

Needs Assessment for Developing Digital Learning Media in Chemistry for Grade XI Students at SMA Negeri 2 Siak Hulu

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Abstract. This study aims to analyse the needs for developing digital-based learning media for teaching chemistry in Grade XI of senior high school. The research was conducted at SMA Negeri 2 Siak Hulu in January 2025. Data collection techniques included questionnaires and interviews. The questionnaire data were collected using the Likert scale, while the interview data were analysed descriptively. This research employed a mixed-methods approach, combining qualitative and quantitative methods, with a phenomenological perspective using Interpretative Phenomenological Analysis (IPA). The results showed that the need for digital-based learning media at SMA Negeri 2 Siak Hulu reached 75%, categorised as "moderately needed." Furthermore, the interview findings supported the quantitative data, revealing that the school requires digital learning media development. Therefore, this study concludes that it is necessary to develop digital-based learning media to support the chemistry learning process for Grade XI students to enhance teaching effectiveness and student engagement.

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Introduction

Education is the most fundamental component of a nation. Through education, individuals can improve the quality of human resources, which plays a crucial role in implementing national development. The enhancement of education quality can be achieved through educational institutions, one of which is schools as formal educational institutions (Moto, 2019). The existence of quality education greatly influences a nation's competitiveness to avoid being left behind compared to other countries. Therefore, educational reform is necessary and a demand to improve the quality of national education, with one of the key components of the education system being the learning process (Hairinal et al., 2021; Ahmad et al., 2024). The learning process is an interactive activity between teachers and students, culminating in evaluating learning outcomes. In this process, the teacher's role as a provider of knowledge is highly important (Nurfaizah & Oktavia, 2020). The learning process aims to implement the curriculum set by educational institutions, with the expectation of influencing students to achieve predetermined educational goals (Danu, 2020). The learning process significantly affects students' success in understanding the teacher's material. Therefore, teachers must utilise engaging learning materials, including chemistry instruction (Sariati et al., 2020).

Chemistry learning requires high concentration, which involves skills beyond basic knowledge and demands a deep understanding (Priliyanti et al., 2021). Thus, senior high school students' comprehension of chemistry—often considered difficult—should not diminish their motivation or willingness to learn (Muderawan et al., 2019). However, many students show little interest in learning and struggle to understand chemistry materials. As a result, students' interest in learning chemistry tends to be low. This issue is mainly due to

passive and uninspired learning processes. Monotonous teaching strategies can reduce students' enthusiasm for learning. Therefore, there is a need for change or innovation in classroom learning processes (Saputra, 2019).

Learning media are defined as supporting tools in the learning process, functioning as intermediaries for transferring knowledge to students. In addition to conveying knowledge, learning media can also influence students' interest and motivation to learn (Kendek, 2023). One of the most popular types of learning media today is digital-based learning media. Digital-based learning media are tools to present instructional materials in audio-visual formats (Mariyah et al., 2021). The presence of audio-visual media can foster and even enhance students' motivation to learn at all levels of education. Learning media can be categorised into several types. According to Silahuddin et al. (2022), the categories include: audio-based media (audio tapes, radio broadcasts, CDs, telephones, MP3s); print-based media (textbooks, modules, brochures, leaflets, pictures, photos); audio-print media (audio tapes with accompanying written materials); still visual projection media (overhead transparencies, slides); still audio-visual projection media (sound slides); moving visual media (silent films); moving audio-visual media (videos/VCDs/television); physical object-based media (real objects, models); human and environmental-based media (teachers, librarians, laboratory staff); and computer-based media. Digital media are different from conventional media. Digital media refer to learning environments that utilise technology as instructional tools, such as the internet and various devices (smartphones, laptops, computers, etc.) (Yuniarti et al., 2023). The effectiveness of digital learning media is also supported by the role of educators who are proficient in utilising and delivering information to students (Tasruddin, 2020).

