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Students' Need Analysis for the Development of Artificial Intelligence (AI)-Based Animated Video Learning Media on The Acid-Base Material

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ABSTRACT

Chemistry learning requires understanding abstract concepts across macroscopic, submicroscopic, and symbolic levels, particularly in the acid-base topic. Conventional instruction often relies on verbal explanations and limited media, which creates a demand for visual and engaging learning tools. Previous studies on video-based media for acid-base learning have mostly focused on product developlemnt and learning outcomes, and little is known about students' need before AI-based animated video media are developed. This study therefore analyzed students' need for AI-based animated video learning media on the acid-base topic. A quantitative descriptive approach was used with 35 students of one Grade XII class at SMA Negeri2 Medan. Data were gathered throught a 25-statement, four-level Likert-scale questionnaire covering five indicators and analyzed descriptively using percentages. The participating students reported a very high overall level of need for AL-based animated video media (86.83%). Indicartor scores were: current learning conditions (82.14%), need for animated videos (87.29%), perceptions of and interest in AI (85.29%), preferences for content and appearance (89.86%), and expectations for media development (89.57%). The findings indicate that these students report a need for media that can visually represent abstract acid-base concepts, which provides an initial empirical basis for designing AI-based animated video media; validator with broader samples is still required.

INTRODUCTION

Chemistry is one of the fields of science that has unique characteristics because it studies the phenomena of matter through various levels of representation. In chemistry learning, students are not only required to understand phenomena that can be observed directly, but must also be able to connect concepts at the macroscopic, submicroscopic, and symbolic levels. The ability to connect these three levels of representation has become one of the main challenges in learning chemistry because many chemistry concepts involve processes that cannot be directly observed, such as interparticle interactions, structural changes, and chemical reaction mechanisms (Popova & Jones, 2021).

One of the chemistry topics with a high level of abstraction is acid-base. This topic covers acid-base theories, the concept of pH, solution ionization, acid and base strength, and the relationship between ion concentration and solution properties. Acid-Base learning is particularly demanding because students must connect observable phenomena, such as indicator color changes and pH measurements, with particle-level processes such as proton transfer and ionization, which cannot be observed directly. As a result, students often find it difficult to explain in terms of particle behavior why a solution is acidic or basic or why acids differ in strength. Because these difficulties arise mainly at the submicroscopic level, learning media are needed that can visualize particle-level processes so that observed phenomena can be related to them (Mutiarasani & Kamaludin, 2025).

The problems in chemistry learning are not only related to the complexity of the material but also to the limited use of learning media capable of supporting the visual understanding

of concepts. Learning that is still dominated by lecture methods or text-based media tends to be less optimal in explaining abstract chemical phenomena, and students may find it difficult to build mental representations of concepts that cannot be observed directly. Static images and verbal explanations in particular cannot show how processes such as ionization and proton transfer unfold over time. A particular type of medium, one that can represent particle-level motion and change, is therefore needed for acid-base learning. Visual media and multimedia have the potential to help students understand the relationship between concepts, symbols, and chemical phenomena (Popova & Jones, 2021).

One of the learning media that can be used to overcome these problems is animated videos. Animated videos are able to integrate visual, audio, text, and motion elements so that concepts or processes that are difficult to observe can be presented more concretely. In chemistry learning, animation can be utilized to depict various processes, such as solution ionization, proton transfer, indicator changes, and interparticle interactions. The research by (Ritonga et al., 2023) showed that the use of animated videos in learning acid-base solutions had a positive impact on the learning process because it helped students understand concepts that were previously difficult to grasp through conventional learning. In addition to serving as visualization media, animated videos also have the potential to improve the quality of material presentation through a more engaging and systematic delivery of concepts. Developed a context-based animated video on acid-base solution material and showed that the media was able to help students understand chemical concepts through attractive visualizations and linkages to phenomena in everyday life (Mutiarasani & Kamaludin, 2025).

The development of digital technology, especially Artificial Intelligence (AI), provides new opportunities in the development of learning media. In the field of education, AI has the potential to support the digital content creation process, the development of learning visualizations, and the preparation of materials that are more suited to user needs. Zhang and Aslan (Zhang & Aslan, 2021) explained that AI has opportunities in improving the quality of learning through the use of smart technologies that support learning interactions. Furthermore (Zahi et al., 2021) stated that AI can support more interactive learning experiences, although its application still requires appropriate pedagogical considerations and supervision.

