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Role of Physics Student Worksheet in Facilitating the Student' Scientific Literacy Skills: A Systematic Literature Review

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ABSTRACT

This study aims to systematically analyze the role of Student Worksheets in facilitating the improvement of students' scientific skills. Student worksheets serve as an instructional medium that encourages students to engage actively in the process of observation, experimentation, and reasoning to develop scientific literacy. Using a systematic literature review approach, this research examined 15 articles published in SINTA-indexed national journals between 2015 and 2025. The review process involved identifying, selecting, and analyzing articles that focused on the development or implementation of student worksheets to enhance students' scientific skills. Data were analyzed descriptively and thematically to identify trends, models, and outcomes from previous studies. The findings reveal that most student worksheets were developed using active learning models, such as Problem-Based Learning (PBL), Guided Inquiry, Learning Cycle 5E, STEM, and Ethnoscience, all of which have been proven valid, practical, and effective in improving students' reasoning, analytical thinking, and inquiry abilities. The integration of digital and contextual elements further supports engagement and aligns with 21st-century learning competencies. Therefore, student worksheets can be regarded as an effective educational tool to strengthen students' scientific skills and promote inquiry-based learning in various scientific contexts.

INTRODUCTION

The Student Worksheet is a teaching material that is compiled to assist students in absorbing concepts and practicing scientific steps in a structured manner. Its function is not limited to a learning guide, but also as a communication tool between teachers and students to create a dynamic and focused learning atmosphere. For physics learning, student worksheets play an important role because it can guide students to explore natural events in real life, practice observation, and hone logic and analysis. Through this activity, students are encouraged to build an understanding of physics concepts independently, not just being told by teachers (Judijanto et al., 2025). Thus, the student worksheets are the right tool to instill a scientific attitude that focuses on the discovery process, not just remembering facts and materials.

In the 21st century, competencies such as critical thinking, problem-solving, and scientific skills have become very important. The world today requires the young generation to be able to think reflectively, logically, and innovatively in responding to life's problems. For this reason, educators need to prepare learning facilities that can train these skills systematically. If student worksheets are designed with good teaching principles, it can be a solution to equip students with competencies in the 21st century. Through exploration, discussion, and experiment activities in student worksheets, students practice critical thinking, collaboration, and decision-making based on observational evidence (Novrianti & Hunaidah, 2024).

Recent studies have proven that the use of student worksheets that integrate the Problem Based Learning (PBL) model, guided inquiry, and Learning Cycle 5E can significantly improve students' scientific skills. These models make students a learning center that actively builds their knowledge through inquiry. The process skills approach guides students through the stages of the scientific method, starting from observing phenomena, finding problems, compiling temporary conjectures, carrying out experiments, to analyzing data to make conclusions. Activities in student worksheets help structure students' thinking processes to become more systematic and comprehensive, enabling learning that moves beyond memorization toward a deeper conceptual understanding (Wulandari, Supeno, & Wahyuni, 2024).

The development of student worksheets with an ethnoscience approach is also increasingly widespread. This approach connects the concept of science with local wisdom, values, and traditions. With ethnoscience-based student worksheets, students not only learn science in theory, but also see how it relates to their lives and cultural context. This has been proven to be able to increase interest in learning while creating a more contextual scientific understanding, because science is seen as something that is integrated with human daily life (Nadhif & Thohir, 2025). Thus, the ethnoscience student worksheets can harmonize aspects of knowledge, attitudes, and actions in a balanced manner.

Various studies also reveal that the use of student worksheets has a positive impact not only on academic achievement, but also on strengthening students' scientific competence. Through structured tasks in student worksheets, students are taught to carefully observe, analyze data, and conclude fact-based research results. This habit trains students to think logically and empirically, which is the foundation of scientific skills (Aisyah, 2025). Therefore, student worksheets are a very potential learning tool to shape students' scientific character from an early age.

Student worksheets also act as a link between theory and practice in science learning. Often, physics learning in schools emphasizes more conceptual aspects and minimal experimental activities. Student worksheets designed with a scientific approach can change this tendency by actively involving students in discovering concepts. Students are not only taught formulas and theories, but also understand the process of discovery behind them through scientific steps. This makes student worksheets a transformative learning tool because it can shift students' learning habits from passive to active and curious (Mahjatia, Susilowati, & Miriam, 2021).

