Development of Module for Grade XI Students: A Preliminary Study at SMAN 2 Siak Hulu

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Abstract

This study examines teachers' experiences designing instruction, particularly regarding instructional models and teaching materials used in the classroom. The research stems from issues in the field, namely the lack of updated teaching materials such as e-modules. To address this, the researcher interviewed teachers, exploring their teaching experiences and their design and use of teaching materials. The study was conducted at SMA Negeri 2 Siak Hulu in December 2024. Data collection techniques included questionnaires and interviews. The questionnaire data were analyzed using a Likert scale, while interview data were analyzed descriptively. This research employed a mixed-methods design, combining quantitative and qualitative approaches, specifically using a Sequential Explanatory model and an Interpretative Phenomenological Analysis (IPA) approach. The results showed that the questionnaire-based observation sheet indicated a teaching material needs score of 78.2% (high need). Interview findings revealed that teachers' experiences applying the Problem-Based Learning (PBL) model were well-structured and systematic. Moreover, the instructional model was integrated with a Scientific Approach that aligned with the students' characteristics, enhancing learning engagement and improving understanding of science literacy. Teachers perceived that the development of e-modules would greatly support both school-based and independent learning processes.

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Introduction

Education is a lifelong learning experience that occurs across various environments. It encompasses all life situations influencing individual development (Debora et al., 2021). Furthermore, education is defined as a conscious and planned effort to create a learning atmosphere and process that enables learners to develop their potential actively (Kearney et al., 2012). Within the education system, the curriculum is an indispensable component at every level, whether primary, junior secondary, or senior secondary. To achieve quality learning objectives, the curriculum is designed with learning standards that serve as references for teachers in the classroom (Kearney et al., 2012). However, observations in the field reveal a tendency towards monotonous and less engaging learning experiences for students (Zebua & Siahaan, 2021). Various factors determine a learning process, including the competence of teaching staff, the availability of facilities and infrastructure, student motivation, and the educational system implemented. One strategic element in supporting quality learning processes is using effective teaching materials. Situmorang (2013) emphasizes that teaching materials play a crucial role in enhancing the quality of human resources, as they constitute a primary component in the learning process. Particularly in

chemistry education, teaching materials are utilized by teachers as essential aids to facilitate students' understanding of the subject matter (Debora et al., 2021).

As a branch of science, chemistry studies the structure, composition, properties, and changes of matter, as well as the energy transformations accompanying these processes. The challenges in chemistry education stem from the complex and abstract nature of the material, which often results in students' difficulty grasping concepts that cannot be directly observed (Ristiyani & Bahriah, 2016; Nugraha, 2018). Consequently, the availability of appropriate and relevant teaching materials becomes essential to bridge these cognitive gaps. According to Widodo and Jasmadi (as cited in Lestari, 2013), teaching materials are instructional tools containing content, methods, boundaries, and evaluations, all systematically and attractively designed to achieve specified competencies. The development of teaching materials demands adequate references and creativity in presentation to ensure alignment with learning objectives (Magdalena et al., 2020). One pertinent form of teaching material in chemistry education is the module. Modules are systematically designed according to the curriculum and are organized into learning units that allow students to engage in self-directed learning over a defined period (Andriani & Dewi, 2019; Arifin et al., 2024). Modules serve as supplementary learning resources and tools to facilitate student autonomy and minimize teacher-centred instruction, shifting the teacher's role towards that of a facilitator in the learning process.

Generally, teaching materials are classified into two broad categories: print and non-print (Hasanah et al., 2024). Fauzan (2019) further categorize teaching materials into four types: (1) print materials (books, modules, worksheets, leaflets, brochures), (2) audio materials (cassettes, radio broadcasts), (3) audiovisual materials (videos, CDs, films), and (4) interactive materials (interactive CDs, Android-based applications). Belawati et al. (2003) add a third category: display materials (charts, posters, photographs, realia). The availability of print and digital teaching materials is crucial for supporting the effectiveness of learning processes. Teaching materials must be selected according to relevance, consistency, and adequacy (Prastowo, 2015). Moreover, periodic updates to the content are necessary to ensure alignment with scientific advancements and learners' evolving needs. In developing teaching materials, collaborative creativity between lecturers and students can enrich content and enhance learning quality (Putnik & Alves, 2019). Therefore, developed teaching materials must meet the criteria of novelty, practicality, accessibility, communicativeness, and engagement, thus motivating learners throughout the educational process (Nafidah & Suratman, 2021).

