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Application of the TPACK Approach in Increasing Student Learning Activity Through the PBL Model in Mathematics Learning in Class V Elementary Schools

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A B S T R A C T

This research was motivated by the low learning activity of class V students at SDN 131/IV Jambi City. This research is classroom action research which aims to describe how the Technological Pedagogical And Content Knowledge (TPACK) approach is implemented in increasing student learning activity through the PBL model in class V of elementary schools. This research was carried out at SDN 131/IV Jambi City. The data in this research was obtained by observation and documentation. The data in this research was analyzed descriptively qualitatively. The research results show that applying the TPACK approach in the mathematics learning process can increase student learning activity. This increase can be seen in the data analysis for each meeting cycle, where for cycles I, meetings I and II, it was 65.74%, for cycles II, meetings I and II, it was 82.22%. Therefore, it can be concluded that the application of the TPACK approach through the PBL model can increase student learning activeness in mathematics learning in class V at SDN 131/IV Jambi City. This is proven by the increase in student learning activity in each cycle by using the TPACK approach through the PBL model.

1. Introduction

In the current era of globalization, humans and technology coexist, where all societal activities are not only centered on humans but are also based on technology (Susilawati & Khaira, 2021). Such conditions show that all human life activities are always related to technology. In line with this, current learning demands focus on developing critical thinking skills, problem solving, communication skills and ICT skills. According to Mutmainah & Julaeha (2021), the forms of ICT implementation as emphasized by the Ministry of Education and

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Culture's Pusdatin, namely optimizing the use of ICT for 21st Century Learning, implementing learning models by utilizing the Rumah Belajar portal, utilizing educational TV learning media, creating learning video media, and implementing classroom management models. integrating ICT in the Learning Environment. These learning demands are an opportunity for educators to be able to help, equip and bring students to become competent in accordance with the demands of 21st century learning.

According to Gusnarib & Rosnawati (2021) learning is a process of conscious effort carried out by individuals to change attitudes and behavior from not knowing to knowing, from not having an attitude to being correct, from being unskilled to being skilled at doing something. Or it can be said that learning is a period after a person goes through a process and then there is a change in himself and he gets a new experience. Teaching mathematics is not only in the form of educators conveying the terms and meanings and procedures for students to memorize, but what is included in teaching mathematics is a way for educators to involve students as active students in the learning process, whereas according to Anitra (2021) "learning mathematics" is one of the compulsory lessons in elementary school, in mathematics subjects there are subject materials that are related to each other and also as subjects that are related to other subjects in elementary school. This shows that mathematics is not just about learning how to count, but can also be applied to other subjects." Based on the description that has been presented, it can be concluded that mathematics is a lesson that must be taught or studied by elementary, middle and high school students. And in mathematics subjects, learning materials are obtained that are related to each other.

Student activity in the learning process plays a very important role in encouraging direct student participation which will enable students to gain experience and be able to develop cognitive, emotional and psychomotor aspects that are useful for their lives. The use of innovative student-centered learning models can be done to provide students with meaningful learning experiences and create an interesting impression, which will encourage them to actively participate in learning activities. These efforts can be made in order to increase student involvement in the learning process. According to Wibowo (2016) there are several ways to measure student activity, including solving problems, ability to pay attention, discuss, students' willingness to ask questions, be brave and listen.

Education is a learning process that includes an information network from educators to students and vice versa from participants to educators (Hanum 2023). Learning currently has characteristics that are student-centered, characteristics are defined as the qualities or characteristics of a person, while according to Asih (2021), characteristic means a special characteristic comes from someone or something. Each individual has different characteristics, therefore, in learning, a more appropriate learning approach or model is needed. This is very helpful in achieving the expected goals. In line with this, Mutia (2021) expressed the opinion that the characteristics of children at elementary school age consist of liking to play, happy to move, happy to work in groups, and finally, happy to feel

or do something directly. Therefore, educators must be able and able to choose from the many learning models that are appropriate to the material to be taught. The appropriate learning model at this time, especially in the 2013 curriculum, is a problem-based learning model, one of which is the Problem Based Learning (PBL) learning model.

