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Integrating Technology into Science Learning in Junior High School: Perspective of Teachers

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Abstract: Technology has a positive role in improving students' learning abilities. The teacher has the leading role in implementing technology in the classroom. This study aims to introduce technology that can be integrated into science learning and report the perspective of science teachers with different educational backgrounds in integrating technology into the learning process. The study uses a qualitative method by using interviews to collect data. The participants were selected randomly from the Association of Science Education Teachers in West Bandung, Indonesia. Six teachers chose to be interviewed based on different teaching experiences and educational backgrounds. The study found that science teachers with different educational backgrounds have different perspectives on the difficulty of teaching science concepts. But they have the same solution to this problem: integrating technology into the learning process. All participants in this study have experience integrating technology in learning but are the first experience in using AR technology. Various technologies are considered appropriate for integration into science learning, but AR technology that can visualize abstract concepts has the potential to be used more in education.

Keywords: Educational background; Perspective; Science learning; Technology

Introduction

Science is a subject that is often considered difficult by students. The rapid development of science and technology also affects education (Rahmat et al., 2022). It is a challenge for teachers in teaching and learning activities. Teachers must create an interactive and fun learning environment in the learning process.

Technology facilitates students to learn independently and explore their skills. In learning science, students must be equipped with real-life experiences (Karagozlu, 2018) and change abstract concepts into concrete (Fidan & Tuncel, 2019). Technology has the potential to provide exciting experiences. Integrating technology into learning science is necessary to develop students' thinking skills and improve their understanding and participation in learning (Cai et al., 2021).

Teachers have an essential role in integrating technology into the learning process because the success of this integration will affect the learning process and students' academic achievements (Rahmat et al., 2023). The innovative technology allows teachers to create a flexible learning environment to meet the different needs of students in their science learning (Kiryakova et al., 2018). Therefore, teachers must be aware of suitable technological capabilities for appropriate learning activities for students to learning achievements (Sahin et al., 2020).

The perspective of science teachers is crucial because they usually come from various educational backgrounds, such as physics, chemistry, and biology. The perspective of science teachers regarding scientific literacy has been carried out using a descriptive survey. The research results found various perspectives, and none were out of context (Budiman et al., 2021). No literature reviews science teachers' perspectives

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regarding technology integration in science learning. This study aims to report the perspective of science teachers with different educational backgrounds in integrating technology into the learning process. The research questions are: what is the difficulty in teaching science concepts to students? what is the experience of teaching using technology? and what technology is appropriate to integrate into science learning?

Method

This study uses a qualitative method using interviews to collect data. The study participant is the Association of Science Education Teachers in West Bandung, West Java Province, Indonesia. The participants attended training on integrating technology in science learning with the procedures shown in Figure 1.

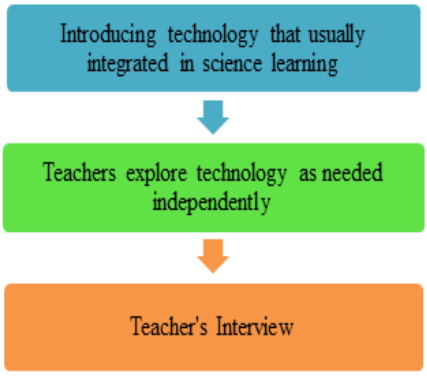

Figure 1. The procedure of the study

Figure 1 shows that the procedure in this study consists of three stages. The first stage introduces technology usually integrated into science learning, namely Mobile learning, Augmented Reality (AR), Physics Education Technology (PhET) simulation, and live worksheets. The next stage is that teachers are asked to independently explore technology according to their teaching needs in their class. Afterward, a teacher interview was conducted regarding technology integration in science learning. The study interview participants were selected randomly, and six teachers chose to be interviewed (Table 1). The selected participants have a teaching experience range of 5-8 years and represent each educational background to obtain a deeper understanding.

Table 1. The Participants of the Study

Educational Background	Number of Participants
Natural science	2
Biology	2
Physics	1
Chemistry	1

In the interview stage, the participants were given some questions that should be answered according to their experiences using technology for integration in science learning. There were three questions in the interview, and answering the question did not give limited time to answer every question. The audio-recorded data were converted into sentences that matched the actual data, so there was no change. Each participant's interview was given a unique code, where B, NS, P, C, and 01 stood for Biology, natural science, physics, chemistry, and the teacher's code, respectively. All texts from interviews were coded according to the purpose of the study (Basit, 2003). After converting the audio into a sentence, the most relevant sentence was selected to answer the research question.

Result and Discussion

Results should be clear and concise. The discussion should explore the significance of the results of the work, not repeat them. A combined Results and Discussion section is often appropriate. Avoid extensive citations and discussion of published literature.

