PERDIKAN (Journal of Community Engagement)
2025, Vol. 7(2): 87–97
Journal Homepage: https://ejournal.iainmadura.ac.id/index.php/perdikan/index

Improving the competence of Geography teachers through training in Mobile-RPG development based on serious games

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Article Info

Article History

Received : 29/07/2025
Revised : 05/09/2025
Accepted : 30/09/2025
Available Online : 16/10/2025

How to cite

Putra, A. K., Septiana, W. D., Khalidy, D. A., Sahrina, A., Arinta, D., Wahyuningtyas, N., Habibah, K., & Kholifah, E. N. (2025). Improving the competence of geography teachers through training in Mobile-RPG development based on serious games. *PERDIKAN: Journal of Community Engagement, 7*(2), 88–97. https://doi.org/10.19105/pjce.v7i2.21417

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Abstract

Based on the analysis of the situation, problems, and needs of MGMP Geography in Malang City, teachers experience obstacles in developing and using technology-based, innovative learning media, namely mobile role-playing games based on serious games. The purpose of community service activities is to provide training in the development of mobile role-playing game learning media based on serious games, which are games designed for specific educational goals, rather than just entertainment, and are formatted as mobile role-playing games (RPGs). This activity also aims to measure the resulting improvement in the teachers' competence. This community service activity employed a participatory training approach, structured into four phases: assessment, preparation, implementation, and evaluation, utilizing a combination of online and offline methods. The subjects in this activity were 50 teachers from MGMP Geography, Malang City. The Wilcoxon test revealed that implementing service activities had a positive impact on improving teachers' competence. In addition, the suggestion from this activity is that similar activities are needed as a form of sustainability for real efforts to improve teacher competence and the quality of geography learning.

Keywords

Learning Media Innovation; Mobile Role Playing Game; serious game

Abstrak

Berdasarkan analisis situasi, permasalahan, dan kebutuhan terhadap MGMP Geografi Kota Malang, guru mengalami kendala dalam mengembangkan dan memanfaatkan media pembelajaran inovatif berbasis teknologi. yaitu *mobile role-playing* game berbasis *serious game,* yaitu permainan yang di desain untuk pendidikan, bukan hanya untuk bersenang-senang, dalam format *role-playing game (RPG).* Tujuan kegiatan pengabdian kepada masyarakat yaitu memberikan pelatihan pengembangan media pembelajaran *mobile role-playing game* berbasis *serious game* dan mengukur tingkat kompetensi guru. Kegiatan pengabdian ini menggunakan pendekatan pelatihan partisipatif yang terdiri dari empat tahapan, yaitu asesmen, persiapan, pelaksanaan, dan evaluasi, dengan kombinasi daring dan luring. Subjek dalam kegiatan ini adalah MGMP Geografi Kota Malang sebanyak 50 guru. Berdasarkan uji Wilcoxson menunjukkan implementasi kegiatan pengabdian berdampak positif terhadap peningkatan kompetensi guru. Selain itu, saran dari kegiatan ini yaitu diperlukan kegiatan serupa sebagai bentuk keberlanjutan terhadap usaha nyata dalam meningkatkan kompetensi guru dan kualitas pembelajaran Geografi.

Kata Kunci
Inovasi Media Pembelajaran; Mobile Role-Playing Game; Serious Game

1. Introduction

The educational paradigm is a perspective or framework that plays a key role in determining how the educational process is designed, implemented, and evaluated (Gonzales-Perez & Ramirez-Montoya, 2022; Zhou et al., 2022). The educational paradigm has shifted from traditional to modern approaches. This change emphasizes critical and creative thinking skills, which align with the learning objectives. The modern paradigm emphasizes developing soft skills, including communication and collaboration abilities, to address complex global challenges (Nermend et al., 2022). The structure and process of learning, including policies, teaching methods, infrastructure, and other components, are designed to achieve educational goals effectively and efficiently (Ismail et al., 2022).

