

**NEEDS ANALYSIS FOR THE DEVELOPMENT OF E-MODULE TEACHING
MATERIAL BASED ON PROJECT BASED LEARNING (PJBL) INTEGRATED
WITH LOCAL WISDOM ON ACID-BASE MATERIAL**

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ABSTRACT

Chemistry learning, especially in acid-base materials, is often considered difficult to understand because it is abstract and less associated with the context of students' daily lives. In addition, the implementation of Project Based Learning (PjBL) and the integration of local wisdom in chemistry learning at SMA Negeri 2 Percut Sei Tuan has not been carried out optimally. This research aims to develop an e-module of acid-base chemistry materials that is integrated with local wisdom of cassava tapai and based on Project Based Learning (PjBL), as well as to determine its feasibility level. This research uses the Research and Development (R&D) method with a 4D development model which includes the Define, Design, Develop, and Disseminate stages. The research was carried out in the even semester of the 2025/2026 school year by involving 36 students of class XI of science. At the development stage, validation was carried out by two lecturers of Chemistry Education at Medan State University and one chemistry teacher. The results of the validation of material experts obtained an average percentage of 88.25% and the results of the validation of media experts of 90.49%, both of which are included in the very feasible category. At the dissemination stage, the results of students' responses obtained an average percentage of 87.61% with the very good category, while the teacher's responses obtained an average percentage of 93.30% with the very good category. The results of the study showed that the e-modules developed met the criteria were very feasible and received excellent responses from students and teachers. Thus, the chemistry e-module of acid-base material that is integrated with local wisdom of cassava tapai and based on Project Based Learning (PjBL) is suitable for use as supporting teaching materials in chemistry learning.

Keywords: *e-module, local wisdom, Project Based Learning (PjBL), Acid-base, Tapai*

ABSTRAK

Pembelajaran kimia, khususnya pada materi asam basa, sering kali dianggap sulit dipahami karena bersifat abstrak dan kurang dikaitkan dengan konteks kehidupan sehari-hari peserta didik. Selain itu, penerapan Project Based Learning (PjBL) serta integrasi kearifan lokal dalam pembelajaran kimia di SMA Negeri 2 Percut Sei Tuan belum dilakukan secara optimal. Penelitian ini bertujuan untuk mengembangkan e-modul kimia materi asam basa yang terintegrasi dengan kearifan lokal tapai

singkong dan berbasis Project Based Learning (PjBL), serta mengetahui tingkat kelayakannya. Penelitian ini menggunakan metode Research and Development (R&D) dengan model pengembangan 4D yang meliputi tahap Define, Design, Develop, dan Disseminate. Penelitian dilaksanakan pada semester genap tahun ajaran 2025/2026 dengan melibatkan 36 peserta didik kelas XI IPA. Pada tahap pengembangan, validasi dilakukan oleh dua dosen Pendidikan Kimia Universitas Negeri Medan dan satu guru kimia. Hasil validasi ahli materi memperoleh persentase rata-rata sebesar 88,25% dan hasil validasi ahli media sebesar 90,49%, yang keduanya termasuk dalam kategori sangat layak. Pada tahap penyebaran, hasil tanggapan peserta didik memperoleh persentase rata-rata sebesar 87,61% dengan kategori sangat baik, sedangkan tanggapan guru memperoleh persentase rata-rata sebesar 93,30% dengan kategori sangat baik. Hasil penelitian menunjukkan bahwa e-modul yang dikembangkan memenuhi kriteria sangat layak dan memperoleh respons yang sangat baik dari peserta didik maupun guru. Dengan demikian, e-modul kimia materi asam basa yang terintegrasi dengan kearifan lokal tapai singkong dan berbasis Project Based Learning (PjBL) layak digunakan sebagai bahan ajar pendukung dalam pembelajaran kimia.

Kata Kunci: e-module, local wisdom, Project Based Learning (PjBL), Acid-base, Tapai

A. Introduction

Education is a clear and focused effort aimed at creating a better learning environment and process that enables students to actively develop their potential. Through education, students can also develop their religious spirituality, self-awareness, personality, intelligence, noble character, and various other skills that can have a positive impact on themselves and society. Education is a process of maximizing the development of students' abilities, skills, attitudes, and potential. Law Number 20 of 2003 states that the goal of education in Indonesia is to develop

the potential of students to become people who believe in and fear God Almighty, have noble character, are healthy, knowledgeable, creative, independent, and become democratic and responsible citizens (Pristiwanti et al., 2022).

