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DEVELOPMENT OF PROJECT BASED OUTDOOR LEARNING TOOLS IN GEOMETRY TO IMPROVE STUDENTS' PROBLEM SOLVING ABILITY

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Abstract

The teaching tools are crucial for teachers in delivering instructional material. However, the development of learning tools that meet content standards and are of high quality is still quite rare. This research aims to develop and evaluate the quality of Project-Based Outdoor Learning (PjBOL) tools for geometry to enhance problem-solving skills. The research sample consists of students from classes VII D and VII E at SMP Negeri 2 Ungaran. The research method used is Research and Development with the Four-D model: Define, Design, Develop, Disseminate. The research instruments include expert assessment sheets, student response sheets, and problem-solving ability tests. Data analysis focuses on validity, practicality, and effectiveness. The results indicate that: (1) the developed PjBOL tools include Learning Objectives Flow, Teaching Modules, and Learning Materials for geometry to enhance problem-solving skills; and (2) the PjBOL tools are of high quality as they meet the criteria of validity, practicality, and effectiveness. The test results show that the problem-solving abilities of students using PjBOL are higher in average and proportion compared to those using Discovery Learning, and there is an improvement in students' problem-solving abilities. Based on these findings, PjBOL tools effectively enhance problem-solving skills.

Keywords: Geometry; learning tools; PjBOL; problem solving

Abstrak

Perangkat pembelajaran merupakan alat yang sangat penting untuk guru dalam menyampaikan materi ajar. Namun pengembangan perangkat pembelajaran yang sesuai dengan standar isi dan berkualitas masih sangat jarang dilakukan. Penelitian ini bertujuan untuk mengembangkan dan menguji kualitas perangkat Project Based Outdoor Learning (PjBOL) materi Geometri untuk meningkatkan kemampuan pemecahan masalah. Sampel penelitian yaitu peserta didik kelas VII D dan VII E SMP Negeri 2 Ungaran. Metode penelitian adalah Research and Development dengan model Four-D yakni Define, Design, Develop, Disseminate. Instrumen penelitian yang digunakan yaitu lembar penilaian ahli, lembar respon peserta didik, dan tes kemampuan pemecahan masalah. Analisis data yang dilakukan adalah kevalidan, kepraktisan, dan keefektifan. Hasil penelitian menunjukkan bahwa; (1) perangkat PjBOL yang dikembangkan meliputi Alur Tujuan Pembelajaran, Modul Ajar, dan Bahan Ajar materi Geometri untuk meningkatkan kemampuan pemecahan masalah, dan (2) perangkat PjBOL berkualitas karena memenuhi kriteria valid, praktis, dan efektif dengan hasil tes tuntas secara klasikal, rata-rata dan proporsi kemampuan pemecahan masalah peserta didik dengan PjBOL lebih dari rata-rata dan proporsi kemampuan pemecahan masalah peserta didik dengan Discovery Learning, serta terdapat peningkatan pada kemampuan pemecahan masalah peserta didik. Berdasarkan hasil penelitian, perangkat PjBOL mampu meningkatkan kemampuan pemecahan masalah.

Kata kunci: Geometri; PjBOL; pemecahan masalah; perangkat pembelajaran



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INTRODUCTION

Learning resources are one of the important components in the implementation of education and improving the quality of education. One of the learning resources that interact educatively in the learning process is students, educators, and learning devices (Mainali, 2021). Learning tools are everything used by teachers and students for the needs of the learning process both from print, audiovisual, computer-based and integrated technology products (Cahyadi, 2019). Learning tools are needed for all subjects, one of which is mathematics (Engelbrecht et al., 2020).

Teachers as educators have a big role in realizing the success of delivering mathematics material and achieving learning goals through the application of approaches and learning models that are in accordance with the needs of students. The success of material delivery will occur if all students can receive and process the knowledge provided properly (Sari & Angreni, 2018; Ayuwanti et al., 2021). Therefore, the development of mathematics learning tools has great urgency in achieving learning objectives.