Based on the description above, it can be concluded that student worksheets can facilitate the understanding of concepts, train scientific skills, and form scientific character. Therefore, this study intends to analyze the role of student worksheets in improving scientific skills through an examination of 15 SINTA-indexed articles from the 2015-2025 range. This study is expected to provide a comprehensive view of the effectiveness of student worksheets development and its development trends in the future, to support more relevant and in-depth physics learning.

METHODS

This study employed a literature review with a qualitative descriptive approach. The goal was to systematically analyze the role of Student Worksheets in improving students' scientific skills in physics learning. This method was chosen because it provides a comprehensive understanding of relevant previous research results and allows for the synthesis of diverse empirical findings. Data collection was conducted by searching articles published in SINTA-indexed national journals between 2015 and 2025 through Google Scholar. The analysis was performed by examining the objectives, research results, and contributions of each study to improving scientific skills.

Several criteria were applied in selecting the reviewed articles. First, the articles must have been published in nationally indexed SINTA journals within the period of 2015–2025. Second, the research should focus on the development or implementation of student worksheets in the context of physics or science education. Third, each article must contain empirical findings or validation results demonstrating improvement in students' scientific skills. Fourth, the articles should be written in Indonesian or English and fully accessible for content analysis. Based on these criteria, fifteen relevant studies were identified and included in the review process.

The scope of this review encompasses an analysis of the student worksheets development model, their application contexts, and their impact on various indicators of scientific skills, including observation, hypothesis formulation, experimentation, data analysis, and conclusion. Additionally, this review examines the aspects of validity, practicality, and effectiveness reported in each study. The discussion focuses on methodological trends and innovations in student worksheets development, such as the integration of active learning models, including Problem Based Learning (PBL), Guided Inquiry, Learning Cycle 5E, STEM, and ethnoscience approaches.

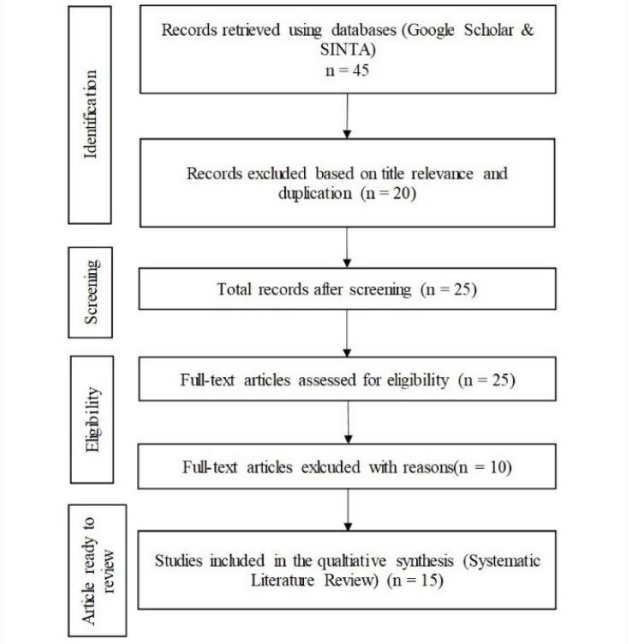

Figure 1. Flow diagram of Literature Selection Process

The literature selection process followed the PRISMA flow diagram as shown in Figure 1. Initially, 45 articles were identified through database searching. After removing 20 records due to irrelevance and duplication, 25 full-text articles were assessed for eligibility. Of these,

10 articles were excluded for not meeting the inclusion criteria that did not focusing on student worksheets development or implementation, did not measure scientific literacy skills, and were outside the 2015-2025 publication range. That resulted in 15 studies that were included in the qualitative synthesis for the systematic review.

The data were analyzed using a descriptive–thematic approach. Each article was reviewed based on its thematic focus on student worksheets development and its impact on students' scientific skills. Findings from the reviewed studies were synthesized to identify interrelations among them and to formulate general conclusions regarding the effectiveness of student worksheets in physics learning. The validity of the synthesis was maintained through cross-comparison and theoretical triangulation. This approach allowed for a comprehensive, critical, and evidence-based overview of how student worksheets contribute to fostering scientific skills among high school students.

