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Literature Review of Sets-Based Practical Guidelines (Science, Environment, Technology and Society) to Improve Concept Understanding and Scientific Process Skills

Literature Review

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Abstract

Concept understanding and science process skills are essential abilities that students must possess to achieve success in science learning. These abilities help students understand scientific phenomena, think logically, and apply concepts in everyday life. However, several studies show that students' concept understanding and science process skills are still relatively low. This issue arises because the teaching materials used in schools have not fully connected scientific concepts with real-life contexts, making learning tend to be theoretical and less meaningful. One solution to address this problem is to develop SETS-based teaching materials (Science, Environment, Technology, and Society) that can link scientific concepts with environmental, technological, and social aspects. This study uses a literature review method by analyzing previous studies indexed in Sinta 2-4 from 2015 to 2025 that are relevant to the theme and research questions. Based on the review of 50 selected articles, it was found that the development of SETS-based teaching materials can significantly improve students' concept understanding and science process skills, making learning more contextual and meaningful.

Keywords: Conceptual Understanding, SETS, Scientific Process Skills, Teaching Materials.

1. Introduction

Rapid advances in science and technology require physics education to move beyond the transmission of concepts toward the development of students' thinking skills, creativity, and scientific process skills. Meaningful learning occurs when students are actively involved through direct experiences, particularly in practical activities that enable them to construct concepts empirically and systematically. However, physics instruction in schools is still largely dominated by lecture-based methods and conventional teaching materials that inadequately connect scientific concepts with real-world phenomena, resulting in passive learning and difficulties in understanding abstract concepts (Hayati & Rosana, 2019).

This condition is not fully aligned with the demands of both the 2013 Curriculum and the Merdeka Curriculum, which emphasize active, exploratory, and science-based learning. Students are expected to engage in observation, data interpretation, and problem-solving activities as part of scientific process skills, which form the foundation for conceptual understanding in physics. Consequently, there is a need for contextual practical teaching materials that support active learning and the development of these skills.

The SETS (Science, Environment, Technology, and Society) approach offers a relevant framework by integrating scientific concepts with environmental contexts, technological

applications, and social aspects. This integration allows students to understand physics concepts not only theoretically but also in terms of their application and impact in everyday life. Previous studies have demonstrated that SETS-based teaching materials are effective in improving scientific process skills, critical thinking, learning motivation, and student learning outcomes (Novianti et al., 2025; Nopiyanti et al., 2025; Daud, 2024).

Nevertheless, existing research on SETS has predominantly focused on the development of modules and worksheets, particularly in digital formats, while studies addressing the development of SETS-based physics laboratory manuals remain limited. Given the central role of laboratory activities in fostering scientific process skills and contextual understanding, this gap highlights the importance of conducting a literature review on the development of SETS-based physics practical guidelines. Such a review is essential to provide a scientific foundation for designing innovative laboratory manuals that can effectively enhance students' conceptual understanding and scientific process skills in a sustainable manner.

2. Methods

This study employed a Systematic Literature Review (SLR) using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol to ensure a transparent and reproducible process in identifying, selecting, and analyzing relevant literature. PRISMA was adopted to minimize selection bias and to provide a structured framework for tracing the flow of article selection from identification to inclusion. The literature search was conducted using the Publish or Perish tool and several relevant academic databases. The keywords used were "SETS", "Physics Practicum Guidelines", "Conceptual Understanding", and "Science Process Skills". These keywords were selected to specifically capture studies that integrate the SETS approach with practical physics learning and empirically measure learning outcomes related to conceptual understanding and scientific process skills. To ensure the relevance and currency of the findings, the search was limited to peer-reviewed journal articles published between 2015 and 2025.

The article selection process followed the four main PRISMA stages, as illustrated in Figure 1. In the identification stage, 122 articles were initially retrieved. During the screening stage, 24 articles were excluded because the full texts were inaccessible. Title and abstract screening were then conducted to assess topical relevance, resulting in the exclusion of 48 articles that did not align with the research focus. In the eligibility stage, 50 articles were retained after abstract evaluation and further assessed using predefined inclusion and exclusion criteria. Finally, 10 articles were selected for in-depth analysis in the included stage after full-text reading.

