



The Activities Framework on Project-Based Learning: The Use of Autodesk Sketchbook to Improve Students' Metacognition Thinking Skills in Solving Polygon Tessellation Problems

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ABSTRACT

Developments in technology, particularly in the computer and android world, play a crucial role in education and have significant benefits in supporting the learning process, thereby promoting students' metacognition thinking skills in solving problems of polygons tessellation problems through the development of project-based learning tools assisted by Autodesk Sketchbook. This research aims to determine the form, process, results, and implementation of the development of project-based learning tools assisted by Autodesk Sketchbook in improving students' metacognition thinking skills in solving problems of polygon tessellation problems. The research used the R&D method with the Four-D development model. The sample for this study consisted of 25 fourth-grade students from SDN Kayen Bandarkedungmulyo, Kab. Jombang. Instruments were used to collect data on students' metacognition, which was analyzed by observing fourth-grade classes at SDN Kayen Bandarkedungmulyo and calculating pretest and posttest scores. The validation test was conducted by subject matter experts (syllabus, lesson plans, teaching materials, and student worksheets). In its application, the project-based learning tools assisted by Autodesk Sketchbook used six syntax concepts in scientific disciplines to improve students' metacognition thinking skills in solving problems of polygon tessellation problems

Keywords: Learning Materials, Project-Based Learning, Autodesk Sketchbook, Student Metacognition thinking skills

1. INTRODUCTION

The development of technology has reached an extraordinary level. Almost all fields of work in the world have utilized technology. Jobs that used to require much human labor are now replaced by machines, all controlled by computer or device technology. With the sophistication of technology, we can obtain much information. The demand and need for information in society have prompted an increase in the dissemination of information. As a result of this advancement in information technology, society has changed in a positive direction. The use of information technology has spread across all fields, including education, but ironically, educators still need to develop instructional media technology. This is supported by the need for teachers to create learning tools that make the application of lecture methods more widespread. However, with the existence of technology, especially the creation of instructional media, it can be made more interesting and contextual. The development of more interesting learning tools can use media. Multimedia software consists of components in a data processing system in the form of programs to control the working of multimedia computer systems. In subjects and exercises, they can be made more interesting by visualizing them in the form of moving pictures accompanied by brief explanations in the form of sound accompanying the image so that students can easily understand them.

Currently, the use of Information and Communication Technology (ICT) is linked to Project-Based Learning (Kubiatio & Vaculova, 2011:68). The Project-Based Learning model is recommended in the implementation of the 2013 Curriculum by applying the scientific approach that provides students with the opportunity to utilize science and technology and shapes scientifically literate students. It is also a learning model suitable for the constructivist framework that views the learning process as an active and meaningful inquiry, and students construct knowledge.

The dimensions or aspects of Project-Based Learning start with assignments to carry out one or more tasks that lead to a final product, including activities such as asking questions, designing project completion stages, creating project implementation schedules, collecting, analyzing, and interpreting data using mathematics, information, computer technology, and computational thinking. Students must also compile reports and presentations on project outcomes and evaluate the project's process and results. Project-Based Learning is not just a learning model that aims to acquire knowledge about a specific content area but also a model that targets the holistic development of students (Tamim & Grant, 2013:74).

Based on the previous explanations, the development of Project-Based Learning instructional materials using Autodesk Sketchbook is needed to enhance students' metacognition thinking skills in solving problems related to the tessellation problems of polygons.

The learning material and methods should align with the learning objectives, integrated competencies, cross-disciplinary connections, and themes that match the learning objectives. They should also consider the students' thinking development level, be appropriate for the project-based learning model, and compare the media, tools, and learning resources. The use of information and communication technology (ICT) should also be incorporated. The learning activities should be designed clearly and sequentially, from the introduction to the core and conclusion, and follow the syntax of project-based Learning while being allocated the appropriate amount of time. Assessment should be done using complete and authentic assessment instruments that align with the learning objectives and the project-based learning model.

Mathematics is a concept of natural Learning and has a broad relationship with human life. Mathematics plays a significant role in the education process and the development of technology because it aims to stimulate human interest and the ability to develop science and technology and understand the universe that still holds many mysteries and secrets. Its discoveries can be developed into new natural sciences and applied daily.

