kepada Masyarakat*, 3(1), 1–14. <https://doi.org/10.17977/um050v3i1p1-14>.
- Taylor, A., & Hung, W. (2022). The Effects of Microlearning: A Scoping Review. *Educational Technology Research and Development*, 70(2), 363–395. <https://doi.org/10.1007/s11423-022-10084-1>
- Wang, C., Bakhet, M., Roberts, D., Gnani, S., & El-Osta, A. (2020). The efficacy of microlearning in improving self-care capability: a systematic review of the literature. *Public Health*, 186, 286–296. <https://doi.org/10.1016/j.puhe.2020.07.007>.