

Improving Cognitive Learning Outcomes through the TAI Model Supported by PAPILA Media on the Topic of Perimeter and Area of Two-Dimensional Shapes in Year 4

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Abstract:

This study aimed to improve students' cognitive learning outcomes through the implementation of the Team Assisted Individualization (TAI) model assisted by PAPILA (Papan Pintar Keliling dan Luas) media on the topic of perimeter and area of plane figures in Grade IV. This classroom

action research was conducted in two cycles involving 30 fourth-grade students at SD Negeri Karangroto 02, Semarang City. Each cycle consisted of planning, action implementation, observation, and reflection. Cognitive learning outcome data were obtained through tests, while learning process data were collected through observation. The results showed an increase in learning mastery from 30% in the initial test to 46.67% in Cycle I and 83.33% in Cycle II. The improvement was accompanied by changes in classroom learning activities, particularly through individual learning, group discussions, and peer assistance within the TAI model supported by PAPILA media. These findings indicate that the implementation of TAI assisted by PAPILA was associated with improved students' cognitive learning outcomes on the topic of perimeter and area of plane figures. The findings also suggest that a learning model combining individual learning and group work, supported by concrete learning media, can serve as an alternative approach to mathematics instruction in elementary schools.

Abstrak :

Penelitian ini bertujuan untuk meningkatkan hasil belajar kognitif murid melalui penerapan model Team Assisted Individualization (TAI) berbantuan media PAPILA (Papan Pintar Keliling dan Luas) pada materi keliling dan luas bangun datar kelas IV. Penelitian ini merupakan Penelitian Tindakan Kelas (PTK) yang dilaksanakan dalam dua siklus dengan subjek 30 murid kelas IV SD Negeri Karangroto 02 Kota Semarang. Setiap siklus terdiri atas tahap perencanaan, pelaksanaan tindakan, observasi, dan refleksi. Data hasil belajar kognitif diperoleh melalui tes dan data proses pembelajaran diperoleh melalui observasi. Hasil penelitian menunjukkan adanya peningkatan ketuntasan belajar dari 30% pada tes awal menjadi 46,67% pada siklus I dan 83,33% pada siklus II. Peningkatan tersebut disertai dengan perubahan aktivitas pembelajaran, terutama melalui kegiatan belajar individu, diskusi kelompok, dan bantuan teman sebaya dalam model TAI dengan penggunaan media PAPILA. Berdasarkan hasil tersebut, penerapan TAI berbantuan PAPILA menunjukkan adanya peningkatan hasil belajar kognitif murid pada materi keliling dan luas

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bangun datar. Hasil penelitian ini menunjukkan bahwa penggunaan model pembelajaran yang memadukan belajar individual dan kerja kelompok serta didukung media konkret dapat menjadi salah satu alternatif dalam pembelajaran matematika di sekolah dasar.

INTRODUCTION

Mathematics learning in primary schools aims not only to enable pupils to arrive at the correct answers but also to understand concepts and apply them to problem-solving. One topic that requires both conceptual understanding and practical application is the perimeter and area of plane figures. In this topic, pupils need to understand the characteristics of two-dimensional shapes, determine the required measurements, select the appropriate formulae, and carry out calculations accurately. Therefore, teaching must provide pupils with the opportunity to understand concepts gradually and apply them through concrete activities (Ningsih, 2024).

Based on the results of initial observations of mathematics lessons in Year 4 at Karangroto 02 State Primary School in Semarang, pupils' cognitive learning outcomes on the topic of the perimeter and area of two-dimensional shapes are still not optimal. The results of the initial test showed that only 9 out of 30 pupils, or 30 per cent, met the set proficiency criteria, whilst 21 pupils, or 70 per cent, did not meet the criteria. This situation indicates that the majority of pupils still require guidance in understanding and applying the concepts of the perimeter and area of two-dimensional shapes. Mathematics teaching on this topic needs to be directed not only towards the ability to memorise formulas, but also towards conceptual understanding and its application in problem-solving (Armidi, 2022).

One factor that needs to be taken into account in learning is the variation in abilities and learning needs amongst pupils. Pupils with diverse abilities require opportunities to learn individually whilst also receiving support when they encounter difficulties. One learning model suited to these conditions is Team Assisted Individualisation (TAI). TAI combines individual learning with group work, ensuring that pupils retain the opportunity to learn according to their abilities whilst receiving assistance from peers within a heterogeneous group (Kusuma et al., 2023). Such interactions provide pupils with the opportunity to explain, ask questions, discuss and help one another in solving problems.

