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Application of the TPACK approach to improve science learning outcomes in grade VI elementary school

Vera Mandailina[1*], Mega Oktyawati[2], Dewi Laksmi Nusa Rinjayani[1], Lina Hartika[1], Wahyu Lailatul Hikmah[1]
[1]Universitas Muhammadiyah Mataram, Jl. KH. Ahmad Dahlan, Mataram, West Nusa Tenggara, 83115, Indonesia
[2]SDN 15 Ampenan, Jl. Sultan Salahudin Batudawa, Mataram, West Nusa Tenggara, 83115, Indonesia
*vrmandailina@gmail.com

Abstract: *The purpose of this research is to describe the improvement of learning outcomes in grade VI students of Primary school 15 Ampenan through the TPACK approach. This research uses descriptive quantitative data analysis type, with classroom action research method, this research was conducted in two cycles, with a total of 13 students. Each cycle consists of action planning, observation, and reflection. Data collection techniques using tests. The results showed student learning outcomes in cycle I with a percentage of 69% learning completeness or 9 students who reached the minimum completeness criteria out of 13 students and in cycle II presentation of learning completeness of 85% or 11 students out of 13 the total number. The results of this study are expected to be used as a reference by teachers at school to apply the TPACK approach.*

Keywords: *TPACK Approach; Improved Learning Outcomes.*

Introduction

Technology development has benefits that if utilized optimally in the development of education will improve the quality of learning in schools (Harini, Wahyuningtyas, Sutrisno, Wanof, & Ausat, 2023). Using technology in education can provide greater access to learning resources, facilitate innovative teaching methods, and expand interactions between teachers and students (Anshori, 2018). This is also in line with Ki Hajar Dewantara's idea of educating children in accordance with the nature of nature and the nature of the times (Yanuarti, 2018). Technology integration in the learning process can increase student engagement, presenting learning content more dynamically and interestingly. In addition, the use of online learning platforms, interactive learning resources, and educational applications can help students develop digital skills that are relevant to future demands (Said, 2023). This is in line with the opinion (Hariyadi & Hariyati, 2020) that the use of technology-based learning facilities can affect student learning outcomes.

Student learning outcomes are changes in behavior in a person that can be observed and measured in the form of knowledge, attitudes, and skills (Suhendri, 2011). These changes can also be interpreted as an increase and better development from not knowing to knowing. In addition, learning outcomes are the overall learning achievement of students which is an indicator of competence and changes in the behavior of the students themselves (Syafi'i et al., 2018). The competencies that students must master need to be stated in such a way that they can be assessed as student learning outcomes which refer to direct experience (Kusuma & Nisa, 2019). Good learning outcomes can be obtained through effective learning (Kristin, 2016). One of them is using technology in learning, such as applying the TPACK approach.

Technological Pedagogical and Content Knowledge (TPACK) or knowledge of learning content or material, pedagogy, and education technology is a framework concept that synergizes the use of technology in the learning process (Ulya et al., 2023). Pedagogy and

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Technology Content Knowledge (TPACK) is a framework that harmonizes knowledge of learning content or materials, pedagogy, and technology in the learning process (Huda et al., 2017). The concept creates synergy between strong content understanding, effective learning strategies, and appropriate utilization of technology to enhance the learning experience. (Angeli & Valanides, 2009) By integrating these three elements, TPACK helps educators develop a holistic approach to teaching, ensuring that technology is used in a relevant manner and supports the achievement of learning objectives (HAYATI, 2022).

TPACK, or Pedagogical Content Knowledge and Technology, brings a holistic concept to education (Wardani, 2022). Through the integration of these three elements, educators can develop a holistic approach to teaching. With a strong understanding of learning materials (Content Knowledge), expertise in teaching (Pedagogical Knowledge), and wise use of technology (Technological Knowledge), TPACK ensures that technology is not only used as an additional tool but also relevantly supports the achievement of learning objectives (Evi Fatimatur Rusydiah, 2019). This approach creates a learning environment that is dynamic and responsive to technological developments, helping to create a more effective and meaningful learning experience for students.

