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Design of Training for Differentiated Mathematics Instruction to Empower Middle School Teachers

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Abstract

This Community Service (PkM) activity aims to design and implement training for junior high school mathematics teachers in Pasuruan Regency. It focuses on differentiated mathematics learning to empower them in the teaching process. This PkM modifies the service-learning method in its implementation. This PkM was held on July 13, 2024, at SMP Negeri 1 Bangil, collaborating with the Pasuruan Education Office and the Junior High School Mathematics MGMP throughout Pasuruan Regency. The training was attended by 20 mathematics teachers from various junior high schools in Pasuruan and consisted of a series of activities, including initiation, sharing in groups, peer review, and evaluation. The activity began with a presentation of basic material on differentiated mathematics learning, continued with a group discussion on the analysis of learning modules, and ended with a peer review session to provide constructive feedback between participants. The evaluation was carried out through a questionnaire filled out by 14 participants, with the results showing that most participants considered this training very useful and effective. The material presented was considered relevant and applicable in learning. The training also revealed the need for further training in applying artificial intelligence in mathematics learning, creating technology-based learning media, and developing more innovative assessments. Overall, this community service activity has succeeded in achieving its objectives and is expected to continue to improve mathematics learning quality sustainably.

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INTRODUCTION

Although differentiated learning is good and ideal, it presents challenges that require creativity for most junior high school mathematics teachers. This learning develops potential according to students' needs, characteristics, and ability levels. However, to realize learning that is in line with this idea, teachers must strive to be trusted facilitators. First, teachers need to know the various characteristics of their students. Teachers' knowledge of the conditions of student diversity is the basis for designing learning to suit the conditions of student diversity. Teachers must invest sufficient time in preparing learning plans. Second, teachers should prepare diagnostic and formative assessments at the beginning of learning. Diagnostic tests are conducted to determine student diversity. Formative assessments at the beginning of learning help determine student performance.

Third, teachers must use many methods, including multimedia, and many sources. Teachers can consider various forms of visual, auditory, and kinesthetic learning for students using various learning methods, media, and resources. Through the implementation of differentiated learning, it is hoped that learning can be improved so that each student can grow and develop optimally (Handayani & Nisa, 2021; Herner-Patnode, 2021; Syarifuddin & Nurmi, 2022).

Differentiated learning provides full support for student development, considering each student has different learning needs. By designing differentiated learning, teachers can understand and respond to students' individual needs so that each student gets a learning experience that suits their level of understanding and learning style (Hapsari, 2018; Lestari & Sari, 2020). Through the activity of designing differentiated learning, it helps teachers in implementing learning and allows teachers to narrow the gap between students with different levels of understanding. Differentiated learning also helps create a more inclusive learning environment. Each student has unique strengths and weaknesses, and different approaches allow teachers to tailor teaching to the needs of each student. In this way, teachers can help students reach their maximum potential (Evendi et al., 2023; Hu, 2024; Rohani & Mulyaningsih, 2022).

Students not only have academic needs but also social and emotional needs. Differentiated approaches allow teachers to address these differences by providing support and instruction to students based on their needs. Designing differentiated learning can help students develop these skills and prepare them for real-world challenges and diversity (Aprima & Sari, 2022; Purnomo et al., 2023). Improving knowledge and practice related to differentiated learning design through training activities is important. Training in designing differentiated learning is essential to equip teachers with the skills and understanding they need to address classroom diversity and support the success of all students. Teachers need to understand diversity in terms of student learning styles, achievement levels, interests, cultural backgrounds, and special needs. Teachers create a stimulating and collaborative learning environment, especially when students understand the subject differently (Herwana & Sukirdi, 2023).

Teachers need to understand the fundamental principles of differentiated learning, such as identifying student needs, utilizing flexible grouping, and adapting instruction. This type of training enables teachers to shift their role from being mere transmitters of information to becoming facilitators of learning who are responsive to students' needs. It also emphasizes using various resources, tools, and instructional strategies to support a differentiated approach. It also emphasizes the importance of continuous assessment and student feedback to evaluate understanding and adjust teaching accordingly (Nurjanah & Syamsudin, 2023).