The use of AI in developing chemistry animated videos may be an alternative innovation for producing media that match the characteristics of the material more efficiently. AI technology enables visualizations, illustrations, and multimedia elements to be developed more efficiently, which may help present abstract chemistry concepts. One example is the use of text-to-video platforms that allow visual learning media to be developed more dynamically (Mambu et al., 2023). Studies on AI-based learning videos in other science topics, such as hydrocarbons and air pollution, have reported that the videos were valid and practical (Ranni et al., 2025). However, before a medium is developed, a needs analysis is required to identify learning problems, user characteristics, and gaps between current learning conditions and student expectations. A user-needs-based approach is a crucial stage in educational development research because it can increase the relevance and usefulness of the resulting products (Sailer et al., 2021).

Previous studies consistently indicate that video-based media can support acid-base learning by providing visual and contextual representations (Gustina & Yasthophi, 2022). However, most of these studies have focused on product development, feasibility, practicality, or learning outcomes. They provide limited information about students' needs before AI-based animated video media are developed. In addition, the AI-assisted video studies cited above addressed other topic and the acid-base video studies cited here did not involve AI-based production. What has not been answered is what students themselves need from AI-based animated video media for acid-base learning, including the media characteristics they expect (Romundza et al., 2023.

The present study is similar to the earlier studies in focusing on video-based media and on the rationale that visualization supports the learning of abstract concepts. It differs in three respects: it addresses the preliminary needs-analysis stage rather than product development or testing; it concerns AI-based animated video, which the acid-base studies above did not examine; and it measures students' reported needs across five indicators rather than learning outcomes. The novelty of this study therefore lies in combining AI-based animated video, the acid-base topic, and a needs analysis to provide empirical information that can guide the design of such media.

Therefore, this study aims to analyze students' needs for the development of Artificial Intelligence (AI)-based animated video learning media on the acid-base topic among students of class XII Mendel 2 at SMA Negeri 2 Medan.

RESEARCH METHOD

This study used a quantitative descriptive method with a needs analysis approach. It aims to describe students' needs for the development of Artificial Intelligence (AI)-based animated video learning media on the acid-base topic. The needs analysis was conducted as an initial stage to identify current learning conditions, students' needs for learning media, students' perceptions of AI technology, and the expected media characteristics before the product development stage.

The research was conducted at SMA Negeri 2 Medan. The research subjects were 35 students of class XII Mendel 2 at SMA Negeri 2 Medan. This class was selected because class XII students had already learned the acid-base topic and could therefore provide information about learning difficulties, experiences using learning media, and the need for technology-based chemistry learning media. Because only one class was involved, the findings describe the needs of this class and are not intended to be generalized to other classes or schools.

The instrument was a student needs analysis questionnaire on AI-based animated video learning media for the acid-base topic. It used a Likert scale with four answer choices: Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). The instrument consisted of 25 statements grouped into five indicators: current conditions of acid-base learning (items 1–5), need for animated video learning media (items 6–10), perceptions of and interest in Artificial Intelligence (AI) technology (items 11–

15), preferences for media content and appearance (items 16–20), and expectations for media development (items 21–25).

The questionnaire was developed based on the theoretical framework of chemistry learning media and students' needs for digital learning resources. Before distribution, the questionnaire was reviewed by four experts in chemistry education and educational technology. The full list of the 25 statements is provided in Appendix.

Data collection was carried out by directly distributing the questionnaires to the students of class XII Mendel 2 at SMA Negeri 2 Medan. Students were given an explanation regarding the research objectives and instructions for filling out the questionnaire before providing their responses.

The data obtained consisted of students' answer scores for each statement in the questionnaire. Furthermore, these data were analyzed to determine the level of students' needs for the development of AI-based animated video learning media.