The implementation of TAI in teaching the perimeter and area of two-dimensional shapes can be enhanced through the use of concrete learning materials (Shoimin, 2021). In this study, PAPILA (Smart Perimeter and Area Board) was utilised; this is a learning board designed to help pupils understand the concepts of perimeter and area of two-dimensional shapes through direct observation and calculation activities. The PAPILA board is used as a tool to help students recognise the shapes of two-dimensional figures, identify the necessary elements or measurements, and relate these measurements to the concepts of perimeter and area. Consequently, students are not merely confronted with

abstract formulas but gain a more concrete and visual learning experience (Arvelia et al., 2025).

The use of PAPILA is closely linked to the characteristics of the TAI model. Individual activities within TAI can be used to provide students with the opportunity to understand and solve problems independently with the aid of teaching aids (Prasetyo et al., 2022). Furthermore, group activities enable pupils to compare results, discuss, and provide assistance to peers experiencing difficulties. PAPILA serves as a concrete learning aid during this process, whilst TAI provides the structure for both individual and group learning activities. The combination of the two is expected to support the process of conceptual understanding and the application of the concepts of perimeter and area of two-dimensional shapes (Nafisah et al., 2025).

Several previous studies have shown that cooperative learning models and approaches that provide opportunities for pupils to learn individually as well as collaboratively can be used to support improvements in mathematics learning outcomes. Research by Munawarah et al. (2022) on TAI demonstrated that combining individual learning and group work provides space for pupils to learn according to their abilities whilst also receiving support from group members. Meanwhile, the study by Nadila et al. (2024) on the use of concrete materials in mathematics learning showed that such materials can help pupils understand concepts that were previously abstract. These findings indicate that learning models and materials play mutually supportive roles; however, the application of the TAI model specifically combined with the PAPILA material on the perimeter and area of two-dimensional shapes in Year 4 still needs to be examined within the context of real-world learning in primary schools.

Based on this prior research, the research gap in this study lies not only in the research location but also in the application of the combined TAI model and PAPILA media to support the learning of the perimeter and area of two-dimensional shapes (Nurpesti, 2021). TAI provides a learning structure through a combination of individual learning and peer support within heterogeneous groups, whilst PAPILA offers a more concrete learning experience in understanding the concepts of perimeter and area (Kholifah & Utami, 2025). This combination forms the focus of this classroom action research to observe changes in pupils' cognitive learning outcomes through gradual improvements in learning across each cycle (Harahap et al., 2023).

This research is important because initial learning outcomes indicate that the majority of pupils have not yet achieved mastery of the topics of perimeter and area of two-dimensional shapes. Furthermore, teaching needs to provide experiences that enable pupils to learn independently, collaborate, and use concrete materials in understanding mathematical concepts (Andinasari et al., 2024). Consequently, this study is expected to provide an overview of the application of the TAI model, supported by the PAPILA medium, in Year 4 mathematics teaching, whilst also serving as an alternative approach to improving learning on the topics of perimeter and area of two-dimensional shapes (Nadiyah et al., 2025).

This study aims to improve pupils' cognitive learning outcomes through the application of the Team Assisted Individualisation (TAI) model, supported by the PAPILA (Smart Perimeter and Area Board) medium, in teaching the topics of perimeter and area of two-dimensional shapes to Year 4 pupils at Karangroto 02 State Primary School in Semarang.

METHOD

This study employed a Classroom Action Research (CAR) approach, conducted at Karangroto 02 State Primary School in Semarang during the first semester of the 2026/2027 academic year. The research focused on Year 4 mathematics learning, specifically the topics of perimeter and area of two-dimensional shapes, with particular emphasis on squares and rectangles. The research was carried out from July to August 2026 with 30 Year 4 pupils of varying academic abilities as the research subjects.

The research was carried out in accordance with the Kemmis and McTaggart CTL model, which comprises four stages: planning, action, observation and reflection (Afandi, 2017). The research was carried out in two cycles, with each cycle consisting of two sessions and one evaluation. Prior to Cycle I, a pre-cycle stage was carried out through observation, interviews and a placement test. The placement test was used to obtain an overview of the pupils' initial abilities and to serve as the basis for forming heterogeneous learning groups (Susilo et al., 2022).

