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Development of guided inquiry-based student worksheets on the Pythagorean theorem to facilitate eighth-grade students' mathematical conceptual understanding

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Abstract
Students' mathematical conceptual understanding of the Pythagorean theorem remains limited because learning often does not actively engage them in constructing mathematical concepts. Consequently, many students experience difficulties understanding conceptual relationships, explaining solutions, translating contextual problems into mathematical models, and selecting appropriate procedures for solving problems. Student worksheets (LKPD) specifically designed for the Pythagorean theorem and systematically aligned with indicators of mathematical conceptual understanding are still limited. This study aimed to develop a valid and practical guided inquiry-based LKPD on the Pythagorean theorem. The study employed the 4-D development model, consisting of the define, design, develop, and disseminate stages. The developed LKPD integrates the five syntaxes of the guided inquiry model with indicators of mathematical conceptual understanding, including restating concepts, representing concepts in various mathematical representations, selecting appropriate procedures, and applying concepts to solve mathematical problems. Validation results showed an average score of 86.73%, indicating that the LKPD was valid. Furthermore, the practicality test involving 36 eighth-grade students of Class VIII.2 at SMP Negeri 8 Pekanbaru produced a score of 91.88%, indicating that the LKPD was very practical. Therefore, the LKPD meets the criteria for validity and practicality and can serve as an alternative instructional material for learning the Pythagorean theorem.

Keywords: mathematical conceptual understanding; comprehension skills; Pythagorean theorem; student worksheets; guided inquiry

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I. Introduction

Mathematical conceptual understanding is one of the fundamental competencies that students should develop in mathematics learning. According to Sengkey, Sampoerno, & Aziz (2023), mathematical conceptual understanding refers to students' ability to recall mathematical ideas, explain concepts in their own words, apply them in problem-solving situations, and establish connections among mathematical concepts. Similarly, Kilpatrick, Swafford, & Findell (2001) define conceptual understanding as the ability to meaningfully understand mathematical concepts, operations, and their relationships, enabling students to comprehend the reasoning underlying mathematical procedures rather than merely memorizing formulas. This perspective is consistent with the National Council of Teachers of Mathematics (NCTM), which emphasizes that mathematical conceptual understanding involves connecting multiple mathematical representations and applying concepts flexibly to solve problems. Based on these perspectives, mathematical conceptual understanding in this study is defined as students' ability to understand, explain, connect, represent, and apply mathematical concepts meaningfully in various problem-solving situations. This competency provides an essential foundation for learning mathematical topics, including the Pythagorean theorem, which requires students not only to know the formula but also to understand the relationships among concepts and apply them appropriately in solving mathematical problems.

In this study, indicators of mathematical conceptual understanding were adopted from the frameworks proposed by the Indonesian Ministry of Education (in Sengkey et al., 2023) and Kartika (in Depitasari, Muchlis, & Irsal, 2021), with adjustments to suit the objectives of this study. The indicators include restating concepts, representing concepts in various mathematical representations, selecting and applying appropriate procedures, and applying concepts to solve mathematical problems. These indicators are relevant to the Pythagorean theorem because students are required to understand the relationships among the sides of a right triangle, connect visual representations to mathematical models, select appropriate formulas, and apply the Pythagorean theorem to solve mathematical problems.

Mathematical conceptual understanding is essential because it provides the foundation for students' reasoning in solving both mathematical and real-life problems and supports them in completing mathematical tasks effectively (Meidianti, Kholifah, & Sari, 2022). Despite its importance, numerous studies have reported that students' mathematical conceptual understanding remains low, particularly in the topic of the Pythagorean theorem (Darwani & Angkat, 2023; Umam & Zulkarnaen, 2022; Gustinawati & Nursa'adah, 2020; Kase, Daniel, & Taneo, 2023; Munadhiroh, Widyawati & Sari, 2024). Students commonly experience difficulties in restating concepts and problem solutions, translating word problems into mathematical models, analyzing contextual problems, selecting appropriate procedures or formulas based on information presented in diagrams, and solving non-routine problems. Furthermore, Sandra (2025) and Rahmah, Putri, Ikram, & Sosa Moguel (2025) reported that many students have weak prerequisite knowledge of the Pythagorean theorem, tend to memorize formulas without understanding the relationships among concepts, experience misconceptions, and struggle to connect visual, symbolic, and verbal representations. As a result, many students are unable to identify relevant information, restate the fundamental concept of the Pythagorean theorem, or apply it appropriately to solve mathematical problems.