Mathematics learning is related to daily life, so it is not just about collecting knowledge in the form of facts, concepts, or principles but also a discovery process. This process involves all senses, thought processes, and muscle movements, so learning mathematics can be done in multiple ways. It requires different tools to make observations, involving scientific meetings, literature studies, visiting an object, forming hypotheses, and others to obtain objective recognition of the truth of the findings. Mathematics learning is an active process involving various cognitive, affective, and psychomotor domains.

In learning at Kayen Bandarkedungmulyo Elementary School in Jombang, the teachers have tried to create an engaging learning environment for students by taking them to the school's surrounding area. However, not all subjects can be related to the surrounding environment, which has caused teachers to resort to conventional teaching methods. As a result, Mathematics class has become less interesting for students, leading to a lack of interest and attention. This has resulted in around 50% of the fifth-grade students at Kayen Bandarkedungmulyo Elementary School in the first semester of the 2021 academic year failing to meet the minimum passing grade for Mathematics set by the school.

One of the teaching methods that is expected to help students better understand Mathematics is using the Project-Based Learning method with the help of Autodesk Sketchbook software to improve students' metacognition thinking skills in solving problems related to the volume of 2D shapes. The Project-Based Learning tool for Mathematics consists of systematically designed and programmed material based on the curriculum, including Autodesk Sketchbook software and the learning objectives.

Metacognition thinking skills was first introduced by John Flavell, a psychologist from Stanford University, around 1976. Flavell (in Wilson & Clark, 2004) defined metacognition thinking skills as a student's awareness, consideration, and control over their cognitive processes and strategies. Metacognition thinking skills plays an important role in Mathematics learning and problem-solving. It is a student's awareness, consideration, and control/monitoring of their cognitive processes and strategies.

According to Suherman (2001), metacognition thinking skills is the ability to be aware of what students know about themselves as learners so that they can control and adjust their behavior optimally. With metacognitive skills, students can be highly able to solve problems because every step can help them become aware of their thinking process and enable them to solve problems optimally. Taccusu (2008) defined metacognition thinking skills as part of the planning, monitoring, and evaluating the learning process, as well as awareness and control over the learning process.

From the explanations above, metacognition thinking skills is students' awareness of using their thinking to plan, consider, control, and evaluate their cognitive processes and strategies.

The flat polygonal shape is used in this research to improve metacognition thinking skills. In mathematics, covering a flat surface with no gaps or overlaps using a special pattern consisting of geometric shapes is called tessellation, which comes from the English word tessellation. Tessellation is a noun derived from the word "tile," a type of object used to cover the floor. A pattern of geometric shapes arranged without gaps or overlaps to cover a flat surface is called tessellation (O'Daffer, 2008).

There are several types of tessellation based on the flat shape used: regular tessellation, semiregular tessellation, and non-regular tessellation. A tessellation entirely formed from regular n-gons, with the shapes fitting together perfectly, is called regular tessellation (O'Daffer, 2008). There are three examples of regular tessellation, namely, tessellation formed by regular triangles (equilateral triangles), regular quadrilaterals (squares), and regular hexagons..

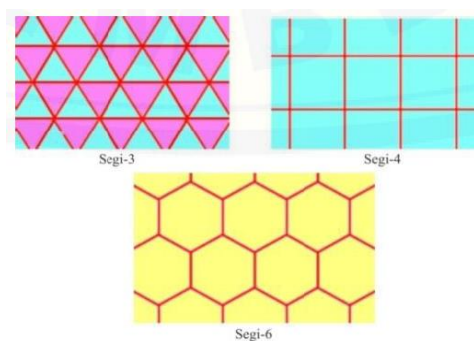


Figure 1 *Regular Tessellation*

Students can construct and design tessellations with the help of Autodesk Sketchbook. The tessellation design can be a combination of regular and irregular polygon shapes. This is also an effort to improve students' metacognition thinking skills so that they can apply math learning to their daily lives.

A learning tool is needed to improve students' metacognition thinking skills through Project-Based Learning aided by Autodesk Sketchbook to achieve this. The learning tool developed for Project-Based Learning aided by Autodesk Sketchbook includes 1) Syllabus; 2) Learning Implementation Plan (RPP); 3) Student Worksheets; and 4) Grid and test sheets for metacognitive skills in problem-solving.