During the planning stage, the researcher identified the initial learning conditions and developed teaching modules, worksheets, the PAPILA medium, observation sheets, interview guidelines and evaluation instruments. The results of the placement test were used as one of the considerations in forming heterogeneous learning groups. Planning also included determining the TAI learning steps, the division of tasks within groups, and the use of PAPILA in learning activities. The teaching aid used in this study was PAPILA (Smart Perimeter and Area Board), designed to support the teaching of perimeter and area of two-dimensional shapes. This aid takes the form of a board equipped with sections for displaying formulas, an activity area, and a storage compartment for question cards. PAPILA was used to help pupils understand the subject matter through activities involving observation, problem-solving, and group discussion.



Figure 1. The PAPILA (Smart Perimeter and Area Board) teaching aid

PAPILA is used in conjunction with the TAI model. The cards and other media components are utilised in both individual and group learning activities, enabling pupils to solve problems and then discuss their results with their group members. This media serves as a visual and concrete aid in linking the shapes of two-dimensional figures, formulas, and the solution of problems involving perimeter and area.

During the action phase, the researcher conducted lessons in accordance with the plan that had been drawn up, using the Team Assisted Individualisation (TAI) cooperative learning model supported by the PAPILA media. The lessons were carried out through individual learning activities and group work. Pupils first received an explanation of the material and worked on tasks independently, before discussing the results of their work with their group members (Rita Rahmaniati, 2024).

During the observation phase, the activities of both the teacher and the pupils were observed throughout the learning process. The observations covered the implementation of the TAI stages, pupils' activities during individual and group learning, interactions between pupils, the use of the PAPILA media, and any difficulties that arose during the learning process. The results of the observations were used to evaluate the implementation of the action phase.

During the reflection stage, test results, observations and other supporting information are analysed to identify which aspects of the learning process have gone well and which still require improvement. The findings from Cycle I are used as the basis for refining the interventions in Cycle II. Improvements are focused on classroom management, student support, the organisation of group work, and the more optimal use of PAPILA. In this study, the cycles can be illustrated by the following flowchart:

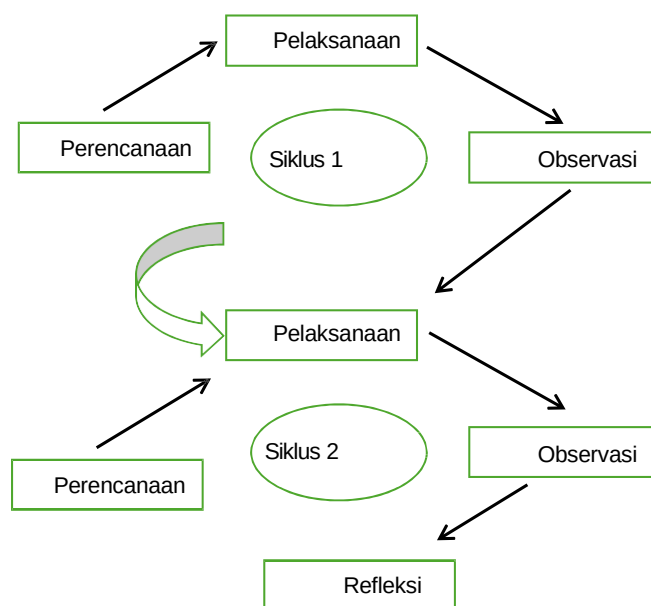


Figure 2.1 Flowchart of the Classroom Action Research Cycle

In this study, the researcher acted as the action implementer/model teacher, directly involved in planning, delivering lessons, collecting data, processing data, and reflection. The materials prepared included teaching modules, worksheets, PAPILA media, observation sheets, interview guidelines, evaluation instruments, and documentation.

Teaching utilised the Team Assisted Individualisation (TAI) model, comprising a placement test, teams, teaching groups, student creativity, team study, whole-class units, a fact test, as well as team scores and team recognition. In this study, each stage of the TAI model was applied in both cycles, with adjustments made based on the reflections from the previous cycle.