Based on the results of interviews with grade VII mathematics teachers at SMP Negeri 2 Ungaran, information was obtained that the learning resources used by teachers and students are still limited to using teaching materials provided by the government, so there has been no innovation made by teachers in developing learning tools. The difficulty experienced in teaching mathematics to grade VII students, namely students are less accustomed to solving math problems by including problem-solving steps so that students tend to solve problems with short

answers without writing down the steps to solve problems in a coherent and coherent manner and students need a long time in solving problems. This can happen because the problem solving ability of students is still weak.

Problem-solving ability is the most important aspect that must be possessed by students. Astutiani et al. (2019) states that problem solving is a process to overcome the difficulties faced to achieve the expected goals. The ability to solve mathematical problems is an ability that requires a high level of mental processes and requires more complex thinking processes (Khafidatul, 2020). NCTM states several problem-solving indicators, namely: (1) building new knowledge of mathematics through problem solving, (2) solving problems that arise by involving mathematics in other contexts, (3) applying and adjusting various kinds of strategies suitable for solving problems, (4) and observing and developing problem-solving processes (Arifin et al., 2019).

The weak ability to solve mathematical problems by students needs to be considered to be corrected (Indriana & Maryati, 2021). This is because problem solving skills are abilities that must be possessed so that every student is able to face problems that require mathematics in everyday life (Rachmantika & Wardono, 2019). Therefore, efforts are needed to improve the problem-solving ability of learners. One of them is the development of learning tools that contain indicators of solving mathematical problems and linking mathematics with problems in everyday life so that it will make it easier for students to understand the material, solve mathematical problems related to daily life, and increase student activity so that learning is not boring and monotonous (Ramadhani, 2016).

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Several studies have stated that the development of outdoor learning-based teaching materials is able to improve students' problem-solving skills because students can find a very meaningful relationship between abstract ideas and practical application in everyday life (Setyani & Amidi, 2022; Rijal Fiqhi et al., 2023). Furthermore, the learning model used in this research is project-based learning. Widyaningrum, (2016) explained that project-based learning is one of the learning processes that emphasizes problem-solving skills as a collaborative effort in learning experienced by students.

However, from the two studies, no one has integrated outdoor learning with project-based learning in the development of their devices. In fact, the project-based learning model, which requires students to explore problem-solving skills, can be easily achieved by outdoor learning so that abstract knowledge can be constructed well outside the classroom. Outdoor and project-based learning can provide direct experience that allows mathematics subject matter to be more concrete and real so that the learning process will be more meaningful (Husamah, 2013). Therefore, the development of project-based outdoor learning tools is very necessary to improve students' problem-solving skills.

Therefore, it is necessary to develop a valid, practical, and effective project-based outdoor learning model learning tool that is expected to be able to improve students' problem-solving skills.

METHODS

This research uses the Research and Development (R&D) method with a 4D model consisting of several stages

including Define, Design, and Develop (Disseminate is not carried out due to time and cost limitations). At the define stage, a needs analysis is carried out in the form of collecting data and information from the potential and problems being researched. Furthermore, the problems prepared according to grade levels in different curricula may vary (Öztürk et al., 2020). At the design stage, test standards are prepared, media selection, format selection, and initial design of project-based outdoor learning (PjBOL) tools consisting of Learning Objectives Flow, Teaching Modules, and Teaching Materials.

At the develop stage, PjBOL tools that have been validated by experts, revised according to suggestions and inputs, then used in learning tool trials to determine the quality of PjBOL devices that have been developed based on valid, practical, and effective criteria.

This research was carried out in the even semester of the 2022/2023 school year. The sample of this study was 34 students of grade VII D and 35 students of grade VII E of SMP Negeri 2 Ungaran. The teaching material developed is flat shapes which study triangles, rectangles, squares, kites, rhombuses, and trapezoids.

The research instrument uses expert validation sheets, student response sheets, and pretest posttest problem-solving abilities. Expert validation sheets are used to assess the flow of learning objectives, teaching modules, and teaching materials. There are three aspects assessed, namely the aspects of content feasibility, presentation feasibility, and language. Expert validation sheets were given to two mathematics lecturers and two mathematics teachers. The results of the

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expert validation sheet assessment are used to test the feasibility of the PjBLOL tools.

