

Preliminary Study on Developing a Chemistry Magazine as a Learning Media for Grade X Senior High School Students

Tasya Akmelia, Nurkhairo Hidayati, Putri Ade Rahma Yulis

Universitas Islam Riau

*Corresponding Author: tasyaakmelia@gmail.com

Abstract

This study aims to examine the initial need for developing a chemistry magazine as a learning medium for the atomic structure topic for Grade X senior high school students. The study employed a mixed-methods approach and was conducted at SMA Negeri 4 Siak Hulu in December 2025. Quantitative data were collected through a student needs analysis questionnaire, whereas qualitative data were obtained through an interview with the chemistry teacher. Data were analyzed using a Likert scale and thematic analysis. The results indicate that developing a chemistry magazine as a learning medium for Grade X students is strongly needed, with a mean score of 83.1%. Furthermore, the findings reveal that students are interested in and need interactive learning media to understand the material better and improve their learning outcomes in the topic of atomic structure.

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INTRODUCTION

Education is defined as a deliberate and planned effort to create a learning atmosphere and learning process in which students actively develop their potential, including spiritual aspects, personality, intelligence, morality, and the skills needed for social and civic life (Hidayat et al., 2019; Arifin et al., 2024; Arifin et al., 2025). In this sense, the learning process involves systematic interaction between teachers as facilitators and students as learners in the transmission and construction of cognitive, affective, and psychomotor domains. Effective delivery of instructional messages requires the appropriate use of media and learning resources so that the information presented can be optimally received by students (Daniyati et al., 2023; Zahwa & Syafi'i, 2022). Several studies indicate that learning media play an important role in improving the quality of learning processes and outcomes, while also maintaining and strengthening students' motivation and learning activity (Rahmawati et al., 2024). From a visual design perspective, reading media such as magazines also relies on graphic design principles in cover design and page layout to attract readers' attention and facilitate comprehension of content (Setiawan & Kartono, 2021).

Chemistry learning at the senior high school level requires mastery of abstract concepts related to the composition, structure, properties, transformations, dynamics, and energetics of matter, thus demanding higher-order reasoning skills. However, many students still perceive chemistry as a difficult subject, especially when instruction is dominated by teacher-centered lecturing, which tends to produce passive learning and ultimately lower learning achievement (Muderawan et al., 2021). This condition underscores the need for innovative learning media that can make abstract concepts more concrete and increase student engagement. Various chemistry media have been developed, ranging from print media such as pop-up books for the basic laws of chemistry topic (Hasanah et al., 2023) and chemistry magazines for the basic laws

of chemistry (Gani & Hasan, 2016; Yuliyanto & Rohaeti, 2013), to multiple-representation-based e-magazines for electrolyte and nonelectrolyte solutions (Jariati & Yenti, 2020), Chemistry-Magz for thermochemistry (Puspaningrum et al., 2021), e-magazines for chemical equilibrium (Epinur & Muhaimin, 2019), and e-magazines for redox reactions (Arief et al., 2021). More specifically, electronic chemistry magazines such as E-Chemagz on chemical bonding (Gultom et al., 2022), a chemisensor-based chemistry magazine integrated with practical work (Rahmawati et al., 2023), and chemistry magazines on elemental chemistry for Grade XII students (Rahmawati et al., 2024) indicate that magazines, both print and digital, can function as supplementary reading materials that present content in a simplified manner, accompanied by educational color illustrations, and have been shown to enhance motivation and learning engagement. Similar findings were reported in the development of a contextual-approach-based digital magazine rated as highly feasible and highly attractive by experts, teachers, and students (Mustari et al., 2024).