RESULTS AND DISCUSSION

Results

This study systematically reviewed 15 research articles published between 2015 and 2025 in nationally indexed SINTA journals, focusing on the development and implementation of Student Worksheets. The analysis revealed that most studies applied active learning approaches such as Problem Based Learning (PBL), Guided Inquiry, Learning Cycle 5E, STEM, and Ethnoscience, each contributing to the improvement of students' scientific skills. Across the reviewed literature, student worksheets served as an effective medium for fostering scientific reasoning, experimentation, and analytical thinking in students. The table of articles reviewed in this systematic literature review is as follows.

Table 1. Literature Review Problem Based Learning

Author and Year	Article Title	Research Objectives	Research Results	Equation
Novrianti & Hunaidah, 2024	Development of CinQASE student worksheets, assisted by Flip PDF Professional	Develop PBL-based digital student worksheets to improve scientific thinking skills.	Student worksheets are valid, practical, and effective in improving critical and scientific thinking.	Improve scientific skills and critical thinking.
Asfiyah & Admoko, 2025	Student Worksheets Based on Problem-Based Learning on Straight Motion Materials	Develop student worksheets based on Learning Cycle 5E to train scientific argumentation.	Student worksheets are valid and effective in improving the ability to explain experimental results.	Improve scientific arguments.
Ramadhani & Andriani, 2024	student worksheets based on *Problem-Based Learning* (PBL) on Motion and Style material	Analyzing the needs of students and teachers for the development of Problem-Based Learning (PBL)-based Student Worksheets on	Student worksheets were declared effective because it succeeded in improving student learning outcomes and critical thinking skills.	Improve scientific thinking and learning outcomes.

		Movement and Style materials.		
Risamasu & Pieter, 2024	Student Worksheets Based on Problem-Based Learning	Develop student worksheets based on Problem-Based Learning (PBL), which is developed to improve students' problem-solving skills.	Student worksheets are effective because it succeed in improving students' problem-solving skills.	Improve scientific skills.

The studies summarized in Table 1 demonstrate that Problem-Based Learning (PBL)-based student worksheets are consistently valid, practical, and effective in enhancing students' scientific thinking and problem-solving abilities. The integration of PBL principles within the worksheets allows students to actively engage in identifying real-life problems, formulating hypotheses, and designing experiments, which fosters a deeper understanding of scientific processes. This engagement not only improves conceptual comprehension but also nurtures higher-order thinking skills such as analysis and evaluation. In addition, the autonomy given to students through guided problem exploration promotes self-directed learning and persistence in inquiry. The consistent improvement across studies indicates that PBL-based worksheets create a learning environment where students can connect scientific theory with practical application. Consequently, these findings affirm that the implementation of PBL in student worksheets plays a crucial role in cultivating students' analytical reasoning, creativity, and ability to apply scientific methods effectively in authentic contexts.

After analyzing the implementation of PBL-based student worksheets, the next focus of review concerns the guided inquiry approach, which emphasizes students' active participation in the discovery process through structured investigation. Table 2 presents a summary of studies that developed or implemented guided inquiry-based worksheets to enhance scientific skills. This model encourages students to explore phenomena, formulate hypotheses, and test their understanding through experimentation under teacher guidance. The guided inquiry framework ensures that students engage in authentic scientific practices while gradually developing independence in scientific reasoning and problem-solving.

Table 2. Literature Review Guided Inquiry

Author and Year	Article Title	Research Objectives	Research Results	Equation
Aksari et al., 2024	Development of Guided Inquiry-Based Physics Student Worksheets on Straight Motion Materials for High School Class X Students	Developing physics student worksheets based on guided inquiry to know the feasibility of the product based on expert and practitioner assessments, and assess student responses to the developed products.	Student worksheets are valid and effective in improving the ability to formulate hypotheses and infer data.	Increase active student engagemen t and strengthen the scientific process.
Rahmawati & Dwiningsih, 2024	Student Worksheets Based on Guided	Apply student worksheets, guided inquiry, to train	Student worksheets were declared effective	Improve learning outcomes

	Inquiry on Colloidal Materials	experimentation and scientific reflection.	and had a positive influence.	and critical thinking skills.
Nahak & Bulu, 2015	Effectiveness of the Scientific Student Worksheets Assisted Guided Inquiry Model	Testing the effectiveness of student worksheets-assisted inquiry on scientific outcomes and skills.	Effective models improve students' scientific outcomes and processes.	Improve learning outcomes and scientific processes.