The application of the TPACK approach is one way to achieve learning objectives that can improve student learning outcomes in the classroom (Purwaningsih, Nurhadi, & Masjkur, 2019). The integration of technology in learning is now becoming important over time (Setyawan, Makkasau, & Syahrani, 2022). Improving student learning outcomes through the TPACK approach has a positive influence, namely it can improve student learning outcomes (Wati & Nafilah, 2020).

TPACK is founded upon three main components: Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK). Technological Knowledge (TK) refers to educators' understanding of hardware and software tools that can be utilized in learning, enabling them to select suitable tools and integrate them effectively in the classroom. On the other hand, Pedagogical Knowledge (PK) involves an understanding of effective teaching strategies, allowing teachers to design engaging learning experiences and support student development (Jacob, John, & Gwany, 2020). Meanwhile, Content Knowledge (CK) is teachers' understanding of the subject matter they teach, enabling them to deliver information clearly and provide relevant context for students. When these three components are integrated within the TPACK framework, educators can create dynamic and relevant learning environments, utilizing technology as a tool to enhance teaching and facilitate deep content understanding for students.

The TPACK approach creates a learning environment that is dynamic and responsive to technological advances (Nelson, Christopher, & Mims, 2009). By aligning Content Knowledge, Pedagogical Knowledge, and Technological Knowledge, educators can produce effective and meaningful learning experiences for students (Rochaendi et al., 2021). In this context, technology is not just an additional tool, but an integral part of the teaching strategy that supports the achievement of learning objectives. Thus, this holistic approach not only enables adaptation to technological change but also enhances the quality of learning, equipping students with relevant skills to face the changing world.

Based on observations in grade VI elementary schools, in the learning process, the use of technology is still not maximally utilized because, in the learning process, most of them use the reading and writing learning style so learning has not been carried out effectively where students appear to have low learning motivation which affects student learning outcomes. This is in line with the opinion (Pratama et al., 2019) that there is an effect of student learning motivation on science learning achievement in elementary schools. Learning is less interesting

because the application of technology is only used to find material by students, the results of observations also show that teachers learning science in the classroom have never applied technology-based learning (Dwiqi et al., 2020).

With the TPACK approach in learning, teachers streamline pedagogical practices and concept understanding by integrating technology (Koehler, Mishra, & Cain, 2013). The technology used can be laptop, LCD projector, video, smart phone, and internet. The TPACK approach aims to develop teachers' creativity and skills in using technology in learning and to improve students' learning experience. The use of the TPACK approach in learning trains and improves students' learning experience in the use of technology, however, this TPACK approach is also tailored to the background of students. With this approach, it is expected that students are more motivated and more active in learning so that the learning outcomes obtained increase and learning objectives can be achieved. The purpose of this study was to determine the improvement of learning outcomes through the TPACK approach in Class VI Elementary School Students.

Research Method

This research uses the Classroom Action Research (PTK) method to overcome problems in classroom learning. The focus of the research is to describe the application of the TPACK approach in classroom learning to improve student learning outcomes. The main objective of this PTK is to increase or improve student learning outcomes and the practice of the learning process in the classroom.

According to the conception of action research proposed by Kemmis and Taggart, the research process runs in cycles consisting of planning, implementation, observation, and reflection stages. This cycle is based on the approach proposed by Kemmis and Taggart (in Rochiati, 2006: 66). This classroom action research was conducted with the subject of grade VI students of elementary school 15 ampenan, which was carried out in November 2023, during the odd semester. Data collection was carried out through giving tests to students, which aims to measure students' abilities or learning outcomes after applying certain actions. Data analysis in this study uses a descriptive quantitative approach, which describes changes in student learning outcomes whether they reach scores above KKM or exceed 65. This analysis is used to analyse whether there is an increase in student learning outcomes through the TPACK approach. To find the average value of students can use the formula:

$$\textbf{Average Score} = \frac{Number\ of\ scores}{Number\ of\ students}$$

The results of the score calculation are categorised into learning completeness with the criteria of Completion and Incompletion, as follows:

Table 1. Criteria for Student Learning Completeness

Criteria for Completion	Qualification
<65	Not completed
≥65	Completed

The research can be said to be successful if it can achieve the indicators set in this study, namely student learning outcomes after participating in learning with the TPACK approach reaching 65% at the KKM score.