Interviews and classroom observations conducted at SMP Negeri 8 Pekanbaru revealed that student worksheets (LKPD) specifically designed to facilitate mathematical conceptual understanding of the Pythagorean theorem had not yet been implemented. The existing LKPD primarily consisted of practice exercises without learning activities that support students in constructing mathematical concepts. Similarly, interviews and observations at MTs Negeri 1 Pekanbaru indicated that although LKPD had been used, they mainly presented formulas and proofs of the Pythagorean theorem, providing limited opportunities for students to construct their own understanding. These findings are consistent with previous studies. Trisandi, Kartini, and Saragih (2024) reported that the LKPD used at SMP Yabri Terpadu Pekanbaru mainly contained summaries, learning materials, worked examples, and practice exercises, without activities that encouraged students to develop conceptual understanding independently. Likewise, Nurhayati, Kartini, and Maimunah (2019) found that the LKPD used at SMP Negeri 40 Pekanbaru provided formulas directly, limiting students' opportunities to construct knowledge through the learning process and encouraging them to rely on memorizing formulas when solving mathematical problems. Therefore, there is a need to develop student worksheets that incorporate an appropriate learning model to facilitate students' conceptual understanding of mathematics.

Creating meaningful learning requires teachers to provide students with opportunities to actively participate throughout the learning process (Apriani, Novaliyosi, & Jaenudin, 2021). One instructional approach that has the potential to facilitate students' mathematical conceptual understanding is the guided inquiry model (Nurhayati et al., 2019). Romiyansah, Karim & Mawaddah (2020) describe guided inquiry as a learning model that enables students to actively construct their own knowledge through direct learning experiences. Similarly, Perdana & Ramadhona (2021), Fitri and Aprilianingsih (2020), and Hikmah, Zawawi, & Suryati (2023) reported that guided inquiry facilitates students' discovery of mathematical concepts independently, while teachers provide guidance through structured questions and learning activities. In this model, teachers do not leave students to construct knowledge without support; instead, they provide appropriate guidance throughout the processes of problem formulation, hypothesis generation, data collection, hypothesis testing, and concluding (Isrok'atun & Rosmala, 2019).

To ensure that the stages of the guided inquiry model are implemented systematically, appropriate instructional materials are needed to guide students throughout the learning process. One such instructional material is the Student Worksheet (LKPD). Choirudin, Anawar, & Khabibah. (2021) stated that LKPD can facilitate students' mathematical conceptual understanding by providing structured learning activities that support concept construction. Thus, LKPD serves not only as a medium for practice but also as a learning guide that helps students systematically engage with each stage of guided inquiry. Previous studies have demonstrated the potential of guided inquiry-based LKPD in mathematics learning. Depitasari et al. (2021) reported that students at SMP Negeri 4 Bengkulu City achieved a good level of mathematical conceptual understanding after learning with guided inquiry-based LKPD, with an average score of 85.43. In addition to supporting learning, an LKPD should also meet validity criteria to ensure that it is appropriate for classroom use and capable of facilitating students' mathematical conceptual understanding.

Nofiah & Jamaan (2021) developed a guided inquiry-based student worksheet (LKPD) on geometric transformation; however, the development process was limited to the small-group trial stage, and the study focused only on students' learning outcomes related to conceptual understanding. Similarly, Sari, Maulidiya, and Susanta (2021) developed a guided inquiry-based LKPD on tangents to circles, but their study primarily examined the LKPD's effectiveness in improving students' learning outcomes. Meanwhile, Herawati and Nurhikmayati (2025) developed an LKPD on the Pythagorean theorem to facilitate students' ability to represent mathematics. Wahyuni (2017) also conducted an LKPD development study using the Borg and Gall development model, combined with the guided discovery learning model, focusing on students' mathematical conceptual understanding and disposition.

