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Strengthening The Pancasila Student Profile Through Guided Inquiry-Based Worksheets on Heat

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Abstrack

The character of the Pancasila Student Profile in schools remains a challenge, especially in its integration into the science learning process. The study aims to develop a student worksheet based on a guided inquiry model using heated material to train the character of independence, cooperation, and critical reasoning. The development was carried out using the 4D model and tested using a one-group pretest-posttest design. Two experts and one practitioner assessed the product's validity, while field trials were conducted with high school students/equivalents. Practicality was measured through the implementation of learning and student responses, while effectiveness was assessed by reviewing character strengthening and improvements in learning outcomes using N-gain analysis. Thus, the student worksheet was classified as valid with the validation results of the student worksheet (3.35), outcome test (3.32), and the Pancasila student profile questionnaire (3.40) in the valid category; practical with the value of the implementation of learning (3.27) and student responses (3.24) in the practical category; and effective with an N-gain value of 0.77 for learning outcomes and a Pancasila character achievement of 3.10 in the good category. Thus, the developed student worksheet has proven to be feasible, practical, and effective in training students to embody the Pancasila student profile and improving student learning outcomes. The findings imply that guided inquiry-based student worksheets are effective in enhancing students' critical reasoning, independence, and cooperation, with the most significant improvement observed in critical reasoning, as well as substantially improving learning outcomes. Therefore, teachers are recommended to design and implement structured inquiry-based worksheets, particularly in abstract topics such as heat, to simultaneously support students' cognitive development and the strengthening of the Pancasila student profile's character.

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INTRODUCTION

Education plays a crucial role in facing the challenges of the era of globalization and increasingly rapid technological advancement. One strategic effort to improve the quality of education is to instill character values based on the Pancasila Student Profile in students (Bashith et al., 2023; Dhitami & Shaleh, 2025; Jumini et al., 2025; Waluyo & Wibowo, 2026). The Pancasila Student Profile reflects the character and competencies students will develop in the future, including independence, cooperation, critical thinking, creativity, and faith and piety. These values are crucial for developing a resilient, character-driven

generation capable of facing future challenges. Its implementation should serve as a primary reference in shaping a school culture that supports the strengthening of student character.

However, implementing the Pancasila Student Profile in schools continues to face various challenges, both internal and external. Internal challenges include teachers' limited understanding of how to reinforce Pancasila values during learning, a limited variety of teaching methods, and a reliance on teaching materials from publishers that are not oriented toward character building (Jayanti et al., 2025). Meanwhile, external challenges arise from the influence of the social and cultural environment, which is not always in line with Pancasila values, as well as technological developments that have the potential to negatively impact students' attitudes and behaviour (Fadilah, 2019; Rondli et al., 2026). These obstacles persist in schools, as evidenced by initial studies in several high schools in Banjarmasin, which still rely heavily on lecture methods and have not yet optimally fostered character values.

Furthermore, teachers often struggle to design learning strategies that align academic goals with character building. Limited facilities and resources, as well as minimal systemic support from schools, further complicate the implementation of Pancasila-based learning activities (Chonitsa et al., 2023). Lack of parental involvement also hinders student character development, resulting in suboptimal synergy between schools and families. This situation demonstrates that strengthening the Pancasila Student Profile requires systematic support from teachers, schools, and the students' surrounding environment.

To address these issues, a student worksheet was developed based on guided inquiry as a concrete effort to cultivate Pancasila values in the learning process. This student worksheet was designed not only to facilitate students' understanding of physics concepts, particularly heat, but also to foster independence through responsible learning, foster a spirit of cooperation through group work, and train critical reasoning skills through logical and evidence-based analysis of phenomena (Fitriani & Fadly, 2020; Soleh & Pratiwi, 2022). The selection of heat as the learning topic is based on its abstract nature and the fact that students often experience misconceptions in understanding concepts such as heat transfer and thermal expansion. These characteristics make heat particularly suitable to be explored through guided inquiry activities that involve experimentation and real-life contextual phenomena. This condition underscores the importance of developing student worksheets that are not only valid in content and effective in enhancing learning outcomes but also systematically cultivate the character values embodied in the Pancasila student profile throughout the learning process. Thus, the worksheet is expected to train students to think critically, collaborate, be independent, and develop character values (Susanti & Rohman, 2025; Waluyo & Wibowo, 2026).