Student response sheets were given to 34 students in class VII D. Student response sheets are used to assess the learning that is carried out. There are three aspects that are assessed, namely ease of use, attractiveness of presentation, and benefits. In the aspect of ease of use, the assessment indicators are the relationship between the use of teaching materials and learning time, flexibility in the use of teaching materials, and understanding of the use of teaching materials. In the aspect of attractiveness of presentation, the assessment indicators are the attractiveness of presentation, the appropriateness of the use of illustrations, images, and photos, and design arrangements. In the aspect of benefits, the assessment indicators are understanding of the material, increasing mathematical abilities, practicality in teaching, and supporting activities in accordance with the curriculum. The results of the assessment determine the practicality of the PjBOL tools developed. Data analysis of the results of validation sheets and student response sheets is based on the Likert scale (1-5).

Pretest and posttest were given to students in grades VII D and VII E to determine the effectiveness of the developed PjBOL tools. The pretest and posttest questions consist of six descriptive questions with the flat shapes material. Each question includes indicators of problem-solving ability, namely, (1) building new mathematical knowledge through problem solving; (2) solving problems that arise in mathematics and in other contexts; (3) applying and adapting various appropriate strategies to solve problems;

and (4) monitoring and reflecting on the process of solving mathematical problems. The analysis of the pretest and posttest data was carried out with the help of SPSS 25 and Ms.Excel. Effectiveness analysis to improve problem-solving ability was performed with individual due diligence based on actual complete limit, classical completeness, two-mean difference, two-proportion difference, and two paired data. The classical completion limit set is more than 75%. The determination of the 75% limit is based on the reality in the field that achieving ideal completion is very rare, so that a criterion of at least 75% is set so that learning for the next competency can be continued. (Masrukan, 2017),

RESULTS AND DISCUSSION

This research produced PjBOL (Project Based Outdoor Learning) tools which include Learning Objectives Flow, Teaching Modules, and Teaching Materials. PjBOL devices are of high quality and suitable for use if they meet valid, practical, and effective criteria to improve students' problem-solving abilities. The PjBOL device was developed through the Four-D (Define, Design, Develop, Disseminate) stages by Thiagarajan et al. (1974). The results of this development research are as follows.

1) Define Stage

At this define stage, it is found that most learners have difficulty in solving mathematical problems. Errors experienced by students in answering problem-solving questions are on average caused by misunderstanding the questions from the beginning.

Because students do not write down the problem-solving steps correctly, the results not only affect students' understanding of the questions given,

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but also affect student learning outcomes. Teaching and learning activities are always carried out in the classroom by providing material explanations and doing practice questions, without any activities to observe real objects in the environment. So that mathematics learning at SMP Negeri 2 Ungaran has never been carried out outside the classroom with a project-based learning model. The main materials presented in teaching materials are the types of quadrangles and triangles, the properties of rectangles and triangles based on their types, the circumference of quadrangles and triangles, and the area of rectangles and triangles.

Based on the information described above, learning tools are needed that can improve the problem-solving ability of students, of course, must be with the appropriate approach and learning model. The learning approach chosen in the development of learning tools is Outdoor Learning and the learning model is Project Based Learning. Then the learning approach and model are integrated in learning tools into Project Based Outdoor Learning.

2) Design Stage

At this stage, test preparation, media selection, format selection, and initial design design are carried out. The research instrument consists of document assessment sheets, namely expert validation sheets and student response sheets. Pretest and posttest are also prepared to measure students' problem-solving abilities. The initial design of the learning objectives flow is presented in the figure 1.

Pengalasan Alur Tujuan Pembelajaran

Mata Pelajaran : Matematika
 Satuan Pendidikan : SMP Negeri 2 Ungaran
 Fase : D
 Kelas : VII
 Tahun Pelajaran : 2022/2023
 Penyesuaian/Instansi : Etnika/Universitas Negeri Semarang
 Elemen : Pengukuran
 Capaian Pembelajaran : Di akhir fase D peserta didik dapat menjelaskan pengaruh perubahan secara proporsional dari bangun datar terhadap ukuran panjang, besar sudut, dan luas.
(Berkas CP_Kepuasan_Kepala_BSK/MP/16.023/PP/UR/2022 Tahun 2023)