Although a range of chemistry magazine and e-magazine media development studies have been conducted across topics and grade levels, their focus has generally been on product development stages and feasibility testing for specific topics or contexts, such as the basic laws of chemistry, chemical bonding, equilibrium, thermochemistry, redox, or elemental chemistry (Gani & Hasan, 2016; Yuliyanto & Rohaeti, 2013; Epinur & Muhaimin, 2019; Puspaningrum et al., 2021; Gultom et al., 2022; Arief et al., 2021; Rahmawati et al., 2023, 2024; Jariati & Yenti, 2020). There remain relatively few studies that explicitly begin with a comprehensive needs analysis and an examination of Grade X students' learning difficulties as a basis for designing a chemistry magazine intended as a supplementary learning resource across topics in senior high school. Yet, a systematic preliminary study of learners' needs, context, and characteristics is essential to ensure that magazine content, format, and design align with students' learning profiles and curriculum demands. Based on analyses of learning difficulties and learning needs, and the literature review, a need was identified for a chemistry magazine specifically developed as a learning supplement for Grade X students. Therefore, this study is directed toward a preliminary investigation of chemistry magazine development as a fundamental step before entering the full design and product development stages.

RESEARCH METHOD

Research Design

This study was conducted at SMA Negeri 4 Siak Hulu in December 2025 using a mixed-methods approach (Nasution et al., 2024). This approach integrates systematic procedures for collecting and analyzing quantitative and qualitative data to obtain a more comprehensive understanding of the need to develop a chemistry magazine as a learning medium for Grade X students. Quantitatively, the study aimed to map students' needs and perceptions regarding the use of a chemistry magazine in learning. Qualitatively, the study focused on a deeper exploration of current learning practices, the availability of learning tools and media, and the teacher's expectations for the development of this medium.

Participants and Data Collection

The participants consisted of one chemistry teacher who taught Grade X and students in the same Grade X class at SMA Negeri 4 Siak Hulu, Province of Riau. The collected data included both qualitative and quantitative data. Qualitative data were obtained through in-depth interviews with the chemistry teacher using a structured interview guide that covered several main aspects: (1) the curriculum used in chemistry learning at the school; (2) the

availability of learning tools such as lesson plans (RPP), modules, and student worksheets (LKPD) for the atomic structure topic; (3) the types of chemistry learning media used to date; (4) learning models and methods implemented for the atomic structure topic; (5) students' participation levels during learning; and (6) the teacher's views and expectations regarding the development of a chemistry magazine on the atomic structure topic as a learning supplement. Quantitative data were obtained by administering a needs analysis questionnaire to Grade X students. The questionnaire was constructed using a Likert scale. It included indicators reflecting: digital-based learning (availability and use of digital media and references at the school), learning media (teachers' efforts to design and update media), magazine display and features (text readability, layout neatness, image quality, design consistency, and visual appeal), contextual learning (connections between content and real life), and the need to develop chemistry-based learning media.

Data Analysis

Data analysis in this study employed two complementary approaches. Qualitative data from the teacher interview were analyzed using thematic analysis (Nurhaliza et al., 2025). This process included transcription, repeated reading, open coding, grouping codes into major themes, and interpreting themes in relation to the need to develop a chemistry magazine for the atomic structure topic, the curriculum implementation context, the availability of learning tools and media, and student characteristics and engagement in learning. Quantitative data from the student needs questionnaire were analyzed using a four-point Likert scale: Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1). Responses were summarized for each item, and mean scores were calculated, then converted to a percentage index by comparing the obtained score with the maximum possible score for each aspect and multiplying by 100%. The percentage index was interpreted as follows: 0–25% (not needed), 26–50% (moderately needed), 51–75% (needed), and 76–100% (strongly needed).

RESULT AND DISCUSSION

The observation results at SMA Negeri 4 Siak Hulu were analyzed quantitatively to obtain a more objective, measurable depiction of the data. This analysis was conducted to identify the observed aspects and to detect trends or patterns emerging from the observation data. The analyzed data were then presented in tables and diagrams to facilitate visualization and interpretation of the results. This presentation is expected to provide a comprehensive understanding and to serve as a basis for decision-making and for planning any necessary follow-up actions. Based on the quantitative analysis, the findings from the observation sheet at SMA Negeri 4 Siak Hulu are presented in Table 1 and Figure 1.