2. METHOD

This study utilized the research and development (R&D) approach, a development model involving repeated activities from designing to implementing (Borg & Gall, in Hamzah, 2019), with a qualitative descriptive research analysis. This study aimed to develop a Project-Based Learning aided by Autodesk Sketchbook to enhance metacognitive abilities in solving problems related to composite polygons. Specifically, the study focuses on using Autodesk Sketchbook, an Android-based technology application, as a tool for problem-solving. The developed learning tools included a syllabus, lesson plans, student worksheets, and assessment instruments, such as a test sheet for assessing metacognitive abilities in problem-solving. In addition, validation sheets, readability questionnaires, student feedback questionnaires, and response sheets for assessing metacognitive abilities were also developed as research instruments.

The research design followed the Four-D model (define, design, develop, and disseminate) proposed by Thiagarajan (1974). This model was chosen because of its sequential and clear stages, suitable for developing Project-Based Learning aided by Autodesk Sketchbook.

The study reviewed relevant literature on Project-Based Learning models, Autodesk Sketchbook applications, composite polygons, and metacognitive thinking abilities. This step was followed by a deeper exploration and presentation of composite polygons problems aided by Autodesk Sketchbook as the basis for creating the research framework. The next stage involved the development of a syntactic framework that integrated Project-Based Learning aided by Autodesk Sketchbook to improve metacognitive abilities in solving problems related to composite polygons. The researchers then developed a syllabus, lesson plans, student worksheets, assessments, and research instruments. The final stage of the research involved the validation process by experts to determine the feasibility of the developed learning tools, which was done by filling out the validation instrument that had been prepared.

Next, the sixth syntax of the Project-Based Learning model is explained in solving problems related to the tessellation problems of polygonal shapes. This is followed by a detailed and sequential description of each learning stage, consisting of learning activities that are carried out and accompanied by completing the activity and metacognitive ability indicators with the help of research instruments. The final step is to describe the portrait of the students' metacognitive skill phases in solving problems based on the completed research instruments..

3. RESULTS

3.1 Syntax of Project-Based Learning Assisted by Autodesk Sketchbook

Application of Project-Based Learning assisted by Autodesk Sketchbook. To improve metacognition thinking skills, this research focuses on the problem of tessellation problems with regular and irregular polygons. The Project-Based Learning model used with the help of Autodesk Sketchbook will make students accustomed to looking at a problem from various scientific perspectives using technology. The first step in problem-solving to improve metacognition thinking skills is understanding the problem first.

Based on these characteristics, the steps of Project-Based Learning (PBL) assisted by Autodesk Sketchbook that teachers can design are as follows:

Table 1. Syntax Analysis of Project-Based Learning (PjBL) assisted by Autodesk Sketchbook

Work steps	Teacher Activity	Student Activity
Fundamental Questions	The teacher presents the topic and asks how to solve the problem.	The fundamental question that needs to be addressed by the students regarding the topic/problem-solving is what they should do.
Mendesain Perencanaan Produk Designing Product Planning	The teacher ensures that each student in the group chooses and knows the procedure for producing the project/product.	The students discuss and develop a plan for the problem-solving project, including dividing tasks and preparing tools, materials, media, and sources needed.
Creating a Production Schedule	The teacher and the students agree on a schedule for project development (stages and submission).	The students develop a project completion schedule by considering the agreed-upon deadline.
Monitoring the Activity and Progress of the Project	The teacher monitors the student's activity during project implementation, monitors the progress of the realization, and guides them if they encounter difficulties.	The students carry out the project according to the schedule, recording each stage and discussing any issues arising during the project's completion with the teacher.

Test Results	The teacher discusses the project prototype, monitors student engagement, and measures the achievement of standards.	We are discussing the feasibility of the project that has been created and creating a product/work report to be presented to others.
Evaluation of Learning Experience	The teacher guides the project presentation process, responds to the results, and then the teacher and students reflect/draw conclusions.	Each student presents their report, other students give feedback, and together with the teacher, they conclude the project's results.