The studies summarized in Table 2 indicate that guided inquiry-based student worksheets are highly effective in promoting students' scientific skills, particularly in observation, hypothesis formulation, experimentation, and data interpretation. The structured guidance provided within the inquiry process helps students gradually build independence in applying the scientific method while reducing cognitive overload during complex problem-solving activities. These findings align with the notion that guided inquiry allows learners to engage in authentic scientific reasoning while still benefiting from teacher scaffolding, ensuring a balance between exploration and conceptual clarity. In addition, guided inquiry worksheets foster curiosity and intrinsic motivation, as students are encouraged to seek evidence-based conclusions rather than rely on rote memorization. The consistent outcomes across reviewed studies suggest that this approach strengthens students' analytical reasoning and experimental design skills. Overall, the integration of guided inquiry in student worksheets has a substantial impact on developing both procedural and conceptual dimensions of scientific literacy.

Following the analysis of guided inquiry-based worksheets, the subsequent focus of the review addresses the Learning Cycle 5E model, which structures learning into five key phases. This model emphasizes a sequential and experiential learning process that encourages students to construct knowledge actively through continuous interaction and reflection. Table 3 provides a summary of studies that applied the 5E framework in the development of student worksheets aimed at enhancing scientific skills. Through this model, students are guided to connect prior knowledge with new experiences, design and conduct experiments, and evaluate their understanding through evidence-based reasoning. The use of the 5E learning cycle in worksheets is thus intended to cultivate deep conceptual understanding and strengthen students' scientific reasoning across different learning contexts.

Table 3. Literature Review Learning Cycle 5E

Author and Year	Article Title	Research Objectives	Research Results	Equation
Wahono et al., 2022	Student Worksheets Based on a Scientific Approach for Elementary Science	Produce scientifically based student worksheets to improve students' scientific analysis.	Student worksheets are considered feasible, practical, and effective in improving scientific analysis.	Improve data analysis and interpretation.
Sari et al., 2023	Development of Student Worksheet (student worksheets)	To develop student worksheets based on the Learning Cycle 5E model for senior high school students to	Student worksheets are valid and effective in improving the	Improve scientific arguments.

	Using the Learning Cycle 5E Model on Matrix Topic	ensure validity, practicality, and learning improvement.	ability to explain experimental results.	
Dalimunthe & Anas, 2024	Science Student Worksheets Based on Scientific Thinking	Develop and test the feasibility of student worksheets based on Scientific Thinking.	Student worksheets are feasible, practical, and effective in improving students' scientific abilities.	Improve the scientific thinking process.

The studies summarized in Table 3 reveal that student worksheets developed using the Learning Cycle 5E model effectively enhance students' scientific reasoning and conceptual understanding through a systematic and interactive process. Each phase of the 5E framework contributes uniquely to scientific skill development. Students are first engaged in identifying phenomena, then explore through experimentation, and finally elaborate their understanding through reflection and evaluation. The findings show that this structured cycle promotes active learning and sustained curiosity while reinforcing students' ability to connect theory with empirical evidence. In addition, the evaluation phase allows students to self-assess their comprehension and refine their reasoning based on experimental data, leading to deeper conceptual retention. These studies consistently indicate that the 5E model fosters higher-order thinking, argumentation, and scientific communication skills. Therefore, integrating the Learning Cycle 5E into student worksheets serves as an effective pedagogical strategy to scaffold scientific inquiry and cognitive growth in a coherent and evidence-based manner.

After reviewing the Learning Cycle 5E model, the next section focuses on the integration of Science, Technology, Engineering, and Mathematics (STEM) principles in the development of student worksheets. This approach emphasizes interdisciplinary learning that connects scientific inquiry with technological design and real-world problem solving. Table 4 summarizes studies that utilized STEM-based worksheets to enhance students' scientific, analytical, and creative skills through hands-on and project-oriented activities. By engaging students in designing, experimenting, and reflecting, STEM-oriented worksheets aim to bridge conceptual knowledge with practical application and innovation.