Tujuan Pembelajaran	Alur Tujuan Pembelajaran	Materi	Model Pembelajaran dan Profil Pelajar Pancasila	Jam Pelajaran	Sumber Belajar
P.1 Memahami dan menyelesaikan masalah yang berkaitan dengan jenis dan sifat bangun datar	P.1 Memahami dan menyelesaikan masalah yang berkaitan dengan jenis dan sifat bangun datar	Jenis dan sifat bangun datar	Model pembelajaran: Project Based Outdoor Learning	2 JP (2x40 menit) 4 pertemuan	Bahan Ajar Project Based Outdoor Learning
P.2 Memahami dan menyelesaikan masalah yang berkaitan dengan keliling dan luas bangun datar	P.2 Memahami dan menyelesaikan masalah yang berkaitan dengan keliling dan luas bangun datar	Keliling dan luas bangun datar	Profil Pelajar Pancasila: • Bergotong royong • Beramal kritis • Kreatif		
P.3 Menentukan pengaruh dan menyelesaikan masalah pada perubahan secara proporsional dari bangun datar terhadap	P.3 Menentukan pengaruh perubahan secara proporsional dari bangun datar terhadap	Perubahan secara proporsional dari bangun datar			

Figure 1. Learning Objectives Flow

Figure 1 is the initial design of the learning objective flow. In the flow of learning objectives, the important things that must be listed are the identity of learning, learning objectives, materials, Pancasila student profiles, and the learning resources used. All elements are explained, without exception the content of the independent curriculum which links the learning model with the Pancasila student profile. Then, the initial design of the teaching module is presented in the figure 2.

Modul Ajar Matematika
 Bangun Datar Segi Empat dan Segitiga
 Kurikulum Merdeka

A. Informasi Umum

Nama Penyusun	Emilia	Satuan Pendidikan	SMP Negeri 2 Ungaran
Jenjang/Fase	SMP/D	Tahun	2023
Kelas/Semester	7/Genap	Domain/Topik	Bangun datar segi empat dan segitiga
Kata Kunci	Bangun datar, segi empat, segitiga, keliling, dan luas	Pengetahuan/ Keterampilan Prasyarat	<ul style="list-style-type: none"> Konsep garis dan sudut Bilangan
Alokasi Waktu	2 x 40 menit	Jumlah Pertemuan	4
Moda	Tatap muka	Model Pembelajaran	Project Based Learning
Karakteristik Siswa	Reguler	Jumlah Siswa	36
Sarana Prasarana	Bahan ajar bangun datar, alat tulis, kertas HVS, penggaris, lem, gunting, laptop, HP, selotip.		
Profil Pelajar Pancasila	<ul style="list-style-type: none"> Bergotong-royong Beramal kritis Kreatif 		

Figure 2. Teaching Module

Figure 2 is the initial design of the PjBOL teaching module. The material content used is to build rectangular and triangular data. The elements that must

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be present in the teaching module include school identity and learning, learning objectives, and descriptions of learning activities from the first to the fourth meeting. The initial design of the teaching material is presented in the Figure 3.



Figure 3. Materials Teaching Cover

Figure 3 is the cover of the teaching materials developed. All teaching material designs are adjusted to the learning theme, namely project-based outdoor learning. There are two learning activities, each of which is carried out during two meetings. In addition to the material, the teaching materials also contain sample questions and practice questions as learning materials for students.

3) Develop Stage

At this stage, the Project Based Outdoor Learning tool developed will be assessed to expert validators, namely lecturers and teachers as a feasibility test stage. After getting revisions and suggestions for improvement, researchers will revise learning tools. Whether or not the learning tools developed are feasible are based on assessments provided by expert validators. In addition, at this stage of development, the Practicality Test of the PjBOL Device was carried out

using Student Response Sheets and the Effectiveness Test of the learning process using pretest and posttest of problem solving abilities.

1) Validity Test

Expert validation is an activity at the development stage that aims to determine the feasibility level of the learning tools developed. The eligibility of ATP and Teaching Modules is assessed based on assessment aspects tailored to the curriculum and mandatory components that must be present in the learning tool. Meanwhile, the feasibility of Teaching Materials is assessed based on aspects and assessment criteria of BSNP. Researchers tested the feasibility of learning tools to four validators consisting of two lecturers and two mathematics teachers. The following table is the result of the Learning Objective Flow validity test from the four validators.