The questionnaire data were analyzed using quantitative descriptive analysis by calculating the percentage of students' reported need levels. Responses were scored 4 (SA), 3 (A), 2 (D), and 1 (SD). The percentage of each indicator was calculated by comparing the score obtained with the ideal maximum score using the following formula:

$$P = (\Sigma X / \Sigma XMax) \times 100\%$$

Where P = percentage of students' reported need level, ΣX = total score obtained, and ΣXMax = ideal maximum total score (700 for each indicator: 35 students × 5 items × 4). The percentages were interpreted as follows: 81–100% (very high), 61–80% (high), 41–60% (moderate), and ≤40% (low) level of reported need.

RESULTS AND DISCUSSION

Results of Students' Needs Analysis for AI-Based Animated Video Media

The needs analysis questionnaire was administered to 35 students of class XII Mendel 2 at SMA Negeri 2 Medan, producing 875 responses (25 items × 35 students). The percentage of each indicator was calculated against the ideal maximum score, and the results are presented in Table 1.

Table 1. Students' Reported Needs by Indicator (N=35)

No	Indicator	SA	A	D	SD	Percentage	Interpretation
1	Current conditions of acid-base learning (items 1–5)	61	104	9	1	82.14%	Very high
2	Need for animated video learning media (items 6–10)	87	87	1	0	87.29%	Very high

No	Indicator	SA	A	D	SD	Percentage	Interpretation
3	Perceptions and interests in AI technology (items 11–15)	72	103	0	0	85.29%	Very high
4	Preferences for media content and appearance (items 16–20)	104	71	0	0	89.86%	Very high
5	Expectations for media development (items 21–25)	102	73	0	0	89.57%	Very high
	Overall Total	426	438	10	1	86.83%	Very high

Table 1 shows that all five indicators exceeded 81% and fell into the very high category. The highest percentage was found for preferences for media content and appearance (89.86%), and the lowest for current conditions of acid-base learning (82.14%). The overall total refers to the accumulated responses to the 25 items from 35 students (875 responses), which gave a percentage of 86.83% (very high level of reported need).

The distribution of responses adds some nuance. All 11 D and SD responses (10 D and 1 SD) occurred in the first two indicators, and 10 of them were in current conditions of acid-base learning. This suggests that students' views on the limitations of current learning were less uniform than their views on the media they would like to have, where all responses on the last three indicators were in the agree or strongly agree categories. The participating students thus reported a need for additional media and held clear expectations about its characteristics: attractive visual appearance, animation, voice narration, sample questions, and ease of access via digital devices.

For media design, these findings point to a medium in which visual presentation and ease of use are prioritized and which helps students relate observable acid-base phenomena to abstract concepts. Because the data come from one class, these needs should be read as the needs of the participating students and as a starting point for design decisions, not as conclusions about all students.

Analysis of Current Acid-Base Learning Conditions

The indicator of current conditions of acid-base learning obtained 82.14% (very high category), the lowest among the five indicators. Students' agreement with these statements suggests that they find current learning insufficient for helping them understand abstract concepts, although ten of the 175 responses on this indicator were disagreement (D or SD), so not all students shared this view.

A plausible reason for this result is the nature of the topic. Acid-base learning involves not only macroscopic phenomena but also submicroscopic processes such as ionization, the presence of ions in a solution, and changes in chemical equilibrium. When these are conveyed mainly through verbal explanations or symbols, students

may find it hard to connect visible phenomena with particle-level mechanisms. This explanation is an interpretation, because the questionnaire did not directly observe classroom practice.

This interpretation is in line with Popova and Jones (Popova & Jones, 2021), who explained that representational competence, the ability to relate phenomena, models, and chemical symbols, is important in chemistry learning. It implies that media for this topic should visualize particle-level processes explicitly rather than simply adding more text or explanation.

Students' Need for Animated Video Media

The indicator of need for animated video learning media obtained 87.29% (very high category). The participating students therefore reported a strong need for media that present acid-base concepts in a more visual and engaging way.

This result can be explained by the characteristics of the topic, which involves ionization, ions in solution, the relationship between ion concentration and pH, and reactions at the microscopic level. These processes are difficult to show through text or speech alone, whereas animation can show how they change over time.

The result is consistent with earlier acid-base studies in which videos or animations were received positively, including a context-based animation made with Powtoon (Mutiarasani & Kamaludin, 2025), environment-based acid-base videos (Handayani et al., 2021), videos on acid and base material (Gustina & Yasthophi, 2022), and a titration video (Londa et al., 2023). Pardi et alreported a student response of 95% (very practical) to audio-visual media on acid-base material. Those studies, however, examined products that had already been developed. The present study adds the perspective of students before development: they themselves report that they need such media. The earlier findings are used here only as a rationale for development, because this study did not test the effectiveness of animated video.