Based on these previous studies, no research has specifically developed a guided inquiry-based LKPD on the Pythagorean theorem that systematically integrates indicators of mathematical conceptual understanding into the learning activities. Therefore, this study aims to fill this gap by developing a guided inquiry-based LKPD to facilitate students' mathematical conceptual understanding of the Pythagorean theorem. The expected contribution of this study is to provide a valid and practical LKPD that can serve as an alternative instructional material for teachers in implementing more student-centered mathematics learning. Accordingly, this study focuses on developing a guided inquiry-based LKPD to facilitate students' mathematical conceptual understanding.

II. Research Method

This development research uses Thiagarajan's 4-D development model (Mulyatiningsih, 2014), which consists of four stages: Define, Design, Development, and Dissemination. The Define stage was carried out through initial and final analyses, identifying fundamental problems and the LKPDs available at the school through interviews and observations with the teachers concerned. In addition, a student analysis was conducted to determine students' characteristics and learning needs through interviews with students. An analysis of tasks and concepts was conducted to determine the competencies that students must achieve based on the Learning Achievement (CP) analysis, so that appropriate material systematics could be obtained. Finally, the learning objectives were formulated.

Next, the design stage was carried out by designing an LKPD prototype through several steps, namely selecting the media and format of the product based on the results of the define stage analysis, then compiling the initial LKPD design and preparing a validation sheet to assess the feasibility of the product and a practicality sheet to assess the product in terms of practicality.

The development stage involved product validation and testing. The validation process involved three mathematics education lecturers. The validation results were then analyzed to assess the LKPD's validity. If the LKPD was not yet considered valid, revisions were made, followed by re-validation until it was valid. In addition to the validation process, a one-to-one trial was conducted with three students representing different levels of mathematical ability to obtain diverse feedback regarding the readability of the LKPD. Subsequently, a small-group trial was conducted involving six students selected by the mathematics teacher based on heterogeneous academic abilities, followed by a large-group trial involving 36 students to obtain broader responses regarding the practicality of the LKPD. The results of the practicality sheet analysis were used to determine the developed LKPD's practicality level. Finally, there was the dissemination stage, which involved conducting a seminar on the results and writing articles for publication in journals.

The data in this study consisted of both qualitative and quantitative data. Qualitative data comprised interviews with mathematics teachers and students, validators' suggestions on the validation sheet, and students' suggestions on the practicality sheet. A semi-structured interview was conducted using an interview guide as the research instrument. The interview guide covered several aspects, including curriculum analysis, the use of student worksheets (LKPD), the Pythagorean theorem topic, the relevance of the guided inquiry learning model, and strategies for improving the quality of the developed LKPD. Quantitative data were obtained from the validation sheet scores given by validators for the LKPD and the practicality sheet scores provided by students. The validation sheet indicators used in this study are presented in Table 1.

Table 1. Indicators of the validation sheet

Aspects	Indikator
Face Validity	The completeness of the components on the LKPD cover
	an attractive and proportional LKPD cover design
	a clear, systematic, and appealing LKPD layout
	as well as an appropriate and readable font size and type.
Content Validity	The suitability of the LKPD content with the learning outcomes and learning objectives
	the up-to-date presentation of materials
	conceptual accuracy of the materials
	The inclusion of exercises designed to develop students' mathematical

	conceptual understanding
Construct Validity	communicative language use
	straightforwardness of language
	The suitability of LKPD activities with the guided inquiry learning syntax
	The inclusion of guided inquiry steps that facilitate the indicators of students' mathematical conceptual understanding

Source: Samosir & Simatupang (2022), Rahmawati & Harun (2019), Festina & Warniasih (2021)

The practicality assessment indicators include ease of use, presentation, and language appropriateness (Rosmiyati & Oktora, 2019; Sukardi, in Ariani, 2022). Prior to their use in the research, the interview guidelines, validation instrument, and practicality instrument were reviewed and validated by experts to ensure that the instruments were suitable for the data collection process. The validation dan practicality sheet was created using a Likert scale with assessment categories. The validation scoring scale is presented in Table 2.