Pengalasan Alur Tujuan Pembelajaran

Mata Pelajaran	: Matematika
Satuan Pendidikan	: SMP Negeri 2 Ujungran
Fase	: D
Kelas	: VII
Tahun Pelajaran	: 2022/2023

Elemen	Kompetensi dalam Capaian Pembelajaran	Alokasi Waktu	Semester
Penyelesaian	Menjabarkan persamaan perubahan secara proporsional dari bangun datar melalui ukuran panjang, lebar, sudut, dan luas.	8 JP	2 (Genap)

Tujuan Pembelajaran

Elemen	Alokasi Waktu	Ruang Lingkup Materi	Tujuan Pembelajaran	Pemahaman Bermakna	Rencana Asesmen	Metode Pengajaran
Penyelesaian	8 JP	Jenis, Sifat, Keliling, dan Luas Bangun Datar	<ol style="list-style-type: none"> Menjelaskan sifat-sifat bangun datar berdasarkan namanya. Menentukan keliling dan luas bangun datar yang berkaitan dengan masalah sehari-hari. 	Menyadari bahwa bangun datar memiliki berbagai jenis dan sifat yang berbeda. Keliling dan luas bangun datar dapat dijabarkan pada berbagai situasi, serta perubahan bangun datar mempengaruhi ukuran.	<ol style="list-style-type: none"> Hasil proyek kelompok Penyelesaian Tes Kemampuan Pemecahan Masalah 	<ul style="list-style-type: none"> Pengamatan Kuis Pembuatan Proyek Penilaian Kelompok

Figure 4. Revision of the Learning Objectives Flow

Based on the validation stages of the four expert validators on the Learning Objective Flow Validity Test, an average score of 4.45 was obtained with Very Good criteria so that the Learning Objective Flow can be used in learning with revisions. ATP improvements that have been made are by changing the ATP writing format from research schools, to the ATP

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Curriculum Merdeka format in accordance with the modified template from the Ministry of Education and Culture. Changes to the Learning Objectives Flow format are shown in Figure 4.

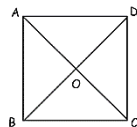
Based on the validation stages of the four expert validators on the Teaching Module Validity Test, an average score of 4.69 was obtained with Very Good criteria so that the Teaching Module can be used in learning with revisions. Improvements to the Teaching Module that have been carried out are by adding links of elements and sub-elements to the dimension (P3) of the Pancasila Student Profile, concise material to be taught, changes in the division of group projects for efficient learning time. Changes to the Teaching Module are shown in Figure 5.

Siswa	
Sarana Prasarana	Bahan ajar bangun datar, alat tulis, kertas HVS, penggaris, lem, gunting, laptop, HP, selotip.
Profil Pelajar Pancasila	<p>1. Bergotong-royong</p> <p>Elemen: Kolaborasi</p> <ul style="list-style-type: none"> Menyelaraskan tindakan sendiri dengan tindakan orang lain untuk melaksanakan kegiatan dan mencapai tujuan kelompok di lingkungan sekitar, serta memberi semangat kepada orang lain untuk bekerja efektif dan mencapai tujuan bersama. Membagi peran dan menyelaraskan tindakan dalam kelompok serta menjaga tindakan agar selaras untuk mencapai tujuan bersama. <p>2. Bernalar kritis</p> <p>Elemen: Memperoleh dan memproses informasi dan gagasan</p> <ul style="list-style-type: none"> Mengajukan pertanyaan untuk klarifikasi dan interpretasi informasi, serta mencari tahu penyebab dan konsekuensi dari informasi tersebut. <p>3. Kreatif</p> <p>Elemen: Menghasilkan gagasan yang orisinal</p> <ul style="list-style-type: none"> Menghubungkan gagasan yang ia miliki dengan informasi atau gagasan baru untuk menghasilkan kombinasi gagasan baru dan imajinatif untuk mengekspresikan pikiran dan/atau perasaannya.

