

Bridging Gaps in Chemistry Instruction: Analyzing the Need for Interactive Learning Media at Senior High School in Sungai Pinang District

Ambar Sari¹, Farhan Yadi², Fakhili Gulo³

¹ Universitas Sriwijaya, Palembang, Indonesia; sariambar2005@gmail.com

² Universitas Sriwijaya, Palembang, Indonesia; farhan@unsri.ac.id

³ Universitas Sriwijaya, Palembang, Indonesia; fgulo@unsri.ac.id

ARTICLE INFO

Keywords:

Learning Media;
Learning Characteristics;
School and Student
Characteristics

Article history:

Received 2024-09-30

Revised 2024-11-11

Accepted 2025-03-07

ABSTRACT

The integration of interactive web-based learning media is essential to address challenges in teaching hydrocarbon materials at SMAN 1 Sungai Pinang. Traditional teaching methods, while effective, often lack student engagement, motivation, and interactivity. This study explores the need for digital learning tools to enhance chemistry education. A needs analysis was conducted through surveys and questionnaires to assess student and teacher perceptions regarding existing teaching methods. The validity and reliability of the questionnaire were confirmed to ensure accurate data collection. The study also examined school facilities and academic challenges that impact the implementation of interactive learning. Findings indicate that well-equipped school facilities support the adoption of interactive and digital learning strategies. While traditional methods remain beneficial, a blended learning approach is necessary to optimize student engagement and academic performance. The study also highlights various academic and non-academic challenges faced by students, necessitating further support and development. Regular evaluation of teaching strategies is crucial to adapting to students' evolving needs. The study underscores the importance of interactive web-based learning media in improving teaching effectiveness and student engagement. The findings suggest that supplementing traditional methods with digital tools can enhance comprehension and motivation. This study supports the development of interactive digital learning media to complement traditional chemistry instruction. Implementing blended learning strategies can address current educational challenges, fostering a more engaging and effective learning environment.

This is an open access article under the [CC BY-NC-SA](https://creativecommons.org/licenses/by-nc-sa/4.0/) license.



Corresponding Author:

Fakhili Gulo

Universitas Sriwijaya, Palembang, Indonesia; fgulo@unsri.ac.id

1. INTRODUCTION

Education is a fundamental human need, playing a crucial role in personal and societal development. It serves as a foundation for enhancing human potential, enabling individuals to contribute meaningfully to their communities and nation. In today's digital era, the integration of technology in education is essential to ensure continuous improvements in learning quality. As highlighted by Rahmawati & Sudarman (2021), learning activities must evolve alongside technological advancements, influencing key educational components such as teaching methods, instructional models, and learning media. This necessity aligns with Permendiknas No. 16 of 2007 (Senawati, 2019), which outlines academic qualification standards for teachers, emphasizing the ability to utilize information technology in the learning process as a core competency for senior high school educators. Similarly, Minister of National Education Regulation No. 41 of 2007 (Suryadewi et al., 2014) mandates that educators integrate technology into instruction to adapt to evolving educational needs.

The quality of learning experiences in educational institutions, particularly at the senior high school level, significantly impacts students' academic achievement. Learning is not merely about delivering information but involves interactive engagement between students, teachers, and educational resources (Umi & Mujiyatun, 2021). According to Pribadi (2009), a learning system comprises interconnected elements such as objectives, resources, methods, media, and evaluation. Dasopang (2017) further emphasizes the complexity of learning systems, highlighting the necessity of effective instructional planning to ensure meaningful educational experiences. In this context, infrastructure, facilities, and educator readiness play a vital role in supporting the development of ICT-based learning media. As schools improve their technological resources, the potential for adopting interactive digital learning tools increases, bridging gaps in traditional chemistry instruction and enhancing student engagement and understanding.

The integration of technology into chemistry education has significantly enhanced both students' conceptual understanding and their enthusiasm for learning. Computer simulations, for instance, provide dynamic visualizations of complex chemical processes and molecular interactions that are often challenging to convey through textbooks or traditional experiments alone. By interacting with these visual representations, students develop a deeper comprehension of concepts such as chemical bonding and molecular structures. Additionally, virtual laboratories offer a risk-free environment for conducting experiments without exposure to hazardous materials. These platforms allow for repeated trials, enabling students to explore experimental variables and refine their problem-solving skills.