The learning process involves the transfer of knowledge, attitude change, and skill development to students in accordance with the applicable curriculum (Qomarudin, 2021). In educational activities, the curriculum is an important part of achieving the expected learning targets. The curriculum serves as a guideline for the design and

implementation of learning activities, starting from the determination or selection of approaches, learning models, learning strategies, choice of methods, and the learning evaluation process. Learning that is directly connected to the context of everyday life includes learning that is linked to local wisdom. Local wisdom, cultural values, and education are two variables that are directly proportional to each other and complement one another. In education, there is a learning process for instilling values as well as for increasing knowledge.

Local wisdom acts as a reflection of national identity, especially in Indonesia, where local wisdom facilitates the dissemination of local knowledge among various cultures, thereby supporting national cultural values (Nasir et al., 2025). Local wisdom encompasses everything that characterizes a region, including food, customs, dances, songs, and regional ceremonies. Local wisdom is the culture of a community consisting of accepted standards of behavior that have developed over time and been passed down from one generation to the next (Rummar, 2022). Indonesia consists of various local wisdoms from each region, one of which is the local

wisdom of food in the North Sumatra region.

One of the local traditions originating from North Sumatra is Tapai. Tapai is a local food tradition that is still preserved today. Tapai is widely found in North Sumatra, not only in the city of Medan but also in several other areas in North Sumatra, namely Batu Bara, Simalungun, Kolam Village, Medan Tuntungan, and other areas. Tapai is a fermented cassava (tapioca) product. Tapai is a traditional food that is highly nutritious and has a distinctive taste. The fermentation process not only enriches the nutritional content of tape but also creates opportunities for the development of other derivative products.

Chemistry material is one of the subjects that can be linked to local wisdom because it is commonly found in everyday life. One of the subjects that is commonly found in everyday life is acids and bases. Teaching materials in the form of modules are one type of learning medium that is interactive, interesting, and effective in improving students' understanding of learning materials. Modules are teaching materials that are systematically arranged using

language that is easy for students to understand according to their level of knowledge and age, so that they can learn independently with minimal assistance or guidance from educators (Aliyah et al., 2023).

In technological developments, the use of electronic-based modules can make it easier for students and teachers to access them through electronic devices such as mobile phones and laptops. In addition to offering convenience, sophistication, and cost savings, the use of E-modules by teachers can maximize student understanding. Therefore, E-modules must be designed to be attractive, efficient, innovative, and tailored to the needs and characteristics of students.

Based on research with the title developed a stoichiometry e-module based on Project-Based Learning (PjBL) integrated with the local wisdom of betel chewing (Man Belo/Marsukil). The results showed very positive student responses and became a foundation for enriching chemistry learning materials with local culture and supporting the contextual and character-based Merdeka Curriculum (Silaban et al., 2025). Ethnopedagogy of innovative acid

base book based on Problem Based Learning integrated Dekke Naniura the local wisdom of batac toba. Result is feasible and effective for chemistry learning. Respondents stated that they really need chemistry teaching materials enriched with local wisdom so that students can see that chemistry is closely related to the surrounding environment (Silaban et al., 2025).

Previous studies have reported that the integration of local wisdom into chemistry learning can enhance students' learning motivation, contextual understanding, and appreciation of cultural values. In addition, the use of digital teaching materials such as e-modules has been shown to support independent learning and improve student engagement in the learning process. However, the integration of Project-Based Learning (PjBL) and local wisdom in chemistry teaching materials, particularly on acid-base topics, remains limited. Furthermore, learning resources that connect acid-base concepts with local cultural practices familiar to students are still rarely available in schools.

Considering these conditions, this study focuses on analyzing the need for developing a Project-Based Learning (PjBL) of e-module integrated with the local wisdom of cassava tapai fermentation on acid-base material. The analysis encompasses teacher needs, student needs, and the alignment of learning objectives based on the Merdeka Curriculum. The findings are expected to provide an empirical foundation for the development of contextual, meaningful, and culturally responsive chemistry teaching materials that support student-centered learning.