Table 1. Results of the Student Needs Analysis Questionnaire (SMA Negeri 4 Siak Hulu)

No	Indicator	Percentage	Category
1	Digital-Based Learning	83.33%	Strongly needed
2	Learning Media	79.76%	Strongly needed
3	Magazine Display and Features	86.01%	Strongly needed
4	Contextual Learning	87.30%	Strongly needed
5	Development	79.16%	Strongly needed
Mean		83.11%	Strongly needed

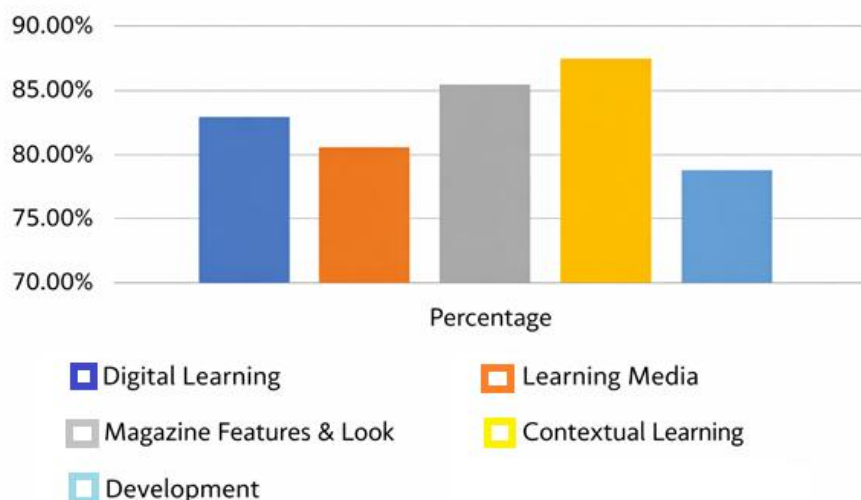


Figure 1. Results of the Student Needs Questionnaire Analysis

To obtain a deeper understanding of these needs, this study was followed by an interview with the chemistry teacher at SMA Negeri 4 Siak Hulu. The interview aimed to elicit information related to curriculum implementation, learning tools, the learning media used to date, learner characteristics, learning models and methods, and the teacher's perspectives on developing a chemistry magazine as a learning medium. The teacher interview results are presented in Table 2.

Table 2. Teacher Interview Results

No	Question	Teacher Response
1	Which curriculum is currently used in your school for chemistry learning?	Merdeka Curriculum.
2	How well does the curriculum align with the atomic structure topic taught in class?	So far, implementation has been running well.
3	Do the learning tools (lesson plans/RPP, modules, LKPD) already include contextual elements?	Yes.
4	In your view, is the allocated instructional time for the atomic structure topic appropriate for the competencies to be achieved?	Yes, it is appropriate.
5	What learning media do you most often use when teaching atomic structure?	The periodic table of elements and simple teaching aids, such as table salt, are used to visualize crystal structures.
6	How effective are these media in helping students understand atomic structure concepts?	Students understand more quickly, and their enthusiasm increases during learning.
7	Have you ever used a magazine or other digital media in chemistry learning? If yes, what were the results?	I have used digital media such as Google Classroom and Zoom, but student participation was low; I also shared literature from YouTube.