Table 2. Validation item scoring scale

Answer options	Score
Strongly agree	5
Agree	4
Undecided	3
Disagree	2
Strongly disagree	1

Source: Sugiyono, 2013

The validity of the LKPD was analyzed using the assessment scores from the validation sheet, scored on a Likert scale, as shown in Table 2. The formula used to calculate the validity percentage for each validator was as follows (Safenita, Jufri, & Yunita, 2023):

$$V_i = \frac{TV_i}{TSM} \times 100\%$$

Description:

V_i = Percentage of validity from the i-th validator

TV_i = Total score from the i-th validator

TSM = Maximum total score

Next, calculate the final validity percentage using the following formula.

$$NV = \frac{TV}{JV}$$

Description:

NV = Validity value

TV = Total percentage of results from all validators

JV = Number of validators

The validation calculation results are presented as scores in Table 3.

Table 3. LKPD validity category

No	Persentase (%)	Validity category
1	$0 < NV \leq 20$	Invalid
2	$20 < NV \leq 40$	Less valid
3	$40 < NV \leq 60$	Sufficiently valid
4	$60 < NV \leq 80$	Valid
5	$80 < NV \leq 100$	Very valid

Source: Safenita, Jufri, & Yunita, (2023)

The guided inquiry LKPD model is considered valid if its validity percentage is≥ 60% and invalid if it is < 60%. If the LKPD validity test score is < 60%, the LKPD must be revised and revalidated. If the minimum validity score has been reached, the LKPD practicality test is conducted. The LKPD practicality criteria are presented in Table 4.

Table 4. Practicality category of LKPD

No	Percentage (%)	Valid category
1	$0 < NP \leq 20$	Not practical
2	$20 < NP \leq 40$	Less practical
3	$40 < NP \leq 60$	Quite practical
4	$60 < NP \leq 80$	Practical
5	$80 < NP \leq 100$	Very practical

Source: Safenita, Jufri, & Yunita, (2023)

The guided inquiry LKPD model is considered practical if its practicality percentage is ≥ 60% and impractical if it is < 60%. If the LKPD practicality test score is < 60%, the LKPD must be revised and retested for practicality.

III. Results and Discussion

The Define stage began with an initial analysis to identify problems in mathematics learning through interviews and observations. The results of interviews and observations conducted with mathematics teachers at SMPN 8 Pekanbaru

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showed that the LKPD specifically designed to facilitate understanding of the Pythagorean Theorem material had not been used. The LKPD contained routine questions, making it difficult for students to work on questions that were different from the examples. In addition, the researcher conducted interviews and observations at MTsN 1 Pekanbaru and found that worksheets were already in use. Still, they contained formulas and proof procedures for the Pythagorean Theorem that did not provide students with opportunities to construct knowledge independently. As a solution, worksheets were developed using a guided inquiry model that encouraged students to construct their knowledge actively. Next, a student analysis showed that students were less active in learning because the learning was still teacher-centered. In addition, group discussions were infrequent, leading students to become more passive in their learning. At the task analysis stage, the tasks to be carried out by students during the learning process using LKPD were described to enable students to achieve the required competencies. Then, a concept analysis was conducted to identify the systematic structure of the Pythagorean theorem material in the LKPD, which aligns with the Learning Outcomes (CP) of the Merdeka Curriculum and the student handbook. Finally, the learning objectives for the Pythagorean theorem material were formulated.

The design stage begins with selecting media and format. The media used in this study are Microsoft Word and Canva. Meanwhile, the LKPD format is determined in accordance with the syntax of the guided inquiry model and indicators of mathematical concept comprehension skills. The developed worksheet (LKPD) was designed for four learning sessions. During the initial design stage, the worksheet was systematically organized into several main components, including the main cover, introductory section, and worksheet content. The content section consists of a cover page for each subtopic and learning activities designed around the five phases of the guided inquiry model: problem formulation, hypothesis formulation, information gathering, hypothesis testing, and concluding. In addition, each worksheet includes two practice exercises to reinforce students' understanding of the learning material. These components were systematically organized according to the standard structure of a worksheet to facilitate students' participation in the learning process

The main cover of the LKPD includes the LKPD title, supporting images, learning topics, and columns for entering the identity and information of the target class. The design of the LKPD main cover is shown in Figure 1.

