CHAPTER I
INTRODUCTION

1.1. Background of The Problem

Education is one of the most important aspects of every individual's life because through education, a person can develop their potential, acquire knowledge, skills, and values useful in life (Rahman et al., 2022). Education is also organized to fulfill the mandate of the 1945 Constitution of the Republic Indonesia, namely to educate the nation, which is a complex process. In this case, education functions as a subsystem in national development, which integrates various important components such as students, educators, curriculum and learning, facilities and infrastructure, governance, and financing. Through a focused learning process, education occupies a strategic position in developing superior, characterful, and competent human resources, as stated in Law Number 20 of 2003 concerning the National Education System (Qomarudin, 2021).

In the context of national development, education not only plays a role in transferring knowledge but also shapes the character and personality of students. Quality education will produce human resources who are not only intellectually intelligent, but also possess skills, creativity, innovation, and high productivity. This is in line with the demands of the 21st century, which emphasize the importance of mastering critical thinking, communication, collaboration, and creativity competencies (Syasmita, 2019). Therefore, schools have a big responsibility as formal educational institutions, where teachers play a key role in improving the quality of learning. To achieve national educational goals, teachers are required not only to master the material but also to provide learning that is appropriate to the characteristics of the students and their environment (Senduk, 2024). One approach that can support this is ethnopedagogy, which is education based on local wisdom. Through ethnopedagogy, learning not only serves as a means of acquiring knowledge but also as a medium of culture that connects modern knowledge with the values and traditions of society (Suarningsih, 2019).

The ethnopedagogical approach, which combines scientific knowledge with local cultural values, provides students with the opportunity to learn in a more relevant

and meaningful context. Therefore, the application of ethnopedagogy in the Indonesian education curriculum is very important to enrich the learning experience while preserving local cultural sustainability. In addition, the ethnopedagogical approach provides opportunities for students to engage directly with the local wisdom that surrounds them, allowing them to see the relevance of science in everyday life. Through this contextual learning experience, students not only gain theoretical understanding, but are also able to connect scientific concepts with real-world practices that develop in society (Sukiastini et al., 2024).

One form of local wisdom that is still preserved by the people of North Sumatra, especially the Batak Toba community, is the tradition of processing and utilizing tuak (Sebayang, 2016). Tuak is a drink made from fermented palm sap (*Arenga pinnata Merr*) that has high social, cultural, and economic value. This tradition not only serves as a household economic activity, but also has symbolic meaning in the social life of the Batak people. In various traditional ceremonies such as *mangulosi, marhata sinamot,* and *ulaon adat,* tuak is often used as a symbol of brotherhood, intimacy, and respect for guests.

In addition to its cultural value, the process of making tuak also reflects the traditional knowledge of the community in the field of simple biotechnology. Sap tapped from the male flowers of the aren palm undergoes natural fermentation by microorganisms, producing ethanol as the main component. Scientifically, this process is a form of redox reaction, in which organic compounds are changed through microbial activity that converts sugar into alcohol. Thus, this tradition can be used as a medium for contextual learning to link scientific concepts such as fermentation, oxidation-reduction reactions, and alternative energy in chemistry education.

Seeing the potential of local wisdom, such as the tradition of making tuak, which has scientific and cultural value, efforts are needed to integrate these local values into the formal education system. This integration not only serves to preserve regional culture but also to provide contextual, meaningful, and relevant learning for students.

In line with this, education in Indonesia is now being adapted to accommodate the needs of the 21st century in various aspects, one of which is through the design of a curriculum that serves as a guideline for teaching and learning. A curriculum

designed to respond to global challenges requires learning that encourages students to be active, creative, and able to relate knowledge to real life (Alhayat et al., 2023).

In the learning process, teachers need to pay attention to students' needs by providing appropriate supporting tools, especially in chemistry lessons. Chemistry is often considered difficult because of its abstract concepts and calculations, so students are required to understand concepts theoretically and through experiments, so that they can obtain the facts, concepts, and principles contained therein (Bowo, 2022). One chemistry topic that often poses a challenge for students is redox reactions. In phase F, this topic discusses the concepts of oxidation and reduction, the mechanism of electron transfer, and its close relationship with everyday events.

Based on interviews conducted at SMA Negeri 2 Percut Sei Tuan, it was found that the use of teaching materials in the learning process was still not optimal. Teachers tended to use conventional learning resources, such as textbooks, so that the material presented was abstract and not connected to the context of local wisdom. This situation caused students to be less motivated to read and to have difficulty understanding the material presented.

This condition shows the importance of developing more innovative, contextual teaching materials that are tailored to the needs of students. One relevant form of development is the E-module, which is digital-based teaching material that can be accessed through electronic devices such as laptops and smartphones. In addition to being developed based on the applicable curriculum, E-modules also allow for the integration of local wisdom values, thereby not only facilitating access to learning but also providing a more engaging, meaningful, and relevant learning experience that aligns with students' daily lives.