B. Research Method

This study employed a descriptive qualitative approach to investigate the need for developing a Project-Based Learning (PjBL)-based e-module integrated with the local wisdom of cassava tapai on acid-base material. The research was conducted at SMA Negeri 2 Percut Sei Tuan during the second semester of the 2025/2026 academic year. Participants were selected using purposive sampling and consisted of one chemistry teacher and 36 eleventh-grade science students who had studied acid-base concepts. Data

were collected through interviews and questionnaires. The interview was conducted with the chemistry teacher to obtain information regarding the implementation of the Merdeka Curriculum, the use of learning models, teaching materials employed in chemistry instruction, and the integration of local wisdom in the learning process. In addition, the teacher assisted in distributing questionnaires to students to support the needs analysis.

The needs analysis was carried out through three stages, namely preliminary analysis, student needs analysis, and Learning Objective Flow (ATP) analysis. Preliminary analysis was conducted to identify existing learning conditions and challenges encountered in teaching acid-base material. Student needs analysis was performed using questionnaires to determine students' learning difficulties, availability of learning resources, experience in using electronic learning media, and interest in utilizing e-modules. Furthermore, ATP analysis was conducted to examine the sequence of learning objectives and the scope of acid-base content in accordance with the Merdeka Curriculum. The interview

data were analyzed descriptively and presented in narrative form, while questionnaire data were analyzed using percentage calculations. The results of these analyses served as the basis for identifying learning needs and determining the necessity of developing a PjBL-based e-module integrated with the local wisdom tapai.

C. Result and Discussion

The needs analysis was conducted to identify the necessity of developing a Project-Based Learning (PjBL)-based e-module integrated with the local wisdom of cassava tapai on acid-base material. The analysis was carried out through preliminary analysis, student needs analysis, and Learning Objective Flow (ATP) analysis. Data were obtained from interviews with a chemistry teacher and questionnaires distributed to students at SMA Negeri 2 Percut Sei Tuan. The findings provide an overview of current learning practices, challenges encountered during the learning process, and the potential need for innovative teaching materials that can support contextual and meaningful chemistry learning.

1. Preliminary Analysis

The preliminary analysis aimed to identify fundamental issues encountered in the teaching and learning process of acid-base material. At this stage, interviews were conducted with a chemistry teacher at SMA Negeri 2 Percut Sei Tuan to obtain information regarding curriculum implementation, learning models, teaching materials, and the integration of local wisdom into chemistry instruction.

Based on the interview results, it was found that the school has implemented the Merdeka Curriculum in the learning process. The chemistry teacher was familiar with the Project-Based Learning (PjBL) model and understood its characteristics and potential benefits. However, the model had not been implemented regularly in classroom instruction. Learning activities were still predominantly carried out through teacher explanations, discussions, and textbook-based exercises. The teacher explained that several chemistry topics were generally delivered using conventional approaches because of limited instructional resources and the absence of supporting teaching

materials specifically designed for project-based learning activities.

The interview further revealed that local wisdom had never been integrated into chemistry learning, including in acid-base topics. Learning materials were generally presented as scientific concepts without linking them to local phenomena familiar to students. In fact, many local cultural practices possess scientific relevance that can be utilized as contextual learning resources. One example is the fermentation process involved in the production of cassava tapai, which can be associated with chemical concepts and everyday experiences encountered by students. The absence of local wisdom integration indicates that learning opportunities to connect scientific knowledge with students' cultural environments have not been fully utilized.

In addition, the teacher stated that the teaching materials used in the classroom mainly consisted of textbooks provided by the school. Although these materials support the delivery of curriculum content, they have not yet facilitated project-based learning activities or contextual exploration related to local culture. Consequently, learning tends to

emphasize conceptual understanding through explanation and practice questions rather than active investigation and real-life problem solving. These findings suggest the need for innovative teaching materials that not only support curriculum objectives but also facilitate meaningful learning experiences through project activities and local wisdom integration.

2. Student Analysis

Student analysis was conducted to obtain information regarding students' learning characteristics, learning difficulties, and instructional media preferences. This analysis serves as an important foundation in determining the design and characteristics of the e-module to be developed. Data were collected through questionnaires distributed to 36 eleventh-grade students who had previously studied acid-base material.

The results showed that 72.22% of students experienced difficulties in learning acid-base concepts. This finding indicates that acid-base material is still perceived as challenging by many students. The topic involves various abstract concepts such as acid-base theories, pH calculations, ionization processes,

and the interpretation of chemical phenomena at the microscopic level. These concepts require not only memorization but also conceptual understanding and the ability to connect different representations of chemical knowledge. Therefore, students often encounter difficulties when learning the material through conventional approaches that rely heavily on textual explanations.

