# Exploring the difficulties of mathematics teachers in developing high-tech media: A case study of mathematics teachers in Ruteng City, Indonesia

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**Abstract.** The use of high-tech media such as Augmented Reality (AR) has recently become a global trend because of its role in clarifying concepts and helping to present objects in a real way. However, in reality, not all teachers have the same attitude as that experienced by mathematics teachers in Langke Rembong District. Literature that specifically reveals teachers' interests and tendencies in using high technology needs to be provided so that it can contribute to future development. For this reason, this survey study was conducted to identify teacher difficulties and efforts that can be made in developing high-tech media such as AR. This study involved 30 respondents, namely mathematics teachers spread across 9 junior high schools. The instruments were distributed via Google Form and analyzed using the SPSS application. The results of the analysis showed teachers' perceptions that technology helps them in learning, and is able to improve students' abstraction, representation, visual, and spatial mathematical abilities (>94%). Furthermore, the teachers agreed that the potential for utilizing technology in the future is very large because its use is increasingly easy and its benefits are great. However, government support to support technological infrastructure and cooperation with higher education institutions is needed so that the implementation of high-tech media becomes realistic.

**Keywords:** Mathematics Teacher; Technology Context Knowledge; High Technology Based Media; Augmented Reality.

## 1 Introduction

Teachers who have innovative character are very important for the sustainability of the education system and are part of efforts to anticipate future challenges [1]. In today's rapidly changing world, where new technologies emerge and become part of students' lives [2]–[4] pedagogical approaches that accommodate new technological frameworks must be mastered and applied by teachers [5]–[9]. Improving teachers' innovative behavior and character has become a significant focus area in the 21st century [10].

Teachers' innovative behavior and character are widely acknowledged to benefit their performance in the learning process and enhance students' academic abilities [11], [12]. As

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stated by [13], recognizing teachers' innovative behavior or character can significantly optimize the learning process, fostering a conducive environment to enhance student engagement. Furthermore, scientific literature shows that embracing innovative behavior empowers teachers to stay informed about the ever-evolving teaching challenges in a dynamic educational landscape [14]–[16]. Teachers' innovative behavior is demonstrated by, among other things, the intention to develop and use media and technological contexts according to the latest developments.

Global research has found that despite increasing demand for teachers to present pedagogical knowledge and technology content in the classroom, they still have difficulty using digital technology devices during teaching and learning [17], [18]. Furthermore, [17] identified that the cause of all this is teachers' lack of technological literacy. In general, this condition is also supported by the results of recent studies. In Indonesia, for example, [19] has explored the digital literacy competencies of teachers and found that, in general, the digital literacy of Indonesian teachers is still lacking due to the lack of professional development. In line with this, the findings of research [20] present the fact that the technological competence of teachers in eastern Indonesia is very low.

Although previous studies have highlighted teachers' difficulties in Eastern Indonesia, they have not been in-depth or detailed on the components of technology development. Therefore, a study that explicitly explores teachers' challenges in developing high-tech-based media is needed. The identified obstacles can be used as input and baseline for the government and universities in developing curricula, strategic plans, and profiles of professional teacher education graduates. These objectives are achieved by answering the following questions: 1) What problems in the classroom are complex for mathematics teachers to overcome, and how can they be overcome? 2) What obstacles are faced in high-tech-based media?

## 2 Method

This study uses a survey method and a questionnaire distributed through Google Forms to collect data. The questionnaire is compiled using closed and open questions. Closed questions use predetermined answer choices, namely multiple choice, checkbox, or Likert scale, while open questions give teachers the freedom to answer in their own words. The questionnaire, compiled and published as a Google Forms link, was then distributed through the WhatsApp group of the FIBONACI mathematics teacher community in Ruteng Manggarai City, NTT-Indonesia. The respondents of this study were 30 mathematics teachers who were graduates of teacher professional education from various universities in East Nusa Tenggara Province. Data was collected via Google Forms, which is connected to email. The incoming data is stored in Google Sheets.

Furthermore, the data is analyzed qualitatively and presented as a percentage chart. Data presentation uses simple data visualization for multiple-choice or checkbox answers in graphs. Before distributing the questionnaire widely, a small-scale trial was conducted on five prospective FKIP Unika Santu Paulus Ruteng teacher students. The test results ensured the questions were easy to understand, and the form worked well.

## 3 Results and Discussion

Regarding the first problem of this survey research, the following presents the findings and discussion based on two main components formulated into two questions.