Difficulty in Teaching Science Concepts to Students

The six teachers interviewed stated they had found it challenging to teach science concepts to students. The answers of science teachers with various backgrounds are as follows:

B01: *I have difficulty explaining the human body's concept of cells and systems in the human body. The concept is difficult for students to imagine because they have never seen it directly.*

B02: *Students often do not focus and get bored easily in science learning. There are many abstract concepts in science, so it is difficult for teachers to visualize them, such as the solar, atomic, and human body systems.*

Two biology teachers said they have difficulty teaching the human body concepts. The system includes the human circulatory, excretory, respiratory, and reproductive systems. In addition, science teachers also have difficulty teaching solar systems and atomic concepts, which are difficult for students to imagine. Students have not seen these human body systems, making it hard for them to imagine. According to previous studies, AR explains new concepts using 3D simulations that present the workings of the human system, facilitating students' imagination (Hilty et al., 2020). Therefore, it is suitable to be implemented for understanding biological concepts.

C01: *In natural science includes physics, biology, and chemistry, and there are several abstract concepts. But the most difficult to teach is physics because there are many abstract concepts, like electricity, magnetism, and waves. Although these concepts are often applied in everyday life, students find it difficult to understand when taught conceptually. If given a contextual (real life) example, then students will be easy to understand*

A science teacher with a chemistry educational background expressed difficulty explaining abstract concepts found in physical materials such as electricity, magnetism, and waves. Although the concept is often applied daily, students have difficulty understanding the science concept. Previous studies showed that AR could help teach magnetism to improve student learning outcomes (Liu et al., 2021). Magnetic lines could be visualized to increase students' representation abilities (Faridi et al., 2021). Similarly, sound waves are found in everyday life using musical instruments. They could be visualized using AR to increase students' understanding and ability to represent images and graphics (Muliyati et al., 2019). Electrical material is also complex and requires AR because it has risks when used in the classroom (Alkurdi, 2019).

NS02: *Teaching science in junior high school includes physics, chemistry, and biology, which are difficult to teach students. Sometimes students are asked to imagine science concepts. Students are invited to imagine a solar system that has never been seen before. Another example is teaching sound wave concepts, whose waves cannot be seen but can be heard. So, contextual-based learning is needed to make the student understand the concept easier.*

NS01: *Science is an exact subject that students rarely like, so it becomes a challenge for teachers. Students do not like learning science, especially physics, because there are mathematical calculations where students' mathematical abilities are still lacking. In addition, students find it difficult to imagine objects that have never been seen before where students' imaginative skills are still low.*

The science teacher with a linear education background stated that teaching science to students is challenging because most students don't like science because there are a lot of calculations. Students claim that lessons related to math are difficult subjects. In addition, students' imagination skills are still low, and sometimes students are asked to imagine science concepts that have never been found before. The science teacher stated contextual-based learning is important to enhance students' understanding of concepts. This statement aligns with previous research, which found that contextual learning is essential to be implemented in science learning (Sudarmin et al., 2019).

P01: *Physics in science learning is challenging to explain, especially phenomena students have not found before. But it can be explained using examples of phenomena in the surrounding environment that students usually encounter. I think microscopic materials such as cells are the most difficult to explain to students.*

As a part of science education, physics was claimed to have a lot of difficult concepts to understand. Science teachers with educational backgrounds in physics stated that phenomena that are difficult to explain could be overcome by bringing these phenomena into the classroom. Using prototypes of phenomena to facilitate students' imagination. But the teacher finds it difficult to explain microscopic materials like cells.

Previous studies found AR suitable for explaining micros invisible to the naked eye (Scarles et al., 2020). Cell learning using AR increases students' motivation and improves their analytical skills (Yildirim, 2020). The biology teacher also encountered another problem explaining the abstract solar and atomic systems. In line with this, previous studies found that learning the solar system using AR could help students visualize abstract concepts (Sahin et al., 2020). Atomic systems are microscopic matter and abstract concepts that could be visualized using AR to realize better learning outcomes among students (Ewais & Troyer, 2019).

From several statements of science teachers related to the difficulties in teaching science concepts, they were asked, "How to solve these difficulties?". Four teachers suggested using video to provide concrete visuals to students. And two teachers suggested using experiments in the laboratory so that students can find the phenomenon directly.