(a)

Lampiran

1. Ringkasan Materi Bangun Datar Segi Empat dan Segitiga
A. Persegi



Sifat-sifatnya:

- Memiliki empat buah sisi yang sama panjang ($AB = BC = CD = DA$).
- Memiliki dua pasang sisi yang sejajar ($AB \parallel CD$ dan $AD \parallel BC$).
- Memiliki dua garis diagonal yang saling berpotongan tegak lurus yang sama panjangnya ($AC = BD$ dan $AC \perp BD$).
- Memiliki empat buah sudut siku-siku $\angle A = \angle B = \angle C = \angle D = 90^\circ$.

Keliling: $4 \times$ sisi

Luas: sisi \times sisi

(b)

Figure 5. Revision of Teaching Modules
(a) Addition of Elements of Pancasila Student Profile, (b) Addition of Material.

Based on the validation stages of the four expert validators on the Teaching Material Validity Test, an average score of 4.70 was obtained in the Very Good category so that Teaching Materials can be used in learning with revisions. Improvements to teaching materials that have been made are by adding examples of Project-Based Outdoor Learning based activities to the material, sample questions, and practice questions. Changes in Teaching Materials are shown in Figure 6.

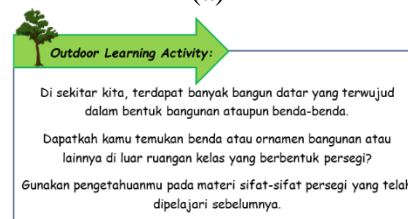
Setelah membaca dan mengamati tabel 1.1 terkait Jenis-jenis Segi Empat, perhatikanlah contoh benda berbentuk segi empat yang dapat kita temui di lingkungan sekitar.

Contoh:



Perhatikan papan rambu lalu lintas yang berwarna hijau. Papan rambu tersebut merupakan salah satu contoh bangun datar yaitu segi empat. Apabila kita gambarkan ulang ke bentuk segi empat, sebagai berikut.

(a)



(b)

Figure 6. Revision of Teaching Materials (a) Addition of real objects outside the classroom (b) Addition of outdoor-based activities.

After the expert validation stage is completed, including improvements to input and suggestions from experts, then the PjBOL device is tested in the experimental class. Learning activities refer to teaching modules that have been developed, using PjBOL teaching

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materials, and are carried out in accordance with the flow of learning objectives. The first and second meetings carried out activity 1 which is listed in the materials. The third and fourth meetings carried out activity 2 listed in the teaching materials. At each meeting, students are in groups and carry out learning outside the classroom. Documentation of students when carrying out learning outside the classroom is presented in figure 7 (a) and (b).



(a)



(b)

Figure 7. Activities of Project Based Outdoor Learning

At the first meeting, students still needed guidance to conduct data searches outside the classroom. From the second meeting onwards, students began to get used to and enjoy learning outside the classroom. They followed the time rules and regional boundaries that were set and mutually agreed upon.

2) Practicality Test

Project Based Outdoor Learning Teaching Materials that have been revised based on improvement suggestions from validators 1 to 4 and applied in learning, will then be tested for practicality. Teaching materials are said to be practical if students consider teaching materials easy to use and in accordance with the researcher's plan through student response sheets. In this study, teaching materials are deemed practical if respondents indicate that the materials can be used effectively in learning, as shown by the results of student response sheets.

Student response sheets were given to 34 students. Student response sheets contain three aspects of assessment, namely ease of use, attractiveness of presentation, and benefits. Based on the results of the practicality test that has been carried out, the results are obtained in Table 1.

Table 1. Practicality Test

Assessment Aspects	Average Score	Criterion
Ease of Use	4.42	Excellent
Attractiveness of Presentation	4.50	Excellent
Benefits	4.51	Excellent

Based on table 1, The Project Based Outdoor Learning tool developed has met the aspect of ease of use so that learning time is more effective and efficient, the content of teaching materials is easy to understand, the description of the material is clear, teaching materials can be used as needed, teaching materials can be used independently and repeatedly. Then the teaching materials also met the aspect of attractiveness of the presentation so that the teaching materials have an attractive display design, the content of the material is equipped with illustrations that match the material, the typeface is

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clearly read, the color combination is very interesting. Teaching materials also meet the beneficial aspects, so that they can help students understand the material, practice solving problems, motivate learning, and add insight to students.