In implementing differentiated learning, particularly in Pasuruan, many teachers still require support in developing their professional competence. MGMP (Subject Teacher Forum) reports in Pasuruan indicate that many teachers have not yet implemented differentiated learning effectively. Most teachers remain uncertain about how to initiate the process and how to differentiate between content and process. In response to this issue, Surabaya State University collaborated with the Pasuruan Regency Mathematics MGMP to enhance the design of differentiated instruction for junior high school mathematics teachers. This support was delivered through integrated learning design training, as part of a community service program (PKM). Therefore, this community service initiative aims to equip teachers with advanced skills and knowledge in differentiated mathematics instruction, both as a theoretical concept and in terms of best practices, to improve classroom instructional quality and enhance teacher professionalism.

METHODS

This community service activity aims to design and implement training for junior high school mathematics teachers in Pasuruan Regency, focusing on differentiated mathematics learning to empower them in the teaching process so that teachers can experience an increase in the quality of classroom learning practices. To achieve this goal, the service learning (SL) method was modified to implement this community service activity (Martín-Sánchez, 2022). This community service activity modified the service learning (SL) method to improve teachers' skills and knowledge related to differentiated mathematics learning. This modification involves adjustments to several key elements of SL, such as an emphasis on in-depth structured reflection on classroom learning practices, direct integration between theory and practice through workshops and intensive mentoring, and close collaboration between the community service team and teachers in designing and implementing differentiated learning strategies that are appropriate to students' needs. Thus, this modification ensures that community service activities provide services to the community (teachers) and significantly improve the quality of classroom mathematics learning practices through continuous teacher professional development. According to Martín-Sánchez (2022), the SL method is important for achieving curriculum competence and environmental awareness because theoretical knowledge is applied to concrete work for real community service. The stages of implementing this community service activity include integration of theory with practical experience by providing a theoretical basis for differentiated mathematics learning through workshops and seminars; partnerships with schools and MGMPs to identify specific needs in mathematics teaching; and reflection and evaluation to discuss experiences and challenges faced.

The implementation of training or workshops in this community service activity was carried out on July 13, 2024, in collaboration with the Pasuruan Education Office. Community service activities were conducted offline on July 13, 2024, at SMP Negeri 1 Bangil in partnership with the MGMP Mathematics SMP Pasuruan Regency. This PkM was attended by 20 mathematics teachers from all junior high schools in Pasuruan Regency. The teachers came from SMPN 1 and 2 Kraton, SMPN 1 Pandaan, SMP IT Baitul Ulum Gempol, SMPN 3 Purwodadi, SMPN 1 and 2 Wonorejo, SMPN 2 Tosari SA, SMPN 2 Prigen, SMPN 2 Bangil, SMPN 1 Puspo, SMPN 2 Lumbang, SMPN 1 Gempol, SMPN 3 Lumbang SA, and SMPN 1 Pasrepan. The indicator of success of this activity is the participants' response to the training assistance in designing differentiated mathematics learning, which is categorized as very good and good based on the questionnaire results. Through this training, it is hoped that the teachers given training can pass on the knowledge and skills they have obtained in their respective schools.

RESULTS AND DISCUSSION

Several activities have been successfully implemented based on the planned community service schedule, including field surveys, discussions, program development, training material preparation, and training and workshop planning. These preparations also involved a series of joint meetings with the PKM implementation committee and coordination with the Pasuruan Education Office to ensure the readiness of the community service program. The training and workshop were conducted on July 13, 2024, in collaboration with the Pasuruan Education Office. The community service activity was offline at SMP Negeri 1 Bangil, in partnership with the Mathematics MGMP of Pasuruan Regency. The PKM event was attended by 20 mathematics teachers from various junior high schools across the regency. The event was officially opened by Dr. Heri Purnomo, M.Pd., followed by remarks from Dr. Endah Budi Rahaju, M.Pd., as the

Coordinator of the Undergraduate Mathematics Education Study Program at UNESA, and P. Soni Widyanto, S.Pd., as the Head of the Pasuruan Regency Mathematics MGMP. Before the presentation, participants were given an overview of the event schedule. The training process carried out during the PKM included several key stages: initiation, group sharing, peer review, and evaluation. These stages facilitated the participants' active engagement and professional development.