Table 1. Application of the TAI Stages in Cycle I and Cycle II

TAI Stages	Cycle I	Cycle II
Placement Test	Pupils take an initial test to assess their starting level. The results are used as the basis for forming heterogeneous groups.	The results of the Cycle I assessment are used to inform the provision of more targeted support for pupils who are still experiencing difficulties.
Teams	Pupils are divided into heterogeneous groups based on the results of the <i>placement test</i> .	Fixed groups are used with a more structured working arrangement to ensure group activities are more conducive to learning.
Teaching Group	The teacher explains the concepts of perimeter and area using the PAPILA resource and provides examples of how to solve problems.	The teacher provides further explanation and reinforcement of concepts that pupils still find difficult to understand and makes more optimal use of PAPILA.
Student Creative	Pupils complete worksheets individually to practise their understanding and ability to solve problems independently.	Pupils continue to work on their tasks individually, with more targeted instructions and support provided to those experiencing difficulties.
Team Study	Pupils discuss their work in groups, compare answers, and help one another to understand the material.	Group discussions are made more structured so that every pupil has the opportunity to participate and receive support according to their needs.
Whole-Class Units	Group representatives present the results of their discussions. The teacher reinforces key points and clarifies any misunderstandings.	Class discussions are conducted in a more focused manner, and the teacher provides reinforcement based on the difficulties identified in Cycle I.
Fact Test	Pupils complete an individual assessment to determine their learning outcomes following the interventions in Cycle I.	Pupils complete an individual assessment to determine their learning outcomes following the learning improvements in Cycle II.

Team Score and Team Recognition	Group work and participation are recognised in accordance with learning outcomes and group collaboration.	Recognition is given whilst taking into account learning outcomes and group cooperation as a means of reinforcing student engagement.
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The research data sources comprised Year 4 pupils, the class teacher, and the learning process throughout the study. Data collection techniques included a placement test, evaluation tests for each cycle, observation, interviews, and documentation. The placement test was used to assess pupils' initial abilities and served as the basis for forming heterogeneous groups, whilst the evaluation tests for each cycle were used to assess pupils' cognitive learning outcomes. Observations were used to gather data on teacher activities, pupil activities, and the implementation of the learning process. Interviews with the class teacher were conducted to obtain information regarding the initial learning conditions and the challenges faced. Documentation was used as supporting data, comprising attendance registers, learning outcomes, teaching modules, worksheets, photographs of activities, and other research documents.

The learning outcome test instrument used in the study consisted of five essay questions designed based on cognitive indicators C1–C4. The instrument's framework covered the ability to recall formulas, explain and distinguish between the concepts of perimeter and area, apply perimeter and area formulas, and analyse contextual problems. The instrument was administered at the outset of the study and at the end of each cycle to assess the progression of pupils' cognitive learning outcomes (Waruwu, 2024).

The pre-test, Cycle I test and Cycle II test used different questions but were designed to be of equivalent difficulty. The equivalence of the instruments was based on the use of the same test blueprint, content, cognitive indicators, essay-type question format and scope of skills. Differences in questions were introduced to avoid repetition, which could affect pupils' performance, whilst the similarity in indicators and scope of content ensured that results across stages remained comparable.

The instruments were developed based on the learning objectives and indicators set out in the syllabus. The validity of the instruments in this study is based on the alignment of the question content with the subject matter, learning objectives, and the cognitive indicators being measured. The instruments did not undergo separate empirical validity and statistical reliability testing. Therefore, the interpretation of test results in this study is based on individual scores, class averages, the percentage of classical achievement, and comparisons of improvements in learning outcomes across cycles.

C1 (recall) measures pupils' ability to recall the formulas for perimeter and area. C2 (understanding) measures pupils' ability to explain and distinguish between the concepts of perimeter and area. C3 (application) measures pupils' ability to use the formulas to solve problems involving perimeter and area. Meanwhile, C4 (analysing) measures pupils' ability to analyse contextual problems relating to the perimeter and area of two-dimensional shapes.

Question No.	Cognitive Level	Indicator Measured
1	C1 (Recall)	Recall the formulae for the perimeter and area of two-dimensional shapes
2	C2 (Understanding)	Explain and distinguish between the concepts of perimeter and area
3	C3 (Applying)	Using the formula to determine the perimeter of a two-dimensional shape
4	C3 (Applying)	Using a formula to calculate the area of a two-dimensional shape
5	C4 (Analysing)	Analysing and solving contextual problems relating to perimeter and area

A placement test was used to assess pupils' initial abilities and to form the basis for the creation of heterogeneous learning groups. Subsequently, tests at the end of Cycle I and Cycle II were used to assess pupils' learning outcomes following the implementation of the Team Assisted Individualisation (TAI) model, supported by the PAPILA media.