The correlation between the elements in Project-Based Learning aided by Autodesk Sketchbook in improving metacognitive skills in solving problems of polygonal flat shape coverings in this research is presented in the following framework table.

Table 2. The Correlation between Elements in Research and Students' Framework

Project-Based Learning aided by Autodesk Sketchbook	Polygonal Coverings	Problem-Solving	Students' Framework
<i>Focus</i>	Searching for Forms of Polygonal Coverings	Understanding the Problem	Students understand the forms of polygonal coverings studied by observing various regular and irregular flat shapes daily.
<i>Detail</i>	Exploring Autodesk Sketchbook Media Study	Understanding the Problem	Students gather information about the features of Autodesk Sketchbook media to create regular and irregular polygonal flat shapes.
<i>Discovery</i>	Designing the Solution	Developing the Plan	Students will conduct experiments as a proposed solution to the problem, creating a product design of regular and irregular polygonal flat shapes from the provided worksheet.
<i>Application</i>	Application in Mathematical Models	Implementing the Plan	Students apply appropriate mathematical models based on the learning model they have studied, related to various designs of regular or irregular polygonal flat shapes they have created.
<i>Presentation</i>	Initial Validation	Implementing the Plan Reviewing the Process and Results	Students engage in group discussions and exchange ideas with each other.
<i>Link</i>	Final Validation	Reviewing the Process and Results	Presentation of the learning outcomes that have been implemented.

3.2 Student Learning Objectives and Achievements

Formulating learning objectives is an important step in the learning process because learning objectives provide direction for the learning process. This stage is the initial step in developing a Project-Based Learning plan with the help of Autodesk Sketchbook. The learning objectives that are intended to be achieved are.

- through observing pictures or direct observation, students can identify regular and irregular polygons;
- through observing pictures or direct observation and gathering information, students can identify the properties of regular and irregular polygons;
- through discussion, students can identify the types of regular and irregular polygons;
- through gathering information, students can create a simple project of polygon tessellation.

The learning outcome expected from this learning process is that students can design and create polygon tessellations. This learning outcome indicates the development of students' metacognitive abilities in solving polygon tessellation problems.

3.3 The Learning Framework for Autodesk Sketchbook-assisted Project-Based Learning

- Focus is choosing the important question or problem to be solved by focusing on the selected field of Project-Based Learning with the help of Autodesk Sketchbook.

Table 3. Learning Activity for Focus Stage

Stage 1	Learning Activities
Focus: Determining the problem to be solved through formulating fundamental questions (Start with Essential Question).	1 The students are divided into five heterogeneous groups
	2 They are asked to observe a video entitled "Polygon Shapes?" https://www.youtube.com/watch?v=_FNRj2JjXiU
	3 (Scientific observation, TPACK, Critical Thinking, ICT, Scientific)
	4 The students have a question and answer session with the teacher about the information obtained from the video "Polygon Shapes" that they observed. (Critical Thinking, Scientific)
	5 The students install the Autodesk Sketchbook application https://play.google.com/store/apps/details?id=com.adsk.sketchbook