No	Question	Teacher Response
8	In your view, are the existing learning media sufficiently interesting to increase students' interest in learning? Why?	Student responses vary; currently, online gaming is associated with reduced focus and fatigue among students.
9	Which learning model do you usually use for the atomic structure topic?	Project-Based Learning (PjBL).
10	Are you familiar with and have you ever implemented Problem-Based Learning (PBL) in chemistry? If yes, how did students respond?	Implementing PBL in combination with LKPD is highly effective at increasing student engagement.
11	In your view, what method is most effective for teaching atomic structure so that students are more active and think critically?	I apply differentiated learning to accommodate students' diverse abilities.
12	How would you describe students' level of participation during learning about atomic structure?	Student participation in the atomic structure topic is fairly good.
13	What difficulties do students often experience in understanding atomic structure concepts?	Difficulty distinguishing protons, neutrons, and electrons, and calculating mass number as well as identifying isotopes, isotones, and isobars.
14	Do students show interest or curiosity about real examples in their environment related to atomic structure?	Yes.
15	In your view, can connecting learning with everyday life increase students' interest and understanding?	Yes.
16	How do you assess students' understanding of atomic structure (tests, projects, observations, etc.)?	Through tests, observations, and projects.
17	Does the assessment used cover knowledge, skills, and attitude aspects?	Our assessment instruments already cover all three aspects.
18	In your view, is it necessary to develop a specific assessment instrument aligned with a chemistry magazine?	It is very necessary.
19	Is the assessment you use aligned with the applicable Kriteria Ketuntasan Tujuan Pembelajaran (KKTP)?	Yes, it is.
20	What is your opinion on developing a chemistry magazine as a learning medium for atomic structure? Is such a magazine needed in your school?	This innovation is very positive for learning, as it can serve as an alternative and attractive learning resource.

Based on the results of the student needs analysis questionnaire in Table 1, the overall mean across aspects was 83.1%. This indicates that a chemistry magazine with content on atomic structure is in the 'strongly needed' category, as its percentage falls within the 76%–100% interval. The bar chart of the mean response percentages across indicators is shown in Figure 1.

Student responses comprised several aspects. The digital-based learning aspect yielded a mean percentage of 83.3%, and the learning media aspect yielded 79.9%. Across these two aspects, students reported more frequent use of digital-based learning media. They perceived that such media make learning materials easier to understand, for example, animated videos or teaching materials accessible via smartphones. This finding reflects a broader trend in educational practice in which technology serves as a supportive tool with substantial significance in teaching and learning processes (Herdianti et al., 2024). The third aspect—magazine display and features—obtained a mean of 86%. According to Rahmawati et al. (2024), images as visual media can attract students' attention; colored images are typically more appealing and can increase learners' interest and focus. The fourth aspect—contextual learning—obtained a mean of 87.3%, indicating that it is strongly needed. Contextual learning can improve students' learning outcomes, especially for abstract chemistry content. This is consistent with Pratama et al. (2019), who reported improvements in students' understanding and activity in each cycle, as reflected in students' enthusiasm in responding to teacher questions and their active collaboration in group discussions (peer tutoring, mutual support, and division of labor). The fifth aspect—the development of a chemistry magazine on atomic structure—obtained a mean of 79.1%, which also falls into the strongly needed category.

Based on the chemistry teacher interview results presented in Table 2, it was revealed that the learning media used thus far are still relatively limited, such as the periodic table and simple teaching aids. Although these media can increase students' enthusiasm, students' conceptual understanding of atomic structure has not yet been optimal. This is indicated by persistent difficulties distinguishing subatomic particles (protons, neutrons, and electrons) and solving problems involving isotopes, isotones, and isobars. The teacher also noted that the use of digital tools such as Google Classroom, Zoom, and YouTube has not significantly increased student participation, partly because online gaming has reduced students' focus and motivation. The teacher has implemented several active learning models, including Project-Based Learning (PjBL), Problem-Based Learning (PBL), and differentiated instruction to accommodate diverse student abilities. The teacher emphasized that attractive interactive learning media are urgently needed to help students understand content effectively and thereby improve learning outcomes (Trisniningsih et al., 2021). This finding supports prior research suggesting that one effective way to create an enjoyable learning atmosphere is to leverage learning media, as such media can increase students' learning motivation (Sinaga & Simbolon, 2021).

CONCLUSION

Based on the research findings and discussion, it can be concluded that the preliminary study on developing a chemistry magazine as a learning medium for Grade X senior high school students, based on the student needs questionnaire and the chemistry teacher interview falls into the strongly needed category, with an overall mean of 83.1%. Furthermore, these results indicate that students are interested in and need interactive learning media to help them understand the material and improve their learning outcomes in the atomic structure topic.

RECOMMENDATIONS

Based on the preliminary findings, this study should be continued to the development stage of a chemistry magazine learning medium for the atomic structure topic.

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