The research data were analysed both quantitatively and qualitatively. Quantitative data, in the form of test scores, were analysed based on individual scores, class averages, the percentage of class-level achievement, and improvements in learning outcomes based on N-Gain. The percentage of class-level achievement was calculated using the formula:

$$P = \frac{n}{N} \times 100\%$$

Explanation

P = Percentage of class-level achievement

n = Number of student who achieved the minimum competency standard

N = Total number of student

N-Gain analysis was used as a supplementary analysis to determine the level of improvement in pupils' cognitive learning outcomes from Cycle I to Cycle II based on individual scores. N-Gain was calculated using the following formula:

$$g = \frac{S_{II} - S_I}{100 - S_I}$$

Explanation

g = N-Gain value

S_{II} = Cycle II test score

S_I = Cycle I test score

100 = The maximum score students can achieve

N-Gain scores are categorised into three levels: high ($g \geq 0.70$), moderate ($0.30 \leq g < 0.70$) and low ($g < 0.30$). N-Gain in this study was used as a supplementary analysis, whilst the success of the intervention was not determined on the basis of N-Gain. The success of learning outcomes was determined on the basis of improvements in learning outcomes and the achievement of classical learning mastery, namely that at least 80 per cent of pupils obtained a mark of ≥ 70 (KKTP).

Qualitative data derived from observations, interviews and documentation were analysed through the stages of data reduction, data presentation and drawing conclusions. This analysis was used to identify developments in teacher and pupil activities, the implementation of the TAI model, the use of the PAPILA media, and the constraints encountered during the learning process. The results of the analysis were used as a basis for reflection and improvement of the intervention in the subsequent cycle.

The validity of the data was checked using triangulation by comparing information obtained through tests, observations, interviews and documentation. Triangulation was used to enhance the consistency and reliability of the research data. The success of the learning process was determined if the implementation of learning using the TAI model supported by PAPILA media, as well as student activities, achieved the 'good' category with a percentage of at least 80 per cent. Learning outcomes are deemed successful if at least 80 per cent of pupils achieve a mark of ≥ 70 (KKTP).

RESULT

1. Initial Conditions Based on the Placement Test

Before the learning intervention was implemented, a placement test was administered to all 30 pupils to identify their mastery of prerequisite material and to determine the formation of heterogeneous groups. Based on the test results, 9 pupils (30 per cent) had met the KKTP threshold of 70, whilst 21 pupils (70 per cent) were still below this criterion. These results indicate that the pupils' initial ability levels were quite varied and that the majority had not yet achieved the required standard of learning.

Table 1. Placement test results

Category	Number of Pupils	Percentage
Proficient (≥ 70)	9	30%
Not passed (< 70)	21	70%
Total	30	100%

Source: Research data

The results of the placement test also formed the basis for the formation of heterogeneous groups. Pupils with different abilities were placed in the same group so that they could help one another during the learning process. The formation of these groups was in line with the characteristics of TAI, which combines individual learning and group work.

2 . Implementation and Results of Cycle I

During the preparation stage of Cycle I, the researcher designed and prepared the learning resources, teaching materials, worksheets, PAPILA media, assessment instruments, and observation sheets. Learning groups were formed heterogeneously based on the results of the placement test so that pupils with different abilities could help one another in the learning process.

The implementation of Cycle I followed the TAI stages, supported by the PAPILA media. During the placement test stage, the initial test results were used to determine the pupils' baseline abilities and served as the basis for group formation. In the 'teams' stage, pupils were placed in heterogeneous groups. Subsequently, in the 'teaching group' stage, the teacher explained the concepts of perimeter and area of two-dimensional shapes and provided examples of how to use the PAPILA media.

In the 'student creative' stage, pupils complete individual tasks using worksheets, utilising PAPILA to aid their understanding of the concepts being studied. Subsequently, in the 'team study' stage, pupils discuss their work with their group members. Pupils who have grasped the material assist group members who are still experiencing difficulties.

During the whole-class units stage, group representatives present the results of their discussions, after which the teacher reinforces key points and corrects any misunderstandings. The fact test stage involves individual assessment to determine pupils' learning outcomes following the lesson. During the team score and team recognition stage, pupils' work is used to assess the group's progress, and recognition is given as a form of appreciation for the group's involvement.

In Cycle I, the PAPILA teaching aid was used primarily as a concrete resource to help pupils understand the concepts of perimeter and area through activities involving observation, problem-solving and discussing the results. The use of this teaching aid provided pupils with the opportunity to engage in the learning process, although in practice some pupils still required guidance in using the aid and completing group tasks.

The evaluation results for Cycle I showed that 14 out of 30 pupils achieved a mark of ≥ 70 , or 46.67 per cent, whilst 16 pupils, or 53.33 per cent, had not yet met the minimum competency standard (KKTP). The class-level achievement rate of 46.67 per cent did not meet the minimum success indicator of 80 per cent.