Indonesia's education system continues to evolve in line with contemporary developments. One such change is evident in the implementation of the National Curriculum (Hazyimara, 2023; Zidan, 2023). The National Curriculum provides opportunities for teachers and students to adapt the material and teaching methods in accordance with their needs and the integration of technology (Putra et al., 2023). The paradigm and education system are closely intertwined and mutually influence one another (Yang & Wang, 2023). A paradigm that emphasizes active, collaborative, and project-based learning can be effective if applied within a flexible, adaptive education system that supports technology (Baker et al., 2021; Walsh et al., 2021). The transformation of learning processes not only affects students but also improves the quality and professional training of teachers (Putra et al., 2024), enabling them to implement more innovative and creative geography teaching methods in line with the development of 21st-century learning (Putra, Anggraini, et al., 2023).

The integration of technology in education, such as digital learning and personalization, enhances the efficiency of educational management (Rakha, 2023; Tiwari, 2023). Technology also influences the learning process by encouraging teachers to use and adapt digital tools to facilitate content delivery (Putra et al., 2022). Technology enables digital learning, allowing students to learn anytime and anywhere through e-learning platforms, video conferencing, and interactive content. Technological advancements in learning continue to develop in response to content needs, student characteristics, curriculum achievements, and the demands of the times (Haleem et al., 2022; Lacka et al., 2021). One such development in educational technology is the use of mobile role-playing games, which are based on serious games.

Mobile role-playing games, based on serious games, are educational media that utilize game principles to create interactive and immersive learning experiences (Aidoune & Singh, 2023; Zhang & Song, 2022). Unlike conventional games, whose primary purpose is entertainment, a serious game is a digital game explicitly designed for serious purposes, such as education, skill training, or simulation (Baptista et al., 2024). Mobile role-playing games based on serious games aim to enhance understanding, engagement, and knowledge retention through experiential learning (Byusa et al., 2022; Rios et al., 2023). The active involvement of students in games provides both emotional and intellectual engagement, thus boosting their motivation to learn (Hassan et al., 2021; Yu et al., 2021). Additionally, mobile role-playing games based on serious games align with students' interests, as they are more likely to be attracted to them (Putra et al., 2023). These games can help students develop various skills, including problem-solving, critical thinking, teamwork, and communication.

Based on an initial analysis of the Geography Teacher Professional Development Group (MGMP) in Malang City, geography teachers face several challenges, one of which is the lack of innovation in educational media. It has impacted the quality of geography learning media in schools. The majority of the media used by teachers is conventional, including PowerPoint presentations and educational videos. Teaching methods also tend to center on the teacher using lecture-based approaches, resulting in limited student engagement in the learning

process. Furthermore, the learning process does not sufficiently leverage technology to deliver content.

One of the primary factors contributing to the lack of innovation is the scarcity of relevant and sustainable training programs that focus on developing modern, technology-based educational media. It creates a significant competency gap, leaving many educators reliant on conventional tools, such as presentation software, and perpetuating traditional, teacher-centered methods. Even when training opportunities exist, teachers often face substantial challenges in accessing them, including time constraints that conflict with teaching duties and a lack of institutional support for their professional development. These issues are further compounded by the severe limitations of school facilities. The insufficiency of computer devices, unreliable Internet access, and the absence of necessary software create a critical theory-practice gap. It means that even a highly motivated teacher who completes external training may be unable to implement new skills in their own classroom. This situation not only hinders the implementation of innovative media but can also lead to teacher demotivation, reinforcing the systemic reluctance to embrace technological advancements in education.

This situation is consistent with various studies in the field of education that have identified similar challenges. For example, Revina et al. (2023) indicate that many teachers in Indonesia still face barriers to adopting innovative learning technologies, often due to a lack of relevant and continuous training. Furthermore, teachers' individual digital literacy and confidence levels have been identified as crucial personal factors that can hinder the integration of technology (Nurhidayat et al., 2024). Other factors, such as limited school infrastructure, have been identified as primary obstacles to the effective implementation of technology-based learning (Rahmi et al., 2025).

Ideally, modern geography learning should shift from a teacher-centered model to a student-centered paradigm, where learners actively construct their own understanding through inquiry-based projects, collaborative problem-solving, and hands-on data analysis. In this model, technology is utilized not just as a presentation tool, but as a dynamic medium for creating immersive experiences through tools such as virtual reality (VR), field trips, and interactive simulations (Putra et al., 2023). Within this framework, game-based learning is a particularly potent approach, proven to enhance not only student engagement but also critical thinking and spatial problem-solving skills (Robinson et al., 2021). This approach transforms abstract geographical theories into tangible, memorable challenges, solidifying core competencies in ways that traditional methods often cannot.