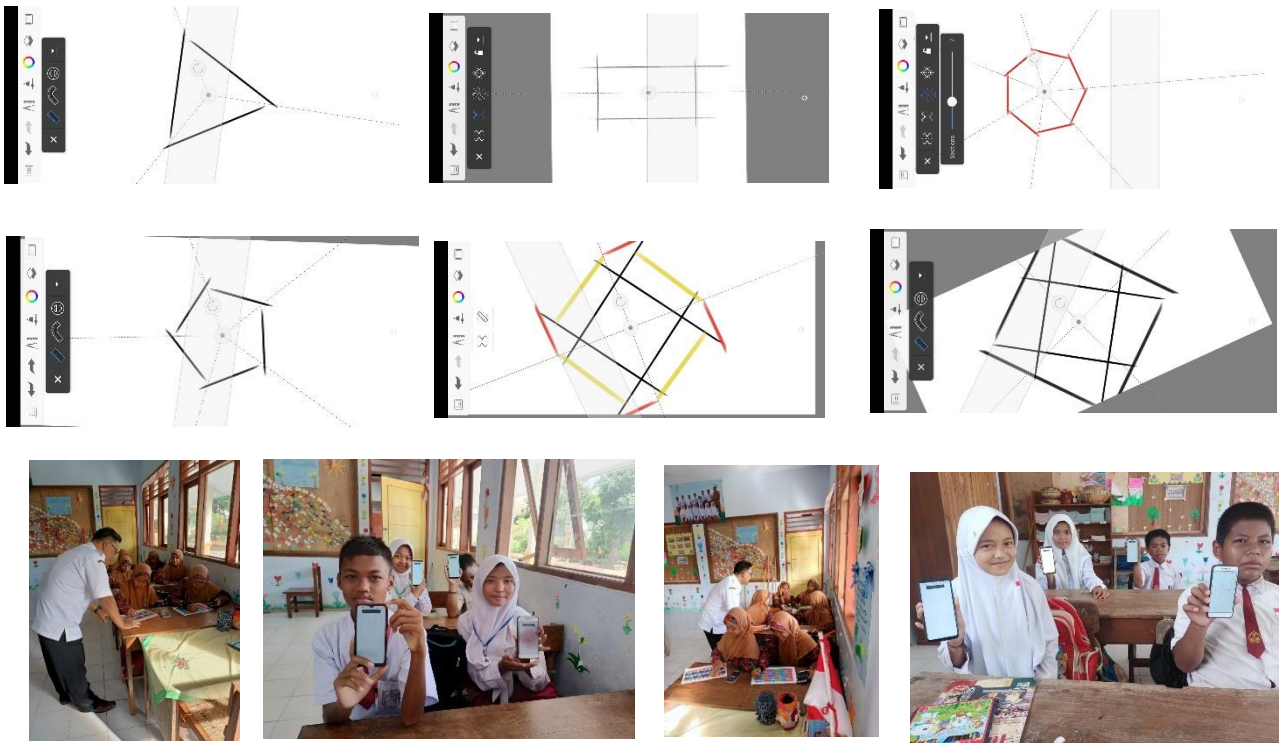


Figure 2 Focus Phase Learning Activities

- Detail is to search for the elements that contribute to the problem or important question. Students need to gather information to answer the question at this stage.

Table 4. Detail Stage Learning Activities

Stage 2	Learning Activities
Designing a Project Plan	1 Students are asked to analyze information about regular and irregular everyday polygons listed in Worksheet 1, "Let's Create a Design," together in groups. (Collaboration, Critical Thinking)
	2 Students are asked to plan the drawing of the regular and irregular polygons tessellation problems listed in Worksheet 2, "Let's Observe." (Collaboration, Communication)



Figure 3. Detail Stage Learning Activities

- Discovery, where students investigate the solutions that will be given and the existing solutions that have yet to be able to solve the problem.

Table 5. Discovery Stage Learning Activities

Stage 3	Learning Activities
Discovery (Make a Schedule)	1 The teacher and students create a timeline to complete the project, including the submission deadline. (collaboration-4C, Communicating Scientifically)
	2 Students plan how to complete the project together with guidance from the teacher. (Collaboration-4C, Scientific Communication, Creativity-4C)
	3 Students are asked to provide a rationale for the chosen method of completing the project. (Scientific Reasoning, Communication-4C)



Figure 4. Discovery Stage Learning Activities

1. Application, where students start creating a work that is a solution by utilizing the skills, processes, and knowledge that have been learned previously and putting them into practice.

Table 6. Application Stage Learning Activities

Stage 4	Learning Activities
Application (Monitoring the activities and progress of the project.)	1 The teacher and students can together identify the strengths and weaknesses of the project they have created (gathering information-Scientific, collaboration-PPK, critical thinking-4C)
	2 The teacher will discuss the feasibility of the project that has been created by the students (Scientific Communication)



Figure 5 Application Stage Learning Activities

- Presentation, where students present the solutions or works created to receive feedback. Presentation is also a means for students to express themselves based on their perspective on their problem.

Table 7. Presentation Stage Learning Activities

Stage 5	Learning Activities
Presentation Testing the results	1 Students give a presentation to showcase their project (Communicating-Scientifically)
	2 Students from other groups can provide feedback to learn together. (Communicating-Scientifically)
	3 The teacher discusses the project prototype, monitors student engagement, and measures achievement standards.