According to Anugraheni (2018), the PBL learning model is a teaching model that emphasizes real-world problems and involves children in learning activities while in society, at school or at home, which is the basis for developing critical thinking and problem-solving abilities and knowledge. According to Irmita & Atun (2017) the learning model has 4 distinct characteristics that are not possessed by learning strategies or methods, including the logical theoretical basis designed by the teacher, the learning objectives to be obtained, the instructional stages needed to implement the model optimal learning, a learning environment is needed to achieve learning goals. Syamsidah & Hamidah (2018) argue that the PBL model is a model where students are given various problems to solve and are exposed to various principles of problem-based learning as part of PBL. Participants must be tough, independent, accustomed to taking initiative, and adept at using critical thinking to solve challenges.

Learning activities are designed to provide learning experiences that involve mental and physical processes through interaction in order to achieve basic competencies (Bella, 2023). Currently technology plays an important role in many aspects of education, this includes the role of technology in the learning process (Mairisiska et al, 2014). In the current era of globalization, humans have lived side by side with technology, where all social activities are not only human-centered but also based on technology. This condition shows that all human life activities are always related to technology. One of the demands of 21st century learning is the integration of technology as a learning medium to develop learning skills.

The rapid development of science and technology has a direct impact on human life, including in the field of education (Agusti, 2023). Students need to learn how to use technology that is essential for everyday life. Apart from that, teaching and learning in the context of 21st century learning, especially in the 2013 curriculum, means that students learn material through examples, applications and real world experiences both inside and outside school. Forms of student activity in learning can be seen from student involvement in the learning process, such as participating in carrying out assignments, being involved in discussions on problem solving processes, asking friends or teachers if they do not understand the material, and being able to present report results.

21st century learning emphasizes students' ability to think critically, relate knowledge to the real world, understand technology, communication, information and collaborate. Achieving these abilities can be achieved by applying the right learning approach in terms of mastery of material and skills. The characteristics of students who are familiar with technology are that educators should apply ICT in the learning process, this is in line with the opinion of Budiman (2017) that "the

presence and role of information technology in the education system has brought a new era in the development of education in the world". Then Nursyam (2019) regarding technology in education, he argued that in the world of education, the application of information technology has caused enormous changes in its development, while the form of development of information technology is an innovation that has made a significant contribution to the transformation of the educational process and the learning process is not just listen to the educator's explanation but rather carry out activities including: observing, doing, demonstrating). TPACK is an approach that applies ICT in learning. TPACK is understood in the field of educational research as a design or framework when developing learning models by applying three main sources, namely technology, pedagogy and content.

Meanwhile, according to Hanik et al (2022), the TPACK element tells about the relationship between three basic knowledge which includes technology, pedagogy and knowledge. The TPACK framework can be used to study and interpret the quality of teacher knowledge and skills with the aim of integrating technology during learning activities. Quality learning requires a complex, interconnected understanding of the three main sources of knowledge, namely technology, pedagogy, and content, as well as how these three sources are applied. Then according to Batubara (2017) technology means the application of machine tools, materials and processes that help humans to solve their problems." From this, it can be concluded that technology is a systematic treatment or handling in the form of machine tools that can help humans solve problems. The aim of the TPACK approach is to develop the creativity and skills of educators using technology in teaching and improve the learning experience for students so that student learning outcomes can improve.

Learning mathematics is a subject that is useful in everyday life and teaching mathematics to students at school is mandatory. According to Ruqoyyah et al (2020) mathematics is a subject studied from elementary to tertiary education. Mathematics is an important subject. The reason is because mathematics is the basis and main in studying other sciences. Mathematics will give students the ability to master technology in the future with the ability to collaborate, think logically, analyze, critically and creatively. The manifestation of student activity can be seen from the extent to which students participate in the learning process, such as participating in completing assignments, participating in discussions on problem solving processes, asking questions to teachers or friends if they do not understand the material and making presentations in front of the class.

Based on the results of direct observations and interviews with the class V teacher, it was found that students' learning activity was low when studying, this was seen during the learning process, namely students were less active in answering and asking questions while studying, students were less active in group discussions, then educators had not implemented Using technology during the learning process, educators tend to use lecture methods, practice questions, questions and answers and rarely involve students in the learning process. This

causes students to become less active when studying. Researchers obtained data that of the 27 students who could be categorized as active, only 4 people.