Figure 1. Main cover of the LKPD

Each worksheet begins with a subtopic cover page containing the worksheet session title, supporting illustrations, session-specific learning objectives, instructions for using the worksheet, and fields for students' identities and target grade information. The cover page format of Worksheet 1 is presented in Figure 2.

Figure 2. Cover of LKPD-1

The developed worksheet was designed by integrating each phase of the guided inquiry model with the indicators of mathematical conceptual understanding. Each guided inquiry phase was translated into learning activities that were intentionally designed to align with specific conceptual understanding indicators.

The first syntax, namely problem formulation, presents students with a contextual problem related to the Pythagorean Theorem. Students are guided to identify the known and unknown information before beginning the investigation. According to Kuhlthau, Maniotes, & Caspari (2015), the initial phase of guided inquiry aims to activate students' prior knowledge by engaging them in meaningful problems as a foundation for constructing new knowledge. Therefore, the activities in this phase were designed to align with the conceptual understanding indicator of restating mathematical concepts, as students are encouraged to interpret and restate the mathematical situation in their own words before proceeding with problem solving. The implementation of the problem formulation phase in the developed worksheet is presented in Figure 3.

Figure 3. Syntax 1 of the guided inquiry model

Syntax 2, namely hypothesis formulation, guides students in proposing tentative answers to the given problem and predicting the relationships among the sides of the geometric figure formed. According to Joyce, Weil, & Calhoun (2015), at this stage, students formulate tentative explanations based on their prior understanding and then verify them with evidence. Therefore, the activities in this syntax were designed to align with the conceptual understanding indicator of restating mathematical concepts, as students are encouraged to express their understanding of mathematical concepts while formulating their hypotheses. The implementation of the hypothesis-formulation syntax in the developed worksheet is shown in Figure 4.

Figure 4. Syntax 2 guided inquiry model

Syntax 3, namely information gathering, requires students to collect relevant data from various sources, including the student textbook and the data collection procedures provided in the worksheet. According to Kuhlthau et al. (2015),

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this syntax provides students with opportunities to gather relevant information through guided exploration to support the inquiry process. Similarly, Joyce, Weil, and Calhoun (2015) stated that inquiry-based learning encourages students to systematically explore evidence before concluding. Therefore, the activities in this syntax were designed to align with the conceptual understanding indicator of selecting and using appropriate mathematical procedures or operations, as students are encouraged to determine and apply appropriate mathematical procedures to obtain evidence supporting their hypotheses. The implementation of the information-gathering syntax in the developed worksheet is presented in Figure 5.

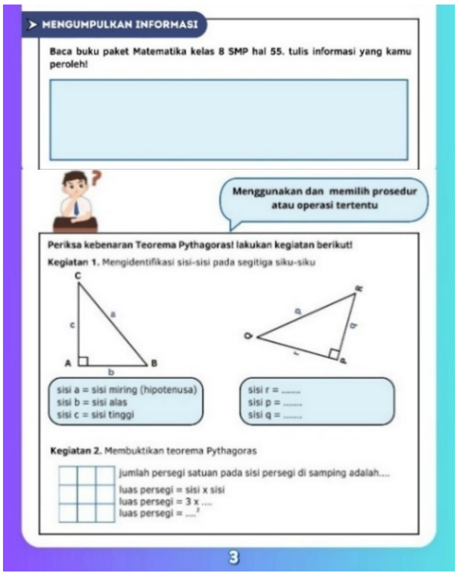

Figure 5. Syntax 3 guided inquiry model

Syntax 4, namely hypothesis testing, requires students to use the data collected during the information-gathering process to analyze the problem and verify their proposed hypotheses. According to Joyce et al. (2015), inquiry-based learning requires students to test their preliminary explanations using logical reasoning and available evidence. Therefore, the activities in this syntax were designed to align with the conceptual understanding indicator of applying mathematical concepts or algorithms in problem solving, as students apply the Pythagorean Theorem to verify the hypotheses they have formulated. The implementation of the hypothesis testing syntax in the developed worksheet is presented in Figure 6.