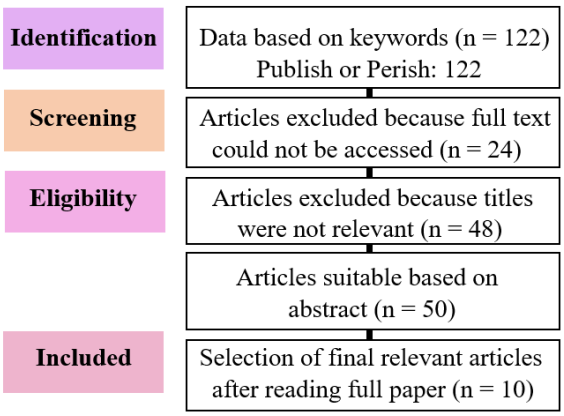

Figure 1. Literature Search Prism Chart

The inclusion criteria were established to ensure analytical relevance and methodological consistency, namely: (a) studies discussing the development, implementation, or evaluation of SETS-based teaching materials; (b) studies explicitly reporting outcomes related to conceptual understanding and/or science process skills; and (c) studies directly related to practical learning tools, laboratory manuals, or learning media. Articles were excluded if they were purely theoretical, did not report measurable learning outcomes, or lacked a clear connection to practical or laboratory-based learning.

After article selection, data analysis was conducted using a qualitative content analysis and thematic synthesis approach. Each article was systematically coded based on several analytical categories: (1) type of product developed, (2) development or learning model used, (3) learning outcomes measured, (4) indicators of conceptual understanding and science process skills, and (5) empirical findings related to the effectiveness of the SETS approach. This coding process enabled the identification of recurring themes and patterns across studies.

To strengthen the reliability of the review, a methodological quality evaluation was also performed. Each article was examined based on clarity of research design, appropriateness of data collection instruments, validity of analysis methods, and consistency between results and conclusions. Although no numerical weighting system was applied, studies with clear experimental or quasi-experimental designs and validated instruments were given greater interpretative emphasis in the synthesis. The results of this analytical process are summarized in Table 1, which presents a comparative overview of the selected studies and their relevance to the development of SETS-based physics laboratory manuals.

Through this systematic analysis, the review provides a robust and transparent synthesis of existing evidence, forming a strong empirical foundation for the development of SETS-based physics practicum guidelines aimed at improving students' conceptual understanding and scientific process skills.

Table 1. Summary of Article Analysis Results

Code	Article Title	Product and model used	Improved results	Relevance to research
P1	*Pengembangan Media Booklet Berbasis SETS pada Materi Pokok Mitigasi dan Adaptasi Bencana Alam untuk Kelas X SMA (Eksperimen pada Siswa Kelas X SMA Negeri 8 Surakarta Tahun Ajaran 2014/2015)* (Pralisaputri et al., 2016)	SETS-based booklet; modified 4D R&D development model becomes 3D	Students' cognitive learning outcomes, ability to relate concepts to real life, engagement, activity, and understanding.	Strengthening SETS as an effective approach to developing KPS and conceptual understanding.
P2	*Pengembangan Multimedia Interaktif Berbasis Pendekatan SETS Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Sekolah Dasar* (Firdaus et al., 2020)	Interactive multimedia based on the SETS approach; 4-D Model	Improvements in critical thinking and multimedia skills have been proven to be valid, practical, and effective.	This study provides supporting evidence that SETS-based practical guidelines in your studies have great potential to improve conceptual understanding and scientific process skills through the integration of science, environment, technology and society elements.