Result and Discussions

The researcher obtained data from 2 research cycles. The last cycle of research applied the TPACK approach in learning in class VI SDN 15 Ampenan. Cycle 1 on Thematic learning, Cycle 2 on Thematic learning. Both cycles were carried out at SDN 15 Ampenan grade VI with a total of 1375 students who focused on applying the TPACK approach to learning. Cycle 1 research on Theme 5 Subtheme 2 Learning 3, cycle 2 research on Theme 5 subtheme 3 Learning 3. The competencies taken in this study are student learning outcomes in science learning in the classroom.

This Classroom Action Research was carried out in 2 cycles and each cycle consisted of 4 stages of activity. The activities include the planning stage, the action stage, the observation stage, and the reflection stage. The results of classroom action research consisting of 2 cycles using the TPACK approach to learning are as follows:

Cycle 1

Research in cycle 1 was carried out in 4 stages

a. Planning Stage

1. Researchers make lesson plans which will be applied in the teaching and learning process.
2. Researchers designed learning strategies and scenarios that would be implemented using the TPACK approach.
3. Researchers determined the indicators of success in learning.
4. Researchers compiled research instruments for the data collection process consisting of assessment and observation sheets.

b. Stages of Action Implementation (Acting)

After carrying out the planning stage, the researcher carried out the action implementation stage. The activities of researchers at this stage are:

1. Researchers explain the learning objectives that will be provided to students.
2. Researchers conducted learning activities using the TPACK approach. In this case, the teacher carries out the learning process using IT such as laptops, projectors, Microsoft PowerPoint, and learning videos.
3. Researchers provide evaluation questions that are used for assessment.

Cycle 1 learning was conducted on Friday, November 17th. The learning implemented was thematic learning with the content of Science (IPA) and Social Studies (IPS). In this learning session, the researcher applied the TPACK approach. With the TPACK approach, the researcher integrated technology into the learning process. The technologies used included a laptop, LCD projector, Microsoft PowerPoint, instructional videos, and an active speaker.

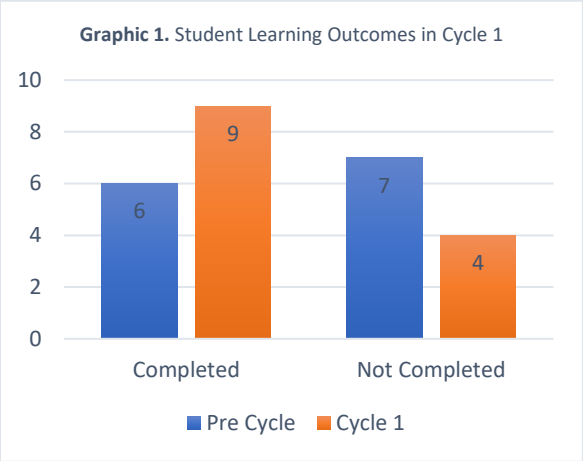
In this learning session, the teacher employed an integrative thematic teaching model with the TPACK approach. At the beginning of the learning session, the teacher initiated the lesson by greeting the students, inquiring about their well-being, taking attendance, praying, stating the learning objectives, connecting the lesson content with previously learned material, and providing an introduction to the students.

During the core learning activities, the first content covered was Social Studies (IPS). The teacher asked the students, "Have you observed the efforts around you?" The use of a laptop in teaching and presenting the material through PowerPoint slides is one of the integrations of the TPACK approach in the learning process.