To address the identified gap between current teaching practices and the ideal technology-rich learning environment, this community service program was designed with two primary objectives. The first was to equip the geography teachers of the MGMP in Malang City with the practical skills and pedagogical knowledge needed to develop their own mobile role-playing games based on a serious game framework. The second objective was to quantitatively measure the effectiveness of this intervention by assessing teachers' competence before and after participating in the training. This initiative aimed to provide a tangible and sustainable solution to enhance teacher competence, thereby improving the quality and engagement of geography learning for students across Malang.

2. Methods

The community service activity employed a participatory training approach, emphasizing a collaborative process where the participants (teachers) were actively involved, from the needs assessment stage to evaluation, to ensure that the training material was relevant to their professional challenges. This community service involved 50 geography teachers from the Geography Teacher Professional Development Group (MGMP) in Malang. The core training activities were conducted offline on August 27-28, 2024, September 10-11, 2024, and December 3-4, 2025. The overall program was structured into four main stages: assessment, preparation, implementation, and evaluation, utilizing a combination of online and offline systems. The online activities were designed for time efficiency during the assessment and preparation stages. In contrast, the offline activities ensured that all participants gained direct

training and experience during the implementation and evaluation stages. The flow of these community service activities is shown in Figure 1.

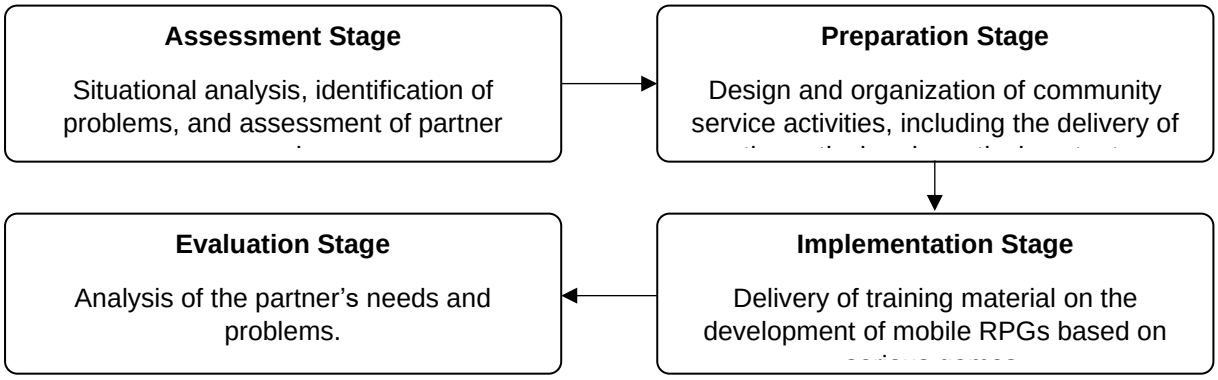


Figure 1. Flow of community service activities
Source: Researcher documentation

2.1. Assessment Stage

This stage marks the beginning of community service activities, focusing on situational analysis, identifying problems, and understanding the needs of the partners. The activity was carried out through a discussion with the partners, highlighting the issues and needs of the teachers regarding training on the development of educational media, particularly mobile role-playing games based on serious games.

2.2. Preparation Stage

The preparation stage is the design and planning phase of the community service activity, based on the results of the situational analysis, problems, and partners' needs. The community service design was conducted both online and offline, with the implementation stage as the core activity. The community service activities were divided into two parts: the delivery of theoretical content related to technology-based educational media and the practical development of mobile role-playing games based on serious games.

2.3. Implementation Stage

The implementation stage is the core activity of a community service program. This stage was conducted offline, involving the delivery of materials and practical training on the development of mobile role-playing games based on serious games.

