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Learners' Needs Analysis for the Development of Reaction Rate Experimental Videos

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Understanding chemical reaction rates requires practical experiences that allow students to observe factors influencing reaction speed. However, limited laboratory equipment and materials in many schools hinder the implementation of meaningful experiments. This study aims to determine the learning media needs of Class XI students for the development of reaction rate experimental videos at SMA Negeri 7 Malinau. A total of 17 students (n = 17) and one science teacher participated in the study. Data were collected using questionnaires and interviews, then analyzed through descriptive, qualitative, and quantitative approaches. The results show that 88.24% of students experience difficulties in learning reaction rate concepts, 76.47% perceive that videos help their understanding, and 100% agree that experimental videos are needed as learning resources. These findings highlight the urgent need for offline, visually engaging, and easy-to-understand experimental videos to support students' conceptual understanding in contexts with limited laboratory facilities. The results of this needs analysis will directly inform the content design, structure, and visual features of the reaction rate experimental videos to be developed.

Keywords: Experiment Video; Learning Media; Reaction Rate; Student Needs

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INTRODUCTION

Chemistry learning materials consist of conceptual, contextual, and procedural elements that must be presented using appropriate media to optimize students' understanding (Putri & Muhtadi, 2018). Contextual materials are easier to deliver because they relate directly to observable phenomena (Sudria et al., 2011). However, abstract concepts, such as particle collisions in reaction rate processes, require visualization and experimental experiences to support deeper conceptual understanding (Cheng, 2018; Sodanango et al., 2021). In many schools, especially those in remote or underserved areas, limitations in laboratory facilities and infrastructure make it difficult for students to grasp these concepts without adequate visual or experimental support.

Without comprehensive teaching materials, teachers will struggle to improve learning effectiveness, and students will also struggle to learn. Teaching materials must also be presented through appropriate media. Chemistry learning requires strong visual and experimental support to reduce misconceptions and help students link macroscopic, microscopic, and symbolic representations (Tasker & Dalton, 2016). Several studies have shown that experimental videos and animations help improve conceptual understanding and learning motivation (Pratiwi et al., 2022; Mazzuco et al., 2022). The use of media is also known to stimulate learning activities and provide realistic experiences, especially for abstract topics such as reaction rates (Asnawir & Usman, 2002; Hamalik, 2021). However, the availability of learning resources in many schools is often limited to printed textbooks, forcing students to rely on text-only explanations even for conceptually demanding topics.

Based on preliminary observations, the main teaching materials used by teachers and students in science subjects at SMA Negeri 7 Malinau are limited to printed textbooks. The school's incomplete laboratory infrastructure, particularly the lack of tools and materials for practical work, prevents the implementation of experiments that are essential for strengthening students' conceptual understanding. Textbooks only present procedural steps without providing descriptions of the practicum process or observational results, causing students to struggle in understanding several chemistry topics, including reaction rates. This limitation is reflected in students' summative assessment results, which show that many of them answered reaction rate questions incorrectly, especially those requiring interpretation of experimental data. These findings indicate the need for a systematic analysis of students' learning material needs so that teachers can develop appropriate instructional resources tailored to the characteristics of the reaction rate topic.

SMA Negeri 7 Malinau is located in a Frontier, Outermost, and Disadvantaged (3T) region where students have limited internet access, making digital online resources difficult to use. This condition aligns with reports on education in 3T regions, where many schools lack adequate laboratory facilities (Kemdikbud, 2021), and with Rahmawati's findings showing that 85% of chemistry teachers in remote areas face challenges in conducting practicums. Therefore, developing offline reaction rate experiment videos is a potential solution to provide students with accessible, contextual visualizations of experimental procedures and observable phenomena. Such videos can be stored on students' devices and played repeatedly, enabling them to build conceptual understanding despite infrastructural limitations.

Several studies have explored the use of experimental videos to support science learning; however, their focus differs from the context of this study. (Amelia & Megalina, 2023) examined videos for improving conceptual understanding but did not analyze students' specific learning needs before product development. (Pratiwi et al., 2022) demonstrated the positive effect of video-based instruction on conceptual understanding, but conducted the study in well-equipped schools. (Susilawati et al., 2023) developed videos aligned with the Merdeka Curriculum but did not address educational challenges in remote 3T areas. To date, no study has specifically analyzed students' needs for reaction rate experimental videos in a 3T school context with limited laboratory facilities and restricted internet access. This gap highlights the importance of conducting a systematic needs analysis before developing offline experimental videos tailored to students' local learning conditions.