In this learning process, diverse approaches and methodologies are utilized to effectively engage students and facilitate their understanding of the subject matter. Firstly, there's an integration of subjects between the topic of "Export-Import Activities" and the Science topic of "Magnets." This integration aids students in seeing the relationship between scientific concepts and real-world contexts. Secondly, there's the integration of technology (TPACK) with the use of PowerPoint as a presentation tool. PowerPoint is employed to deliver instructional content, including videos and visual aids, enhancing the presentation and comprehension of the material. Thirdly, active learning strategies are employed by avoiding conventional teaching methods and adopting a more interactive approach. This encourages student participation and engagement throughout the session, promoting a deeper understanding of the material. Fourthly, collaborative learning occurs through question-and-answer sessions and worksheet activities, where students work together with the teacher to discuss and comprehend the material. Fifthly, to assess the achievement of learning objectives, students work on evaluation questions. Formative assessment techniques provide ongoing feedback to both students and teachers, aiding in monitoring progress and adjusting instruction as needed. Sixthly, reflective practice is conducted through shared reflection on the learning experience, summarizing learning, and concluding with a prayer. Reflection fosters metacognition and helps students consolidate their learning while also providing an opportunity for spiritual or personal growth. Finally, the session is concluded with a closing greeting, reinforcing a sense of closure and connection within the learning community, providing a positive end to the lesson, and leaving students feeling valued and motivated.

c. Observation Stage (*Observing*)

In this stage, the researcher observes and records all data and information during the action research learning process, determining whether the teaching process aligns with the established plan. Evaluation is conducted in this stage to assess the level of students' achievement in the expected learning outcomes. The table below shows the learning outcomes in Cycle I:



Based on Graphic 1, the list of pre-cycle learning outcomes indicates that the average score of students is 60 with 13 students. Out of these, 6 students, or 46%, have completed the learning objectives, while 7 students, or 54% have not. In Cycle I, the average score is 69 with 13 students. Among them, 9 students, or 69%, have completed the objectives, while 4 students, or 31%, have not. From this data, it can be observed that the student's learning outcomes have not yet reached the success indicator, which is a 70% completion rate.

d. Reflection Stage (*Reflecting*)

In the reflection stage, the activities involve a comprehensive review of the actions taken. This stage includes evaluation assessments, analysis of learning outcomes, and discussions based on the acquired data. If the students' learning outcomes are still low improvements are made in the next cycle. Evaluation is a process conducted to measure the continuous achievement of students' competencies in the learning process. It aims to monitor progress, make improvements to the learning process, and determine the success of students' learning. Evaluation activities are conducted periodically to measure students' competency achievement after completing one or more Basic Competencies (KD). Continuous assessment by teachers is aimed at monitoring the process and progress of students' learning and improving the effectiveness of learning activities.

By conducting evaluation activities, teachers can determine the level of achievement of learning objectives, identify students who have and have not mastered the learning objectives, and assess the appropriateness of the materials and methods used. After that, teachers provide feedback to students based on the evaluation results. In Cycle I of the TPACK approach, students appeared interested and found it easier to absorb the presented material. This is evident from the average learning outcome of 69%. Nine students, or 69%, achieved learning mastery, while four students, or 31%, did not. Therefore, based on this data, improvements are necessary for Cycle II.

Cycle II

In conducting classroom action research, researchers carried out the same four stages of the learning activity process in cycle II as in cycle I, which consisted of 4 stages, namely

planning, implementation, observation, and reflection. The details of the four stages are as follows:

a. Planning Stages (Planning)

1) Researchers make lesson plans that will be applied in the teaching and learning process.
2) Researchers designed learning strategies and scenarios that would be implemented using the TPACK approach.
3) Researchers determine indicators of success in learning.
4) Researchers compiled research instruments for the data collection process consisting of assessment and observation sheets.

b. Stages of Action Implementation (Acting)

After carrying out the planning stage, the researcher carried out the action implementation stage. The activities of researchers at this stage are:

1) Researchers explain the learning objectives that will be given to students.
2) Researchers conducted learning activities using the TPACK approach. In this case, the teacher carries out the learning process using IT such as laptops, projectors, Microsoft PowerPoint, Smart Phones, learning videos, Wordwall, and Quizizz.
3) Researchers provide evaluation questions that are used for assessment.

