

Teachers' Perception Towards the Use of Augmented Reality in the Learning Process in Elementary and Secondary Schools

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Abstract: Augmented Reality (AR) is a technology that combines the real world with three-dimensional virtual elements interactively, thus providing a more engaging, contextual, and meaningful learning experience for students. This study uses the Technology Acceptance Model (TAM) to explore the perceptions of elementary and secondary school teachers towards the use of AR in the learning process by looking at Perceived Ease of Use and Perceived Usefulness, which then influence attitudes and behavioral intention or future follow-up to use the AR technology. The research method used is a qualitative approach using Focus Group Discussion (FGD), and the data analysis technique used is Miles dan Huberman model. This study involved six teachers in Makedonia Private Schools as participants. The results of this study indicate that AR is highly beneficial and engaging for use in learning. Teachers have the intention or plan to implement AR in future lessons, but implementation is quite challenging due to inadequate networks and devices, lengthy preparation, and teachers' lack of AR skills, which necessitates training/mentoring.

Keyword: Teacher Perceptions; Augmented Reality; FGDs

Introduction

"Educational technology is a combination of human elements, machines, ideas, and management procedures (Widiyono & Millati, 2021)." This opinion states that educational technology is a combination of several elements such as humans as users, ideas, the use of machines, and the existence of procedures in management. Subandowo D (2022) also added that educational technology is a system that is used to support learning, so that the desired results are achieved. Thus, through the explanation of the two experts, it can be concluded that educational technology is a combination of humans, hardware (machines), ideas, and management procedures that have the goal of simplifying or improving the quality of education. According to Leliavia (2023), Augmented Reality is one of the educational technology innovations that supports learning in the classroom.

According to Rachman et al. (2022) in Maharani et al. (2025) and Sari et al. (2025), Augmented Reality is an application that combines the real world with the virtual world in two-dimensional or three-dimensional form and is realized in a real environment, thus creating a learning experience that seems to be experienced directly. In addition, the results of research conducted by Carolina (2022) state that the use of AR in social studies learning can increase learning motivation. Likewise, research conducted by Nuraini et al. (2024) states that the use of AR in Biology subjects can provide interactive and immersive learning experience, which allows students to directly visualize and interact with objects that cannot be done by traditional methods in general. However, its implementation still has several obstacles or challenges. According to Leliavia (2023) his research at SMP Negeri 5 Sekadau Hulu, West Kalimantan, found that there are still many who have not created and used AR for learning activities, not all educators have the ability to create and operate AR because AR media emphasizes digital and technological mastery, and Augmented Reality uses android technology so it is difficult to be used by students with low economic levels and schools located in disadvantaged areas. Sari et al. (2025) also added that most teachers are not familiar with AR-based learning designs, schools in non-urban areas experience limited devices and internet connections.

While most previous research has focused on the development of AR media and its impact on student learning outcomes, the teachers' perspectives, particularly regarding readiness, perceptions, and practical challenges in implementation, remain relatively underexplored. The success of educational technology utilization is determined not only by the availability of devices but also by teachers' acceptance and perceptions of the technology. Based on the aforementioned research findings, and considering the benefits and emerging issues, the authors conducted this study to determine teachers' perceptions of the use of AR in the learning process in Macedonian private schools.

This research is in accordance with the areas found in educational technology, namely the utilization area. Mundir (2022) explained that the utilization area can be seen as the beginning of the preparation of content, materials, and learning systems

that have been previously designed through the learning planning design. By referring to the utilization area, AR should provide benefits or contribute to the world of education. Therefore, this is in accordance with the statement by Subandowo D (2022) that educational technology is able to support learning, so that the desired results are achieved.

Methods

This study uses the TAM Model. "TAM is a theoretical model that aids in explaining and predicting information technology user behavior" (Legris et al. in Tarumingkeng, 2024). It means that TAM (Technology Acceptance Model) is a model used to explain and predict a person's behavior towards technology. Arianto et al. (2020) also stated that research with the TAM model focuses on four variables to be analyzed, namely Perceived Usefulness (PU) which is the extent to which AR is considered useful, Perceived Ease of Use (PEU) as the extent to which AR is easy to use, Attitude Toward Use (ATU) as one's attitudes towards using AR, and Intention of

Use (IU) which is one's intention to use AR in the future. In addition to the TAM model, this study employed an FGD approach. Wijaya & Perdana (2023) stated that Focus Group Discussion (FGD) is a systematic process of collecting qualitative data and information on a problem through group discussions. Therefore, research using TAM and FGD allows for in-depth and open information acquisition. The advantages of FGDs according to Tarumingkeng (2024) are in-depth data, time efficiency, demonstrating how individual views are influenced by the opinions of others, and flexibility because it can be used in various contexts and research topics. Furthermore, Bisjoe (2018) in Waluyati (2020) supports this stating that the FGD method can provide more extensive, informative, cost-effective and greater amount of data in a shorter time. This motivated the author to use FGDs as a data collection method.

The stages of FGD implementation carried out by the author according to Tarumingkeng (2024) are as follows.