Table 4. Literature Review STEM

Author and Year	Article Title	Research Objectives	Research Results	Equation
Ulina & Jubaidah, 2025	Development of STEM-Based Student Worksheets to Improve Students' Critical Thinking Skills in Dynamic Fluid Materials	Develop STEM-based student worksheets to improve physics experiment skills.	Student worksheets are considered valid and effective in improving students' experimental skills.	Improve scientific experiment skills.
Nazira et al., 2024	Development of STEM-Based Physics Student Worksheets	Develop PBL student worksheets to improve thinking and problem-solving skills.	PBL-student worksheets improve the ability to formulate and test hypotheses.	Improve scientific problem-solving.

The studies summarized in Table 4 demonstrate that STEM-based student worksheets effectively promote integrated scientific skills by combining inquiry, experimentation, and design-based learning. Through the application of interdisciplinary concepts, students are encouraged to solve complex problems that mirror real-world challenges, thereby fostering creativity and innovation. These worksheets not only strengthen scientific reasoning but also enhance collaboration, communication, and technological literacy. The reviewed studies indicate that embedding STEM principles into learning activities helps students connect theoretical understanding with practical implementation, leading to more meaningful learning experiences. Moreover, the use of engineering design processes within the worksheets encourages iterative thinking, where students plan, test, and refine their ideas systematically. Collectively, these findings suggest that STEM-based worksheets cultivate a holistic set of scientific competencies, preparing students to think critically and innovatively in addressing scientific and societal issues.

The final category of the reviewed studies focuses on the integration of the ethnoscience approach in the development of student worksheets. This approach connects scientific concepts with local wisdom, cultural practices, and community knowledge to create more contextual and meaningful learning experiences. Table 5 presents studies that developed ethnoscience-based worksheets aimed at improving students' scientific understanding while fostering appreciation for cultural values. By linking science learning with students' everyday contexts, ethnoscience-based worksheets help bridge abstract scientific concepts with real-life experiences, promoting both conceptual understanding and cultural relevance.

Table 5. Literature Review Ethnoscience Approaches

Author and Year	Article Title	Research Objectives	Research Results	Equation
Rahmatin et al., 2022	Student Worksheets Based on Local Wisdom in Physics Learning	Develop student worksheets that integrate local wisdom to strengthen scientific literacy skills.	Student worksheets are valid and foster the ability to observe local phenomena.	Improve scientific observation and interpretation.
Walidah et al., 2023	Ethnoscience-Based student worksheets at SMP Negeri 8 Banda Aceh	Develop ethnoscience student worksheets to improve students' attitudes and scientific literacy skills.	Student worksheets are declared feasible and improve scientific attitudes.	Improve scientific attitudes and observations.
Muliani et al., 2025	Ethnoscience-Based Student Worksheets for Sound Wave Materials	Develop ethnoscience-based student worksheets to integrate local culture and scientific literacy skills.	Student worksheets are suitable for use and improve the ability to observe and explain phenomena.	Improve scientific observation and explanation.

The studies summarized in Table 5 reveal that ethnoscience-based student worksheets effectively integrate scientific concepts with local wisdom, allowing students to understand science through culturally relevant experiences. This contextualization enhances students' engagement and comprehension, as they can relate scientific phenomena to their daily lives and community practices. The reviewed studies consistently show that the ethnoscience

approach strengthens observation, reasoning, and communication skills while fostering respect for cultural diversity. In addition, the incorporation of cultural elements within the worksheets encourages students to view science not as an isolated discipline, but as a dynamic process embedded in social and environmental contexts. Such integration promotes holistic learning, combining cognitive understanding with affective and ethical dimensions. Overall, ethnoscience-based worksheets contribute significantly to the development of scientific literacy that is both conceptually deep and socially grounded, making science education more inclusive and contextually meaningful.