Therefore, this study aims to explicitly analyze the learning needs of Class XI students at SMA Negeri 7 Malinau regarding the development of offline reaction rate experimental videos, which will serve as the foundation for designing instructional media that address existing contextual constraints and improve students' conceptual understanding.

METHOD

Participants

This study involved 17 Class XI students (n = 17) and one science teacher from SMA Negeri 7 Malinau. The participants were selected using a saturated sampling technique because the total population of students within the targeted class level was small. The science teacher served as the key informant to provide information regarding the availability and use of teaching materials as well as constraints related to laboratory facilities.

Instruments

Two instruments were used in this study. The first was a Student Needs Questionnaire consisting of 12 closed-ended items using a Guttman scale (Yes = 1, No = 0) and two open-ended items. The questionnaire measured five aspects: chemistry content, learning support facilities, experimental activities, effectiveness of textbook materials, and effectiveness of video learning materials. Sample items include:

a. *"I find it difficult to understand the concept of reaction rates without visual explanations,"*
b. *"My school provides adequate tools and materials for conducting chemistry experiments,"*
c. and *"I need learning videos to understand the steps in reaction rate experiments."*
d. An example of an open-ended item is: *"Explain what type of video explanation would help you understand reaction rate concepts better."*

The content validity of the questionnaire was ensured through expert judgment conducted by two chemistry education lecturers who reviewed item clarity, construct alignment, and relevance to the needs analysis.

The second instrument was a Teacher Interview Guide developed as a semi-structured protocol covering five areas: availability of teaching materials, frequency of use, constraints in implementing experiments, needs for material development, and essential elements required for effective teaching materials. The validity of the interview instrument was strengthened through peer debriefing, in which another researcher reviewed the interview questions to evaluate their clarity, appropriateness, and alignment with the research objectives.

Data Collection

Data collection was carried out in October 2024 through two main procedures. First, direct interviews were conducted with the science teacher using the validated interview guide. Second, questionnaires were administered to 17 students in a classroom setting, where each student completed the instrument individually without time pressure. In addition to these procedures, documentation of students' summative test results on reaction rate topics was also examined to support data triangulation and strengthen the credibility of the findings.

Data Analysis

The data analysis consisted of qualitative and quantitative data obtained from interviews and questionnaire responses. The steps for quantitative descriptive data analysis are: a) Calculating respondents' answers for each statement indicator; b) Summarizing the values; c) Calculating the percentage using the formula (Jakiah, et al. 2024). The student used a questionnaire that used the Guttman scale, which is a very good scale for convincing research results. The answer "Yes" is worth "1" and "No" is worth "0", for alternative answers in the questionnaire with a checklist instrument. The equation used is:

$$\text{Percentage}=\frac{\text{Frequency of yes answer}}{\text{Total number of answers}} \times 100\ \%$$

The categories for interpreting the percentage results of the student needs analysis were obtained from modified research results (Munggaran, 2012). These categories are presented in Table 1.

[Table 1 about here.]

The percentage of questionnaire responses for each indicator of learning material needs is interpreted according to Table 1. If the percentage is greater than or equal to 50%, it can be concluded that a learning video on reaction rate experiments is needed. However, if it is less than 50%, the development of such a learning video is unnecessary.

The descriptive results present the overall results of the activity analysis stage. This data consists of descriptive interpretations of the questionnaire, suggestions, and comments provided by students on the questionnaire, and interviews with teachers of related subjects. Responses from the open-ended questionnaire items and interview transcripts were analyzed using thematic coding. The process began with initial coding, in which meaningful statements related to student difficulties, media preferences, and learning constraints were identified. These codes were then categorized by grouping similar ideas into broader thematic clusters such as "laboratory limitations," "media accessibility," and "visual explanation needs." The categories were subsequently synthesized into final themes that supported the interpretation of students' learning needs. To strengthen the credibility of the findings, data triangulation was conducted by comparing responses from the teacher interview, student questionnaires, and existing school documentation.

RESULT AND DISCUSSION

The results of this study were obtained from teacher interviews and a student needs analysis questionnaire. The following are the results of teacher interviews and the student learning materials needs analysis questionnaire at SMA Negeri 7 Malinau. These results serve as the basis for discussion and conclusions regarding the development needs of student learning materials.