Experience Teaching Using Technology

The six interviewed participants found they had experience teaching using technology in the learning process. Then, participants were asked, "What is the effect of integrating technology on student learning achievement?". The answers from the participants are as follows:

P01**:** *Students are more enthusiastic about learning, so learning achievement is better when using technology.*

B01: *Students are more active in asking questions in the learning process and fast to understand science concepts.*

C01: *Students have a significant change in learning achievement when using technology and helping students to understand science concepts better.*

NS01: *Using technology can provide better learning achievement for students.*

The four teacher statements regarding the effect of technology on student learning achievement showed that teachers agree that technology can improve student learning achievement. In addition, it was also found that students were more enthusiastic by asking many questions in the learning process and helping students understand science concepts. These results support previous studies that technology affects students' enthusiasm and interest during learning and increases their curiosity (Onyema et al., 2019).

The study found that students were more active in asking questions and understanding concepts faster. This shows that technology creates an enjoyable learning environment, making students feel comfortable channeling their curiosity by asking questions (Hochberg et al., 2018). Furthermore, technology facilitates students to understand detailed science concepts by providing more explanations, increasing students' curiosity and learning outcomes (Rahmat et al., 2023). It also facilitates visualizing abstract concepts.

B02: *Technology can provide better visualization of science concepts.*

Biology teachers stated that technology could help better visualize science concepts. In addition, the use of technology also has drawbacks, such as the following teacher statement:

NS2: *Using technology in science learning needs to add more time until students understand how to use the technology. As for learning achievement, there has changed for the better.*

Natural science teacher states that using technology is not as easy as imagined because it will take a lot of time to explain the use of technology to students. Although technology positively affects learning achievement, teachers must focus on time management. However, much time is required to teach students how to use technology for the first time, necessitating integrating technology into learning to enhance their understanding. In line with this, previous studies found that technology-based learning improved students' outcomes (Fidan & Tuncel, 2018).

Appropriate Technology to be Integrated Into Science Learning

The following answers relate to the research question regarding appropriate technology to integrate into science learning**.**

P01: *In learning science, many phenomena need to be simulated so students can easily understand them, so PhET simulation is suitable for use. On the other hand, AR technology is a technology that is new to me. However, this technology has the potential to be applied in science learning, especially with 3D simulations that can visualize abstract concepts into concrete ones.*

B02: *In science learning, many abstract concepts are difficult to explain to students, so AR technology suits this problem. For practicum activities, students can use Live Worksheets to fill out worksheets.*

C01: *There is an increase in smartphone ownership among students, so the current technology is mobile learning. Our job as teachers is to prepare good content so students can easily understand it. Besides that, I also have an interest in AR technology. This is the first time I have heard the term technology, but I hope this technology can be widely used in education, especially in science, with many abstract concepts. The results will be more optimal if mobile learning is combined with AR technology.*

NS01: *In my opinion, the most suitable technology is the one that fits the needs of the material to be taught. For example, when teaching the solar system, students have never seen the object before, so a simulation or image is needed to visualize the object, such as AR technology. To make understanding the relationship of mathematical equations easier, you can use PhET simulation.*

Based on the statement above, the four teachers with different educational backgrounds have the same perspective regarding AR technology which is appropriate for integration in science learning. AR could facilitate abstract science concepts and make learning contextual. The technology's 3D simulation helps visualize abstract concepts (Olim & Nisi, 2020). Furthermore, it has the potential to be used in learning to increase students' motivation and create a more contextual environment where real concepts are visualized. AR technology could help overcome boredom among students, increasing their curiosity (Rahmat et al., 2023).

Furthermore, science teachers with educational backgrounds in physics and natural sciences also consider that PhET simulation is appropriate for application in science learning. Previous research stated that PhET simulations improved student learning of science concepts (Prima et al., 2018). Other technologies that are considered suitable are also live worksheets which have the potential to make it easier for teachers to present worksheets and create contextual learning (Sulistyowati & Syar, 2021). Also, the chemistry teacher stated that mobile learning is the right technology to be

integrated into science learning, seeing the increase in smartphone ownership among students. Mobile learning is appropriate for science learning (Rahmat et al., 2023). Also, implementing mobile learning will significantly impact student learning achievement (Criollo-C et al., 2021).

Conclusion

Technology has a positive impact on student learning. Science teachers with different educational backgrounds have different perceptions of integrating technology into learning. Science teachers with various educational backgrounds have different perspectives on the difficulty of teaching science concepts. But they have the same solution to this problem: integrating technology into the learning process. All participants in this study have experience integrating technology in learning but are the first experience in using AR technology. Various technologies are considered appropriate for integration into science learning, but AR technology that can visualize abstract concepts has the potential to be used more in education. The limitation of the study is a small sample size and limited area coverage (West Bandung only). Future research can conduct an in-depth analysis of the potential of each technology considered appropriate for use in science learning.

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Author Contributions

ADR discovered problems regarding integrating technology in learning, compiled research instruments, interviewed, analyzed data, and built manuscripts. HK and IW reviewed and monitored the research progress and provided input on the research. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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