Regarding indicators of active learning, Kanza et al (2020) state that indicators of active learning can be classified as paying attention to and listening to teacher explanations, answering teacher questions, asking questions to teachers and other students, recording teacher explanations and discussion results, reading material, giving opinions when discussion, listening to friends' opinions, providing feedback, practicing completing practice questions, having the courage to present the results of the discussion. Indicators of student activity can also be observed from student attention in learning, student cooperation in learning, participation in solving problems, student willingness to participate in learning and express opinions or ideas.

Furthermore, Rikawati & Sitinjak (2020) argue that the indicators of active learning consist of being enthusiastic about learning, daring to ask questions during learning, daring to answer the questions given, daring to present the results of one's understanding in front of the class. Furthermore, Hasanah & Himami (2021) stated that we can see student learning activeness from student involvement in every learning process, such as when listening to explanations of material, discussing, making reports assignments and so on. From this opinion, the researcher determines indicators of active learning, including answering and asking questions, concluding material that has been studied, recording important information, being active in group discussions, presenting the results of discussions.

In this research the author wants to implement the Problem Based Learning (PBL) learning model where PBL learning has a very important role in the learning process. Learning that uses Problem Based Learning is intended to support the development of student understanding, present information in an interesting way, facilitate the interpretation of information, and understand information. That is one of the reasons researchers use the problem-based learning model. According to Kusumawati et al (2022), in their research, they argue that Problem Based Learning (PBL) is a learning model that involves students in solving problems contextually.

According to Masrinah et al (2019), the advantages of problem based learning are that students can find their own concepts so they can better understand the concepts, students can be active in solving problems, students feel the benefits of learning because the problems they solve are related to everyday life, and students more independent and mature so they are able to accept other people's opinions. The use of appropriate learning models is expected to increase students' understanding and activeness in obtaining information. Based on the results of observations carried out at SD 131/IV Jambi City, it was found that students' learning activity was low when studying, this was seen during the learning process, namely that students were less active in answering and asking questions while studying, students were less active in group discussions, then educators have not implemented the use of technology during the learning process,

educators tend to use lecture methods, practice questions, questions and answers and rarely involve students in the learning process. This causes students to become less active when studying. Researchers obtained data that of the 27 students who could be categorized as active, only 4 students were during the lesson, the other 23 students were still in the less active category.

The application of the TPACK approach has been proven by Stefani et al (2021) in their research which states that the TPACK-based PBL model approach can improve the integrated thematic learning process in class V. TPACK PBL paradigm has a significant impact on increasing student learning activities. This was then reinforced by research conducted by Maira et al (2022) which stated that "the PBL learning approach helps class IV students at SDN 55/I Sridadi to engage more actively in material related to electrical circuits in Natural Sciences subjects".

The aim of this research is to describe the process of increasing student learning activeness through the application of the TPACK approach using the PBL model in mathematics learning in class V of elementary schools.

2. Methodology

This research uses Classroom Action Research (PTK), where there are several stages including planning, implementation, observation and reflection. The subjects of this research were 27 class V students at SDN 131/IV Jambi City.

The techniques used by researchers in collecting data are observation and documentation. Observations or observations are carried out carefully so that they can be recorded systematically. This aims to obtain data about the application of the TPACK approach through the PBL model in increasing student learning activeness in mathematics learning in class V of elementary schools. Meanwhile, documentation is used as supporting data for the results of observations and interviews relating to the forms of verbal and non-verbal messages encountered by researchers. The data analysis techniques carried out by researchers in this study are: 1. Data reduction; 2. Presentation of data; 3. Drawing conclusions. Then it is presented in general by describing the results of the research. Classroom action research helps to improve the quality and excellence of learning outcomes and processes and classroom action research includes four stages, namely planning, implementation, observation and reflection. These four steps can form a cycle as in Figure 1.

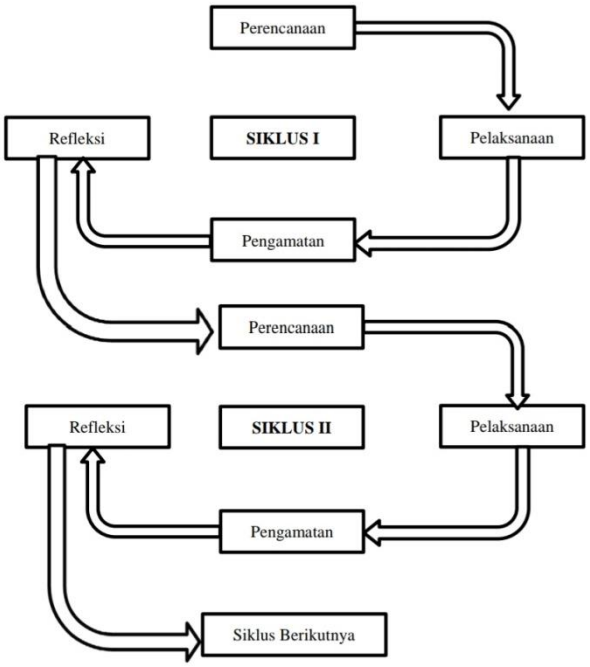

Figure 1. Arikunto's Classroom Action Research Model (2019)