One of the reasons why E-modules are considered relevant to be developed as teaching materials is because they are interactive and engaging. E-modules are equipped with various supporting media, such as videos, animations, audio, and interactive quizzes that can provide a more varied and enjoyable learning experience (Sukma et al., 2025). These advantages can increase motivation and deepen students' understanding of the material. In addition, E-modules enable independent and flexible learning because they can be accessed anytime and anywhere as needed (Ashari et al., 2023).

The development of e-modules based on ethnopedagogical that link chemistry material with aspects of local wisdom can provide contextual learning and serve as a source of independent learning for students. In this case, ethnopedagogy is an important approach because it combines scientific knowledge with local wisdom so that learning is more relevant and meaningful. Through ethnopedagogy, the learning process is not only oriented towards mastery of material, but also towards character building and understanding of cultural values that have been passed down from generation to generation. The integration of local culture into learning becomes more contextual, closer to students' daily lives, and easier to understand because it is presented through real practices that they are familiar with.

The integration of ethnopedagogy in chemistry learning plays a strategic role in connecting abstract scientific concepts with the local cultural realities familiar to students. Ethnopedagogy is defined as an educational approach that incorporates local cultural values and wisdom into the learning process, positioning them as sources of innovation and practical knowledge that can be empowered to create meaningful learning experiences (Silaban et al., 2025). Through culturally contextualized instruction, students are better able to construct conceptual understanding because the material is related to practices embedded in their daily lives. Moreover, this approach aligns with the objectives of the Merdeka Curriculum, particularly in strengthening the Pancasila Student Profile (P5). Learning activities grounded in local culture encourage students to appreciate diversity (global diversity), collaborate in analyzing chemical phenomena (mutual cooperation), and develop independence, creativity, and critical thinking by linking traditional practices with scientific principles. Therefore, the implementation of ethnopedagogy not only enhances students' mastery of chemistry content but also contributes to the development of character and competencies emphasized in the Merdeka Curriculum.

To support the implementation of active and contextual learning, one of the appropriate models to use is Project-Based Learning (PjBL), where students are involved in real projects that allow them to explore scientific concepts and connect them with the surrounding culture and environment. The advantage of this model is that it can represent learning theory in a real, simple, and easy-to-understand way because it can be organized independently by students (Rifai et al., 2021).

Based on the facts and results of research conducted by Ambar et al., (2022), the application of the Project-Based Learning (PjBL) model can have a significant impact on improving high school students' learning outcomes and critical thinking skills. The results of the study show that students' critical thinking skills have improved, as seen from the learning outcomes in the knowledge domain, with an increase in the percentage of students who have mastered the material. In addition, students' skills have also improved. Data from the study shows that PjBL is not only effective in improving students' conceptual understanding of abstract material but also capable of developing affective and psychomotor aspects in a balanced manner. This study also emphasizes that project-based learning can improve students' critical thinking, collaboration, and independent learning skills.

In relation to efforts to improve chemistry learning outcomes, particularly in developing students' critical thinking skills, various studies have been conducted by applying innovative learning models. One such study was conducted by Harling and Martono (2023) at SMA Negeri 3 Kota Sorong, which showed that the application of the Project-Based Learning (PjBL) model to redox material was able to significantly improve students' critical thinking skills. The study found a very strong correlation between the implementation of PjBL syntax and an increase in students' critical thinking skills, where students became more active, analytical, and reflective during the learning process. However, the study still focused on developing critical thinking skills without linking them to cultural contexts or local values that could strengthen the relevance of learning to students' daily lives.

In order for PjBL to be more meaningful and relevant to everyday life, learning needs to be linked to real contexts that are close to students' lives. Integration with ethnopedagogy allows scientific concepts to be connected to local culture, so that in addition to improving cognitive, affective, and psychomotor aspects, it also fosters students' appreciation of local wisdom. In this way, modern science can be studied alongside community traditions, making learning more relevant and meaningful.

Based on the findings of research conducted by Rakhman et al., (2025) it is known that integrating the ethnopedagogy approach with the Project-Based Learning (PjBL) model has been proven to improve the quality of learning. The study shows that ethnopedagogy can maximize educators' behavior, improve student learning

outcomes, create a contextual, collaborative, and meaningful learning atmosphere, and enrich learning resources and media with elements of local wisdom. However, the study is still theoretical and does not specifically mention the media or teaching materials used in the process of integrating the two approaches. Therefore, further research is needed to develop more applicable ethnopedagogical-based learning tools.