Empirical research demonstrates that using module-based teaching materials positively impacts learning outcomes. Perdana, Ashadi, and Yamtinah (2016) reported improvements in student performance after implementing inquiry-based chemistry modules. Similarly, Susrini (2016) identified a significant interaction effect between teaching materials and students' interest in learning on their chemistry achievement. Furthermore, Hulu and Simorangkir's research confirmed that the use of project-based modules effectively enhanced learning outcomes in thermochemistry among first-semester eleventh-grade students. Thus, it can be concluded that the development and application of teaching materials, particularly in the form of modules, hold substantial potential for improving conceptual understanding, fostering learning interest, and enhancing student achievement. Accordingly, this research focuses on developing relevant and engaging teaching modules that meet learners' needs to support the creation of more effective, efficient, and student-centred learning environments. It is anticipated that this research will offer empirical contributions regarding the effectiveness of

module-based teaching materials and provide practical implications for educators in improving the quality of classroom instruction.

Research Method
Research Design
This study employed a concurrent mixed-methods research design that integrates quantitative and qualitative approaches within a single investigation. The mixed-methods design enables the integration of numerical data and in-depth qualitative insights to comprehensively understand the research phenomenon (Nasution et al., 2024). Specifically, the qualitative strand adopted an Interpretative Phenomenological Analysis (IPA) approach, a phenomenological method that explores how participants make sense of their personal and social world in detail. IPA is concerned with understanding lived experiences and the meanings participants assign to these experiences (Halaluddin, 2018; Adlini et al., 2022).

Research Site and Participants
The study was conducted at SMAN 2 Siak Hulu in December 2024. The participants comprised two groups, including (a) qualitative strand**:** Chemistry teachers of Grade XI were selected as interview subjects using purposive sampling, considering their relevance to the subject matter, and (b) quantitative strand: The sample consisted of Grade XI students, selected using simple random sampling to ensure representativeness.

Data Collection
Data were collected using multiple methods to ensure triangulation and strengthen the validity of the findings including (a) observation sheets: Used to capture classroom practices and behaviors related to the learning process (Table 1); (b) questionnaires: Two types were administered (i) a needs assessment questionnaire and (ii) a material understanding questionnaire to both teachers and students (Table 2); and (c) semi-structured interviews: Conducted with chemistry teachers and students to obtain deeper insights into their experiences, perceptions, and understanding related to the instructional materials and teaching practices (Table 3).

Table 1. Observation Sheet Indicators

Aspect	Indicator
Opening Activities	Teacher initiates the lesson and instructs group formation.
Main Activities	Teacher activities in managing the class and facilitating group discussions.
	Student activities during group discussions.
	Integration of material with other knowledge areas and its application to real life.
	Teacher assessment of students during group discussions.
	Teacher's skills in revising and reinforcing the delivered material.
Student Activeness	Student activities during the learning process (paying attention, participating in discussions, asking questions, responding, and problem-solving).

Aspect	Indicator
Closing Activities	Conducting reflection and concluding together with students. Conducting evaluations and providing homework or enrichment assignments. Introducing the material for the next meeting and closing the session with a joint prayer.

Table 2. Indicators of the needs questionnaire

Aspect	Indicator
E-module teaching material	Printed books and other references used by the school.
E-module teaching material	Designing and updating contemporary teaching materials.
Material	Utilization of e-module teaching materials.
Learning model	Methods and learning models.
Development	Development of e-module teaching materials.

Table 3. Interview guide indicators

Aspect	Indicator
Curriculum	The type of curriculum implemented
Learning tools	Designing instructional tools following the allocated time
Learning media and materials	Selection and utilization of learning media and materials
Learning model	Implementation of learning models during the teaching and learning process
Approach	Selection of instructional approaches
Practicum	Implementation of practicum activities in schools
Students	Learning participation
Assessment and Minimum Mastery Criteria (MMC)	Selection and application of assessments and alignment with the MMC
Learning material	Learning difficulties in certain subject matter
Development	Negotiation for the development of teaching materials

Data Analysis

The quantitative data analysis technique was applied to the assessment instrument concerning the needs questionnaire, which comprised 20 statements utilizing a Likert scale. The range of this Likert scale consists of four categories: strongly agree (SA), agree (A), disagree (D), and strongly disagree (SD). In contrast, the instrument for assessing comprehension of the material consisted of five statements related to the content studied in the Acid-Base topic, employing a Likert scale with the following four categories: very understand (VU), understand (U), somewhat understand (SU), and do not understand (DU). The qualitative data analysis technique involved descriptive analysis of the results obtained from interviews conducted with chemistry teachers.

The needs questionnaires for teachers and students were analyzed and evaluated using a scoring interval criterion to conclude from the results. The interviews were conducted using a structured interview guideline and subsequently analyzed qualitatively in a descriptive manner. The intervals and criteria for the needs questionnaire scores are presented in Table 4.