Furthermore, 61.11% of students stated that the learning methods commonly used in the classroom were less interesting. This result suggests that learning activities may not yet provide sufficient opportunities for students to actively participate in constructing their own understanding. Learning experiences that focus primarily on teacher explanations may reduce student engagement and motivation, particularly when studying chemistry topics that require visualization and contextual application. The finding indicates the importance of implementing learning approaches that encourage active participation, collaboration, and problem-solving activities.

The questionnaire results also revealed that 58.33% of students considered the available learning

resources to be limited. Most students relied on textbooks as their primary learning source. Although textbooks provide essential information, the limited variety of learning resources may reduce opportunities for students to explore concepts from different perspectives. The availability of supplementary learning media that present content in more interactive and contextual formats is therefore considered necessary to support students' understanding of acid-base concepts.

Regarding instructional media utilization, 66.66% of students reported that they had never used electronic learning media in studying acid-base material. This finding demonstrates that digital learning resources have not been widely utilized in chemistry instruction. However, despite their limited experience with electronic media, students demonstrated a strong interest in technology-supported learning. The questionnaire results showed that 88.88% of students expressed interest in using e-modules as learning media.

The contrast between limited exposure to digital learning resources and high student interest highlights a

gap between existing instructional practices and students' learning preferences. These findings indicate that students are ready to adopt more interactive and technology-based learning environments. Therefore, the development of an e-module is expected to provide learning experiences that are more engaging, accessible, and flexible while supporting students in understanding abstract acid-base concepts through contextual examples and project-based activities related to cassava tapai fermentation.

3. Learning Objective Flow (ATP) Analysis

The Learning Objective Flow (ATP) analysis was conducted to ensure that the proposed e-module aligns with the competencies and learning objectives outlined in the Merdeka Curriculum. The ATP analyzed in this study refers to the learning objectives implemented at SMA Negeri 2 Percut Sei Tuan for acid-base material.

The analysis showed that the acid-base topic is structured systematically, beginning with the introduction of acid and base concepts, followed by acid-base theories, acid-base indicators, pH and

pOH calculations, acid-base strength, and the application of acid-base concepts in everyday life. The ATP also specifies the competencies students are expected to achieve, including the ability to explain acid-base phenomena scientifically, analyze experimental results, and apply acid-base concepts in various contexts.

The ATP analysis serves as an important guideline in determining the organization, scope, and sequence of learning materials within the developed e-module. By referring to the existing ATP, the e-module can be designed to remain consistent with curriculum standards while accommodating the identified needs for more contextual, project-based, and student-centered learning experiences. Furthermore, integrating local wisdom through cassava tapai fermentation activities provides opportunities to connect curriculum objectives with authentic cultural contexts that are familiar to students.

Overall, the results of the needs analysis indicate a clear necessity for developing a Project-Based Learning (PjBL)-based e-module integrated

with the local wisdom of cassava tapai. The findings reveal limitations in current learning practices, the absence of local wisdom integration, students' difficulties in understanding acid-base concepts, and strong interest in digital learning resources. These conditions provide a strong empirical basis for the development of teaching materials that can support meaningful, contextual, and culturally relevant chemistry learning.

D. Conclusion

The findings of this study indicate that acid-base learning at SMA Negeri 24 Tanjung Pinggir has not yet fully reflected the contextual and student-centered learning principles promoted by the Merdeka Curriculum. Although the curriculum has been implemented, the application of Project-Based Learning (PjBL) in chemistry instruction remains limited, and local wisdom has not been integrated into the learning process. The needs analysis also revealed that a considerable number of students still experience difficulties in understanding acid-base concepts, perceive current learning methods as less engaging, and rely on limited learning resources.

On the other hand, students demonstrated strong interest in utilizing electronic learning media, indicating their readiness to engage with more innovative learning environments. The results of the teacher interviews, student needs analysis, and ATP analysis collectively provide empirical evidence supporting the development of a PjBL-based e-module integrated with the local wisdom of cassava tapai. These findings highlight the need for teaching materials that not only align with curriculum requirements but also facilitate meaningful, contextual, and culturally relevant learning experiences. Therefore, the proposed e-module is expected to serve as an alternative instructional resource that can support students' conceptual understanding while strengthening the connection between chemistry learning and local cultural practices.

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