2.4. Evaluation Stage

The evaluation stage measures the success of community service activities. This stage utilized Google Forms, which included both open-ended and closed-ended questions. The closed-ended questions are designed to assess the teachers' competence after participating in the community service activities, based on nine variables that have been developed, namely: (1) competence in using applications, (2) understanding of content and integration of teaching materials with games, (3) skills in designing game-based learning, (4) ability to use features for evaluation, (5) technical competence in troubleshooting game applications, (6) pedagogical adaptation to the use of games, (7) ability to develop materials, (8) use of games as tools for collaboration and discussion, and (9) evaluation of the achievement of learning objectives. The open-ended questions aimed to gather feedback and suggestions from the partners regarding the implementation of community service activities. The evaluation stage is crucial for measuring the success of activities, identifying areas for improvement, and enhancing strengths.

3. Result and Discussion

Community service is one of the programs organized by Universitas Negeri Malang, which is part of the Tri Dharma of Higher Education, encompassing education, research, and

community services. The main goal of community service is to enhance the quality of partners through collaboration between faculty and students. In this activity, the community service team identifies the problems faced by the partners and provides appropriate solutions. One of the focuses of this service is to improve the quality of learning in partner schools through training on the development of technology-based educational media, specifically mobile role-playing games based on serious-game principles.

Based on the identification of the partners' problems, there is a need for an innovative learning approach that can stimulate active student participation through the use of serious games, which have proven effective in increasing cognitive engagement and student motivation. This innovation allows the creation of a more dynamic learning environment that aligns with the demands of modern education. The next phase of the community service activity will be held on August 27-28, 2024, September 10-11, 2024, and December 3-4, 2025, with the participation of 50 geography teachers from the MGMP Geografi in Malang. The activity will be conducted offline and will consist of two sessions: the delivery of theoretical material related to technology-based educational media and the development of mobile role-playing games based on serious games. The topics covered include an introduction to the concept of serious games, the development of interactive learning modules, and the application of mobile technology in education.

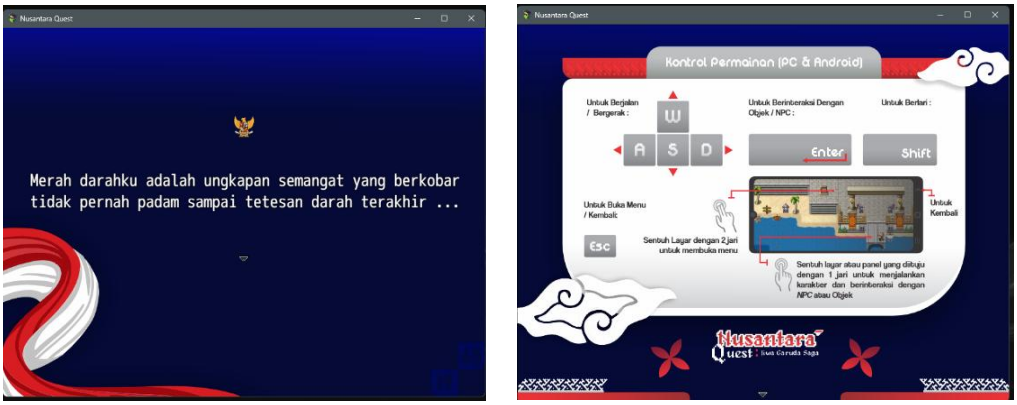
In the first session, the instructor presents an introduction to the concept of serious games, which are games designed not only for entertainment but also to achieve educational goals. This introduction provides a basic understanding of how serious games can be used in education, the differences between educational and conventional games, and their impact on the learning process. Participants will be invited to explore case studies and examples of serious game applications implemented in educational settings.

(a) (b)

Figure 2. Delivery of material (a) and trial product usage (b)
Source: Researcher documentation

After understanding the basic concepts of serious games, participants will receive training on how to develop interactive learning modules that are integrated with games. It includes planning the learning objectives, mapping the learning content into the game, and designing game-based activities. Participants will also practice creating game flows based on specific competencies aligned with the applicable curriculum.

The media development session focused on how to create and use mobile technology as a medium for serious games. The participants will be taught how to develop games based on the prepared content. Subsequently, the participants will be guided on how to utilize the developed mobile application in the learning process. The media development session included installing the application, setting up application features, and integrating it with the digital platforms. Additionally, participants will be instructed on how to utilize data from the game application to evaluate their competence and assess the effectiveness of the learning process. The results of the developed products are shown in Figure 3.