Learning media is a crucial factor in the teaching and learning process. In classroom instruction, teachers typically rely on learning media as intermediaries to deliver content that is accessible and comprehensible to students. Learning media can generate interest and new aspirations, stimulate motivation, and positively affect learning (Wulandari et al., 2023; Arifin et al., (2024b)). According to Wiratmojo and Sasonohardjo in Junaidi (2019), learning media in the orientation stage of teaching can significantly enhance the effectiveness of the learning process and the delivery of instructional content.

The role of digital-based learning media in modern education is highly significant. Learning media are not merely tools, but also serve as a means to create a more engaging, inclusive, and responsive learning environment that meets students' needs. With increasing technological literacy among younger generations, learning media can boost student engagement and equip them with essential future skills. The use of learning media also represents a response to the paradigm shift in education during the digital era. The learning process is no longer confined to textbooks and blackboards but extends into the digital realm, offering various educational content and resources (Dany, A., Rifan, H., & Suryandari, 2024). Learning media serves as a medium to communicate instructional content and helps attract students' interest, facilitate classroom activities, and improve the effectiveness of the learning process (Wulandari et al., 2023).

Previous studies have investigated the use of learning media. Using digital-based learning media has shown positive results based on relevant research conducted by Nenohai et al. (2022) and Pradilasari et al. (2020). It has proven to be feasible for chemistry learning. These findings need to be strengthened through further studies. Therefore, this research aims to overview of the initial needs for developing digital-based learning media in chemistry for Grade XI students at SMA Negeri 2 Siak Hulu.

Research Methods

This research was conducted at SMA Negeri 2 Siak Hulu in January 2025. The study employed a mixed-methods design, integrating qualitative and quantitative approaches, with a phenomenological orientation—specifically through Interpretative Phenomenological Analysis (IPA). Mixed-methods research combines qualitative and quantitative approaches, including data collection, analysis, and inference techniques, to achieve a more comprehensive and in-depth understanding. According to Parjaman and Akhmad (2019), mixed-methods research is a systematic model that integrates techniques, methods, perspectives, concepts, and languages from both qualitative and quantitative paradigms. This approach provides the advantage of holistically understanding a phenomenon by involving the simultaneous or sequential analysis of qualitative and quantitative data. The applied approach offers a more thorough comprehension of the research phenomenon or problem (Hakim Nasution et al., 2024).

The phenomenological approach, particularly Interpretative Phenomenological Analysis (IPA), aims to examine individuals' lived experiences (Bustard, Bolan, Devine, & Hutchinson, 2019:119). IPA is an inductive research method that begins with specific instances to develop broader theoretical insights. IPA researchers collect data (e.g., through interviews) and analyse it to identify themes and meanings, thereby understanding how individuals interpret their experiences (Smith & Nizza, 2022).

The interview subjects included an eleventh-grade chemistry teacher and 31 students from the same class. Data collection techniques included interviews and questionnaires to obtain comprehensive information regarding the needs and effectiveness of digital-based learning media for chemistry content. Interviews were conducted to gather in-depth qualitative data on the need for developing digital learning media (Table 2). The interview with the chemistry teacher aimed to understand challenges in the teaching process, the methods applied, and expectations for digital learning media. In addition, interviews were also conducted with several eleventh-grade students to explore their difficulties in understanding chemistry content, learning experiences, and expectations for innovative learning media. Questionnaires were used to collect quantitative and qualitative data from the various stakeholders involved in this research, including a needs analysis questionnaire (Table 1). The questionnaire employed a Likert scale with four response options: 4 = strongly agree, 3 = agree, 2 = disagree, and 1 = strongly disagree (Table 3). The needs analysis data from the questionnaire were then clustered, as presented in Table 4. The interview and questionnaire data will be the foundation for designing, developing, and evaluating digital-based learning media for chemistry content.