Table 2. Results of the Cycle I evaluation

Category	Number of Pupils	Percentage
Passed (≥ 70)	14	46.67%
Not passed (< 70)	16	53.33%
Total	30	100%

Source: Research data

Reflections on Cycle I indicate that group activities carried out simultaneously still resulted in a less than conducive classroom environment. Some pupils were still noisy, lacked focus, and required guidance in understanding concepts and applying formulas. Therefore, improvements in Cycle II were directed towards classroom management, clarity of instructions, the allocation of tasks within groups, pupil support, and the optimisation of PAPILA usage.

3. Implementation and Results of Cycle II

The planning for Cycle II was drawn up based on the reflections from Cycle I. The TAI model and PAPILA resources continued to be used, but each stage of learning was carried out with a more structured approach. The teacher provided clearer instructions, organised the division of tasks within groups, and offered more intensive support to pupils who were still experiencing difficulties.

During the placement test stage, the results of the Cycle I evaluation were used to identify pupils who still required support. During the 'teams' stage, pupils were grouped heterogeneously to encourage collaboration and mutual assistance. During the 'teaching group' stage, the teacher revisited concepts that pupils were still struggling with, particularly in understanding and applying the concept of the area of two-dimensional shapes.

During the 'student creative' stage, pupils complete tasks independently, using PAPILA as a tool to understand the relationship between the shape of a figure, its dimensions, and the calculation of its area. Subsequently, during the 'team study' stage, pupils compare and discuss their work with their group members. The teacher provides support to pupils who are still experiencing difficulties.

In the 'whole-class units' stage, the results of the group work are discussed collectively. The teacher reinforces the correct steps for solving problems and corrects any remaining errors. Subsequently, in the 'fact test' stage, pupils complete an individual assessment. The 'team score and team recognition' stage involves acknowledging the group's participation and progress.

In Cycle II, the use of PAPILA was directed more towards clarifying concepts and supporting group discussion activities. Compared to Cycle I, the more structured management of activities made the use of the medium more focused. The learning environment also became more conducive, enabling pupils to participate in group activities more effectively and allowing the teacher to provide more targeted guidance.

Based on the evaluation results of Cycle II, 25 out of 30 pupils, or 83.33 per cent, achieved a mark of ≥ 70 , whilst 5 pupils, or 16.67 per cent, did not meet the minimum passing mark. The class pass rate of 83.33 per cent met the set success indicator of at least 80 per cent.

Table 3. Results of the Cycle II evaluation

Category	Number of Pupils	Percentage
Pass (≥ 70)	25	83.33%

Not passed (<70)	5	16.67%
Total	30	100%

Source: Research data

The findings from Cycle II indicate that improvements in group management, mentoring and the use of PAPILA have created a more conducive learning environment. As the class-based achievement rate has reached 83.33 per cent, the research success criteria have been met and the intervention was discontinued at the end of Cycle II.

4. Comparison of Learning Achievement

Table 4. Comparison of learning achievement

Stage	Pupils Who Have Achieved Mastery	Students Not Achieving Mastery	Achievement
Placement Test	9	21	30%
Cycle I	14	16	46.67%
Cycle II	25	5	83.33%

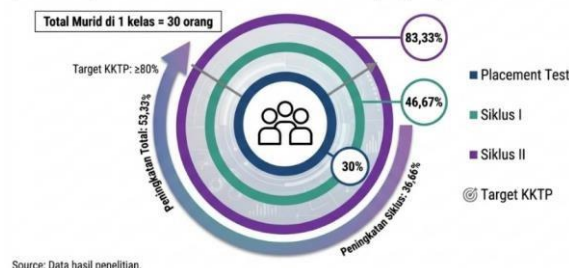
Source: Research data

The research results show a gradual improvement in learning achievement at each stage of the intervention. At the outset, only 9 pupils, or 30 per cent, had met the minimum learning standards. Following the implementation of the intervention in Cycle I, the number of pupils achieving the standards rose to 14, or 46.67 per cent. After learning improvements were made in Cycle II, the number of pupils achieving the standards rose to 25, or 83.33 per cent. Overall, learning attainment increased by 53.33 percentage points from the initial stage to Cycle II, whilst the increase from Cycle I to Cycle II was 36.66 percentage points. This increase indicates that the learning interventions carried out progressively through the TAI model, supported by PAPILA, were accompanied by an improvement in pupils' learning attainment.

PENINGKATAN PERSENTASE KETUNTASAN BELAJAR

Progres Ketuntasan Klasikal

Peningkatan dari Kondisi Awal (*Placement Test*) ke Siklus II adalah 53,33 poin persentase, dan dari Siklus I ke Siklus II adalah 36,66 poin persentase.