3) Effectiveness Test

The prerequisite tests that have been carried out produce pretest and posttest data on problem solving ability is normal and homogeneous. Here are some data tests to determine the effectiveness of PjBOL devices that have been developed.

Individual Adequacy Test

The goal is to find out the average problem-solving ability of students in Project Based Outdoor Learning is more than the Actual Complete Limit (ACL) that has been set or not. The ACL in this study was 63.5.

Table 2. Individual Adequacy Test

Average (μ)	83.93
t_{value}	10.972
$t_{(0,95)(33)}$	1.6924
Criterion	$t_{value} > t_{1-\alpha,dk}$
Conclusion	$\mu > 63.5$

Obtained results (Table 2) $10.972 > 1.6924$ so $t_{hitung} > t_{1-\alpha,dk}$, so that H_0 was rejected. It can be concluded that the average problem-solving ability of students in Project Based Outdoor Learning is 83.93 more than the actual complete limit (ACL) which is 63.5. This means that students' problem-solving skills have improved after implementing learning using project-based outdoor learning tools. Learning carried out in groups is able to create positive interactions between students in groups. This interaction makes it easier for students to understand abstract mathematics learning, especially flat building materials. In addition, the outdoor

learning learning model is able to make it easier for students to explore flat buildings in real life outside the classroom environment.

Classical Completeness Test

The classical completeness criterion in this study is the percentage of experimental class students which is more than the percentage of completeness of 75%. The following is presented classical completeness test data in Table 3.

Table 3. Classical Completeness Test

Proporsi (π)	0.9705
Z_{hitung}	2.970
$Z_{(0,5-\alpha)}$	1.645
Criterion	$Z_{hitung} > \frac{Z_{1-\alpha}}{2}$
Conclusion	$\pi > 0.75$

Obtained results $2.970 > 1.645$ so $Z_{hitung} > \frac{Z_{1-\alpha}}{2}$, so that H_0 was rejected.

It can be concluded that the percentage of students who complete the Project Based Outdoor Learning is 97.05% more than the percentage of completeness of 75%. The completeness value is very high from the specified limit of 75%, meaning that only 2.95% of students have not achieved learning completeness. This indicates that the project-based outdoor learning models and tools implemented have been effective in developing students' problem-solving abilities almost comprehensively.

Mean Difference Test

The goal is to find out whether the Problem Solving Ability of students in Project Based Outdoor Learning is more than the Problem Solving Ability of students in Discovery Learning.

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Table 4. Mean Difference Test

\bar{x}_1	83.93
\bar{x}_2	74.39
t_{hitung}	3.2649
$t_{1-\alpha,dk}$	1.6684
Criterion	$t_{value} > t_{1-\alpha,dk}$
Conclusion	$\mu_1 > \mu_2$

Obtained results (Table 4) $3.2649 > 1.6684$, so $t_{hitung} > t_{1-\alpha,dk}$ so that H_0 was rejected. It can be concluded that the average of Problem Solving Ability of students in Project Based Outdoor Learning is 83.93 more than the average of Problem Solving Ability of students in Discovery Learning which is 74.39. These results indicate that the use of project-based outdoor learning tools for rectangular and triangular flat shape materials can be said to be more effective than the use of discovery learning models on average. Factors that affect this include, how students learn outside the classroom makes it easier for students to understand flat building materials in real life, learning that is carried out in groups is useful for students to find their own understanding. In addition, the tools used, namely project-based outdoor learning which is interesting and according to learning objectives, are able to improve more effective problem-solving skills.

Proportion Difference Test

The goal is to determine whether the proportion of students' problem-solving ability in project-based outdoor learning is greater than the proportion of students' problem-solving ability in discovery learning. The results of the calculation regarding the proportional difference test are presented in Table 5.

Table 5. Proportion Difference Test

Z_{value}	1.953
$Z_{(0.5-\alpha)}$	1.645
Criterion	$Z_{hitung} > Z_{\frac{1}{2}-\alpha}$
Conclusion	$\pi_1 > \pi_2$
Obtained results $1.953 > 1.645$ or $Z_{hitung} \geq Z_{\frac{1}{2}-\alpha}$. So that H_0 was rejected.	