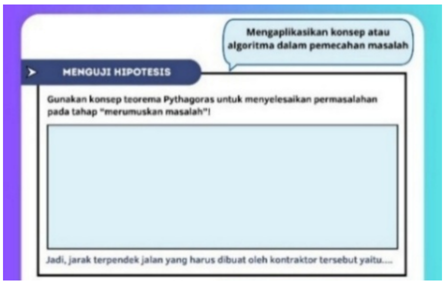

Figure 6. Syntax 4 guided inquiry model

Syntax 5, namely concluding, requires students to summarize the results of their investigation by identifying the facts, principles, and procedures learned from the topic. At this stage, students formulate conclusions by representing the mathematical concepts they have learned in various forms, such as written statements, diagrams, and mathematical symbols. According to Kuhlthau et al. (2015), the concluding syntax enables students to synthesize the information obtained throughout the inquiry process to construct a coherent understanding. Therefore, the activities in this syntax were designed to align with the conceptual understanding indicator of representing mathematical concepts in various forms, as students are encouraged to express their understanding through verbal, visual, and symbolic representations. The implementation of the drawing conclusions syntax in the developed worksheet is presented in Figure 7

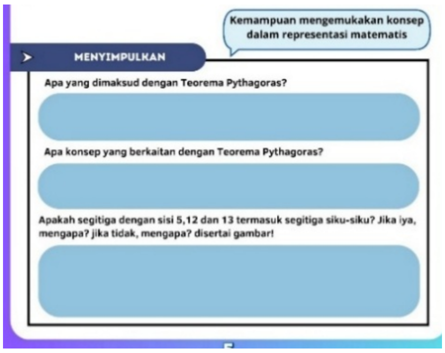

Figure 7. Syntax 5 guided inquiry model

The LKPD using a guided inquiry learning model has completed the design stage and is now in the development stage. During the development stage, validation tests were conducted by three validators, namely three mathematics education lecturers. The purpose of LKPD validation is to determine its validity across form, content, and construct. The appearance aspect relates to the appearance and design of the LKPD, the content aspect relates to the suitability of the material concepts, and the construct aspect evaluates the alignment between the guided inquiry syntax embedded in the worksheet activities and the indicators of mathematical conceptual understanding. The following is a summary of the validation results presented in Table 4.

Table 5. Validation results by 3 validators

Products evaluated	Average validity (%)			Average
	Face	Content	Construct	
LKPD-1	89.09	85.93	84.89	86.64
LKPD-2	89.70	83.70	84.88	86.09
LKPD-3	89.70	88.15	85.77	87.87
LKPD-4	86.66	87.40	84.89	86.32
Average Validity of LKPD				86.73
Category				Very valid

The LKPD assessment obtained a final average of 86.73% with a highly valid criterion. Although the LKPD falls into the highly valid category, several suggestions from the validators are based on the results of the LKPD revision. The following are the validators' suggestions and the results of the LKPD revision, as presented below.

Table 6. Validator suggestions and results

Validator Suggestions	Follow-up
On the introductory page, it is recommended that the font size be reduced so that the proportions are better. Change the layout and font size on the introductory page.	Changing the font style and size on the introductory page
The problem presented in LKPD 4 are replaced with more effective wording and and clearer images. Replace ineffective sentences with more effective ones and present cleare images.	Replacing ineffective sentences with more effective ones and presenting images more clearly
In the “gathering information” activity, add details or spesifications about what kind of information to look for. Specify the information to be sought.	Detailing the information to be searched for

As part of the validation process, a one-to-one test was also conducted with three students to assess readability. Several revisions were made, namely, in the activity of formulating problems in LKPD-3. The images presented were confusing to the students, so the researcher replaced them with clearer ones. Furthermore, during the information-gathering activity in LKPD-2, the instructions were clarified by adding clues. After the one-to-one test, a small-group test was conducted with six students from SMP Negeri 8 Pekanbaru. This test was performed to see the practicality of the LKPD on a small scale. The average practicality for the six students is presented in Table 7.