Table 1. Questionnaire Indicators of Needs Assessment

Aspect	Indicator
Digital-Based Learning Media	Media and other references used in school
Media	Designing and updating instructional media
Media	Use of digital-based learning media
Learning Model	Methods and learning models
Development	Development of chemistry-based learning media

Table 2. Interview Guide Indicators

Aspect	Indicator
Curriculum	Type of curriculum in use Teacher's perspective on the curriculum
Learning Tools	Designing and reviewing instructional materials Suitable instructional materials for use
Learning Media	Use of media Media selection
Learning Model	Use of learning models
Approach	Use of pedagogical approaches
Practicum	Implementation of practicum activities
Students	Learning participation
Assessment	Selection and use of assessments
KKTP and Grading	Use of competency-based assessment (KKTP)
Subject Matter	Learning difficulties in certain topics Topics that interest students
Development	Support for the development of digital-based learning media

Table 3. Likert Scale Assessment Criteria for Student Needs Questionnaire

Response Option	Score
Strongly Agree	4
Agree	3
Disagree	2
Strongly Disagree	1

Table 4. Interval and Criteria of Needs Assessment Questionnaire

Interval	Criteria
0% - 25%	Not Needed
26% - 50%	Slightly Needed
51% - 75%	Moderately Needed
76% - 100%	Highly Needed

Research Results and Discussion

The SMA Negeri 2 Siak Hulu observations were analysed quantitatively for a clearer, measurable picture. This analysis aims to determine students' needs and expectations for digital-based learning media. The processed data is then presented as tables to facilitate the visualisation and interpretation of observation results. The results of the analysis of the student needs questionnaire are shown in Table 5.

Table 5. Results of the Needs Assessment Questionnaire at SMA Negeri 2 Siak Hulu

Needs Assessment Indicator	Percentage
Approach, Method, and Learning Model	68%
Digital-Based Learning Media	79%
Motivation	78%
Average	75%

Based on Table 5, it is known that students need the need for teaching materials that are more efficient in use, which is followed by the total results of an average percentage of 75% with the category Quite necessary. This trend is in line with the times that demand technology-based adaptive learning. Digital-based learning media is relevant to today's learning needs but also relevant to today's learning needs and global trends where technology integration is becoming essential in education. In line with the opinion (Siringoringo & Alfaridzi, 2024), integrating technology in learning through digital devices, online platforms, and multimedia resources creates a dynamic learning environment and enriches students' learning experience.

The results of teacher interviews conducted at SMA Negeri 2 Siak Hulu are presented in Table 6 below.

Table 6. Interview Results of SMA Negeri 2 Siak Hulu

No Indicator	Description of Interview Results
1 Applicable Curriculum	Grade XI has adopted the <i>Merdeka</i> Curriculum.
2 Teacher's Perspective on the Curriculum	The <i>Merdeka</i> Curriculum places more emphasis on Problem-Based Learning (PBL).
3 Designing and Reviewing Teaching Materials	The teaching materials used include PowerPoint presentations and video screenings. Final learning evaluations are conducted using Quizizz.
4 Suitable Teaching Materials	During practicum sessions, obstacles such as the unavailability of materials often prevent the implementing of practical activities. Therefore, virtual labs and engaging animated videos are the most effective digital-based materials.
5 Use of Media	Students are more interested in video-based media that contains animations.
6 Media Selection	Commonly used media include Canva, where students are asked to create PowerPoint presentations and present their work. In addition, PowerPoint and educational videos are also used.
7 Use of Learning Models	The appropriate models are PBL and Project-Based Learning (PJBL). PJBL is used for chemistry topics requiring project implementation. At the same time, PBL is more effective for discussing and solving complex

