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Science Literacy Competency Profile of Science Education Students in Understanding the Concept of Thermodynamics

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ABSTRACT

Objective: This study aimed to analyze the science literacy competency profile of science education students in understanding thermodynamics concepts at the State University of Surabaya, with a specific focus on identifying competency levels and gender differences in science literacy achievement. **Method:** A quantitative descriptive research was conducted involving 35 students from Science Education Class B, selected through random sampling. Data collection was conducted using a science literacy test instrument adapted from the 2025 PISA framwork, consisting of 15 questions (10 multiple choice and 5 essay question) designed to measure three primary science compenties. **Results:** The analysis revealed that 51.42% of students achieved a proficient level, 28.58% reached an advanced level, and 20% were at a basic level. Students showed the highest competency in explaining scientific phenomena (74.4%), followed by constructing and evaluating scientific investigations (65.7%), and lowest in research and scientific information used for decision-making (60.6%). Female students exhibited slightly better performance, with a 4-point advantage over their male counterparts. **Novelty:** This study provides a detailed analysis of science literacy competencies in understanding thermodynamics among pre-service science teacher. It also incorporates the lates 2025 PISA framework and highlights gender-based performance differences. The findings provide valuable insights for developing targeted interventions in science teacher education programs, particularly in strengthening evidence-based decision-making skills and practical applications of thermodynamics concepts.

INTRODUCTION

Education plays a fundamental role in the development of high-quality human resources. In the era of increasingly complex globalization, the demands of competencies and skills that must be possessed by the younger generation are getting higher, especially in the field of science and technology (Sinyanyuri et al., 2022). This makes science learning one of the main focuses in the modern education system (Lubis et al., 2023). Science learning is not only limited to knowledge transfer but also includes developing critical thinking, problem-solving, and science literacy competencies (Thahir et al., 2021). Science literacy is a fundamental competency needed to understand natural phenomena, make evidence-based decisions, and contribute to societal issues related to science (Eviota & Liangco, 2020).

In the context of higher education, especially in the science education study program, science literacy is a vital competency that prospective teacher students must master. This is because they will serve a facilitator of science learning in the future and are responsible for developing the science literacy of their students in the future (Novitasari, 2018). Understanding basic scientific concepts, especially fundamental concepts such as thermodynamics, is an important foundation in the development of science literacy

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