Table 7. The average practicality of six students

Products evaluated	Average practicality of 6 students (%)			Average (%)
	EU	PR	LS	
LKPD-1	94.02	90.00	88.89	90.97
LKPD-2	90.66	90.95	87.77	89.79
LKPD-3	92.00	90.47	91.13	91.20
LKPD-4	93.33	92.38	93.33	93.01
Overall Average	92.50	90.95	90.28	91.24
Average practicality of LKPD				91.24
Category				Very practical

Description:
EU: Ease of Use
PR: Presentation
LS: Language Suitability

Based on Table 5, the average practicality score from the small group trial was 91.88%, which is categorized as very practical. Next, a large-group trial was conducted with 36 students from SMP Negeri 8 Pekanbaru. In this trial, students were given LKPD and worked on it in group discussions. This test was conducted to determine the students’ level of practicality. In this test, students were given a student response questionnaire and asked to fill it out using a Likert scale. The average practicality of the 36 students is presented in Table 8 below.

Tabel 8. The average practicality of 36 students

Products evaluated	Average practicality of 36 students (%)			Average (%)
	EU	PR	LS	
LKPD-1	90.55	90.23	90.74	90.51
LKPD-2	91.66	92.14	93.70	92.50
LKPD-3	93.00	91.35	90.92	91.76
LKPD-4	93.22	92.77	92.22	92.74
Overall Average	92.11	91.62	91.90	91.88
Average practicality of LKPD				91.88
Category				Very practical

Description:
EU: Ease of Use
PR: Presentation
LS: Language Suitability

Based on Table 6, the average practicality score in the large-group trial was 91.88%, with a very practical rating. Therefore, based on the validation results, the small- and large-group trials concluded that the developed LKPD meets the requirements for validity and practicality in facilitating students' mathematical conceptual understanding.

The final stage is dissemination. This stage is carried out through the distribution of books and the submission of articles to scientific journals. Overall, this LKPD produces a product in the form of a guided inquiry-based LKPD to facilitate the mathematical conceptual understanding in the content of the Pythagorean theorem. The cover image of the distributed LKPD is presented in Figure 8.

Figure 11. Final product cover design

This study produced a student worksheet based on a guided inquiry learning model on the Pythagorean Theorem, designed to facilitate the mathematical conceptual understanding abilities of phase-D students, and is valid and practical. The Student Worksheet (LKPD) serves to increase student activity and as a guideline for students in carrying out the learning process. This aligns with Prastowo (in Muslimah, 2020), who stated that LKPD serves to increase student activity, as a guideline and instructional tool, trains process skills, helps students obtain learning notes, and helps students add information about the concepts being studied. LKPD is designed to help students understand learning concepts, thereby facilitating their mathematical conceptual understanding. This aligns with Choirudin, Anawar, and Khabibah's (2021) view that LKPD can help students comprehend the concepts being studied through systematic learning activities. Therefore, LKPD can be designed as a supporting tool in learning.

The design of the LKPD aims to create a learning environment where students are actively involved in the learning process, enabling them to understand mathematical concepts more effectively. According to Apriani, Novaliyosi, & Jaenudin (2021), to foster effective learning, educators must provide opportunities for students to play an active role in every learning activity. Sari, Maulidiya, and Susanta (2019) added that for students to actively understand and learn mathematical concepts, teachers should develop innovative learning methods. One learning model that can be used is guided inquiry. This aligns with Nurhayati, Kartini, and Maimunah (2019), who state that helping students discover and understand mathematical concepts in the material can be achieved through the guided inquiry model. According to Hikmah, Zawawi, & Suryati (2023), the guided inquiry learning model is effective in helping students understand concepts. Furthermore, Huang, Doorman, and Van Joolingen (2020) found that inquiry-based learning enables students to actively explore and construct mathematical concepts through meaningful learning experiences and the process of knowledge construction.

The development of this LKPD involves two categories of assessment, namely validity and practicality. Validity in this study comprises three aspects: face validity, content validity, and construct validity (Pedhazur & Bailey, in Siregar, 2017). Meanwhile, practicality includes three aspects: ease of use, presentation, and language suitability (Rosmiyati & Oktora, 2019; Sukardi in Ariani, 2022). Based on validation results of 86.73% and practicality results of 91.88%, the LKPD using a guided inquiry model to facilitate mathematical conceptual understanding is categorized as valid and practical. To assess the practicality of the developed LKPD, the researcher distributed a questionnaire to students. Students responded positively to the LKPD using the guided inquiry model. Students engaged in learning using the LKPD, following the syntax of the guided inquiry model. The phases of the guided inquiry model, according to Isrok'atun & Amelia (2019), are: (1) formulating problems; (2) formulating hypotheses; (3) collecting data; (4) testing hypotheses; (5) concluding.