(a) (b)

Figure 3. Game introduction (a) and product usage guide (b)
Source: Researcher documentation

At the end of the implementation phase, participants were asked to fill out a Google form as part of the evaluation of the community service activity. The form consisted of two types of questions: closed-ended and open-ended. The closed-ended questions aimed to assess the teachers' competencies after participating in the activity, while the open-ended questions were used to gather feedback, comments, and suggestions from the teachers. The results of the closed-ended questions are presented in Table 1.

Table 1. Descriptive statistical analysis of teacher competencies before and after the community service activity

Variable	Mean		Median		Variance		Std. Deviation	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Usage	52.0	88.5	50.0	90.0	43.9	53.3	6.6	7.3
Content Integration	51.6	87.2	50.0	90.0	22.9	56.3	4.8	7.5
Learning Design	53.0	88.9	52.5	90.0	35.7	66.6	5.9	8.2
Evaluation Features	52.0	89.7	50.0	90.0	31.6	49.4	5.6	7.0
Technical	52.0	91.1	55.0	90.0	34.9	32.4	5.9	5.7
Pedagogical Adaptation	50.9	87.8	50.0	90.0	31.3	62.4	5.6	7.9
Material Development	52.7	88.0	52.5	90.0	36.9	63.3	6.1	7.9
Collaboration Tools	50.2	88.7	50.0	90.0	36.7	49.8	6.1	7.1
Learning Outcome Evaluation	51.6	88.6	50.0	90.0	30.0	57.2	5.5	7.6

Source: Analysis result

The pre- and post-test data were tested using non-parametric tests, as the data did not meet the prerequisite testing stage. The normality test results indicated that the data were not normally distributed and were not homogeneous (sig. (2-tailed) below 0.05). This result indicates that parametric statistical tests, such as the paired sample t-test, are not applicable; therefore, the Wilcoxon test was employed. Testing was conducted using SPSS Windows 25 software. The results of the Wilcoxon test are shown in Table 2.

Table 2. Wilcoxon Test results

	Pretest-Posttest Indicator								
	1	2	3	4	5	6	7	8	9
Z	-6.176	-6.176	-6.174	-6.177	-6.177	-6.171	-6.171	-6.180	-6.173
	.000	.000	.000	.000	.000	.000	.000	.000	.000

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks
Source: Analysis result

The significant increase in teacher competencies across all nine variables, as confirmed by the Wilcoxon test ($p < .05$), demonstrates the effectiveness of the hands-on training model. This success can be attributed to the participatory approach, which moves beyond theoretical lectures to provide direct and practical experience in media development. By actively engaging in the creation process, the teachers not only acquired technical skills but also gained a deeper understanding of the pedagogical principles behind game-based learning (Abedi, 2024), aligning with the principles of adult learning theory (andragogy), which emphasizes experiential learning (Govindaraju, 2021).

Based on the open-ended feedback evaluation, the activity received constructive comments, criticisms, and suggestions from the participants. Suggestions were provided for improving application features, including adjusting the game's difficulty level to better meet learning needs. Criticisms included issues related to application stability and the need for further development of the interface design to be more user-friendly, especially for teachers and students who are less familiar with technology. Despite these concerns, many participants expressed positive impressions of community service, particularly the potential for developing more interactive and enjoyable learning media. All this feedback is crucial for the community service team to improve and enhance the quality of future activities.

This qualitative feedback offers more than just a list of practical improvements; it reflects well-documented challenges in the broader field of educational technology (EdTech) adoption. Criticisms regarding application stability and the need for a more user-friendly interface, for example, underscore the critical importance of usability and User Experience (UX) design (Schmidt & Stumpe, 2025). Echoing the principles of the Technology Acceptance Model (TAM), this feedback suggests that, regardless of a tool's pedagogical innovation, its adoption will be severely hindered if teachers and students perceive it as complicated or unreliable to use (Firomumwe & Gamira, 2021; Pittalis, 2021). Similarly, the request for adjustable difficulty levels is not merely a technical suggestion but a call for differentiated instruction within the digital medium, highlighting the need for learning tools that can adapt to diverse student abilities (Mhlongo et al., 2023). Taken together, this feedback highlights the dual imperative for successful educational technology: it must be both pedagogically sound and technically robust, a balance that is crucial for meaningful and sustainable integration into the classroom.