Based on research conducted by Silaban et al., (2025) the development of a Project-Based Learning (PjBL) E-module integrated with the local wisdom of Man Belo/Marsukil (the tradition of chewing betel nut) has been proven to increase student interest, strengthen conceptual understanding, and foster a love for local culture. The study demonstrates that integrating culture into chemistry learning aligns with the characteristics of the Merdeka Curriculum, which emphasizes contextual and student-centered learning that is relevant to the socio-cultural environment of the students. However, the innovation developed still focuses on stoichiometric materials, so it does not yet cover other chemistry competencies that also require a deep conceptual understanding, such as oxidation-reduction (redox) reactions.

The integration of the Project-Based Learning (PjBL) model with local wisdom will provide a more meaningful learning experience through the presentation of cultural contexts that are close to students' lives. In redox reaction material, the tradition of processing tuak from the sap of the *Arenga pinnata Merr* palm tree can be used as a starting point for designing more contextual and interactive learning projects and fostering local cultural values in the chemistry learning process.

Based on this background, there is a need to develop teaching materials based on project-based learning integrated with ethnopedagogy, which led the researchers to conduct a study entitled **"Development of an Innovative Redox Reaction E-Module Based on Project-Based Learning (PjBL) Integrated with Ethnopedagogy".**

1.2. Identification of Problems

Based on the background described above, the problems identified in this study are as follows:

1. The learning resources used in schools are not yet fully in line with the curriculum requirements that emphasize student activity, creativity, and involvement in the learning process.
2. The teaching materials used by teachers are still limited to textbooks and do not yet utilize project-based learning models.
3. There are no e-modules available for redox reaction material developed using Project-Based Learning (PjBL) integrated with ethnopedagogy.
4. Redox reaction material is considered abstract and difficult for students to understand due to the use of teaching materials that are not innovative and do not link scientific concepts with local wisdom.

1.3. Scope of Research

Based on the identification of problems described above, this study focuses on the development of innovative e-modules on redox reaction material by applying the Project-Based Learning (PjBL) model integrated with ethnopedagogy. This study seeks to develop contextual, interactive, and locally-based learning resources that can help students understand redox concepts more deeply while fostering an appreciation for local culture.

1.4. Problem Limitations

In order for the research to be more focused and in line with the objectives that have been formulated, the scope of this research is as follows:

1. The product developed is an innovative e-module on redox reaction material based on Project-Based Learning (PjBL) integrated with ethnopedagogy.
2. The material used in the e-module focuses on the subject of redox reactions with subchapters that are in accordance with the applicable curriculum.
3. The local wisdom integrated into the e-module is the tradition of processing tuak from the sap of the *Arenga pinnata Merr* palm tree, which originates from the Batak Toba culture.
4. The research trial is limited to the validation of the e-module by subject material experts and media experts, as well as obtaining feedback from teachers and students after the product has been declared valid.

1.5. Problem Formulations

Based on the background, problem identification, and problem limitations that have been described, the research questions in this study are as follows:

1. What are the results of the initial needs analysis of innovative e-module based on Project-Based Learning (PjBL) integrated with ethnopedagogy in redox reaction material?
2. How feasible is the e-module based on Project-Based Learning (PjBL) integrated with ethnopedagogy in redox reaction material when reviewed by subject material experts and media experts?
3. How do teachers and students respond to the e-module based on Project-Based Learning (PjBL) integrated with ethnopedagogy in redox reaction material?

1.6. Research Purposes

Based on the problems mentioned above, the objectives of this study are to:

1. To determine the results of the initial needs analysis of innovative e-module based on Project-Based Learning (PjBL) integrated with ethnopedagogy in redox reaction material.
2. To know the design of the e-module based on Project-Based Learning (PjBL) integrated with ethnopedagogy in redox reaction material to meet the standards set by BSNP
3. To determine the feasibility of the e-module based on Project-Based Learning (PjBL) integrated with ethnopedagogy in redox reaction material based on validation that refers to the BSNP validity criteria
4. To analyze the responses of teachers and students to the e-module based on Project-Based Learning (PjBL) integrated with ethnopedagogy in redox reaction material.

1.7. Research Benefit

The results of this study are expected to provide the following benefits:

1) Theoretical Benefits
    a. Contributing to the development of science, particularly in the field of chemistry education, through the development of innovative e-module

based on Project-Based Learning (PjBL) integrated with ethnopedagogy.

b. Serve as an academic reference for further research focusing on the integration of local wisdom in chemistry learning, especially in redox reaction material.

2) Practical Benefits

a. For Teachers

Provide an innovative alternative learning resource to support the chemistry learning process, making learning more interactive, contextual, and relevant to everyday life.

b. For Students

Provides an engaging learning experience, facilitates independent learning, and helps students understand redox reaction concepts through a project-based approach integrated with local wisdom.

c. For Schools

Makes a positive contribution to improving the quality of learning and supports the implementation of a curriculum that emphasizes student activity, creativity, and potential development.