After the researchers conducted a small-group trial followed by several revisions from the students, the next activity was a large-group trial involving 36 eighth-grade students at SMPN 8 Pekanbaru. The trial took place from October 20 to October 29. In this trial, students were asked to complete the LKPD under the researcher's facilitation and guidance. After completing the LKPD, students were asked to complete a questionnaire about their responses to the LKPD. Next, the researcher analyzed the student response questionnaire data and found an overall average of 91.88% in the "Very Practical" category.

Based on the trial results, students were able to work on the LKPD in accordance with the syntax in the guided inquiry model. In the first stage, the problem formulation stage, the researchers presented problems as story questions that directed students to the concept of the Pythagorean Theorem by having them create bus routes to school and make chairs, bridges, and wall decorations in the shape of right-angled triangles. This aligns with the views of Wiyoko & Astuti (2020), who stated that, in the problem formulation stage, students formulate problems based on the information or problems provided at the beginning. At this stage, students restate the concept by writing down the problem identification.

In the second stage, students formulate hypotheses. At this stage, students are directed to present problems in picture form so they can formulate temporary answers to the concepts in the problems. This aligns with the findings of Wiyoko & Astuti (2020), who state that, in the hypothesis formulation stage, students construct hypotheses based on previously identified problems. In the third stage, which is gathering information, students are instructed to consult other sources in the Grade VIII Merdeka Curriculum student handbook and to follow the steps for proving the Pythagorean Theorem in the student worksheet, selecting and using appropriate procedures to discover the concepts. This aligns with Sitepu, Afni, Saputri, Pratama, & Wirevenska (2024), who state that, during the data collection stage, students conduct investigations to obtain concepts for learning materials.

The fourth stage, namely testing hypotheses, is when students are allowed to apply the concepts discovered in the previous stage to solve problems in the worksheets. At this stage, students re-examine the hypotheses that were formulated earlier. This aligns with the findings of Syafila, Islami, & Siswoyo (2024), who state that at this stage, students solve problems based on their hypotheses, with the researcher guiding the outcomes of these hypotheses. The fifth stage is the conclusion, in which students formulate findings on the Pythagorean Theorem and present them in various mathematical representations.

Overall, the guided inquiry learning model can positively impact students' potential for mathematical conceptual understanding. The stages of formulating problems, proposing hypotheses, collecting data, testing hypotheses, and drawing conclusions provide students with opportunities to construct mathematical concepts through guided inquiry. Irsan, Haji, Sumardi, & Syafri (2024) reported that the guided inquiry learning model can improve students' mathematical conceptual understanding by actively engaging them in constructing knowledge through systematic investigation and concept discovery. Similarly, Nurjanah, Dahlan, and Wibisono (2021) stated that learning environments that provide students with opportunities to explore, observe, and discover relationships among mathematical concepts can strengthen their conceptual understanding of mathematics.

Depitasari et al. (2021) reported that the use of guided inquiry-based student worksheets (LKPD) resulted in students' mathematical conceptual understanding being categorized as good. Their findings suggest that the learning activities embedded in the LKPD encouraged students to independently discover relationships among mathematical concepts rather than relying solely on information provided by the teacher. Building on these findings, each stage of the guided inquiry model in the present study was integrated with learning activities designed to help students restate concepts, represent them in various mathematical forms, select appropriate procedures, and apply them to solve mathematical problems.

However, this study was limited to the validity and practicality evaluation stages and did not proceed to the effectiveness testing stage. Therefore, further research is needed to examine the effectiveness of the developed LKPD in improving students' mathematical conceptual understanding.

IV. Conclusion

Based on the study's results, the development of Student Worksheets (LKPD) is valid and practical. The validation results show that the LKPD is very valid, with a percentage of 86.73%, and the LKPD is very practical, with a rate of 91.88%. Thus, the Student Worksheet (LKPD) with a guided inquiry model was designed to facilitate students' mathematical conceptual understanding.

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