Figure 6 Presentation Stage Learning Activities

- Linkage, where students can reflect on the feedback given, revise their work as needed, and develop better solutions.

Table 8. Link Stage Learning Activities

Stage 6	Learning Activities
Link (Learning Experience Evaluation)	1 The teacher guides the process of presenting the project.
	2 Both the teacher and the students respond to the results,
	3 And then, they reflect and conclude. (Communicating-Scientifically)



Figure 7. Link Stage Learning Activities

3.4 The Framework for assessing metacognitive abilities

The instrument used to measure metacognition thinking skills is an observation sheet of students' metacognitive activities. The sheet contains indicators of metacognitive skills that will be observed. The three aspects observed are planning, monitoring, and evaluation.

Table 9. Metacognition thinking skills Instrument Grid

The Aspect of Metacognition thinking skills	Indicator
Planning	Understanding the problem
	Thinking about representations and recalling prerequisite material that can help solve the task
	Solution strategies used
Monitoring	Monitoring the implementation of problem-solving activities
Evaluating	Correction strategies if there are errors
	Evaluating the results obtained
	Evaluating the ways/strategies used to solve the problem.

Table 10. Rubric Assessment and Scoring Guide for Metacognitive Skills

No.	Factor	Indicator	Rubric	Scor
1.	Planning	Understanding the problem	Thinking about how to gather information known and asked from the given problem	5
			Thinking about reading the problem more than once	3
			Thinking about how to understand the problem	1
		Thinking about representations and recalling prerequisite material that can help solve the task.	Thinking about how to model the problem in a figure	5
			Thinking about how to provide notation and symbols in the Figure modeling	3
			Thinking about what prerequisite concepts are required when reading the problem	1
			The strategies used to solve the problem	Thinking of different strategies or approaches that can be used to solve the problem

			Thinking of how to organize the steps or procedures used to solve the problem	3
			Thinking of whether or not the problem has been solved before and trying to remember how it was solved	1
2.	Monitoring	Controlling the execution of problem-solving activities	To check the suitability of the notation and symbols used based on the available information and to consider checking the suitability of prerequisite concepts (such as flat shapes) used to solve the problem.	5
			Think about checking each step of the solution and giving a checkmark on the part that has been checked.	3
			To control the accuracy of calculations stage by stage.	1
3.	Evaluating	Strategies for correcting errors, if any	Consider repeating some steps that have been done if an error is found.	5
			Trying another method if an error is found.	3
			Thinking of how to check the compatibility of the answer with the question asked.	1
		Evaluating the obtained results	Evaluating the results obtained.	5
			Thinking about how to check again the method used to ensure that the answer is correct.	3
			Thinking again whether the obtained answer is something new.	1