3. Results and Discussion

The results of observations carried out by researchers when the TPACK approach was initially implemented in increasing student learning activity through the PBL model had not yet reached the specified criteria for the completeness indicator, namely ≥75%. Based on the analysis of research data, the results of the actions taken in cycle I can be seen in table 1 which shows the number of students who have fulfilled all the indicators of student activity which increases at each meeting and the percentage of success is depicted in a graph, namely in Table 1.

Table 1. Student Activity Observation Sheet

No.	Cycle I	The number of students	%
1.	Meeting I	5	61.85%
2.	Meeting II	8	65.74%

Based on the table and graph of the recapitulation of the success of the actions above, it shows that 61.85% of the students who met all the criteria for indicators of student activity in cycle I at the first meeting or 5 of all students and at the second meeting were 65.74% or 8 students. The success indicator that has been determined is ≥75%, therefore it can be concluded that in cycle I the actions taken were not successful, therefore the researcher decided to continue in cycle II by correcting the deficiencies in cycle I (Figure 2).

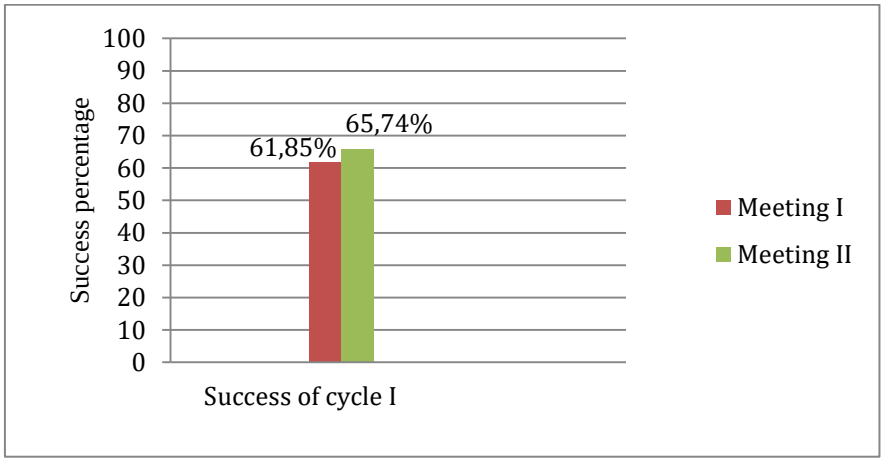

Figure 2. Percentage of Success in Cycle I

The results of the actions taken in cycle II can be seen in table 2 showing the number of students who meet all the criteria for student activity indicators, and the percentage of success can be seen in the graph, namely in Figure 3.

Table 2. Student Activity Observation Sheet

No.	Cycle II	The number of students	%
1.	Meeting I	15	73.70%
2.	Meeting II	22	82.22%