Table 4. Intervals and Criteria for Needs Assessment Questionnaire

Interval Value	Criteria
0% - 25%	Not needed
26% - 50%	Somewhat needed
51% - 75%	Moderately needed
76% - 100%	Extremely needed

Source: Adapted from Sugiyono (2021)

Furthermore, the intervals and scoring criteria for the observation sheets utilized during the learning process should also be presented. This is to obtain factual data from the field that aligns with the results of the subsequent interviews. The intervals from the observation sheet can be seen in Table 5 below.

Table 5. Range and criteria of Observation Sheet

Interval Value	Criteria
80% - 100 %	Very good
70 % - 79 %	Good
60 % - 69 %	Good enough
< 60 %	Not good

Source: Modification of researchers (Sugiyono, 2021)

Research Findings and Discussion

The results of the SMA Negeri 2 Siak Hulu observations have been quantitatively analyzed to obtain a more transparent and more measurable depiction. This analytical process aims to identify various observed aspects and understand the emerging patterns or trends. The processed data is subsequently presented in tables and diagrams to facilitate the visualization and interpretation of the observational results. This presentation is anticipated to provide comprehensive insights and serve as a foundation for decision-making or necessary follow-up actions. Following the quantitative analysis, the results from the observation sheets conducted at SMA Negeri 2 Siak Hulu are displayed in Table 6 below.

Table 6. Results of the Needs Questionnaire of SMA N 2 Siak Hulu

Indicator	Percentage	Criteria
Learning model/method	71,8 %	Quite necessary
Teaching materials	78,2 %	Very necessary
Assessment	71,5 %	Quite necessary

Based on the data presented above, it can be concluded that there is a considerable need for more efficient teaching materials among students. This is evidenced by the overall average percentage of 70.9%, which falls into the category of *moderately needed*. In line with the advancement of increasingly sophisticated technology, the development of electronic teaching materials (e-modules) is highly recommended, and students agree with the plan to develop an e-module on the topic of Cells based on the Problem-Based Learning (PBL) model. This aligns with the opinion of Utami & Atmojo (2021), who emphasized that

teaching materials should be developed according to students' needs and the principles of instructional material development to optimize the achievement of learning objectives. Learning resources solely dependent on the teacher indicate that students have not yet achieved learning autonomy. In contrast, independent learning is crucial, especially in distance learning environments without direct face-to-face interaction. Consequently, teachers must provide diverse, engaging teaching materials that encourage students' independence in learning (Yuhana et al., 2021).

Table 7. Teacher interview results

No	Question	Teacher's Response
1	What curriculum is used at SMAN 2 Siak Hulu?	The Merdeka Curriculum.
2	What are the strengths and weaknesses of this curriculum according to you?	The strength is that students are more active because they must be student-centered. The weakness is that some science materials are not explored in depth; some materials are disorganized because certain materials introduced in Grade X are continued in Grade XI, causing a shift in material sequencing.
3	Do you implement innovations when applying this curriculum? If yes, what innovations have you implemented?	Yes, for example, by using various learning models and instructional media.
4	After implementing the curriculum, how does the learning process proceed to achieve the learning objectives?	For example, the teacher applies the PBL model so that students can be more active and seek answers independently.
5	Does the learning process delivered to students align with the learning objectives set in the curriculum?	Yes, because the teacher delivers the material according to the prepared content, such as using teaching materials like modules and PowerPoint, and uses language that students can easily understand.
6	How do you prepare for teaching before the learning activity begins?	When using media such as e-modules, the teacher sends it to the group chat the night before the chemistry lesson, so that students can study beforehand. When using an in-focus projector, the teacher prepares it prior to class.
7	How do you conduct orientation before starting the learning process?	The teacher provides real-life examples related to the material to be studied.
8	What learning model do you apply during class?	Since there is a lot of calculation-based material in Grade XI, the teacher applies the PBL model to challenge students to complete worksheets (LKPD). The teacher also uses the student-teacher model to make students more active, creative, and engaged.
9	How does the learning model you apply function during the learning process?	The model implemented by the teacher is effective because students are more active, creative, and challenged.

