

CHAPTER I

INTRODUCTION

1.1. Background

Science education plays a very important role in developing students' critical and creative thinking skills. Through science learning, students are invited to not only understand scientific concepts, but also to analyze, evaluate, and create solutions to various problems they face. Interactive learning methods, such as group discussions, can increase student engagement and encourage them to dare to express opinions and scientific arguments, which are important aspects of critical thinking. In addition, science learning also equips students with 21st-century skills, such as digital literacy and effective communication skills, which are essential in facing global challenges. Thus, science learning does not only focus on mastering the material, but also on developing creative and critical thinking skills, which will be very useful for students in their daily lives and future careers (Saputra et al., 2024).

The low achievement of students in science subjects in Indonesia is a significant issue that requires serious attention. Data from PISA (Programme for International Student Assessment) shows that Indonesian students' science literacy is below the global average, reflecting a weak understanding of scientific concepts (OECD, 2022). One of the main factors contributing to this low achievement is the use of learning materials that are less contextual and not aligned with students' needs. The material presented tends to be theoretical and poorly connected to real-life situations, making it difficult for students to understand the practical benefits of learning science (Susanti & Kurniawan, 2020). In 2019, the PISA survey reported that Indonesia ranked 70th out of 78 countries, with a decline in science literacy scores from 403 in 2015 to 396 (Hikmawati et al., 2020). This poor performance is also influenced by the lack of emphasis on developing critical and analytical thinking skills, as well as learning materials that do not support the demands of 21st-century education, as they focus more on rote memorization than on conceptual application (Hanum et al., 2023). In addition, the suboptimal use of instructional media further limits students' mastery of scientific literacy and critical

thinking skills, thereby hindering their understanding of the subject matter (Parawansa, 2023).

Creative thinking is essential in facing the challenges of the 21st century because it is closely related to innovation and the advancement of scientific knowledge (Pratiwi et al., 2021; Fitri et al., 2023). Creativity enables students to explore various innovative solutions, approach problems in unconventional ways, and develop a deeper understanding of the complex issues they encounter (Runco & Acar, 2020). In education, creative thinking not only supports academic problem-solving but also prepares students to adapt to an ever-changing environment. Therefore, educational curricula such as the *Kurikulum Merdeka* in Indonesia emphasize the development of 21st-century skills, with creative thinking as one of the key competencies targeted in the learning process (Kemendikbud, 2022).

Science education (IPA) aims to foster curiosity and a positive attitude toward science, technology, and social interaction. However, in practice, many students struggle to understand the material provided in existing textbooks, which are often considered inadequate in terms of content completeness, supporting illustrations, and the accuracy of scientific concept delivery. This risks causing misconceptions, namely when students' understanding deviates from the correct concept. Cahyanto et al. (2019) reported that students' comprehension of the topic of elements, compounds, and mixtures remains low, especially in distinguishing among the three types of matter and understanding their physical and chemical variations and changes. Only 38.43% of students achieved mastery, while 52% experienced misconceptions, particularly in identifying the differences. One of the main causes of these misconceptions is the use of teaching materials that do not meet proper standards. For example, the student textbook published by the Ministry of Education and Culture in 2016 does not provide detailed indicators and lacks direct alignment with the core and basic competencies outlined in the 2013 Curriculum. Although the book content aligns with the syllabus, its explanations are not sufficiently in-depth and fail to build a strong conceptual understanding. Interviews with teachers also revealed that the textbook does not adequately elaborate on the concept of matter classification and its properties and even contains

conceptual errors, such as classifying hydrogen as a semimetal, which may further worsen students' misconceptions of basic science concepts.

One of the challenges faced by junior high school students in learning science is their low level of creative thinking ability (Fitri et al., 2023). Pratiwi, Sunarno, and Sugiyarto (2021) revealed that students' creativity remains very low, with scores of 26.25% in fluency, 28.75% in flexibility, 38.75% in elaboration, and 28.75% in originality. Similar findings were reported by Amaliyah et al. (2023), showing that the average creative thinking ability of students was only 44.98%, with notable weaknesses in flexibility (35.2%) and elaboration (40.9%). Meanwhile, Hidayati and Ardiansyah (2023) reported that only around 30% of secondary school students were able to express creative ideas in science projects, while the majority merely followed instructions without taking initiative to innovate. This condition is largely caused by conventional teaching methods that focus on memorizing facts and formulas, offering little opportunity for students to explore and apply knowledge creatively (Yulianti & Supriyanto, 2022). Lecture-centered instruction, minimal hands-on activities, and a lack of learning tools that support creativity development further reinforce the reality that students are not accustomed to thinking creatively to solve real-world problems (Pratiwi et al., 2021). Therefore, it is crucial for teachers to understand students' creative thinking skill profiles so that learning processes can be more appropriately designed, especially for topics that require innovative solutions, such as alternative energy (Amaliyah et al., 2023).