For design, the animations should prioritize particle-level processes and the relationship between ion concentration and pH, and AI-generated content should be checked by chemistry experts for conceptual accuracy.

Analysis of Students' Perceptions of AI Technology

The indicator of perceptions of and interest in AI technology obtained 85.29% (very high category), and there were no D or SD responses on this indicator; all responses were agree or strongly agree. The findings indicate positive student responses toward the use of AI in learning media. However, agreement with the idea of AI-based media does not by itself show that students are ready or able to use such media, and readiness was not measured in this study.

These responses are in line with research on Artificial Intelligence in Education (AIED), which describes AI as supporting adaptive, personalized, and need-based learning, ranging from intelligent tutoring systems to other forms of technological support (zhang & Aslan, 2021). At the same time, (Ouyang & Jiao, 2021) stress that AI should be directed as a supporting technology that continues to consider pedagogical aspects and human involvement.

This matters because acceptance of a technology is one condition for its successful use, but it is not sufficient. The present findings show positive responses, not readiness or ability, and the pedagogical considerations and supervision noted by Zhai et al. (Zhai et al., 2021) still apply to the development of AI-based media.

From a technological perspective, AI may potentially support more dynamic visualizations, more communicative automated narrations, and more adaptive content presentation. For the acid-base topic, AI may help produce animations that show ionization, particle interactions, and the relationship between acidity and indicator changes. This is a potential of the technology and was not tested in this study; the accuracy and pedagogical quality of AI-generated animations will need to be checked in the development stage.

Students' Preferences for Media Design

The indicator of preferences for media content and appearance obtained 89.86%, the highest among the five indicators. The students reported preferences for proportional video duration, voice narration, sample questions, microscopic-level animation, and links between acid-base concepts and everyday life. The relatively high score suggests that students have specific expectations about how the media should look and be presented.

These preferences are in line (Handayani et al., 2021) whose videos combined visualization, everyday context, and readable presentation. For the acid-base topic, microscopic-level animation is particularly relevant because ionization, proton transfer, acid-base strength, and pH changes are difficult to grasp when delivered only in text. Linking the topic to everyday life may help students see its relevance, although this study did not test that effect.

As a design implication, the media should combine particle-level animation, narration, everyday context, and sample questions in a systematic flow with clear language, so that visual attractiveness is accompanied by support for students' thinking.

Students' Expectations for Media Development

The indicator of expectations for media development obtained 89.57% (very high category). The students reported expectations for easy access to the media, the availability of practice questions or evaluations, and their willingness to use the media in learning.

These expectations indicate that students want media that can be accessed through digital devices so that they can learn flexibly at school and at home, and that includes practice questions so that they can check their understanding after watching the video. These are reported expectations, not observed behavior.

For product development, these findings suggest paying attention to accessibility, interactivity, and the suitability of content to student needs.

Limitations

This study has several limitations. It involved one class of 35 students at one school, so the results cannot be generalized. The data are self-reported perceptions from a

questionnaire; they describe reported need and do not measure students' actual conceptual difficulties, achievement, or the effectiveness of AI-based media. Future studies should involve more classes and schools, add interviews or diagnostic tests of students' acid-base difficulties, and test the effectiveness of the developed media.

CONCLUSION

Based on the needs analysis of class XII Mendel 2 students at SMA Negeri 2 Medan, the participating students demonstrated a very high level of reported need (86.83%) for Artificial Intelligence (AI)-based animated video learning media on the acid-base topic. The students' responses indicate that they find current learning insufficient for abstract concepts, particularly at the submicroscopic level, and they expressed expectations for media that are visually attractive, interactive, narrated, and equipped with sample questions. The findings also indicate positive student responses toward the use of AI in learning media. Because the sample was limited to one class and the data are self-reported, these findings should be treated as an initial basis for design decisions. Future media development should be centered on these student-reported needs, with expert validation of conceptual accuracy, and subsequent studies should test the feasibility and effectiveness of the developed media with broader samples.

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