Source: Data hasil penelitian.

Source: Research data (optional if the graph uses research data)

5. N-Gain Analysis

The N-Gain calculation was carried out as a supplementary analysis to identify the extent of the improvement in pupils' cognitive learning outcomes from Cycle I to Cycle II. Based on calculations of the individual scores of 30 pupils, an average N-Gain of 0.5390 was obtained.

This value was derived from a comparison between the increase in scores achieved by pupils from Cycle I to Cycle II and the maximum score that could still be achieved. Thus, the average N-Gain value of 0.5390 indicates that, on average, pupils experienced a 53.90 per cent improvement in learning outcomes within the range of improvement still possible after Cycle I.

Based on the N-Gain criteria used in this study, the value of 0.5390 falls into the 'moderate' category as it lies within the range of 0.30 to less than 0.70. The distribution of N-Gain values shows that 1 pupil (3.33 per cent) was in the low category, 22 pupils (73.33 per cent) were in the moderate category, and 7 pupils (23.33 per cent) were in the high category.

Table 5. Distribution of N-Gain results

N-Gain Categories	Frequency	Percentage
Low	1	3.33%
Medium	22	73.33%
High	7	23.33%
Total	30	100%

Source: Research data

These results indicate that 29 pupils (96.67 per cent) fell into the moderate to high categories, meaning that the majority of pupils showed an improvement in learning outcomes from Cycle I to Cycle II. Nevertheless, N-Gain was used as supporting data, whilst the success of the intervention in this study was still determined on the basis of a minimum classical mastery rate of 80 per cent. In Cycle II, the minimum pass rate reached 83.33 per cent, meaning that the research success criteria were met.

DISCUSSION

The improvement in learning outcomes observed during the study indicates a change in the learning process from the initial stage, through Cycle I, to Cycle II. This change should not be understood as the result of a single factor, but rather as the outcome of the interaction between the implementation of the Team Assisted Individualisation (TAI) model, the use of the PAPILA medium, and improvements to the learning process based on reflections following each cycle. In Cycle I, the learning process still faced several challenges, particularly in managing group activities and pupils' understanding of the application of the concepts of perimeter and area. Following improvements in Cycle II, learning proceeded in a more focused and conducive manner, enabling more pupils to achieve the Minimum Competency Standard (KKTP).

The TAI model provides a learning structure that combines individual and group learning activities. Pupils first complete tasks independently, then have the opportunity to discuss and help one another within their groups. This approach allows pupils who have already grasped the material to assist their peers, whilst those still experiencing difficulties receive support during group activities. In this study, the implementation of TAI also enabled teachers to provide more targeted support to pupils requiring assistance. However, the implementation of group work does not automatically ensure effective learning. In Cycle I, the classroom environment was still found to be less conducive when several groups were working simultaneously. This served as the basis for making improvements in the subsequent cycle (Kholifah & Utami, 2025).

The PAPILA medium acts as a learning aid by providing a more concrete and visual experience in understanding the concepts of perimeter and area. Harahap et al. (2023) demonstrated that the use of this medium enables pupils not only to receive explanations of the formulas but also to observe and use two-dimensional shapes directly during learning activities. This media was primarily used when pupils were working on individual tasks or during group discussions. Thus, PAPILA helps to bridge abstract concepts with more concrete learning experiences. Nevertheless, the improvement in learning outcomes in this study cannot be attributed solely to the use of PAPILA, as this media was implemented alongside the TAI model and improvements to the learning process in each cycle (Aprilia et al., 2023).

The differences between Cycle I and Cycle II were primarily evident in the management of the learning process. Based on the reflections from Cycle I, activity instructions were clarified, the division of tasks within groups was made more focused, and more intensive support was provided to pupils experiencing difficulties. The use of PAPILA was also directed so that pupils did not merely use the medium but linked it to the concepts being studied. These improvements made the learning activities in Cycle II more conducive. These findings indicate that reflection in action research plays a crucial role, as the results from one cycle are used as the basis for determining actions in the subsequent cycle (Munawarah et al., 2022).

The research instruments covered cognitive indicators C1 to C4, ranging from recalling concepts and formulae, explaining and applying the concepts of perimeter and area, to analysing contextual problems. However, this study did not analyse changes in outcomes separately for each of the indicators C1–C4. Therefore, the improvement that can be confirmed based on the research data is an overall improvement in cognitive learning outcomes, rather than an improvement at each individual cognitive level. This is important to ensure that the interpretation of the research results remains consistent with the data obtained.