This research offers novelty compared to previous studies, specifically in its effort to develop a guided inquiry-based student worksheet explicitly designed to train the character of the Pancasila Student Profile, particularly in the material on heat and the expansion of matter. This student worksheet is not only used as an aid in understanding physics concepts but also as a means of character formation through stages of inquiry activities that emphasize exploration, collaboration, and reflection of values so that it can achieve the goal, namely, producing a guided inquiry-based worksheet to train the character of the Pancasila on the material of heat.

To address these issues, a student worksheet was developed based on a guided inquiry model as a concrete effort to cultivate Pancasila values in the learning process. The selection of guided inquiry is grounded in its ability to actively engage students in constructing knowledge through investigation, which is essential for fostering critical reasoning and scientific attitudes. In addition, the heat topic was chosen because it is

abstract in nature and often leads to student misconceptions, particularly in concepts such as heat transfer and thermal expansion, making it highly suitable for inquiry-based learning supported by experimental activities. This student worksheet was designed not only to facilitate students' understanding of physics concepts but also to foster independence through responsible learning, promote cooperation through structured group activities, and develop critical reasoning skills through evidence-based analysis (Fitriani & Fadly, 2020; Soleh & Pratiwi, 2022).

The urgency of this study arises from the ongoing challenges in integrating the Pancasila Student Profile into classroom practices, where learning is still predominantly teacher-centered and lacks explicit strategies to embed character values within subject matter learning. Without innovative instructional tools, the implementation of character education risks remaining conceptual rather than practical.

Previous studies have developed student worksheets or learning materials based on inquiry or character education; however, most of them tend to focus separately on cognitive achievement or general character development without explicitly integrating the dimensions of the Pancasila Student Profile within a structured inquiry framework. Therefore, this study addresses this gap by developing a guided inquiry-based student worksheet that simultaneously integrates physics content, particularly heat, with targeted Pancasila character dimensions, namely independence, cooperation, and critical reasoning, making the learning process both conceptually meaningful and character-oriented.

METHODS

The research employed a research and development (R&D) approach using the 4D model type (Define, Design, Develop, and Disseminate) (Hidayatin et al., 2022). This study was conducted using a quantitative-descriptive approach, as the research focused on testing the feasibility, practicality, and effectiveness of the product (Student Worksheet). This model was selected because it offers systematic stages for producing learning products that are valid, practical, and effective in addressing students' learning needs.

In the definition stage, a needs analysis was conducted through interviews with physics teachers and the distribution of self-assessment questionnaires to students to identify learning difficulties in the heat material and the need to strengthen students' character in line with the Pancasila profile. In addition, a curriculum analysis was carried out to examine learning outcomes, learning objectives, and elements of the Pancasila student profile relevant to the heat and expansion of matter material. An analysis of student characteristics was also conducted to determine their initial abilities and readiness for inquiry-based activities.

The design stage focuses on preparing an initial draft of the guided inquiry-based worksheet, including the stages of orientation, problem formulation, hypothesis design, data collection and analysis, and conclusion. The worksheet is designed to integrate simple experimental activities that support the understanding of heat and expansion concepts, as well as strengthen the values of independence, cooperation, and critical reasoning. At this stage, research instruments are also prepared, including the student worksheet validation sheet, the outcome test, the Pancasila student profile questionnaire, and the teacher and student practicality questionnaire.