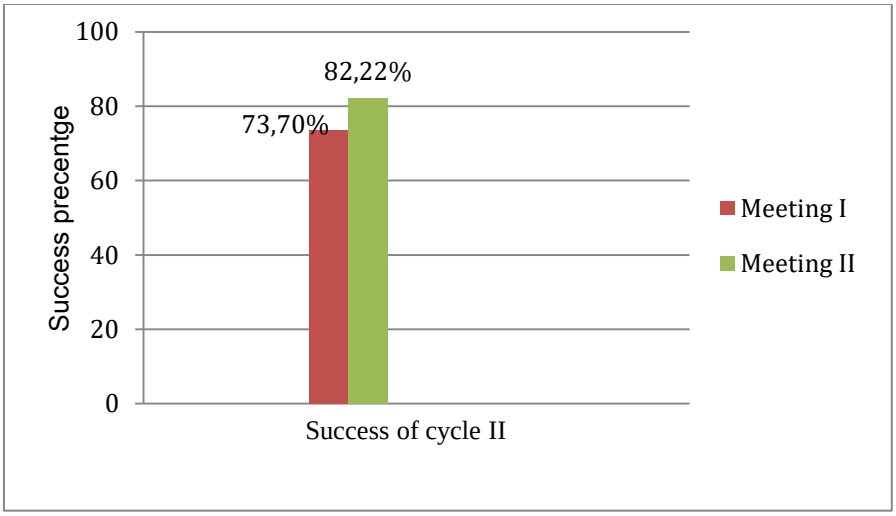

Figure 3. Percentage of Success in Cycle I

Based on the table and picture of the success of the action above, it shows that students who met all the indicator criteria in cycle II at meeting I were 73.70% or 15 of all students and at meeting II there was an increase of 82.22% or as many as 22 students. The criterion indicator for research success is ≥75%, therefore it can be concluded that the success of the action using the TPACK approach with the PBL model in cycle II has reached the research success criteria so that the cycle can be stopped.

This action research was carried out in class V at SDN 131/IV Jambi City, based on initial findings that the problem encountered was the lack of active learning of class V students in the mathematics learning process. Preliminary data shows that students have not reached the predetermined indicator of learning activity completion, namely ≥ 75, therefore it is necessary to implement learning approaches and learning models that are able to increase student learning activity during the teaching and learning process. According to Nurfatimah et al (2020), active learning is a condition or condition where students are able to be active when studying. Meanwhile, according to Kanza et al (2020), students' activeness in learning activities is to emphasize understanding of the problems or everything they face in the learning process.

The form of student activeness can be seen from when students are actively involved during the teaching and learning process, behavior which includes discussions, listening to explanations, solving problems, being active when doing assignments or working on reports, being able to present the results of reports, answering questions and asking questions, this can be considered as a form of student activity in learning. In order to solve this problem, researchers collaborated with class teachers to take action using the Technological Pedagogycal And Content Knowledge (TPACK) approach with the Problem Based Learning (PBL) learning model.

TPACK is a complex and interconnected framework between its constituent components, including technological knowledge and pedagogical knowledge, content knowledge (Sari et al, 2021). Meanwhile, according to Athnindya (2023) TPACK is a learning approach that integrates technological and pedagogical developments into content development training. Furthermore, according to Haniefa & Samsudin (2023), there are seven components in TPACK, namely (1) Content knowledge (CK), (2) Pedagogical knowledge (PK), (3) Pedagogical content knowledge (PCK), (4) Technological knowledge (TK) , (5) Technological Content Knowledge (TCK), (6) Technological Pedagogical Knowledge (TPK), (7) Technological Pedagogical Content Knowledge (TPACK).

When starting learning, the initial stage carried out by the teacher is to orient students to the problem. The teacher gives students motivation to focus students' attention on the topic of the problem to be solved, students observe the display and follow the instructions on the PowerPoint slide. This can be seen in Figure 4. The teacher and students conduct discussions and ask questions about objects around them that are shaped build space (cube). Technological Pedagogical and Content Knowledge (TPACK) is learning that uses three aspects, namely technology, pedagogy, and content or material knowledge (Amrina et al, 2022). Then Yanuarti (2021) also stated that the Technological Pedagogical and Content Knowledge (TPACK) design is a learning design consisting of a combination of technology, pedagogy and content knowledge (Figure 4).

Figure 4. Teacher Shows Learning Video

The teacher divides the students into 1 group with 4-5 members in each group, then the students discuss the problems in the LKPD given by the teacher on the volume of geometric figures (cubes). This can be seen in Figure 5. Observation activities are carried out in cycle I. meeting I by implementing the Technological Pedagogycal And Content Knowledge (TPACK) approach through the PBL model. The observation stage was carried out to determine students' active learning in carrying out the process of teaching and learning activities by observing students' behavior and attitudes when taking part in learning, seen from their behavior of observing, trying to ask questions, reasoning and students' activeness when studying. In cycle I, meeting I did not seem to be in accordance with what we wanted to achieve, meeting I was with material about volumes of geometric shapes (cubes) and in meeting II was with material about volumes of geometric shapes (cubes) (Figure 5).