Based on the results of a questionnaire conducted at SMP 27 Medan, the majority of students showed a strong interest in learning science, with 78% expressing enthusiasm and 91% recognizing its importance in daily life. However, 72% struggled to understand science concepts, and 84% stated they would be more motivated if the material were linked to real-life contexts. While 55% reported that teachers occasionally provided supplementary materials beyond textbooks and 57% found existing materials somewhat helpful, only 47% considered learning modules accessible and 46% found them difficult to understand. Additionally, only 57% felt that examples were relevant to everyday life, and 61% found the illustrations easy to follow. As many as 57% of students considered the science material quite

relevant to real life, and 80% expressed interest if science learning was linked to local culture or local wisdom, although only 50% felt that the science teaching materials included science concepts that were relevant to their culture. Interest in hands-on learning was high (81%), and 85% believed additional resources like modules or videos were needed. Teacher interviews revealed that lessons often used visual aids and PowerPoint presentations; while students' creativity had been assessed, it remained generally low. Although understanding of elements, compounds, and mixtures was relatively adequate, students had difficulty relating these concepts to real-life situations. Discussions and Q&A are considered effective, but students' low knowledge of local culture is an obstacle, because most of them come from urban environments. Teachers consider learning to be more interesting if linked to local cultural elements, and although this approach has never been applied, teachers believe that the use of local culture-based modules can encourage students' creativity and exploration of ideas, especially if adapted to their cultural context.

Creative thinking skills play a vital role in addressing the challenges of the 21st century because they are directly related to innovation and the advancement of science (Pratiwi et al., 2021; Fitri et al., 2023). However, creativity does not develop automatically; it must be cultivated through a structured and continuous learning process. The STEM (Science, Technology, Engineering, and Mathematics) approach is highly relevant for training students to solve problems and create innovative solutions in real-life contexts (Pratiwi et al., 2021; Sawu et al., 2023). Additionally, project-based learning, which allows students to design and implement contextual science projects, can make the learning experience more active, meaningful, and conducive to the optimal development of creativity (Rachmawati & Prabowo, 2022).

On the other hand, Indonesia possesses a rich diversity of cultures and local knowledge, yet this potential has not been widely utilized in modern science education. The forces of modernization and globalization have marginalized traditional knowledge, even though the ethnoscience approach holds great potential for integrating local values into the educational process. Through this approach, students can connect science learning with their social and cultural environment,

making the material more contextual and meaningful (Murwitaningsih & Maesaroh, 2023). In addition to enriching the learning process, ethnoscience enables the connection between scientific concepts and local wisdom, although its implementation remains suboptimal in many regions and still lacks innovative development (Rizki et al., 2025). This approach integrates science with local values and practices that are passed down through generations, enabling students to understand science within the context of their own lives (Lightner et al., 2021; Suprpto et al., 2021; Hermawan & Susanti, 2023; Rahmawati & Prasetyo, 2023).

The idea of integrating local culture into science education has been further developed through the Ethno-STEM approach, which combines the STEM disciplines (Science, Technology, Engineering, and Mathematics) with local wisdom or ethnoscience. The Ethno-STEM concept emphasizes the use of traditional knowledge to create science learning experiences that are more contextual and meaningful for students. Through this approach, students are able to connect scientific theories with the cultural realities they are familiar with. Rahmawati et al. (2021) demonstrated that Ethno-STEM can enhance students' understanding of scientific concepts while also developing their critical and creative thinking skills, as it encourages students to solve problems by simultaneously considering both cultural and scientific perspectives. Moreover, this approach contributes to the preservation of local knowledge, which is increasingly at risk of being lost due to the rapid advancement of technology.

The development of ethno-STEM-based modules has shown effectiveness in improving students' creative thinking skills through the integration of local cultural contexts with the STEM approach, but its implementation still has several limitations that need to be improved in further research. Research by Almuharomah et al. (2019) showed a significant increase in creative thinking through a physics module with a drum theme, but the application of the STEM approach has not been fully integrated because it is less than optimal in explaining scientific phenomena in an integrated manner. Shodiq et al. (2025) also found that the increase in students' creative thinking skills was in the moderate category, with the elaboration indicator showing the lowest achievement, indicating the need for strengthening the aspect of idea detail. Rinto et al. (2022) reported that although there was an increase in

flexibility and fluency of thinking, students had difficulty evaluating project results and expressing opinions reflectively. In addition, Sumarni and Kadarwati (2020) found that many students were not yet able to connect field observations with the concepts learned, and were not yet familiar with analytical questions such as "why" in the exploration process. Therefore, further research is needed to examine the development of an Ethno-STEM module that explicitly strengthens the structure of STEM stages, adds guidance in the early stages of project learning, and includes assessments that are able to assess all aspects of creative thinking more holistically.