The development stage produces a worksheet product that is suitable for use. Validation is carried out by two physics education lecturers and one physics teacher across content, language, presentation, and graphics. The validation results serve as the basis for revisions to ensure the worksheet is valid. Next, a limited trial is conducted using a one-group pre-test-post-test design on grade XI MIPA students. This design was selected to measure students' improvement before and after the implementation of the guided inquiry-based

worksheet within the same group, allowing for the evaluation of its effectiveness under real classroom conditions without disrupting the existing learning structure. The trial aims to assess the practicality and effectiveness of the worksheet through indicators such as learning implementation, student responses, improvement in learning outcomes, and the strengthening of students' Pancasila profile character (Hasnunidah, 2017). Moreover, the dissemination stage is conducted on a limited scale through outreach and academic sharing sessions with physics teachers at partner schools to communicate the results of the product development. The subjects of this study included 32 grade XI high school students in the even semester of the 2024/2025 academic year, while the object of the study was the guided inquiry-based student worksheet that was developed.

The effectiveness of the worksheet was evaluated using a student self-assessment questionnaire to assess achievement of the Pancasila student profile development and learning outcomes and learning outcome tests to measure improvements in students' academic performance. Prior to implementation, all instruments were examined for content validity through expert judgment and empirically tested to ensure construct validity and reliability. The reliability of the questionnaire and test items was analyzed using appropriate reliability coefficients to confirm internal consistency. The specifications of the Pancasila student profile questionnaire are listed in Table 1.

Table 1 Specification of pancasila student profile questionnaire

Character Aspect	Indicator	Item Number	Item Type
Independence	Setting learning goals	1, 2	Positive, Negative
	Initiative in solving tasks	3	Positive
	Learning preparation	4	Positive
	Responsibility in completing tasks	5, 6	Positive, Negative
	Self-awareness of learning needs	7, 8	Positive, Negative
Cooperation	Participation in learning	9, 10	Positive
	Willingness to discuss with peers	11, 12	Negative, Positive
	Learning monitoring and reflection	13, 14	Positive
	Engagement with learning tasks	15, 16	Positive
Critical Reasoning	Listening and evaluating ideas	17, 18	Positive, Negative
	Collaboration in problem solving	19, 20	Positive
	Responsibility in group work	21	Negative
	Encouraging peer participation	22, 23	Positive, Negative
	Exemplary behaviour in learning	24	Positive

The character assessment of the Pancasila student profile in this study was conducted through a student self-assessment questionnaire and a character observation sheet, which were used to measure the extent to which guided inquiry-based student worksheets enabled students to practice the expected character values.

The Pancasila Student Profile character data were analyzed based on the results of a self-assessment questionnaire and observation sheets that measured three prominent character traits: independence, cooperation, and critical reasoning. The assessment scores were then categorized into four levels: very good, good, sufficient, and unsatisfactory, which were adapted from Pratiwi et al., (2023). The assessment categories were determined based on the average score ($\bar{x}$), with the following criteria: $0 <$ low ≤ 2.2; $2.2 <$ moderate ≤ 2.8; $2.8 <$ good ≤ 3.4; and $3.4 <$ very good ≤ 2.8.

The learning outcome data from students were analyzed using the normalized gain (N-gain) equation to determine the level of improvement in learning outcomes after

implementing the worksheet. N-gain analysis was used to compare pre-test and post-test scores with the maximum achievable score. Based on Hake's (1998) criteria, the analysis results were categorized as 〈g〉 > 0.7 (high), 0.3 ≤ 〈g〉 ≤ 0.7 (medium), and 〈g〉 < 0.3 (low). The flowchart of the research procedure using the 4D model is shown in Figure 1.