Initiation

Following the opening session, the next activity presented the concept of differentiated mathematics learning, which was part of the initiation stage (Initiation). The main speakers, Dr. Endah Budi Rahaju, M.Pd., and Dr. Siti Khabibah, M.Pd., delivered the initiation process. This session aimed to introduce the fundamental concepts of differentiated mathematics learning design to junior high school teachers participating in the training. In a 45-minute presentation, Dr. Endah Budi Rahaju explained the design of differentiated mathematics learning for junior high school teachers, including the elements that can be differentiated, strategies that teachers can implement, the learning environment, the importance of identifying students' learning needs, the targets of differentiated learning design, and the challenges associated with its implementation. The second material presentation was delivered by Dr. Siti Khabibah, M.Pd., focusing on practical examples of differentiated learning and teaching modules that support its implementation. During this session, Dr. Siti Khabibah also conducted a module analysis and presented examples of student worksheets (LKPD) that support differentiated learning by considering students' diverse needs. This initiation activity is illustrated in Figure 1.

Figure 1 Initiation

Sharing in Groups

After the initiation activity, the Sharing in Groups activity was carried out. The Sharing in Groups activity is a forum for sharing ideas and experiences through discussion and Q&A in groups. In this activity, teachers are allowed to discuss and ask questions in groups facilitated by the PkM Team related to the material that has been presented, which is connected to their learning experiences. Participants are asked to analyze modules supporting differentiated learning for approximately 45 minutes in this activity. Participants are allowed to ask the PkM Team about the analysis by considering students' needs in differentiated learning. This Sharing in Groups activity can be seen in Figure 2.

In this Sharing in Groups, participants in group discussion activities share their understanding and findings related to module analysis and differentiated learning. In this session, each group member presents ideas, approaches, and challenges they encounter in designing learning in accordance with the concept of differentiation. This discussion aims to provide insight, enrich perspectives, and identify the analyzed modules' strengths and weaknesses (Geel, 2019; Nurfata & Pujiastuti, 2023). After sharing, group members

provide input and suggestions to each other, which will later become the basis for peer review to improve the quality of the learning design being developed.

Figure 2 Sharing in groups

Peer Review

Peer review during group discussion activities on module analysis and differentiated learning aims to provide constructive feedback on the design and implementation of learning modules analysed by the participants. In this activity, each group member evaluates one another and offers suggestions regarding the discussed learning modules, focusing on aspects such as content, teaching strategies, and instructional methods that can be applied to accommodate the diverse needs of students. The peer review process also assesses the appropriateness of the applied differentiation strategies, ensuring they effectively address variations in learning styles, ability levels, and students with special needs. Through this process, it is expected that teachers will gain broader insights and be able to enhance their learning designs for more optimal outcomes. In other words, teachers must pay close attention to their students' needs and capabilities at this stage (Amalia, 2023).

In this activity, group representatives were asked to present the analysis results they had conducted. During the presentations, the moderator facilitated a question-and-answer session among participants and provided opportunities for feedback from the resource persons. After conceptualizing differentiated learning and reviewing examples, participants formed groups to design differentiated mathematics learning. They then analysed modules that could support differentiated mathematics instruction. Participants were free to select which aspect of differentiation would be the focus for their respective classrooms. A total of two modules were analysed for their strengths and weaknesses in supporting differentiated learning, and participants submitted the results via Google Form.

Evaluation

At the end of the training, participants conducted an evaluation to assess their achievement and effectiveness. Evaluation activities in this training were reflections related to the implementation of mentoring and the knowledge obtained by participants. This evaluation activity is shown in Figure 3.