No	Question	Teacher's Response
10	Do students understand the media used during class?	Yes, because the teacher uses simple and clear language in the media. Additionally, the media are self-created, not copied from external sources.
11	How often do you use instructional media in the teaching process?	The teacher frequently uses teaching materials such as PowerPoint and worksheets (LKPD). However, modules are rarely used because developing them takes time.
12	What types of media do you use most frequently?	PowerPoint and worksheets (LKPD).
13	What types of media do students prefer during the learning process?	Videos and virtual laboratory practices are beneficial because these media make it easier to understand difficult materials.
14	Are the instructional media you use effective, and how important is media use in the learning process?	They are effective because using media helps students understand the material.
15	What teaching methods do you use in the learning process?	Discussions and question-and-answer sessions.
16	Are these methods effective? How significant is their impact in helping students learn effectively?	The effectiveness is about 80%, as the Minimum Mastery Criteria (KKM) in Grade XI is 85, and out of 32 students, 25 meet the criteria.
17	What are the strengths and weaknesses of the chemistry learning models you use?	The strength is that students are more active. The weakness is related to time constraints. When using the PBL model, time is often insufficient for solving problems, affecting learning in syntax achievement.
18	How do you use modules, worksheets (LKPD), and PowerPoint as references in the learning process?	When using a module, the teacher sends it one day before class so students can study it. Worksheets are also sent to the group chat; students are asked to print them before class. When using PowerPoint, the teacher explains the material directly.
19	What internal factors, according to you, influence student participation levels?	Student interest.
20	How do you motivate students who are less active in participating?	The teacher asks less active students to come forward and encourages their self-confidence. The teacher prefers to ask less active students to participate so they can be as engaged as other students.
21	How often do you conduct assessments of students?	Assessments are conducted at the end of each chapter. In addition, daily assessments are done when students complete worksheets. The teacher also conducts tests (quizzes).
22	How do you ensure that the types of assessments you choose are relevant to the learning objectives and materials taught?	The teacher refers to the learning objectives. Since Grade XI includes many calculation-based materials, assessments are carried out using essay questions, aligned with the indicators and learning objectives.

No	Question	Teacher's Response
23	What types of assessment instruments do you usually use in teaching?	For knowledge: essay, objective, matching, and short-answer questions. For skills: how students use tools, work collaboratively in groups, are active, and responsibility, particularly during practical sessions.
24	How do you ensure that the assessment instruments have good validity and reliability?	For practical sessions, the teacher uses existing guidelines. The teacher reviews students' answers for written tests to evaluate their understanding of the items. The teacher also participates in MGMP (Subject Teacher Deliberation) activities, where teachers collaboratively develop and discuss assessments to ensure validity.
25	What materials are often difficult for students in your class?	Calculation-based materials.
26	According to you, what internal factors might cause students to struggle with understanding these materials?	Student interest, as the difficulty level of calculation-based materials.
27	Based on this interview, how important is the development of teaching materials, such as printed and electronic modules, in improving the quality of teaching at senior high school?	It is essential because the teacher is better prepared for class with teaching materials. Teaching materials also increase students' interest because attractive modules enhance students' enthusiasm for reading.

Table 7 demonstrates that the teacher responded positively to the development of e-modules. The interview results with the chemistry teacher indicated that instructional materials such as electronic modules need to be developed because students do not always rely on conventional learning materials. By using engaging instructional resources like electronic modules, students are expected to shift their perception of chemistry from a difficult subject to an enjoyable one (Dalimunthe & Simorangkir, 2022).

Learning resources are crucial in the teaching and learning of chemistry at school to ensure that the learning process proceeds optimally. Electronic modules based on Problem-Based Learning (PBL) are developed by providing problems for students to analyze, allowing them to investigate those issues. This module is effective because it encourages students to actively think and understand the material through investigation and inquiry into real-world problems around them. In this way, students gain a deeper and more meaningful understanding of their studies. Moreover, the module allows students more time to study the material independently. With the development of PBL-based e-modules, students are expected to become more independent and capable of comprehending the material better (Asmi et al., 2024).

The e-module demonstrates that the advancement of knowledge and technology has significantly impacted education, shifting from printed media to digital media. E-modules provide access to multimedia information in the form of audio, video, images, or animations. These features direct students to engage directly, increasing student activity and honing their

skills. Using e-modules, students are more motivated to learn because they are given a detailed learning experience and are encouraged to share knowledge with peers in discussion forums. Additionally, students can experience greater freedom of expression, particularly for shy students, as e-modules allow them to comfortably access learning materials and manage their own space and time (Hutahaean et al., 2019; Ahmad et al., 2024). Online-packaged e-modules exhibit several high-quality attributes that students associate with engagement and deeper learning in immersive models: interactivity, media richness, constructive alignment, flexibility, and responsiveness. Research findings also indicate that e-modules make learning more flexible, responsive, and enhance student engagement in the learning process (Goode et al., 2022).

Conclusion

Based on the research conducted by the researcher, it can be concluded that at SMA Negeri 2 Siak Hulu, the results of the instructional material needs questionnaire indicate that 78.2% of respondents (Strongly Needed) expressed a high demand for e-modules. Teachers expressed a strong need for interactive instructional materials such as e-modules, and it is expected that the module's content will not only enhance students' knowledge but also guide them towards problem-based learning so that students can gain a deeper understanding of chemistry. Teachers provided suggestions for the criteria of e-module needs, including that the presented material should be easier for students to understand, concise, compact, and more precise than the existing textbooks. Additionally, the module should be accessible and usable anytime and anywhere, so chemistry learning becomes more structured even when students engage in independent study.

Acknowledgements

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