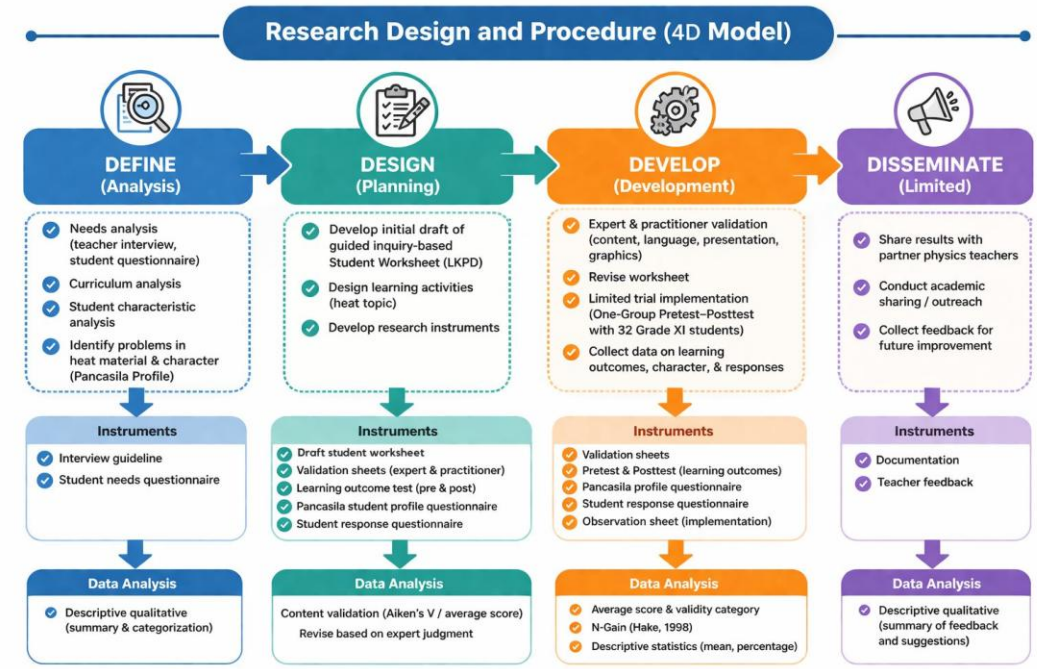

Figure 1 Flowchart of the research procedure using the 4D model

RESULTS AND DISCUSSION

The product of this research is a guided-inquiry worksheet using heat learning materials for high school students in grade XI. The student worksheet was developed to not only help students understand the concepts of heat and the expansion of matter but also to train the character of the Pancasila student profile, especially in critical reasoning, independence, and cooperation. The student worksheet structure is systematically arranged, including a cover, preface, table of contents, general information, user instructions, concept map, student worksheet 1–3, answer key, author biodata, and bibliography. The Student Worksheet product is presented in printed form, allowing students to write down their observations and answers directly on the activity sheet (Figure 2).

The learning activities were designed based on the stages of the guided inquiry model, which consist of identifying the problem, formulating a hypothesis, conducting experiments, analyzing data, and concluding. Through these stages, students are guided to actively construct their own knowledge, while reflection activities foster character awareness and group collaboration.

According to previous research (Patahuddin et al., 2022; Savitri & David, 2025) visual aspects such as layout, illustrations, and the use of color in teaching materials significantly influence student motivation and understanding. Therefore, student worksheets are designed to draw on displays and illustrations relevant to everyday contexts to facilitate quicker comprehension. After the development process, the Student Worksheet is then tested through three aspects of feasibility: validity, practicality, and effectiveness (Suliyanah et al., 2020; Yusuf et al., 2024)