### 3.1 Math Teacher Difficulties

Related to the learning process in the classroom after taking professional teacher education, the teachers stated that they still had difficulties in overcoming the problems of students' misconceptions, students' independence and motivation to learn, and low students' mathematical literacy. The detailed survey results related to the first question are described in Table 1 below.

**Table 1.** Summary of Teachers' Difficulty Survey Results.

| Problems in the Classroom | Percentage |
|---|---|
| Conceptual error | 27,8% |
| Learning independence | 61,1% |
| Student learning motivation | 61,1% |
| Low mathematical literacy of students | 5,6% |

Based on Table 1, mathematics teachers stated that the dominant problems faced were students' learning independence and learning motivation. Both variables are recognized as influencing students' academic abilities in learning mathematics. As stated by [21] learning independence and motivation are related to students' mathematical academic abilities. Furthermore, it is stated that students' learning independence and motivation are quite strong in influencing mathematics learning outcomes and should be a concern for mathematics teachers [21], [22].

### 3.2 Teachers' difficulties in using technology

This study also highlights the obstacles faced by teachers in developing or using high-tech media. Figure 1 presents the teachers' answers related to the second component of the study question.

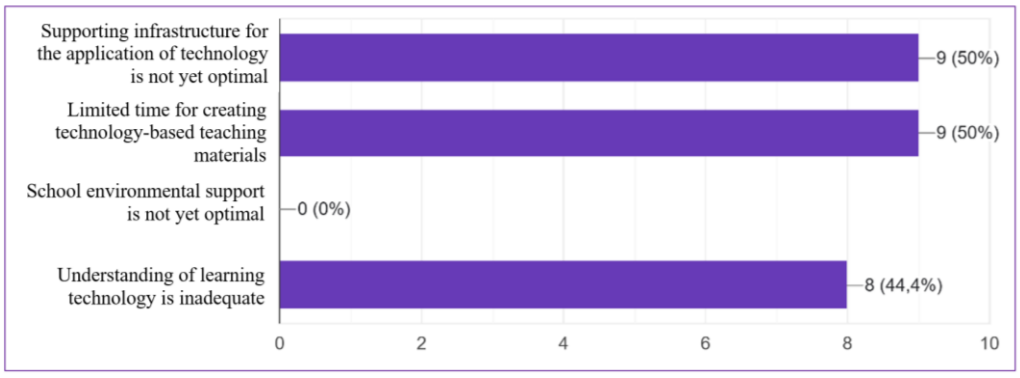


**Fig. 1.** Teacher Challenges in the Learning Process.

Based on Figure 1, it can be seen that the difficulties of teachers in developing and using high-tech media such as augmented reality are due to limited time, less than optimal supporting infrastructure, and low understanding of the technological context. Scientific literature widely acknowledges that teacher professionalism is a dominant factor determining the improvement of teaching quality [23]. Furthermore, extensive teacher professional development that includes the use of strategies, content and technology must be carried out to achieve the ultimate goal of learning [24]–[27]. In addition, teacher motivation to participate in professional development must be increased through professional development.

Based on the results of the analysis, it was found that mathematics teachers face two main challenges that hinder their ability to foster creativity and novelty in the design of teaching and learning activities. First, they often rely on established teaching habits and methods that hinder their desire to explore alternative approaches. Second, some consider themselves to lack innate creativity, which further hinders their confidence in innovative practices.

This study shows examples where teachers incorporate innovation into teaching activities. However, this innovation is often determined by administrative obligations and school standards rather than creative efforts generated by themselves. Some obstacles such as the standardization of teaching and learning activities that focus on mathematics ability and individual student learning outcomes, lead to a decrease in innovation. Given this context, it is important to identify factors that influence innovative behavior and explore ways to improve the innovative behavior of school mathematics teachers in further research.

## 4 Conclusion

This research answers two main problems faced by mathematics teachers in Ruteng City, namely related to the difficulties found in the learning process in the classroom and difficulties in developing and using high-tech media. The dominant problems found in the classroom lead to low learning attendance and student learning motivation. This requires cooperation and active participation from parents and stakeholders. In addition, the difficulties of teachers in developing media are influenced by the teacher's own factors, namely limited time, less than optimal supporting infrastructure, and low understanding of the technological context. In implementing learning, teachers seem to be still comfortable using existing models and media, thus closing the door for them to develop and use high-tech media.

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