- Determining the objectives of the FGD: To find out teachers' perceptions of the use of AR.
- Determining participants: The informants were selected using purposive sampling techniques and consisted of six people. The ideal number of FGD participants mentioned by Tarumingkeng (2024) is 6-12 participants. The research informants consisted of one elementary school teacher, one high school teacher (Sociology), and four junior high school teachers (Science, Physical Education, English Language and Bahasa Indonesia). Informants were selected based on their willingness or readiness to be interviewed or share their experiences, their knowledge or experience in using AR, and their accessibility due to proximity.
- Developing a discussion guide: the FGD was moderated by the author, with a question guide based on TAM. The activity began with a reintroduction of AR (the author re-explained her practice of teaching Pancasila in class), starting a light discussion, then the main topic and closing.

- Determining the place and time: The FGD was held on October 17, 2025 at Makedonia Private School involving elementary, middle and high school departments.
- Prepare logistics: Stationery (result notes), documentation (photos) and snacks to create a comfortable atmosphere.

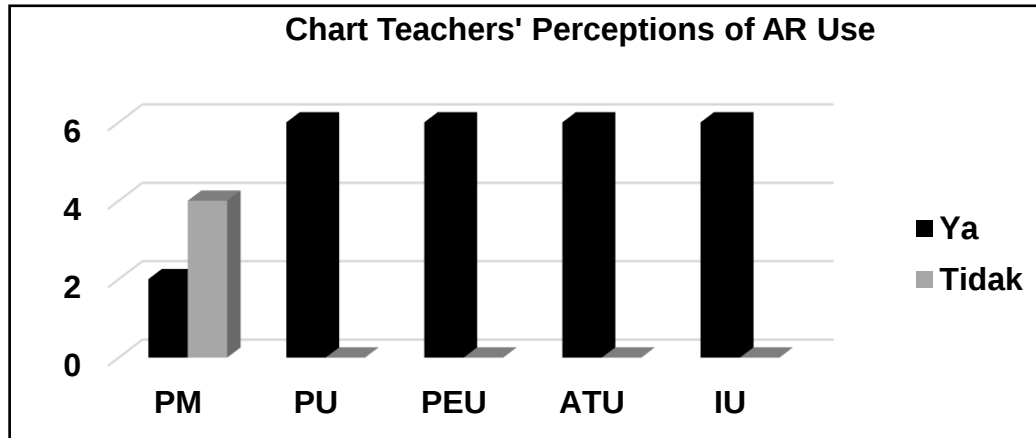
The FGD stages served as the researchers' reference for obtaining data from informants through interviews and discussions, resulting in qualitative data for later analysis. Furthermore, the data analysis technique used was qualitative analysis using the Miles and Huberman model. According to Sugiono (2018) in Kase et al. (2023), the Miles and Huberman model has four stages: data collection, data reduction, data display (using codes), and drawing conclusions. The data obtained were then validated by (1) source triangulation, namely comparing the results of discussions between informants and linking them to relevant literature, (2) member checking, namely asking informants to review (check) the summary of the FGD results to ensure the appropriateness of meaning and interpretation, and (3) inter-code reliability, carried out by involving another researcher to match the coding results on some of the data with the results of the analysis description. After the data was collected and reduced (in the form of codes), the data was then presented in the form of tables and graphs and then conclusions were drawn.

Results And Discussion

Based on constructivist learning theory where individuals actively construct their own understanding and knowledge through direct experience, this opinion aligns with the following statement: "Learning is best when individuals actively construct their own understanding " (Pritchard, 2009). This is what is done by the teachers who served as participants of this research. Informants directly shared their experiences based on what they have done regarding the use of AR through focus group discussions (FGDs). The results of the study showed that two informants had used AR and four informants had never used AR in classroom learning. However, each informant had a good understanding of the meaning and benefits provided by AR. Informant IA-S said that "I know that Augmented Reality or AR is a technology that can display 3D images or objects in the real world through a cellphone camera or other device." In addition, informant IP-Ig also said that AR is an additional reality, which is a technological application that can make an object/thing appear real. This is certainly in accordance with the understanding expressed by Maharani et al. (2025), Sari et al. (2025) and Pranata et al. (2023) which states that AR is a technology that integrates digital media with the real-world environment through the use of digital visual objects, sounds and stimulus sensors delivered using technology. Five informants learned about AR through independent learning, while one informant (IA-S) learned about AR after attending a presentation by a teacher explaining how to use AR in high school. The following table shows the results of the FGD analysis with six informants using

the TAM model to determine teachers' perceptions of the use of AR in the learning process in elementary and secondary schools.

Table 1. Teachers' Perceptions of AR Use



Tabel 2. Graph of Teacher Perceptions of AR Use

TAM	INFORMANT					
	ID	IP-O	IP-In	IP-Ig	IP-A	IA-S
PM	✓	-	-	-	-	✓
PU	✓	✓	✓	✓	✓	✓
PEU	✓	✓	✓	✓	✓	✓
ATU	✓	✓	✓	✓	✓	✓
IU	✓	✓	✓	✓	✓	✓

Information:

- PM : Ever Used
- PU : Perceived Usefulness
- PEU : Perceived Ease of Use
- ATU : Attitude Toward Use
- IU : Intention of Use
- ID : Elementary School Teacher Informant
- IP-O : Junior High School Teacher Informant (PJOK)
- IP-In : Junior High School Teacher Informant (Indonesian)
- IP-Ig : Junior High School Teacher Informant (English)
- IP-A : Junior High School Teacher Informant (Science)
- IA-S : High School Teacher Informant (Sociology)

To better understand the results of the FGD conducted, below is a graphic image.