[Table 2 about here.]

Based on the interview results presented in Table 2, from the teacher's perspective, there is a need for more comprehensive and diverse teaching materials. Regarding teaching materials and their availability in schools, teachers revealed that printed teaching materials in the form of textbooks and worksheets are the main teaching materials used, while non-printed teaching materials, such as learning videos and broadcast materials, are used only for certain materials. Learning support facilities related to learning science materials, especially experimental tools and materials, are still limited, so that science materials that should be supported by experimental activities are not fully facilitated, and only simple experiments can be conducted at school. In addition to limitations in facilities and infrastructure, limitations in internet access also cause students to only focus on teaching materials in textbooks, so there is a need for the development of teaching materials by teachers so that students' learning needs can be properly accommodated. By developing more diverse teaching materials, students can more easily understand the science material being studied (Reksamunandar, 2020; Rafi'y, et al., 2023; Basri & Akhmad, 2022). One way is by creating offline experimental learning videos. Teaching materials in the form of experimental learning videos are expected to provide visual representations of experimental activities, especially for science subjects that are not yet facilitated through practical activities in schools. The integration of experimental videos has been shown to help students understand scientific concepts and independently practice science process skills (Andiantosa et al., 2024).

[Table 3 about here.]

Based on the results of the needs analysis questionnaire, findings were obtained as shown in Table 3. In the chemical material content indicator, it was found that 52.94% of students found it difficult to learn chemical material, and 88.24% of students found it difficult to learn reaction rate material. This is in accordance with the learning results in the summative test, where most of the class XI phase F students at SMA Negeri 7 Malinau were unable to answer questions on the topic of reaction rate, especially on analysis and calculation questions that present experimental data on factors that influence reaction rate. The results of the teacher evaluation showed that the cause of this led to teaching materials that did not facilitate students' experimental activities due to the limitations of the tools and materials used in the reaction rate experiment, so that students did not understand well the factors that influence reaction rate and the processing of observational data to determine the reaction rate equation. Based on the categorization, most students need the development of teaching materials on the reaction rate material.

The learning support facility indicator shows that 100% of students own an Android phone or computer, but 88.24% have difficulty accessing the internet. This is because students live in remote, underdeveloped (3T) areas with limited internet access, unless they use the Bakti Aksi Kominfo Wi-Fi facility. This is certainly a consideration for teachers when developing non-printed teaching materials, preferably offline so that students can still access them in file form on their respective mobile devices.

The effectiveness of student learning materials indicator revealed that 82.35% of students felt that textbooks were inadequate to meet their needs in learning reaction rates, and 100% felt the need for alternative, non-printed learning materials. Based on the categorization, all students required non-printed learning materials.

The experimental activity indicator for learning reaction rates revealed that 100% of students required experimental activities, and 94.12% felt that chemistry laboratory facilities were inadequate to support learning activities related to reaction rates. Based on the categorization, all students required experimental activities on reaction rates. Given the limited availability of experimental tools and materials at school, it is necessary to provide alternative audio-visual experimental experiences through offline experimental video materials so that students can still access them independently.

The effectiveness indicator for video teaching materials indicates that 76.47% of students have used videos as teaching materials. 76.47% of students found videos helpful in their learning. 100% of students agreed that experimental videos should be used as teaching materials for reaction rates. Based on the categorization, all students require experimental videos to support their learning activities and understand the reaction rate material.

Based on the data in Table 3 and analysis of teacher interviews, the development of alternative teaching materials in the form of experimental videos is necessary to meet student learning needs and overcome limitations in schools. Adequate preparation of equipment, materials, and work procedures related to the experimental video content to be created by teachers is necessary to produce high-quality teaching materials that meet student needs.

[Table 4 about here.]

Based on the answers to the open-ended questions in the questionnaire presented in Table 4, students provided suggestions for making the developed experimental video interesting, with clear visualizations, clear, detailed, and easy-to-understand narratives, clear audio, written explanations, and music that does not interfere with the material. A quality experimental video is characterized by good visual appearance (color composition, layout, shooting angle, and lighting), clarity of information, technical quality (images and editing), pedagogical and coherent delivery of material, informative data visualization, and audio-visual appeal, all of which contribute to improving students' conceptual understanding and learning motivation (Alamiyah, 2018; Amelia and Megalina, 2023).