Figure 5. Students Holding Discussions in Groups

Based on observations of the learning that was carried out in cycle I, it still did not show the expected results. The disadvantages include: teachers and students are not used to implementing the TPACK approach using the PBL model so that not all of the learning process is implemented, then when dividing into groups, the teacher does not separate active students from those who are less active, during group discussions students do not collaborate well. and student activity in groups needs to be increased further, then at the first meeting the teacher does not give quizzes and there are activities in the RPP that have not been implemented and students are less active when given the opportunity to ask and answer questions during learning. This can be seen from the number of students who reach the activity completion indicator. The student learning activity observation sheet is used as a guide to see student learning activity during the learning process carried out in cycle I, meeting I.

According to observation findings, using the TPACK approach through the PBL model can increase student learning activity as evidenced by an increase in the average score of each student, even though it is still in the K predicate category and not yet comprehensively. It can be seen from the results achieved that there were students who received the predicate C or complete, namely 5 students out of 27 students. Through observation of student learning activity in the first cycle of action, meeting I still did not reach the average. Then at the second meeting, there was an increase as seen from the results achieved, there were students who received the complete title, namely 8 people out of 27 students, so the cycle. Because the criteria for research completeness have not yet been achieved, cycle II is carried out based on the results of reflection from cycle I.

In cycle II, the first meeting was with material on geometric nets (cubes) and in the second meeting with material on spatial nets (beams). Observations on the implementation of actions in cycle II, meeting I and meeting II, were based on teacher and student observation sheets. The implementation of the RPP by implementing the TPACK approach using the PBL model has reached 100%. Cycle II was better than cycle I because all the learning activities in the RPP and the implementation of the TPACK approach using the PBL model had been implemented. The observation sheet on student learning activity was used as a guide to see student learning activity during the learning process carried out in cycle II, meeting I. It can be seen from the results achieved that there were 15 of the 27 students who received the title of complete. This can also be seen from the indicators: when asked a question there were 9 students who achieved a score of 4, then the indicator; answering the question there were 8 students who achieved a score of 4, then the indicator; then the indicator records important information, there are 6 students who have a score of 4, then the indicator; In active group discussions, there were 4 students who got a score of 4, and the last indicator: student participation in summarizing the material, there were 5 students who got a score of 4. Then in the second cycle of the second meeting there were students who got the complete title, namely 22 students out of 27 students.

Based on the results of observations and the results of the observation sheet on learning activities, it shows that the actions in cycle II have been successful. The

application of the TPACK approach with the implementation of the PBL model to facilitate learning has proven to be effective. The increasing activeness of students' mathematics learning is one proof of this. This research was stopped in cycle II because the overall score for each cycle had increased as well as the percentage of students who had achieved the success indicator criteria.

The results of observations carried out by researchers when initially applying the TPACK approach in increasing student learning activity through the PBL model had not yet reached the specified criteria for the completeness indicator, namely ≥75%. The results of student observations showed an increase from cycle I to cycle II actions. The results of pre-action observations were 35.18% in cycle I. After action was implemented by applying the TPACK approach in increasing student learning activity through the PBL model, it increased to 65.74% and in cycle II there was an increase to 82.22%. Observation data can be seen in the Table 3.

Table 3. Comparison Between Cycles

No.	Stage of Increased	Value	%
1.	Pre-action	35.18%	-
2.	Cycle I	65.74%	30.56%
3.	Cycle II	82.22%	16.48%

From the figure and table, it can be concluded that students' learning activity in pre-action, cycle I and cycle II experienced an increase, namely from pre-action to cycle I there was an increase of 30.56%. Furthermore, from cycle I to cycle II there was an increase of 16.48%. Therefore, the results of cycle II were categorized as very good and were said to be successfully achieved because they had achieved a completeness score of ≥75% for all students.

4. Conclusion

Based on the research results, it was concluded that the application of the Technological Pedagogical Content Knowledge (TPACK) approach through the PBL model can increase students' active mathematics learning in spatial building material in class V of SDN 131/IV Jambi City. Increased student learning activity is characterized by students who often ask and answer questions, write down important information, are active in group discussions and can conclude good material gradually in each cycle through the PBL model, including orienting students to problems, organizing students to study, guiding personal experiences or groups, develop and present work results, and evaluate the problem solving process. From the results of this research, applying the Technological Pedagogical Content Knowledge (TPACK) approach through the PBL model can increase the activeness of fifth grade students' mathematics learning.

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