This finding strongly aligns with previous research on effective teacher professional development, which emphasizes the superiority of intensive, skill-based workshops over passive, theory-based seminars (Ichsan et al., 2025). The success of this program can be explained through the lens of andragogy (adult learning theory), which posits that adults learn best when actively involved in a hands-on, problem-solving process that is directly relevant to their professional needs (Mangtani, 2024). By engaging directly in the development of a mobile RPG, the teachers were not just passive recipients of information but active creators, applying new knowledge in real-time —a far more effective method for skill acquisition and retention.

Furthermore, the choice of serious games as the primary focus of training is significant. While the literature extensively supports the efficacy of serious games in enhancing student motivation and outcomes (Yu et al., 2021), this study highlights a less-explored benefit: the very act of developing a serious game as a powerful form of professional development. To design an effective educational game, teachers are compelled to deconstruct complex subject matter into sequential learning objectives (game levels), design embedded assessments (such as puzzles or quizzes), and consider player motivation and feedback loops. This process forces a fundamental shift in perspective, from being a mere "content deliverer" to becoming a "learning experience designer." In doing so, they deepen their Technological Pedagogical Content Knowledge (TPACK), learning to think critically about how students learn in a digital environment, a skill that transcends the use of any single application (Tseng et al., 2022).

It is important to acknowledge the limitations of this study. First, the intervention was conducted over a short period (two days). While the pre-test/post-test results show a significant immediate increase in competence, this design does not measure the long-term sustainability or the crucial 'transfer of learning' into the teachers' actual classroom practices. The initial positive results could be partially influenced by a novelty effect, and the study does not capture whether these new skills were maintained once teachers returned to their daily institutional

settings. Second, the participants were a homogenous group from a single professional body (MGMP Geografi) in a specific urban context (Malang). Geography, as a visual and spatial discipline, may be particularly well-suited for a game-based approach, and these findings may not be directly generalizable to teachers of other subjects or those in more rural areas with different levels of technological access and support.

Furthermore, the third limitation lies in the nature of the assessment, which focused on competence (the ability to use the tools) rather than actual implementation. This study did not measure potential shifts in pedagogical beliefs or teachers' intrinsic motivation, which are critical predictors of long-term technology adoption. Methodologically, the study employed a single-group design without a control group, making it difficult to rule out other external factors definitively. There is also a potential for self-selection bias, as the volunteer participants may have been more technologically inclined and motivated than the general teacher population. Future research should address these limitations by employing longitudinal designs to track classroom implementation, including control groups for more robust comparisons, and recruiting a more diverse sample of teachers across different subjects and regions.

4. Conclusion

The community service activity, which involves the development and use of mobile role-playing games based on serious games, has shown a positive impact on improving the competencies of teachers, particularly those from the MGMP Geografi in Malang City. The activity consisted of two sessions: the delivery of the material and the practical development of mobile role-playing games based on serious games. Based on the results of the Wilcoxon test, this activity had a positive effect on enhancing teacher competencies. Additionally, various impressions, criticisms, and suggestions were gathered to evaluate the activity, aimed at improving its shortcomings while maintaining and enhancing its strengths in future iterations. Although several challenges, such as limited infrastructure and technology adaptation, were encountered, the execution proceeded smoothly. It served as a valuable evaluation for organizing similar activities as part of a sustainable initiative.

Based on the executed activities, several recommendations can be made to improve the effectiveness of future community service activities. These include the continuous development and refinement of mobile role-playing game features to align with the game's level of difficulty. The interface design and various features should be evaluated to ensure they are more user-friendly, particularly for teachers and students, the primary users. Furthermore, teachers should be provided with ongoing technical training and collaborative support to ensure their understanding of the tools, as well as to guarantee the availability of the necessary infrastructure at the partner schools.

Acknowledgements

Gratitude is expressed to the Faculty of Social Sciences and the Teacher Professional Education Program (PPG) at Universitas Negeri Malang for providing a funding grant for the Community Service Program in 2024. Additionally, heartfelt thanks are extended to the MGMP Geografi Malang City for their participation as partners in this community service project.

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