CONCLUSION

Based on the results of interviews and questionnaires, it can be concluded that students at SMA Negeri 7 Malinau urgently require non-printed teaching materials that facilitate the understanding of reaction rate concepts, particularly due to limited laboratory facilities and restricted internet access in the 3T region. Offline experimental videos are therefore necessary to provide accessible visual representations of reaction procedures and observational phenomena, enabling students to develop stronger conceptual understanding in chemistry learning.

This study has several limitations, including its focus on a single school with a relatively small number of participants, which may limit the generalizability of the findings. Future research should continue by developing the reaction rate experimental videos based on the identified needs and subsequently testing their effectiveness in improving students' conceptual understanding and learning outcomes. Additionally, the findings highlight the need for educational policy support in the Malinau region, particularly in strengthening infrastructure, encouraging the creation of offline learning media, and promoting teacher capacity-building initiatives to address persistent resource limitations in 3T schools.

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

LIST OF TABLES

TABLE 1 / Percentage Categories

Percentage	Category
0 – 1,9%	Not needed
2% – 25,9 %	A small portion is needed
26% – 49,9 %	Less than half needed
50%	Half needed
50,1% – 75,9 %	More than half needed
76% – 99,9 %	Most needed
100%	All needed

TABLE 2 / Interview Results Regarding Teaching Materials

Topic Question	Answer
Availability of teaching materials and teaching tools in schools	The teaching materials available at the school consist of printed materials, including textbooks, student worksheets, and several learning posters. Non-textual materials, such as instructional videos, virtual lab applications, and teaching materials, are provided by teachers as references. The learning tools available at the school include projectors, Chromebooks, and several computers. Science experiment tools and materials are incomplete, so experimental activities are still limited to simple ones.
Intensitas penggunaan bahan ajar	The most frequently used teaching materials are printed materials in the form of textbooks and student worksheets. Non-printed supporting media, such as instructional videos, are used for certain abstract learning topics.
Problems regarding teaching materials	The teaching materials used by students come only from textbooks. Access to additional teaching materials as reference material during independent learning, such as videos, digital teaching materials, and other learning applications, is still very limited due to difficulties in obtaining internet access. This results in a lack of learning resources for students and makes it difficult to understand subject matter that requires conceptual visualization or experiments that are not possible at school.
The need for the development of teaching materials	A variety of teaching materials, both printed and non-printed, are essential to maximizing learning activities, ensuring they can accommodate students' needs, tailored to their learning styles, and the characteristics of the subject matter. The limitations of experimental activities, which are essential for science lessons, need to be replaced with learning media that can interpret experimental activities on specific materials, for example, using experimental videos or virtual lab applications. This is expected to ensure teachers can continue to facilitate students' learning needs.
Elements required to complete teaching materials	Teaching materials should contain instructions for use, suitability to Learning Outcomes, contain a detailed Learning Objective Flow, and cover all domains of knowledge, skills, and attitudes, systematic material accompanied by contextual examples, interesting and appropriate infographics, good readability, evaluation questions, and a variety of student activity guidelines.

TABLE 3 / Results of the Needs Analysis Questionnaire

No	Question Indicator	Answers Yes	Percentage (%)
Chemical content			
1	Difficulty understanding chemical material	9	52,94
2	Difficulty understanding reaction rate material	15	88,24
Learning support facilities			
3	Ownership of an Android phone or computer	17	100,00
4	Difficulty accessing the internet	15	88,24
Effectiveness of student learning materials			
5	Textbook learning resources do not yet accommodate students' understanding of reaction rate material	14	82,35
6	Need for alternative non-printed learning materials	17	100,00
Experimental activities in learning the reaction rate material			
7	Need for experimental activities	17	100 ,00
8	The availability of chemistry laboratory equipment and materials is not yet sufficient to support learning activities	16	94,12
9	Experimental activities have not been facilitated by the teacher	17	100,00
Effectiveness of Video Learning Materials			
10	Students who have used videos as a learning resource	13	76,47
11	Learning videos help students understand the material	13	76,47
12	Experimental video learning materials are needed to understand the material on reaction rates	17	100 ,00

TABLE 4 / Suggestions for Developing Learning Videos

No	Suggestion
1	The video is engaging and clear.
2	The video is accompanied by written explanations.
3	The audio is clear.
4	The accompanying music does not interfere with the material.
5	The material is easy to understand.