Six informants stated that AR is very beneficial in learning (PU). The benefits include increased conceptual understanding, learning motivation, and student engagement. Using AR can provide a tangible representation of concepts that are

difficult to explain with text or images alone. These findings align with research by Carolina (2022) and Nuraini et al. (2024), which showed that AR can increase student interest and understanding. Therefore, the high PU demonstrated by the informants indicate a positive attitude toward AR use. Teachers consider AR not only a visual aid but also a tool that can enrich the learning experience. This all depends on the teacher's readiness to use AR (IP-In). If they haven't mastered it, it may not be effective and efficient in its implementation. Research results related to ease of use (PEU), six informants stated that using AR was quite easy. Five informants stated that using AR technology did not require much skill because it only requires basic skills in operating digital devices such as mobile phones or tablets. Furthermore, one informant must have an open attitude to learn (IA-S). Meanwhile, one informant felt hesitant because she had never tried it (IP-In) in the classroom learning process and needed a mentor. Within the TAM framework, perceived ease of use (PEU) not only impacts usage intention but can also enhance perceived usefulness (PU). Teachers who perceive AR as easily accessible tend to rate the technology as more useful. Therefore, this finding reinforces the notion that PEU is a crucial factor in developing positive attitudes toward technology.

The attitude (ATU) and intention (IU) aspects indicate that six informants are interested and want to use AR in future learning. This is in line with Masgumelar & Mustafa (2021) the theory of constructivism, which states that individuals who learn actively construct understanding/knowledge (not just receiving it from the teacher). Therefore, teacher involvement in the use of AR influences attitudes and motivation or future intentions in using AR. Six informants felt that the use of AR was very interesting, fun, and challenging because this technology provided a new, positive experience for teachers and students, increased student interest in learning, made the learning process more interactive and lively, and students became more focused on the material presented. In addition, six informants also had the intention to use AR in future learning. Two informants (ID and IA-S) who had used AR stated that using AR was proven to increase student enthusiasm and understanding in learning and the results were positive for students. This is certainly in accordance with previous research conducted by Carolina (2022), Nuraini et al. (2024) and Sari et al. (2025) which stated that learning using AR can make classes fun, abstract material feels more real and increases student learning motivation. However, with the benefits provided, the results of the study also showed that the implementation in learning was quite difficult because it added the load on teachers in preparing the teaching media, required guidance/mentoring, as well as inadequate network and facilities/devices. Students who live in dormitories and do not bring mobile phones experienced obstacles when using AR. Informants also added that there is a need for regular training related to the use of AR or future technology training. This is in line with the opinion of Sari et al. (2025) who stated that infrastructure and technological readiness are important elements in the success of AR adoption.

Conclusion

Research on teachers' perceptions of the use of AR in the learning process in Elementary and Middle Schools with the TAM model and FGD approach shows that teachers understand the concept of the meaning of AR, teachers are interested (ATU) and intend (IU) to use AR in the future because it is quite easy (PEU), and teachers realize that the use of AR as a learning technology provides significant benefits (PU), but have not been able to use it regularly. This is because it adds to the burden of preparing teaching media before implementation in class, requires guidance/mentoring, lack of literacy, inadequate networks and facilities/ devices as the students who live in dormitories do not bring mobile phones so they experience obstacles when using AR. Therefore, it can be concluded that research using the TAM model and FGD approach is able to explore teachers' perceptions in elementary and middle schools on the use of AR in the learning process by looking at Perceived Ease of Use (PEU) and Perceived Usefulness (PU), which then influence the Attitude Toward Use (ATU) and Intention of Use (IU) of AR technology in the future. The application of TAM in AR adoption among teachers is able to contribute to academic studies, particularly by showing that the TAM model is relevant to understand the factors that influence AR adoption by teachers.

Practically, teachers are advised to use AR on abstract concepts and materials that cannot be explained with text, audio or images (not necessarily on every material/topic or even meeting) so that it is not too burdensome. Teachers can coordinate with the school regarding the provision of internet networks (Wi-Fi) and create a policy of bringing devices/cell phones for students who live in dormitories. In addition, schools also need to carry out training related to the use of AR and other technologies to further enrich and maximize the potential of teachers.

This study has limitations, specifically the small number of informants and the context of the study, which only covered one school. Therefore, generalization of the findings requires caution. The researcher recommends future researchers to use diverse research instruments and a larger number of informants to produce more valid and comprehensive results that are representative of the study population. Furthermore, future study can also use a mixed-methods approach or quantitative analysis to examine the relationships between TAM variables in more depth and generate more comprehensive data.

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