No Indicator	Description of Interview Results
8 Learning Approach	chemistry problems because it engages students actively, not just the teacher delivering content. The approach is student-centered, where learners are at the center of the process, and the teacher is a facilitator. However, this approach becomes less effective when students do not understand the material. In cases of misconception, the teacher re-explains the concepts. Digital-based learning media strongly support this approach, as students tend to be bored with textbooks but are more interested in using digital applications.
9 Practicum Implementation	Practicums are conducted regularly. However, if materials are unavailable, virtual labs are used as alternatives.
10 Learning Participation	Students' interest and motivation to learn are fairly high. Teachers incorporate ice-breaking activities or games when students feel bored to create a more relaxed learning atmosphere. Students tend to be active learners and are more enthusiastic when directly involved, such as during practicum sessions.
11 Assessment Selection and Application	At the beginning of the semester, diagnostic assessments are used to identify students' characteristics and interests (e.g., visual preferences), after which students are grouped accordingly. Formative assessments are conducted through daily quizzes in essay, objective, or matching formats. Summative assessments take the form of semester exams using objective questions. For practical activities, assessments include students' abilities to use tools and engage in group discussions, evaluated through specific rubrics.
12 Use of Competency-Based Assessment (KKTP)	The teacher has not yet integrated digital learning media with Competency-Based Assessment (KKTP).
13 Learning Difficulties in Specific Topics	For Grade XI, chemistry topics that involve calculations, such as thermochemistry and chemical kinetics, are perceived as the most difficult.
14 Topics of Student Interest	Students are most interested in topics that involve practical experiments, such as atomic structure and acid-base concepts.
15 Support for the Development of Digital Learning Media	Required support includes access to applications for creating moving animations. This is important so students can visually perceive concepts like atomic structure rather than relying on abstract imagination.

The results of the quantitative data analysis obtained from the needs assessment questionnaire indicate that the demand for developing digital-based learning media reached an average of 75%. This figure falls into the "moderately needed" category, suggesting that the development of digital media is not only relevant but also an urgent necessity in the context of chemistry education at the senior high school level. This finding is consistent with Tsuroyya et al (2022) research, who emphasized the importance of digital media, such as digital comics, in enhancing students' interest in and understanding of abstract chemical concepts. Furthermore, the data provide a strong foundation for developing media that effectively and engagingly integrate technology into the learning process. Digital learning media have significant potential to bridge the gap between conceptual chemistry content and students' concrete and applicable learning experiences. This aligns with the findings of Fauziah (2020); Arifin et al (2024b) who noted that the development of interactive, technology-based media significantly enhances student engagement and learning motivation.

The phenomenological approach employed in this study also provides rich insights into the lived experiences of both students and teachers in using digital-based learning media. In-depth interviews revealed that teachers have been incorporating digital media into their teaching practices, actively engaging students in utilizing technology as a learning aid. This implementation reflects an integration between pedagogical needs and technological readiness, as highlighted by Ichsan et al. (2018), who stressed the importance of adaptive learning media across educational levels to support effective science learning. Additionally, the findings indicate that the use of digital learning media has had a positive impact on teaching effectiveness and student participation. Teachers reported that it helped them deliver material visually and interactively, while students were more motivated and involved in the learning process. This situation demonstrates a strong synergy between modern learning strategies and institutional readiness for technology adoption. In this context, Shofa et al (2020) findings support the notion that mapping the needs for learning media development must consider the end-user context to ensure its effectiveness and utility.

Ultimately, the urgency to develop and optimize digital-based learning media is becoming increasingly evident. The need for interactive, innovative, and contextually relevant media demands a systematic approach in its development, including aspects of design, content, and implementation strategies in the classroom. Priyatni et al (2020) affirm that inquiry-based digital books can foster student engagement in more meaningful chemistry learning. Therefore, this study reflects the empirical conditions regarding the need for digital media at SMA Negeri 2 Siak Hulu and highlights the importance of technology-based pedagogical interventions to improve the quality of chemistry education.

Conclusion

Based on the analysis and discussion, it can be concluded that the need for digital-based learning media in chemistry education at SMA Negeri 2 Siak Hulu is relatively high, with an average questionnaire result of 75%. These findings confirm that digital media strategically enhance teaching effectiveness and student engagement while addressing chemistry instruction's inherently abstract and complex nature. The current implementation of digital media by teachers, along with the active participation of students in its use, indicates the school's readiness to adopt educational technology. The phenomenological approach employed in this study successfully uncovered the authentic experiences of both teachers and students, reinforcing the urgency of developing adaptive, interactive, and learner-centred

media. As such, the development of digital-based chemistry learning media is important as a pedagogical innovation but also important as a pedagogical innovation and a strategic step in creating a contextualized learning process aligned with 21st-century educational technology advancements.

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