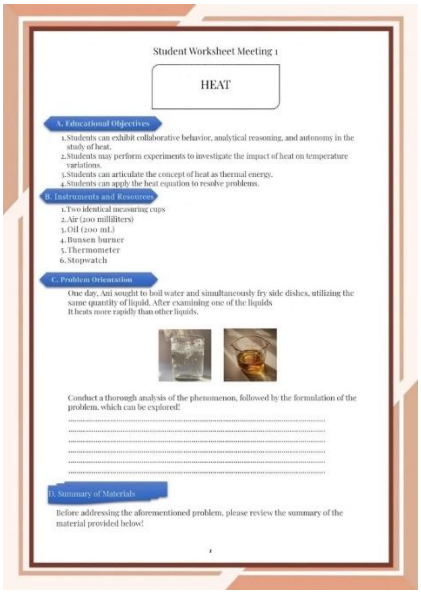

Figure 2 Student worksheet 1

The validity test results, conducted by two academic validators and one practitioner validator, showed that the Student Worksheet obtained an average score of 3.35, categorized as valid. The aspects assessed included format, appropriateness of content, language use, presentation structure, and graphics. This validity is important because it demonstrates that the developed Student Worksheet aligns with learning theory and curriculum principles and meets the eligibility criteria for use in physics learning. Good validation ensures that the worksheet supports the achievement of learning objectives and is relevant to students' characteristics. The results of the students' worksheet validation are presented in Table 2.

Table 2 Validation results of student worksheets

Review Aspect	**Validity**	
	Score	**Category**
Format	3.39	Valid
Feasibility	3.50	Very Valid
Language	3.17	Valid
Presentation	3.50	Very Valid
Graphics	3.20	Valid
Average	3.35	Valid

Table 2 shows that the presentation and feasibility aspects received the highest scores, indicating a strong alignment between the guided inquiry stages and the learning objectives, as well as the appropriateness of the content with curriculum standards. This suggests that the developed worksheet is conceptually sound and pedagogically well-structured. Meanwhile, the language aspect scored slightly lower because several sentences required simplification to improve clarity and readability for students.

In contrast, the graphics aspect obtained a relatively lower score compared to the other aspects. This indicates that although the content quality of the worksheet is strong, the visual presentation, including layout consistency, design attractiveness, and the use of supporting illustrations, has not been fully optimized. This contrast suggests that validators tend to prioritize the accuracy and relevance of content over visual design elements, reflecting the current tendency in instructional material development where pedagogical

correctness is emphasized more than aesthetic quality. However, visual aspects play an important role in enhancing students' motivation and comprehension, especially in physics learning, which often involves abstract concepts. Therefore, improving graphical elements such as layout organization, color balance, and contextual illustrations is necessary to create a more engaging and effective learning resource.

These results are consistent with the state that effective learning tools should not only meet content and construct validity but also support student engagement through appropriate design Sekarningrum et al. (2025). Furthermore, Table 3 presents the results of the analysis of the implementation of the student worksheets and students' responses.

Table 3 Analysis of the implementation of worksheets and student responses

Aspect	Average Score	Category	Percentage
Introduction	3.26	Good	81.5
Main activities	3.11	Good	77.8
Closing	3.44	Very Good	86.0
Average implementation	3.27	Good	81.8
Ease of use of student worksheets	3.44	Very Good	86.0
Student worksheet benefits	2.90	Good	72.5
Time efficiency	3.39	Good	84.8
Average student response	3.24	Good	81.1

Practicality was evaluated based on learning implementation and student responses. The observation results indicated that the implementation level reached 81.8% (very good), while student responses to the worksheet achieved 81.1% (very good). Student responses to the worksheet were very positive because the developed worksheet provided clear instructions, step-by-step directions, and attractive visual displays, making it easy to understand and use. In addition, the implementation of guided inquiry-based activities encouraged students to be active in discovering concepts independently through a process of investigation and discussion, rather than simply receiving information from the teacher. This approach increased students' curiosity, engagement, and learning motivation during the physics learning process (Waridah & Selvia, 2024). According to Astuti (2021) and Mahmudah et al. (2023), practical learning tools are easy for both teachers and students to use without creating significant obstacles. Therefore, this Student Worksheet is practical and suitable for application in physics learning.

The effectiveness of the Student Worksheet was demonstrated by improvements in students' learning outcomes and character development after the learning process. The criteria for interpreting the magnitude of improvement based on N-gain scores are presented in Table 4.