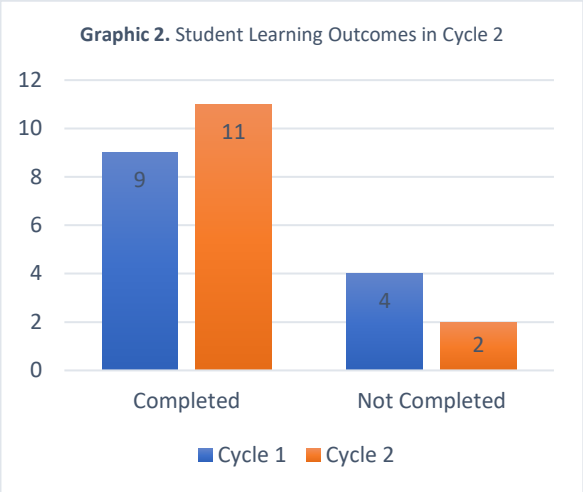
Cycle II learning was carried out on Wednesday, November 29, 2023. The learning that was carried out was Thematic learning, with the learning content of the Indonesian Language, Science. In Indonesian language learning, learning is carried out by applying the TPACK approach, which integrates technology into learning. Researchers carry out the learning process using Technology (IT) such as laptops, projectors, Microsoft PowerPoint, videos, and speakers.

In this lesson, the teacher as a researcher used a problem-based learning model. In this lesson, the teacher carried out the learning by applying the syntax of the learning model used. In the core activities, the first learning content is Indonesian language content with learning material "filling out forms." Teachers as researchers use PowerPoint and learning videos to reinforce students. The second learning material content, namely science content with the subject matter "the kinds and properties of magnets."

Teachers use learning videos in exploration activities by asking questions to students related to learning materials. The use of smartphones is one of the uses of technology (IT) in the TPACK approach. From these activities, students find it easier to find information. In addition, teachers as researchers use learning videos in demonstrating magnetic properties and evaluation. After the content of the learning material is carried out, students work on evaluations using smartphones with Wordwall and Quizizz applications to measure the success of learning and outcomes.

c. Observing Stages (*Observing*)

At this stage, researchers observe and record all data and information in the learning process during action research, so that they can find out whether the learning process is by the design that has been made or not. At this stage, an evaluation was carried out to know the level of achievement of student learning outcomes expected in the learning. The following is a table of learning outcomes in cycle II:



Based on Graphic 2, the list of learning outcomes in cycle I shows that the average student score is 69 with 13 total students, where 9 or 69% of students are complete, and 4 or 31% of students are not complete. In cycle II, it shows that the average score is 79 with 13 students, where 85% or 11 students are complete, while 15% or 2 students are not complete. From this data, it can be seen that the value of student learning outcomes has reached the student completeness indicator of 85%.

d. Reflection Stages (*Reflecting*)

In the reflection stage, the activities carried out are to thoroughly review the actions that have been taken. At this stage, the author conducts evaluation assessments, analyzes learning outcomes, and discusses the data that has been obtained. If student learning outcomes are still low, improvements are made in the next cycle.

Evaluation activities are a process carried out to measure the achievement of learner competencies on an ongoing basis in the learning process, to monitor progress, make learning improvements, and determine the success of learner learning. Evaluation activities are activities carried out periodically to measure the achievement of learner competencies after completing one or more Basic Competencies (KD). The assessment of learning outcomes by teachers is carried out on an ongoing basis, aiming to monitor the learning process and progress of students and to improve the effectiveness of learning activities.

After conducting evaluation assessment activities, analysing learning outcomes, and discussing the data obtained. If student learning outcomes are low, then improvements are made in the next cycle. Evaluation activities aim to measure the competence of students on an ongoing basis, monitor progress, improve learning, and determine the success of learning. Assessment is carried out periodically after completing one or more Basic Competencies. Teachers assess learning outcomes on an ongoing basis to monitor progress and improve learning effectiveness. Through evaluation activities, teachers can assess the achievement of learning objectives, determine student mastery, and evaluate the accuracy of materials and methods. In cycle II with the TPACK approach, students looked more active and proficient in absorbing the material presented, with an average learning outcome of 79, although it has