To overcome the challenges of the limited relevance of science learning and the prevalent use of conventional teaching methods, developing Ethno-STEM-based modules offers a promising alternative to improve students' creative thinking. These modules integrate science, technology, engineering, and mathematics with elements of local wisdom and cultural traditions, making learning more meaningful and easier to relate to real-life experiences. The Ethno-STEM approach encourages students to think critically and creatively by linking scientific problems to cultural contexts for instance, exploring traditional resource use through scientific reasoning. In a culturally diverse country like Indonesia, module development should reflect the local context. In this study, the module is tailored to SMP Negeri 27 Medan in North Sumatra, using ethnoscience rooted in the wisdom of local ethnic groups. Research by Rahmawati and Ridwan (2022) revealed that Ethno-STEM modules could enhance student creativity by up to 35%. Likewise, Pratiwi et al. (2023) found that this approach strengthens the connection between science and culture, increases student engagement, and boosts learning motivation. Ultimately, Ethno-STEM supports the objectives of the Merdeka Curriculum by fostering both scientific literacy and cultural appreciation among students in a more engaging and relevant way.

Based on the background above, the research title is formulated as follows: "Development of Ethno-STEM Based Modules Integrated with Creative Thinking on Elements, Compounds and Mixtures Material"

1.2. Identification of problems

The identification of problems in this research is as follows:

1. Students' creative thinking skills in science learning are still low due to teacher-centered teaching methods.
2. Science learning at SMP Negeri 27 Medan still uses conventional methods that rarely relate the material to real-life situations.
3. The topic of elements, compounds, and mixtures often cause misconceptions due to limited teaching materials that are in-depth, interesting, and relevant to students' lives.
4. The learning approach is still conventional and lacks integration of local culture.
5. The learning media used have not been fully designed to stimulate student creativity and have not optimally integrated the STEM approach within the local cultural context.
6. Ethno-STEM-based modules that support the development of creative thinking are not yet available and have not been widely developed.
7. The availability of teaching materials that are interesting and relevant to the local context is still limited.

1.3. Scope

This research was limited to the development of Ethno-STEM-based modules for 8th grade science materials at SMP 27 Medan. The developed module was adapted to local wisdom and surrounding culture. This research only reached the stage of validating the feasibility of the module by experts, as well as the assessment or response from teachers and students to the quality and attractiveness of the developed module, without measuring the improvement of students' creative thinking skills directly.

1.4. Problem Limitation

The scope of problems in this research is as follows:

1. Science learning at SMP Negeri 27 Medan still uses conventional methods that do not relate the material to real life, so this study developed an Ethno-STEM-based learning module.

2. Students' creative thinking skills in science learning are still low, so developing an Ethno-STEM Learning module integrated with creative thinking based on indicators from Torrance's theory only reached the stage of validation of feasibility by experts and responses/assessments from teachers and students to the developed module.
3. The material on elements, compounds, and mixtures often causes misconceptions due to limited teaching materials, so this study only focuses on the development of an Ethno-STEM-based science learning module integrated with creative thinking aspects, specifically on the material on elements, compounds, and mixtures for junior high school level.
4. Module development is limited only to teaching materials and learning activities, not including the preparation of learning outcomes evaluation tools or broad implementation in the learning process in the classroom.

1.5. Formulation of the problem

The formulation of the problems in this research is as follows:

1. How is the development of an Ethno-STEM-based module integrated with creative thinking on elements, compounds and mixtures material?
2. Is the developed ethno-STEM-based module on elements, compounds, and mixtures integrated with creative thinking feasible (valid) for use based on assessments by validators from subject matter experts, media experts, learning experts, test instrument experts, and science teachers?
3. Is the developed ethno-STEM-based module on elements, compounds, and mixtures integrated with creative thinking practical for use based on student responses?

1.6. Research purposes

The research purpose in this research is as follows:

1. To develop an Ethno-STEM-based module integrated with creative thinking on elements, compounds and mixtures material.
2. To produce an Ethno-STEM-based module on elements, compounds, and mixtures integrated with creative thinking that is feasible (valid) for use based

on assessments by validators from subject matter experts, media experts, learning experts, test instrument experts, and science teachers.

3. To produce an ethno-STEM-based module on elements, compounds, and mixtures integrated with creative thinking that is practical for use based on student responses.

1.7. Benefits of research

This research is expected to provide the following benefits:

1. **For students**, this research can improve their understanding and interest in science with a local cultural context, as well as improve their creative thinking skills.
2. **For teachers**, the research results can be a reference in developing more contextual and creative Learning resource.
3. **For schools**, this research is expected to improve the quality science learning that is more in line with the Independent Curriculum, so that it can motivate students to be more active in learning.