Table 4 N-gain criteria

Average Pre-test	Average Posttest	N-gain	Criteria
7.94	78.56	0.77	High

The average pre-test score of 7.94 increased to 78.56 in the post-test, yielding an N-gain of 0.71, which falls in the high category. This improvement in learning outcomes occurred because the stages in the guided inquiry model encouraged students to build concepts through direct experience and analysis of experimental data. The improvement in student learning outcomes is facilitated by both the structure of the guided inquiry learning process and the design of the student worksheet itself. The guided inquiry model engages students actively in constructing their understanding through sequential stages, such as problem identification, hypothesis formulation, experimentation, data analysis, and conclusion. These stages encourage students to interact directly with physical phenomena, allowing them to build conceptual understanding through experience rather than memorization.

In addition, the student worksheet is designed to provide clear guidance and scaffolding at each stage of inquiry, helping students organize their thinking and focus on key concepts. The inclusion of contextual problems and simple experiments on heat enables students to connect abstract concepts with real-life situations, which enhances conceptual clarity and retention. Furthermore, collaborative activities embedded in the worksheet promote discussion and idea exchange, allowing students to refine their understanding through peer interaction.

The combination of structured inquiry processes and well-designed instructional materials thus creates a meaningful learning environment that supports active engagement, critical thinking, and deeper conceptual understanding, ultimately leading to significant improvements in student learning outcomes.

These results indicate that implementing the guided inquiry-based student worksheet not only strengthens students' cognitive abilities but also reinforces students' character in line with the Pancasila profile. The detailed results of the questionnaire are presented in Table 5.

Table 5 Results of the pancasila student profile questionnaire

Character Aspect	by Aspect	
	Value	Category
Independent	3.09	Good
Cooperation	2.99	Good
Critical reasoning	3.24	Good

The results of the Pancasila student profile assessment indicate that all three character aspects, independence, cooperation, and critical reasoning, achieved the "good" category, with critical reasoning obtaining the highest score, followed by independence, while cooperation showed relatively lower achievement. This pattern provides an important basis for further analysis of how the guided inquiry-based worksheet facilitates character development.

The relatively lower score in cooperation, despite showing improvement, may be influenced by students' limited prior experience in collaborative inquiry-based learning. Although the worksheet includes group activities, effective cooperation requires not only task distribution but also structured interaction, such as clear roles, communication guidance, and collaborative problem-solving strategies. The absence of explicit scaffolding for group dynamics may have limited the optimization of cooperation skills. However, the increase from the initial condition indicates that inquiry-based activities still provide opportunities for students to engage in discussion and shared problem-solving, which gradually fosters collaborative behavior.

In contrast, the higher achievement in critical reasoning can be attributed to the structured inquiry stages embedded in the worksheet, particularly in activities involving data analysis, hypothesis testing, and drawing conclusions. These processes require students to think analytically and make evidence-based decisions, which directly train critical reasoning skills. Similarly, the independence aspect showed positive results, as the worksheet design encourages students to take responsibility for completing tasks, preparing learning tools, and managing their own learning process through guided yet student-centered activities.

These findings are consistent with previous studies that highlight the effectiveness of guided inquiry in promoting higher-order thinking skills and scientific attitudes. For instance, inquiry-based learning enhances students' critical thinking through active engagement in problem-solving processes (Fitriani & Fadly, 2020). In addition, structured learning activities can foster students' independence and responsibility in completing tasks

Soleh & Pratiwi, 2022). However, the relatively lower cooperation score in this study suggests that, compared to cognitive and individual character development, collaborative skills may require more explicit instructional support and longer adaptation time.

Therefore, while guided inquiry-based worksheets are effective in strengthening critical reasoning and independence, additional design considerations, such as structured group roles and guided interaction prompts, are needed to further optimize the development of cooperation skills. This finding highlights the importance of balancing cognitive, individual, and social dimensions in designing character-based learning materials. This is in accordance with the views of Aryanto & Shofiyullah (2022) and Rahmawati et al. (2024) that the model used, namely guided inquiry, is effective in developing critical thinking skills and scientific attitudes in students.