The findings of this study are consistent with previous research indicating that cooperative learning can provide pupils with opportunities to learn through peer interaction and mutual support (Nadila et al., 2024). However, this study has a more specific context as the application of the TAI model was integrated with the PAPILA

medium in teaching the perimeter and area of two-dimensional shapes to Year 4 primary school pupils. The contribution of this study lies not only in the use of the TAI model but also in its implementation through concrete media and the adjustment of teaching strategies based on issues identified during the learning process. Thus, this study provides an illustration of the application of TAI tailored to the characteristics of the subject matter and classroom conditions.

Although the majority of pupils had achieved the Minimum Competency Threshold (KKTP) by the end of Cycle II, there were still five pupils who had not reached this threshold. This indicates that improvements in learning outcomes have not yet been achieved uniformly across all pupils. Differences in initial ability, the speed at which they grasp the material, and the need for more intensive support should be taken into account when planning follow-up measures. Consequently, pupils who have not yet reached the KKTP threshold still require conceptual reinforcement, progressive practice and support so that the difficulties they face can be addressed more specifically.

An N-Gain value of 0.5390 was used as supplementary information to examine changes in individual scores between Cycle I and Cycle II. This value falls within the 'moderate' category and indicates a relative improvement following the implementation of Cycle II. However, the N-Gain was not used as the primary basis for determining the success of the intervention. The success of the study is still based on the established criteria, namely that at least 80 per cent of pupils achieved a minimum score of 70. Furthermore, as the study involved a single class without a control group, it cannot be confirmed that the improvement in learning outcomes was solely due to the TAI and PAPILA programmes.

This study has several limitations. The research was conducted in only one class comprising 30 pupils; consequently, the results cannot yet be generalised to all primary school classes. Furthermore, the study did not employ a control group, making it impossible to compare the findings with learning using alternative models. Furthermore, the researcher was directly involved as the intervention implementer/model teacher, meaning the researcher's involvement became part of the research context. The subject matter examined was also limited to the perimeter and area of two-dimensional shapes; consequently, the application of these findings to other areas of mathematics requires further research. The contributions of the TAI model and the PAPILA medium cannot be experimentally separated as both were implemented simultaneously.

In practical terms, the research results indicate that the application of TAI can be considered in mathematics teaching when teachers wish to combine individual learning responsibility with group collaboration. The use of concrete media such as PAPILA can help make abstract concepts easier for pupils to observe and apply. However, its implementation must be accompanied by clear instructions, a clear division of roles within the group, effective classroom management, and support for pupils experiencing difficulties. Thus, the success of learning depends not only on the choice of model or

media, but also on the teacher's ability to adapt the delivery of the lesson based on the pupils' circumstances and needs.

CONCLUSION

The research results indicate an improvement in pupils' cognitive learning outcomes following the implementation of the Team Assisted Individualisation (TAI) cooperative learning strategy, supported by the PAPILA medium, on the topic of the perimeter and area of two-dimensional shapes in Year 4 at SDN Karangroto 02. This improvement is evident from the changes in learning achievement rates across each cycle. By the end of Cycle II, 25 out of 30 pupils, or 83.33 per cent, had achieved a KKTP score of ≥ 70 . This achievement met the predefined success indicator for the study, namely that at least 80 per cent of pupils should achieve a KKTP score. Improvements in teaching during Cycle II—particularly in classroom management, the delivery of instruction, the allocation of group tasks, student support, and the use of PAPILA teaching aids—contributed to a more focused and conducive learning process.

The implementation of TAI provides pupils with the opportunity to learn individually whilst also working collaboratively in groups, whilst PAPILA is used as a supporting medium to help pupils understand the concepts of perimeter and area through more concrete experiences. However, the improvement in learning outcomes in this study cannot be attributed to a single component, as the model, media, guidance and action refinement were implemented simultaneously within the PTK cycle. Therefore, the research conclusions focus on the improvement in learning outcomes following the implementation of the actions, rather than on testing the influence of each component separately.

This study has limitations as it was conducted in only one class comprising 30 pupils at SDN Karangroto 02, utilised a PTK design without a control group, and the researcher was directly involved as the implementer of the interventions. These conditions mean that the research findings are contextual in nature and cannot be generalised to all primary schools, as pupil characteristics, classroom conditions, the school environment, and the learning process may differ. Furthermore, the study is limited to the topics of perimeter and area of two-dimensional shapes; therefore, the application of the findings to other areas of mathematics requires further investigation.

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