Furthermore, the flipped classroom model presents an effective approach to chemistry learning. By engaging with instructional videos and online materials at home, students can dedicate class time to hands-on experiments and in-depth discussions, promoting a more interactive and application-based learning experience. Gamification strategies, such as point-based systems and challenge-based learning, also play a crucial role in increasing engagement. This approach is particularly beneficial for mastering complex topics like organic chemistry and thermochemistry, as it fosters motivation and encourages students to persist in their studies (Moore et al., 2014; Kolil et al., 2020; Blonder et al., 2022; Swartz, 2024).

The evolution of learning media, particularly multimedia, continues to progress alongside advancements in information technology. Multimedia can take various forms, including digital publications, presentations, tutorials, and online references, making it a versatile tool for education (Kurniawan et al., 2022). As technology advances, its application in learning becomes increasingly diverse, reinforcing the importance of integrating technological innovations into educational strategies. This requires a structured approach known as instructional design to ensure effective implementation.

According to Ali and Sukardi (2021), mobile learning enhances student engagement by making learning activities more enjoyable and interactive. When students experience positive emotions such as enjoyment and curiosity, the learning process becomes more effective and meaningful. Conversely, feelings of fear, anxiety, or discomfort can hinder comprehension and retention. Additionally, an overly

rigid or forced learning environment may result in poor academic outcomes, emphasizing the need for a balanced and student-centred instructional approach (Irawan & Sukarna, 2015).

According to Arthur et. al. (2019), A systematic procedure known as instructional design is used to develop and structure educational programs with the goal of significantly improving learning. Needs analysis is the first stage of the instructional design process. According to Songhori (2008) in Tambunan (2021), needs analysis generally refers to activities that involve collecting data and information to identify what is needed by a group of students. By using needs analysis when creating learning media, designers can better understand the differences between the knowledge and skills of a group of students and the desired result Arthur et al. (2019). To adapt learning media to current needs based on problems found through needs analysis. Needs analysis is carried out when developing learning media to determine how students assess the learning media they are currently using and what they want to achieve from the learning media that will be created later.

Chemistry is a type of science that has relationships between its sub-disciplines. Experiments are used to identify the problems and why and how natural phenomena arise, mainly regarding the composition, shape, structure, transformation, dynamics, and energetics of substances. This field of science study involves reasoning and skills (Emda, 2017). According to Sukmawati (2020) in Kartini & Putra (2021) states that chemistry consists of processes, which include the abilities and attitudes of a scientist in collecting and developing new information in a particular field. In addition, product chemistry, which is a knowledge domain that includes information, ideas, and principles related to chemistry. Chemistry learning usually starts in high school (SMA) to increase students' knowledge. Learning is an important part of all school processes. Almost consistent changes in behavior that are caused by experience or training and include physical and psychological aspects are known as learning (Syarifuddin, 2020). So, studying chemistry is an effort to understand the entire world of chemistry through 3 levels of representation: macroscopic, submicroscopic, and symbolic (Agustina, 2016). Chemistry has an active role that is very useful for everyday life and has helped many people. However, because many students have difficulty understanding the concept, chemistry is often considered one of the subject materials that is relatively difficult to comprehend and understand, so students do not want to study it further. Due to the limited amount of media available during online learning, practical activities cannot be carried out. The inability to create their own media for the chemistry subject Hydrocarbons also causes a lack of student motivation to learn about the material provided. Apart from that, there are no teachers or instructors who are able to create their own media for these subjects.

Additional insights for this study were gathered through interviews with teachers at SMAN 1 Sungai Pinang, providing valuable perspectives on the challenges and opportunities of integrating technology into chemistry education. The interviews revealed that many teachers struggle with the technical skills and pedagogical knowledge required to effectively implement technology-based learning. As a result, they often rely on traditional teaching methods, which feel more familiar and manageable. Adapting to digital tools requires time, effort, and a willingness to embrace change, posing a significant challenge for educators.

To address these issues, the school has implemented several strategies, including training sessions on educational applications aligned with the current curriculum. These programs provide both technical guidance and insights into technology-based teaching methods to enhance teachers' skills and confidence. Additionally, the school is fostering a professional learning community where teachers can exchange experiences and best practices, facilitating a smoother transition to digital learning.

Given these challenges, interactive media emerges as a crucial innovation in modern education. Web-based learning tools, featuring interactive exercises and quizzes, offer students accessible, engaging, and flexible learning experiences. This approach can improve comprehension, motivation, and overall learning outcomes in chemistry. Recognizing this need, the present study aims to analyze the necessity of developing web-based interactive learning media for chemistry instruction. The research seeks to explore how digital tools can enhance teaching effectiveness and student engagement.