Figure 3 Evaluation

This evaluation was detailed from the response questionnaire distributed after the activity. Of the 20 participants involved in the mentoring activity, 14 completed the response questionnaire via Google Forms. The results of this questionnaire include responses to the implementation of the community service activities based on the following criteria: (1) organization of the mentoring materials—7 participants rated it as very good, and the remaining participants rated it as good; (2) the workshop methods used—7 participants rated them as good, and the rest as very good; (3) the usefulness of the workshop materials for classroom learning—9 participants rated them as very good; (4) the time allocation for material delivery—7 participants rated it as good; (5) the responsiveness of the community service team to participants' statements or suggestions—7 participants rated it as very good; (6) interactive class control—7 participants rated it as very good; (7) effectiveness of discussion implementation—7 participants rated it as very good; and (8) the appropriateness of the speakers' responses to questions—7 participants rated it as very good. The following Table 1 section presents a detailed description of the evaluation results from this community service activity.

Table 1 Results of the evaluation stage of this community service activity

Evaluation Criteria	Very Good	Good	Fair	Poor	Very Poor
Material Organization	7	7	0	0	0
Workshop Methods	4	10	0	0	0
Material Usefulness	9	5	0	0	0
Time Allocation	6	7	1	0	0
Participant Responsiveness	7	7	0	0	0
Class Interactivity	7	7	0	0	0
Discussion Effectiveness	7	6	1	0	0
Facilitator Answer Alignment	7	7	0	0	0

The participants generally considered this training activity very good and useful. The activities included initiating, group sharing, peer review, and evaluation. Participants felt this training was inspiring, interactive, and representative, with the appropriate implementation time. The delivery of the material was considered good, although there was input that the speaker's voice volume should be increased to maximize the information delivery. The enthusiasm of UNESA lecturers in sharing knowledge also received high appreciation from the participants. Participants suggested that similar training be held more often, with additional meeting time for in-depth material. In addition, it was proposed that there be a follow-up to the training activities, not just stopping at the implementation stage. As a development, participants hope the following training material will be more diverse to enrich their insights and skills further. This activity was considered successful and is expected to continue to be carried out sustainably. This community service activity can support teacher professionalism in teaching activities in the classroom (Apriyantini & Sukendra, 2023; Hendel, 2021).

Based on the results of the questionnaire responses regarding the implementation of the community service activities, most participants felt that the organization of mentoring materials, the workshop methods used, the usefulness of the workshop materials for classroom learning, the allocation of time for delivering materials, the responsiveness of the community service team to participant statements or suggestions, interactive class control, effective discussion implementation, and the appropriateness of the speakers' responses to questions were all in the "very good" category. In line with the needs expressed by participants, the advanced training they expect includes various themes relevant to instructional development. Some key themes include the application of artificial intelligence (AI) in mathematics learning, differentiated learning in theory and

practical implementation in the classroom, and the development of learning media using the latest technology. Additionally, there is a need for in-depth exploration of mathematics content, the development of objective and effective assessment methods, and strategies for designing innovative and creative instruction that aligns with student characteristics and available school resources.

CONCLUSION

The training was highly beneficial and effective based on the results obtained from this community service activity. The training activities were considered relevant and very good, with strong potential for application in classroom learning. A series of activities—including initiation as an introduction to basic concepts, group sharing as a forum for exchanging ideas and experiences, peer review for providing constructive feedback, and evaluation to assess the achievement and effectiveness of the training—were all rated as very good.

Most participants successfully designed differentiated mathematics learning by identifying and analyzing students' basic needs in preparation. This is reflected in the activity implementation being categorized as very good across all evaluation indicators. Therefore, this community service activity has successfully delivered positive outcomes for the junior high school teachers.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTIONS STATEMENT

Conceptualization, EBR and HP; methodology, SK; formal analysis, SK and NRP; writing—preparation of the original draft, EBR and HP; and editing, NRP.

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