Table 11. Levels of Metacognitive Aspects

Aspek Tingkat Metakognisi	Indikator
Level 6 Reflective use	<ol style="list-style-type: none"> a. Planning indicators: Students know the methods used to solve problems, students can explain the strategies used to solve problems, students understand the problem well because they can identify important information in the problem, and students can explain what is written on the answer sheet. b. Monitoring indicators: Students can apply the same strategy to other problems, know of conceptual errors, and correct them. c. Assessment indicators: Students evaluate each step made and believe in the results.
Level 5 Semireflective use	<ol style="list-style-type: none"> 1. Planning indicators, namely: students understand the problem by being able to express it. Students can identify information in the problem, know how to solve the problem, and students can explain the strategy used to solve the problem. 2. Monitoring indicators: Students are aware of conceptual and calculation errors, can correct errors in the steps taken, and can apply the same strategy to other problems. 3. Assessment indicators, namely: students evaluate their work, but not necessarily every step taken
Level 4 Strategic use	<ol style="list-style-type: none"> a. Planning indicators: Students understand the problem and can express it clearly, do not experience difficulty or confusion in finding formulas and calculating methods, and can explain most of what they have written. b. Monitoring indicators: Students are aware of their conceptual and calculation errors and can provide reasoning that supports their thinking c. Evaluation indicators: Students do not evaluate or, if they do, appear confused or unclear about the results obtained, and students evaluate but need more confidence in the results obtained.
Level 3 Semistrategic use	<ul style="list-style-type: none"> ○ Planning indicators: Students understand the problem and can express it clearly, but they need clarification about the concept (formula) and calculation method to be used. ○ Monitoring indicators: Students know conceptual (formula) and calculation errors but cannot correct them. They need assistance to ensure the accuracy of the concept and the results obtained. ○ Assessment indicators: Students do not evaluate or, if they do, they appear confused or uncertain about the results obtained, and they evaluate but need to be more confident in the results obtained.
Level 2 Aware use	<ol style="list-style-type: none"> 1. Planning indicators: Students experience difficulty and confusion in thinking about the concept (formula) and the calculation method to be used, students only explain some of what is written, and students understand the problem because they can express it clearly. 2. Monitoring indicators: Students need clarification because they cannot continue their actions. They realize errors in concepts (formulas) and calculations but need help to correct them. 3. Assessment indicators: Students do not evaluate, or if they do evaluate, they appear confused or unclear about the results obtained, and students evaluate but need more confidence about the results obtained.
Level 1 Tacit use	<ol style="list-style-type: none"> a. Planning indicator, which is: students cannot explain what they know, cannot explain what is being asked, and cannot explain the problem clearly. b. Monitoring indicator: Students need to be more aware of what is being monitored and realize errors in concepts and results obtained.

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- c. Assessment indicator: Students do not evaluate; if they do, they need clarification or clarity about the results obtained.
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3.6 The Follow-up of Learning Device Development

The follow-up of the development of learning tools in this research refers to the 4-D (Four-D model) development model consisting of four stages: define, design, develop, and disseminate (Thiagarajan, 1974). The 4-D model was chosen because its stages are sequential, clear, and appropriate for developing Project-Based Learning aided by Autodesk Sketchbook.

According to Thiagarajan (1974), the development stages using the 4-D model consist of four stages: the defining or establishing stage (define), the design stage, the development stage, and the dissemination stage (disseminate), which are described as follows:

1) The Definition Stage

The Define stage sets and determines the rules for developing learning materials. The Define stage has five main steps: analysis of the root problem, analysis of students, analysis of concepts, analysis of tasks, and formulation of learning activity objectives. The initial analysis is carried out by analyzing the fundamental problems in mathematics learning to generate ideas and determine the root problems encountered during the learning process. Student analysis examines their characteristics, including knowledgeability, character development level, and diverse cognitive development, through document studies of grade lists and records, observation, and interviews. Concept analysis involves identifying the main concepts that students will learn and organizing them sequentially to formulate indicators to improve creative thinking skills in solving two-dimensional and three-dimensional geometric problems. Task analysis aims to identify the main tasks that students will perform. The planned task for the students is to observe relevant figures and discuss various two-dimensional shapes. Formulating learning objectives is an important stage in Learning Activities because they serve as the direction for learning. This stage is the first step in creating a plan for implementing Project-Based Learning Assisted by Autodesk Sketchbook.

2) Design Stage

The planning stage aims to prepare an initial form or design of the development of learning tools, namely the Project-Based Learning with Autodesk Sketchbook, to improve metacognitive abilities in solving tessellation problems for fourth-grade elementary school students. This stage consists of four steps, namely:

- a. After the completion of the determination stage, observation assessment criteria are developed so that the test assessment criteria remain related to the task that will be given.
- b. The selection of the learning model to be used, namely the Project-Based Learning with Autodesk Sketchbook learning model.
- c. The format selection is made by adjusting the learning model with a suitable format for easy use.
- d. The initial design is an initial design or outline of the syllabus, lesson plans, worksheets, and creative thinking skills test sheets in solving problems, including the Project-Based Learning with Autodesk Sketchbook learning model.

3) Development Stage

The Development stage aims to produce the final form of the learning tool that has been revised based on expert opinions. There are two steps in the Development stage, namely:

- expert appraisal followed by revision;
- development testing.

4) Disseminate Stage

The Dissemination stage aims to disseminate Project-Based Learning with the Autodesk Sketchbook learning tool for several elementary educational institutions. This learning tool is disseminated through journal publications, seminars through Teacher Working Groups (KKG), and uploading learning videos on YouTube.