2. METHODS

2.1. Research sites

This research was carried out at the educational institution SMAN 1, Sungai Pinang District, Ogan Ilir Regency, in May - June 2024. This is because the results of the needs analysis will be used in planning for class XI.

2.2. Population, Sample and Sampling Technique

a. Population

The research subjects were 113 Class X students of SMAN 1 Sungai Pinang, Ogan Ilir Regency.

b. Sample

Once everything is known for certain, the Slovin formula with a 95% accuracy rate is used to determine the correct sample size. This formula is described as follows:

$$n = \frac{N}{1 + N(\varepsilon)^2}$$

Formula description:

n : Number of Research Samples required

N : Number of Research Population

ε : Research sample error rate (sampling error) = 5% or 0.05.

With an error tolerance limit of 5% for the required sample, a student population of 113, the number of samples taken is:

$$n = \frac{113}{1 + 113(0,05)^2} = \frac{113}{1 + (113)(0,0025)} = \frac{113}{1,2825} = 88,109 \approx 89 \text{ Respondents}$$

c. Sampling technique

According to Sugiyono (2021), engineering *simple random sampling* is the simplest technique in the sampling method because research samples from the population are taken randomly without needing to pay attention to similarities, levels or standards in the population. This method is used in cases where the population is considered homogeneous.

2.3. Data Collection Instrument

This study uses various methods to collect data from respondents, namely observation, documentation and questionnaires.

2.4. Data analysis technique

Data analysis and data estimation methods in this research use quantitative descriptive analysis methods and frequency distribution methods. Research that uses quantitative descriptive analysis is a type of research that aims to describe variables as they are and is supported by numbers made from the actual situation in the data (Sugiyono, 2021). A data series in the form of numbers based on quantity is called a quantitative frequency distribution, and a data series of numbers based on quality is called a qualitative frequency distribution. The data used as study material can be learning outcomes, learning achievements, number of students, and so on, which are examples of simple quantitative data, while qualitative data includes information about gender, education level, class, and so on. A frequency distribution table is a statistical tool used to arrange data in rows and columns, showing the frequency distribution of variables being studied (Wahab et al., 2021).

3. FINDINGS AND DISCUSSION

3.1. Respondent Identification

The research subjects who acted as the research population were all class X students of SMAN 1 Sungai Pinang Ogan Ilir Regency, totalling 113 students. Meanwhile, to obtain the sample size

estimated using the Slovin method, the calculation results using the Slovin Formula amounted to 89 respondents. The subjects used as respondents for this research with detailed data are as follows:

3.1.1 Frequency of Respondents Based on Gender

Table 1. Identify Respondents Based on Gender

No.	Gender	Amount	Percentage
1	Man	34	38.2
2	Woman	55	61.8
Total		89	100

Source: Data Estimate Results, 2024.

According to the provided table on respondent gender, out of the total responders, there were 30 males, making up 33.7% of the total, and 59 females, making up 66.3%. Based on the respondents' answers, it is evident that the majority of respondents, 59 respondents or 66.3%, were female.

3.1.2 Frequency of Respondents Based on Android-Based Mobile Phone Ownership

Based on the findings of giving study participants questionnaires, the number of respondents based on Android-based cellphone ownership was as follows:

Table 2. Frequency of Respondents Based on Android-Based Mobile Phone Ownership

No.	Ownership of Android-Based Cell Phones	Amount	Percentage
1	Yes	86	96.6
2	No	3	3.4
Total		89	100

Source: Data Estimate Results, 2024

Based on the table above regarding ownership of Android-based cellphones, it can be seen that the number of respondents who own Android-based cellphones is 86 respondents or 96.6% and the number of respondents who do not own Android-based cellphones is 3 respondents or 3.4%. From the results of the respondents' answers, it is known that the respondents who were categorized based on ownership of Android-based cellphones were mostly 86 respondents or 96.6% of respondents who owned Android-based cellphones.

3.2. Questionnaire Reliability Test

3.2.1 Questionnaire Validity Test

The validity test will test each question item used in this research. The criteria used to determine whether or not the statements used in this research are valid are as follows: level of significance *Pearson Correlation* (R) > P-Value (0.05), then the statement item is said to be valid.