It can be conclude that the proportion of students' problem-solving ability in Project Based Outdoor Learning is more than the proportion of students' problem-solving ability in Discovery Learning. Similar to the average difference test, the two-proportion difference test also indicates that the effectiveness of learning to improve problem-solving skills can be better achieved using project-based outdoor learning tools than the discovery learning model.

Problem Solving Ability Improvement Test

The test of improving problem-solving skills in classes using project-based outdoor learning tools is presented in the Table 6.

Table 6. Problem Solving Ability Improvement Test

t_{value}	11.6613
$t_{(0.5-\alpha)}$	2.035
Criterion	$t_{hitung} > t_{\frac{1}{2}-\alpha}$
Conclusion	$\mu_B \neq 0$

Obtained results $11.6631 > 2.035$ or $t_{value} > t_{\frac{1}{2}-\alpha}$ so that H_0 was rejected. It can be concluded that there is an increase in students' problem-solving skills after using project-based outdoor learning tools. This means that learning using project-based outdoor learning tools is effective, so that the devices meet the criteria for effectiveness.

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Furthermore, a gain test was carried out by analyzing the pretest and posttest scores of the experimental class to determine the increase in students' Problem Solving Ability.

Table 7. Gain Percentage

Criterion	Number of Students	Percentage
High	13	38,24%
Medium	19	55,88%
Low	2	5,88%

From Table 7, data was obtained that most of the students experienced an increase in problem-solving skills with medium criteria. This means that the use of project-based outdoor learning tools can improve problem-solving skills, and can be improved so that the improvement is more optimal with high criteria.

The research that has been conducted has produced a product in the form of a Project Based Outdoor Learning tools that meets the criteria of being valid, practical, and effective for use in learning. The research findings obtained were that students' understanding of flat-sided spatial geometry material was better due to learning outside the classroom. This was caused by various factors, including the project-based learning model which required students to work on project worksheets in groups. As previous research has proven, project based learning can improve students' problem solving abilities (Hardiningsih et al., 2023; Safithri et al., 2021).

Activities carried out with an outdoor approach also influenced students' understanding, they could explore the outside environment, construct their understanding of flat-sided spatial geometry in buildings outside the classroom while still in the school environment. This is in line with

previous research that outdoor learning can improve students' problem-solving abilities using the building exploration learning method outside the classroom (Taqwan, 2019). Likewise, learning carried out using the outdoor learning method produces better results in problem-solving skills compared to other methods, namely lecture method (ceramah) (Rosanti & Harahap, 2022).

Based on the implementation of learning in schools, there are several shortcomings such as the learning process requires very thorough preparation and supervision. Considering that learning outside the classroom requires preparation such as tools and materials to be used and supervision of students outside the classroom must be carried out properly, especially when they are in groups exploring buildings outside the classroom. So teachers must manage their time, energy, and thoughts when guiding students outside the classroom.

In addition to the shortcomings, there are advantages to project-based outdoor learning devices, including: 1) the problems presented on the worksheets are in accordance with everyday problems so that students are able to understand the problems and how to solve them by applying and exploring outside the classroom. 2) Project-based outdoor learning teaching materials are in accordance with the applicable curriculum, so that the content can be adjusted to students' abilities. 3) Project-based outdoor learning teaching materials contain practice questions related to everyday problems so that students are skilled in understanding and solving problems.

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CONCLUSIONS AND SUGGESTIONS

Based on the findings from the study, the study concluded that the project-based outdoor learning tools developed meet the quality criteria, namely valid, practical, and effective to improve problem-solving skills. There is a significant relationship between the learning model and student learning outcomes, especially with regard to flat shape materials. Specifically, understanding of flat shape concepts is enhanced when students directly explore real objects or buildings outside the classroom.

Based on this research, the suggestion is to ensure that the enhancement of students' mathematical abilities reaches a high level, it is essential to develop project-based outdoor learning materials thoroughly, particularly during the define and design stages, to identify students' needs. Furthermore, the future research needs to develop project-based outdoor learning tools on other geometry materials, such as three dimensional shapes because these tools are highly suitable for exploring geometry concepts in outdoor learning.

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