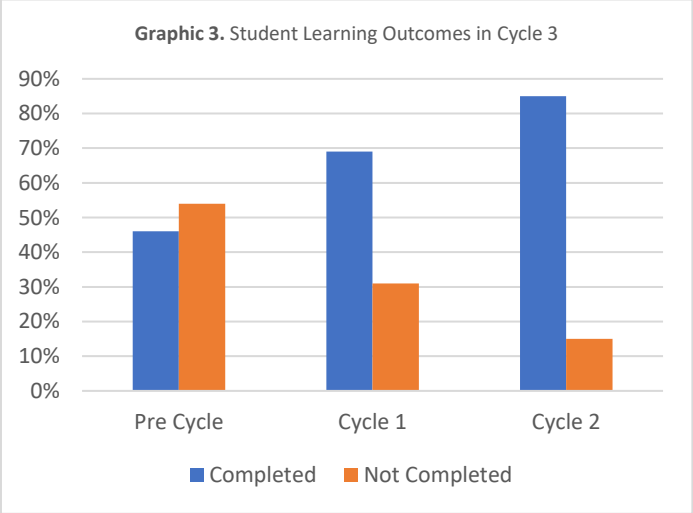
not reached 100% completeness. This classroom action research shows a correlation between the teacher's approach and student learning outcomes.

The Technological Pedagogical Content Knowledge (TPACK) framework emphasises the integration of technology, pedagogy, and content knowledge in teaching. The framework guides educators in effectively integrating technology into their teaching practices by considering how technology, pedagogy and subject matter interact and influence each other.

TPACK helps teachers make informed decisions in selecting appropriate technologies, designing engaging learning experiences, and assessing student learning effectively. By integrating technology with pedagogy and content knowledge, teachers can create meaningful learning experiences that can increase student engagement and achievement.

In the context of cycle I and II learning, the application of the TPACK approach involves strategically integrating technological tools and resources into lesson planning and implementation. This integration aims to improve teaching effectiveness and student learning outcomes by utilising technology to support pedagogical practices and deliver content in an engaging and accessible way.

Through the TPACK approach, teachers can meet diverse learning needs, encourage critical thinking and problem-solving skills, and foster a collaborative learning environment. By continuously reflecting on and refining their teaching practices, teachers can optimise the integration of technology, pedagogy and content knowledge to meet evolving student needs and improve learning outcomes.



Graphic 3. Student Learning Outcomes in Cycle 3

From Graph 3, it can be seen that there was a significant increase in the percentage of students' learning outcomes from pre-cycle to cycle II. In the pre-cycle, the percentage of completeness only reached 46%, which then increased to 69% in cycle I, and increased again to 85% in cycle II. These results show that the use of the TPACK approach in learning has been effective in improving the learning achievement of grade VI students of SDN 15 Ampenan.

During the learning process, the TPACK approach allows the integration of technology, pedagogy, and content knowledge to create a more meaningful learning experience for students. By using technology such as PowerPoint to present materials in a more interactive and engaging way, students become more involved in learning. In addition, the use of visual

aids such as videos can also facilitate the understanding of scientific concepts, such as the complex topic of magnets.

In addition, the active, collaborative, and reflective approach adopted during learning also contributed to the improvement of students' learning outcomes. Through question-and-answer sessions, group activities and shared reflections, students are encouraged to actively engage in the learning process to strengthen their understanding of the material. In addition, regularly conducted formative assessments provide valuable feedback to students and teachers, helping them understand their progress and areas for improvement.

Overall, the consistent improvement in student learning outcomes from pre-cycle to cycle II is clear evidence that the TPACK approach is effective in improving learning quality. By continuing to develop and implement learning strategies that are in line with this approach, it is expected that student learning achievement can continue to improve continually.

Conclusion

The results of the study concluded that the application of the TPACK approach had a positive impact on improving the science learning outcomes of grade VI students in elementary schools. It can be seen that before the application of the TPACK approach (pre-cycle), the percentage of learning completeness was 46%. After going through the first cycle, there was a significant increase to 69%, and in the second cycle, the percentage of learning completeness reached 85%. This shows that the TPACK approach is effective in improving students' understanding and skills in science subjects. Suggestions for Further Research involve developing learning materials that are more contextual and relevant to students' daily lives to increase the attractiveness and understanding of science concepts.

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