Based on the results of a review of 15 articles indexed by SINTA between 2015 and 2025, shows that student worksheet development commonly adopts active learning models such as PBL, guided inquiry, STEM integration, and contextual approaches like ethnoscience. Across the studies, these models are consistently validated as practical and effective in improving students' scientific literacy through observation, hypothesis formulation, experimentation, data analysis, and conclusion making. These results align with Syahgiah, Zan, and Asrizal (2023), who found that inquiry-based learning enhances science process and critical thinking skills. Likewise, Novrianti and Hunaidah (2024) reported that PBL-based digital worksheets significantly improved students' scientific and critical thinking abilities, and inquiry supported by computer simulations has been shown to strengthen scientific reasoning (Sulistiyo & Wijaya, 2015). Ethnoscience-based worksheet development also indicates that connecting scientific concepts to local cultural contexts boosts students' observation and reasoning skills, suggesting that contextualized learning fosters stronger scientific argumentation (Weiss, McDermott, & Hand, 2022). STEM-based and e-media student worksheets also stand out for systematically supporting experimentation and problem-solving; integrating exploration, experimentation, and reflection has been shown to strengthen scientific thinking (Ernawati & Sujatmika, 2021). Other studies likewise report that worksheets designed around the stages of the scientific process significantly improve students' ability to formulate hypotheses, conduct experiments, and draw conclusions (Widodo, 2021). Overall, the thematic analysis reveals consistent patterns: (1) most studies report improved scientific literacy after the use of student worksheets; (2) effective worksheet designs follow the steps of the scientific method; (3) technology and local context are increasingly incorporated; and (4) practicality and validity serve as key quality indicators. Thus, developing student worksheets plays an essential role in enhancing students' scientific literacy, provided that pedagogical models, contextual relevance, media integration, and validation procedures are carefully considered.

Discussion

Based on the synthesis of 15 SINTA-indexed articles published between 2015 and 2025, it can be concluded that the development of student worksheets (LKPD) is dominated by the application of active learning models. Models such as Problem-Based Learning (PBL), guided inquiry, STEM integration, and ethnoscience-based contextual approaches have consistently been reported to meet the criteria of validity, practicality, and effectiveness in training students' scientific skills (Verawati, Rokhmat, Harjono, Makhrus, & Sukarso, 2025). These skills include a series of scientific processes ranging from observation, hypothesis formulation, experiment execution, data analysis, to concluding. These findings indicate that inquiry-based teaching materials are highly effective in developing students' critical and creative thinking skills in science learning (Sutiani, 2021). The innovation of PBL-based student worksheets is a real example of success, showing a significant increase in students' scientific and critical thinking (Harahap, Sudarma, Novika, & Festiyed, 2025). These findings

align with research in science education, which reveals that worksheets designed using inquiry models positively impact students' scientific literacy. On the other hand, the ethnoscience approach in student worksheets plays a role in strengthening students' scientific observation and reasoning skills by connecting abstract science concepts with familiar cultural contexts and local wisdom (Muliani, Lembong, Sakdiah, Fatmi, & Novita, 2025). In addition, the trend in student worksheet development also shows the increasing adoption of STEM approaches and digital media. Student worksheets that combine exploration, experimentation, and reflection activities with technological support have been proven to deepen students' scientific thinking processes (Andriana, Fauzany, & Alamsyah, 2022). In terms of the quality of teaching materials, several studies emphasize that student worksheets carefully designed with complete stages of the scientific method yield tangible results. Students show significant progress in formulating hypotheses, conducting experiments, and inferring results based on data (Pranata, 2025). Thus, this discussion explains that the development of student worksheets plays a central and strategic role in fostering students' scientific skills. For optimal implementation, careful consideration is needed in selecting appropriate learning models, utilizing media and technology, incorporating local contexts, and ensuring rigorous validation and practicality testing processes (Ulina & Jubaidah, 2025).

CONCLUSION

Based on the synthesis of 15 SINTA-indexed research articles published between 2015 and 2025, it can be concluded that the development of Student Worksheets plays a crucial role in enhancing students' scientific skills, particularly in physics learning. The reviewed studies consistently demonstrate that student worksheets designed through active learning models, such as Problem-Based Learning (PBL), Guided Inquiry, Learning Cycle 5E, STEM, and Ethnoscience, are valid, practical, and effective in supporting scientific reasoning, experimentation, and analytical thinking. These worksheets not only serve as learning aids but also function as scaffolds that guide students through inquiry-based processes and foster higher-order thinking. The integration of contextual and digital elements in student worksheets further strengthens its relevance to 21st-century learning demands. To ensure optimal outcomes, student worksheet development should be aligned with pedagogical principles, validated by experts, and tested for practicality in real classroom settings. Overall, well-structured student worksheets contribute significantly to cultivating students who are not only conceptually competent but also scientifically literate, reflective, and capable of applying scientific inquiry in problem-solving.

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