4. DISCUSSION

One of the teaching methods that is expected to help students better understand Mathematics is using the Project-Based Learning method with the help of Autodesk Sketchbook software to improve students' metacognition thinking skills in solving problems related to the volume of 2D shapes. This approach involves engaging students in hands-on projects that require them to apply mathematical concepts and skills to real-world situations. By actively participating in project-based activities, students can develop a deeper understanding of the subject matter and improve their problem-solving abilities.

The Project-Based Learning tool for Mathematics consists of systematically designed and programmed material based on the curriculum, including Autodesk Sketchbook software and the learning objectives. This tool provides students with a structured framework to explore and apply mathematical concepts in a practical and meaningful way. The use of Autodesk Sketchbook software further enhances the learning experience by allowing students to

visualize and manipulate geometric shapes, calculate their volumes, and analyze the results. The combination of project-based learning and digital tools like Autodesk Sketchbook creates an engaging and interactive learning environment for students.

Metacognition thinking skills, as first introduced by John Flavell, a psychologist from Stanford University, around 1976, play a crucial role in Mathematics learning and problem-solving. Flavell (in Wilson & Clark, 2004) defined metacognition thinking skills as a student's awareness, consideration, and control over their cognitive processes and strategies. In the context of Mathematics, metacognition thinking skills enable students to reflect on their thinking, evaluate their problem-solving strategies, and make necessary adjustments to improve their performance. By developing metacognitive abilities, students become more independent learners who can monitor their own progress, identify areas for improvement, and apply appropriate problem-solving strategies.

The development of the Learning Activities Framework for Project-Based Learning with Autodesk Sketchbook to improve metacognitive abilities in solving problems related to the tessellation problems of polygons is essential and beneficial, especially for elementary school students. Elementary school is a critical period for the development of metacognitive skills as one of the 21st-century skills and critical thinking. By engaging students in projects that involve tessellation, they can explore mathematical patterns, analyze their properties, and make connections to real-world applications. The use of Autodesk Sketchbook software provides a digital platform for students to create and manipulate tessellations, fostering their creativity and spatial reasoning skills.

From this research activity, several aspects can be further developed by exploring technology and surrounding activities to improve metacognitive abilities and promote the application of mathematical concepts in daily life. The 4-D development model for Project-Based Learning with Autodesk Sketchbook learning tool offers a comprehensive approach that considers time, depth, complexity, and authenticity. This model allows for extended exploration and in-depth understanding of mathematical concepts, enabling students to engage in complex problem-solving tasks and apply their knowledge in authentic contexts.

Additionally, analyzing the metacognitive abilities in solving problems related to tessellation problems polygons using the Autodesk Sketchbook application technology can be further studied. By conducting thorough research and gathering empirical evidence, educators can gain insights into the effectiveness of the learning activity framework in enhancing metacognitive abilities. This information can inform instructional practices and help refine the framework to better meet the needs of students. The integration of Project-Based Learning with Autodesk Sketchbook software provides a promising approach to enhance students' understanding of Mathematics. By incorporating metacognition thinking skills, students can develop a deeper understanding of mathematical concepts, improve their problem-solving abilities, and apply their knowledge in real-world situations. The continuous development and refinement of the Learning Activities Framework, along with the exploration of technology integration and real-world applications, contribute to the enhancement of metacognitive abilities and the promotion of mathematical

CONCLUSION

The results of this research illustrate the problems and syntax or activity framework of Project-Based Learning assisted by Autodesk Sketchbook. The activity framework involves utilizing technology to create designs of polygons with regular and irregular shapes created by students on provided worksheets. The research also includes a framework for assessment instruments with indicators of metacognitive abilities. Based on the research process and results, it would be easier to conduct further studies related to developing and analyzing the implementation of Project-Based Learning assisted by Autodesk Sketchbook.

As a suggestion, teachers need to ensure that the Android devices used by students support the Autodesk Sketchbook application and that the materials used to create polygon designs are easy for students to use. Teachers should also facilitate learning activities that support the development of metacognitive abilities and guide students who experience learning difficulties

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