Code	Article Title	Product and model used	Improved results	Relevance to research
P3	Hydrocarbon and Petroleum with SETS Approach Module to Train Students' Critical Thinking Skills (Putri & Rusmini, 2021)	Learning modules based on the SETS (Science, Environment, Technology, and Society) approach; R&D Method	Improvements in Students' Critical Thinking Skills	
P4	*Pengembangan E-Modul Kimia Berbasis SETS (Science, Environment, Technology, and Society) untuk Siswa SMAN 1 Kecamatan Payakumbuh* (Safitri & Sari, 2022)	SETS-based e-modules for chemistry (Science, Environment, Technology, and Society); 4-D Development Model	Validity Results, Practicality Results, Focused Skill Improvement, and Enhanced Conceptual Understanding and Science Literacy	These findings indicate that the SETS approach in practical guidelines can improve conceptual understanding and scientific process skills through the interconnection of material with the environment, technology, and society.
P5	*Pengembangan E-LKPD Berbasis SETS Untuk Meningkatkan Aktivitas Belajar Siswa Sekolah Dasar* (Suryani & Rini, 2023)	SETS-based E-LKPD (electronic worksheets) for primary school students; R&D	Valid, Practical, and Effective	This study shows that SETS-based media are valid and practical, thereby effectively assisting conceptual understanding and connecting material with real-world contexts.
P6	*Pengembangan Bahan Ajar Berbasis SETS (Science, Environment, Technology, Society) Untuk Meningkatkan Literasi Sains Peserta Didik* (Hardianti et al., 2021)	SETS-integrated science teaching materials for junior high school students on the subject of living organisms' movement systems; R&D with a Pretest-Posttest Control Group design	Validity, increased science literacy, and significant MANOVA	It supports the notion that SETS-based practical instructions can improve learning activities, conceptual understanding, and scientific abilities because SETS E-LKPD has been proven to be valid, practical, and effective.
P7	*EMOSETS: Pengembangan E-Modul Berbasis Science, Environment, Technology, and Society (SETS) Materi Fluida Dinamis* (Ningsih et al., 2020)	SETS-based 'EMOSETS' physics e-module for the subject of fluid dynamics, complete with materials, evaluations, self-assessments, and SETS syntax; R&D with a 4-D model	Student Responses	It shows that SETS integration strengthens science literacy, which is part of scientific process skills (KPS). This reinforces the relevance of SETS practical instructions for improving KPS and conceptual understanding.
P8	Development of Science Module SETS Approach to	SETS-based science modules on the theme of	Significant improvement in cognitive	Demonstrates that SETS-based learning modules are effective in

Code	Article Title	Product and model used	Improved results	Relevance to research
	Strengthen Cognitive Learning Outcomes of Primary School Students (Candra et al., 2020)	the environment for primary school students; Modification of Borg & Gall (three stages: preliminary study, development, evaluation)	learning outcomes.	connecting concepts to real life, supporting the theory that SETS laboratory instructions improve conceptual understanding and scientific experiences.
P9	Development of Interactive E-Module Integrated with Science, Environment, Technology, Society on Environmental Change Material (Maria & Paidi, 2024)	Interactive E-Module based on SETS; 4-D model	This article assesses the feasibility and practicality of the SETS e-module.	These SETS modules have been proven to improve learning outcomes, conceptual understanding, and scientific thinking, supporting that SETS laboratory instructions can improve conceptual understanding and KPS.
P10	*Pengembangan E-LKPD Berbasis SETS (Science, Environment, Technology, and Society) pada Sub Materi Pencemaran Lingkungan untuk Melatihkan Keterampilan Literasi Sains Siswa* (Itaunada & Rachmadiarti, 2023)	Science Learning Tools based on SETS; R&D model based on Borg & Gall (modified)	Effectiveness in Improving Scientific Literacy and Effectiveness in Improving Foundational Knowledge	Environmental change material is similar to science laboratory material:

3. Results and Discussion

This section synthesizes findings from ten selected studies that were analysed in depth to evaluate their relevance to the proposed research framework, particularly from the perspective of language-mediated learning and literacy development. Rather than merely describing science learning outcomes, this discussion critically examines how SETS-based practical materials contribute to students' scientific literacy, academic discourse skills, and contextual language use, which are central concerns in language education research. A comparative summary of the reviewed studies is presented in Table 1, while overarching trends are illustrated in Figure 1.

The synthesis indicates that the selection of the SETS (Science, Environment, Technology, and Society) approach as the foundation for developing practical guidelines is supported by strong empirical evidence (P1-P6). Studies by Pralisaputri et al. (2016); Firdaus et al. (2020); Putri & Rusmini (2021); Safitri & Sari (2022); Suryani & Rini (2023); and Hardianti et al. (2021) consistently demonstrate that SETS-based learning products such as e-modules, worksheets, booklets, and instructional tools significantly enhance students' conceptual understanding through contextualized learning. From a language education standpoint, this contextualization aligns with constructivist and sociocultural theories of learning, which emphasize that meaning is constructed through interaction, discourse, and engagement with real-world contexts. SETS-based materials therefore function not only as

content-delivery tools, but also as language-rich learning environments that support comprehension, explanation, and conceptual articulation.

Several studies further highlight the role of SETS-based media in strengthening scientific literacy, a construct that inherently integrates language skills such as reading scientific texts, interpreting representations, formulating explanations, and constructing arguments. Fitri et al. (2021), for instance, reported high validity (82.16) and practicality (84.29) scores for a SETS-based physics module, alongside improvements in students' interpretative abilities. These findings suggest that SETS-based materials support students' capacity to process and express disciplinary knowledge using appropriate academic language, in line with curriculum frameworks that promote literacy across subject areas.