Each character in the Pancasila Student Profile has indicators that serve as references in compiling statement items and observation sheets. Independent character is reflected in discipline, responsibility, initiative, and self-motivation, demonstrating students' ability to organize and direct their learning. Cooperation is evident in active participation in group activities and the ability to collaborate with classmates to achieve common goals. Meanwhile, critical reasoning is evident in students' ability to analyze and evaluate information and make decisions based on data and facts obtained during learning activities.

The questionnaire results showed that implementing guided inquiry-based worksheets had a positive impact on students' character development. Improvements were observed in independent learning through discipline and responsibility when completing assignments, as well as in collaborative work, reflecting a spirit of cooperation and an awareness of teamwork's importance. Furthermore, critical reasoning skills were strengthened the most, as evidenced by students' ability to analyze problems, evaluate the outcomes of activities, and make decisions based on available evidence. This indicates that guided inquiry-based learning is not only effective in understanding physics concepts but also plays a significant role in fostering the character values embodied in the Pancasila Student Profile.

This study has several limitations that should be considered as a reflective guide for future research. First, the use of a one-group pretest–posttest design without a control group limits the ability to attribute the observed improvements solely to the implementation of the guided inquiry-based worksheet. Future studies are encouraged to employ experimental designs with control groups to strengthen causal interpretation. Second, the sample was limited to a single class consisting of 32 students, which may restrict the generalisability of the findings to broader educational contexts. Further research involving larger and more diverse samples across different schools is needed to enhance external validity. Third, the assessment of the Pancasila student profile relied partly on self-report questionnaires, which may be subject to response bias. Future studies could incorporate more objective measures, such as structured observations or peer assessments, to obtain more comprehensive data. In addition, the relatively lower achievement in the cooperation aspect indicates that the current worksheet design may not yet fully support the development of collaborative skills. This highlights the need for future research to explore more structured collaboration strategies, such as role assignment and guided interaction, within inquiry-based learning. These limitations provide important directions for improving both research design and instructional development, particularly in integrating character education within science learning more effectively.

This finding aligns with Rusdiyana et al. (2021), who found that implementing the inquiry learning model often faces challenges related to time, facilities, and student readiness.

However, these challenges can be overcome through gradual familiarization and the development of teacher competency in implementing the guided inquiry model. With

proper planning and adequate facilities, this inquiry-based student worksheet has the potential to be implemented more widely in other physics subjects.

CONCLUSION

This study developed a guided inquiry-based student worksheet on heat to strengthen the Pancasila student profile, particularly critical reasoning, independence, and cooperation. The results show that the worksheet is valid, practical, and effective, with a high N-gain (0.77) indicating significant improvement in learning outcomes. The most prominent improvement was found in critical reasoning due to the structured inquiry process, while independence also increased through student-centered activities. However, the lower achievement in cooperation suggests that collaborative skills require more explicit scaffolding. These findings indicate that guided inquiry-based worksheets are effective in enhancing higher-order thinking and learning responsibility but need to be supported with structured collaboration strategies to optimize character development.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTIONS STATEMENT

The first author contributed to research design, theoretical framework development, and data collection and analysis. The second author was involved in instrument validation, compiling research results, and conducting a literature review. The third author contributed to data interpretation, development of the discussion, and refinement of the manuscript. All authors actively participated in the revision process, provided substantial input, approved the final manuscript, and bear full responsibility for the article's content.

AI DISCLOSURE STATEMENT

The author used Google Scholar, Google Translate, and Grammarly to search for and identify reference sources, translate text, and improve the structure of the English. The author thoroughly reviewed and edited the article’s content as needed and takes full responsibility for the published content. Furthermore, this article was prepared, researched, written, and edited without the use of artificial intelligence techniques.

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