Articles coded P7-P10 (Ningsih et al., 2020; Candra et al., 2020; Maria & Paidi, 2024; Hardianti et al., 2021) indicate a consistent trend in which SETS-based learning fosters the development of science process skills, including observing, classifying, hypothesizing, and interpreting data. Importantly, these skills are closely mediated by language use in classroom practice. Inquiry-oriented activities embedded in SETS require students to formulate questions, describe observations, justify conclusions, and communicate findings orally and in writing. This pattern reflects principles of Content and Language Integrated Learning (CLIL), where content mastery and language development occur simultaneously through cognitively demanding and communicative tasks.

A cross-study comparison also reveals that visual and print-based SETS media, such as booklets and practical guides (P5), are particularly effective in supporting structured scientific communication. Suryani & Rini (2023) demonstrated that SETS-based printed materials improved science literacy by guiding students through systematic stages of observation, interpretation, and explanation. From an applied linguistics perspective, such materials serve as language scaffolding tools, enabling learners to organize ideas, use scientific terminology accurately, and engage in reflective discourse during practical activities.

The motivational dimension of SETS-based instruction further strengthens its relevance to language education. Huldan & Arnyana (2025) reported significant increases in both learning outcomes and motivation following SETS-based interventions. Motivation is a critical variable in language learning, as it influences students' willingness to participate in discussion, inquiry, and written reflection. Thus, the motivational impact of SETS-based visual media indirectly enhances students' engagement in language-mediated scientific activities, including collaborative learning and explanatory talk.

Overall, the synthesis of findings from P1-P10 demonstrates a clear empirical pattern: SETS-based practical guidelines promote contextualised learning, scientific literacy, and inquiry processes that are fundamentally mediated by language. Although the reviewed studies originate primarily from science education, their collective findings provide strong support for integrating SETS into language-aware instructional design, particularly within curricula that emphasise literacy development, academic discourse competence, and interdisciplinary learning. Consequently, this study contributes to the field of language education by illustrating how contextual, inquiry-based practical instruction can enhance students' academic language skills within content learning, thereby reinforcing the relevance of SETS-based practical guidelines for language-rich, curriculum-aligned classroom practices.

4. Conclusion

Based on the systematic review of ten selected studies, this research produces a distinctive synthesis that positions the SETS (Science, Environment, Technology, and Society) approach not merely as an effective instructional strategy, but as a methodological framework that integrates conceptual understanding and science process skills through contextual and language-mediated learning. Unlike previous studies that examined SETS in isolation through individual learning products, this review highlights a consistent pattern showing that SETS-based practical guidelines function as an integrative learning tool that simultaneously supports conceptual construction, inquiry-based reasoning, and structured scientific communication.

The key finding of this study lies in the identification of SETS-based practicum guidelines as a pedagogical nexus where contextual content, visual representation, and procedural scaffolding converge. The analyzed literature demonstrates that SETS-oriented media such as e-modules, worksheets, and booklets are not only valid and practical, but also act as catalysts for core scientific activities, including systematic observation, problem formulation, data interpretation, and explanation. This synthesis reveals that the effectiveness of SETS does not solely stem from contextual content integration, but from its capacity to structure students' engagement in inquiry processes that are essential for meaningful science learning.

Despite these strengths, this study has several limitations that should be acknowledged. First, the review is limited to ten articles published between 2015 and 2025, which may not fully represent the breadth of SETS-based research across different educational levels, cultural contexts, or disciplines. Second, the analysis relied on qualitative synthesis without applying a quantitative weighting or meta-analytic approach, which may limit the generalizability of the findings. Third, most of the reviewed studies were situated within science education contexts, with limited explicit examination of language development outcomes.

In terms of theoretical implications, this study reinforces the relevance of constructivist, sociocultural, and inquiry-based learning theories by demonstrating how contextualised practicum activities mediate knowledge construction through interaction, discourse, and experience. Practically, the findings suggest that educators and curriculum developers should consider SETS-based practicum guidelines as a strategic instructional resource to promote active learning, scientific literacy, and integrated skill development.

For future research, further studies are recommended to expand the scope of analysis by including a larger corpus of literature, employing mixed-method or meta-analytic approaches, and explicitly investigating the intersection between SETS-based practicum design and language development, such as scientific argumentation, academic writing, or bilingual science learning. Such directions will strengthen the empirical foundation and broaden the contribution of SETS-based learning to both science education and interdisciplinary instructional practices.

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