Table 3. Validity Test Per Question Item

No.	Question	Pearson Correlation Value	R-Table (DF = 87)	Sig. Pearson Correlation
Learning Facilities				
1.	The school building is sturdy, clean, and well maintained.	0.703	0.2084	0.012
2.	The classroom has windows and ventilation, which allows a lot of light and air to come in and makes it easier for me to study.	0.701	0.2084	0.002
3.	The school already has an adequate laboratory for chemistry practicum.	0.769	0.2084	0.009
4.	The school has an adequate library for complete reading sources for chemistry subject matter.	0.814	0.2084	0.000
5.	Learning aids and school chemistry teaching materials are in good working order.	0.811	0.2084	0.003
6.	The school has prepared a complete student handbook to support learning activities.	0.531	0.2084	0.000
Learning Characteristics				
7.	Your learning activities are carried out interactively or communicatively.	0.718	0.2084	0.000
8.	When delivering lesson material, teachers always provide examples and motivation for their students.	0.745	0.2084	0.000
9.	Learning activities in class are fun and encourage students to actively participate.	0.633	0.2084	0.000
10.	The teacher delivers learning material according to current conditions.	0.664	0.2084	0.001
11.	In the school laboratory, teachers always accompany students on chemistry experiment activities.	0.841	0.2084	0.000
12.	Teachers provide freedom to build student creativity in the learning process.	0.605	0.2084	0.000
13.	Teachers tailor learning material to students' abilities and encourage student interest.	0.707	0.2084	0.000
School Characteristics				
14.	Your learning activities are carried out interactively or communicatively.	0.810	0.2084	0.000
15.	SMAN 1 Sungai Pinang is able to develop the potential that exists in every student.	0.657	0.2084	0.000
16.	SMAN 1 Sungai Pinang frequently provides solutions to problems that students encounter.	0.737	0.2084	0.000
17.	SMAN 1 Sungai Pinang has adequate internet access to support chemistry learning.	0.594	0.2084	0.000
No.	Question	Pearson Correlation Value	R-Table (DF = 87)	Sig. Pearson Correlation
Student Characteristics				
18.	I am interested in studying chemistry.	0.667	0.2084	0.000
19.	I will continue to try as hard as possible, focus, and be serious about studying chemistry learning material.	0.714	0.2084	0.000
20.	I am motivated to study chemistry because the subject matter is interesting and easy to understand.	0.629	0.2084	0.000
21.	I comply with the rules or regulations determined by the school and educational unit.	0.596	0.2084	0.000
22.	I am aware of the tasks and obligations that I must carry out in the process of learning chemistry material.	0.558	0.2084	0.000
23.	Success in studying chemistry depends on my own efforts.	0.444	0.2084	0.000
24.	I don't easily depend on, be influenced by, or follow other people when completing tasks.	0.509	0.2084	0.000
25.	I do not hesitate to ask questions and communicate with the teacher if I feel that I do not understand the material presented.	0.534	0.2084	0.000

26.	I respect and always say polite things to all of my school's teachers.	0.683	0.2084	0.000
27.	I don't like copying assignments from friends because I am very confident in my own abilities.	0.591	0.2084	0.000
28.	I prefer to find reading materials in books.	0.577	0.2084	0.000
29.	I prefer to search for reading sources via the internet (electronic).	0.441	0.2084	0.000

Problems In Learning

30.	I have difficulty understanding abstract chemical concepts.	0.704	0.2084	0.000
31.	Students have difficulty solving complex chemistry problems.	0.747	0.2084	0.000
32.	The availability of interesting and interactive learning media is very lacking (inadequate).	0.711	0.2084	0.000
33.	The learning method used is very monotonous or does not vary.	0.795	0.2084	0.000
34.	The practicum is not in accordance with the teaching material.	0.471	0.2084	0.000

Source: Data Estimate Results, 2024

From the results of validity testing of the question items as shown in the table above, the calculated value test results were obtained $Sig. Corrected Item-Total Correlation > 0.05$ so that all items are declared valid.

3.2.2 Questionnaire Reliability Test

Reliability tests are employed to assess the coherence of all the elements in a research question. The Cronbach Alpha statistical test is utilised to measure the reliability of a test. A question item is regarded to be dependable if the Cronbach's Alpha coefficient score is more than 0.60.

Table 4. Reliability Test of Question Items

No.	Item	Cronbach's Alpha	N Of Item
1.	Learning Facilities	0.871	7
2.	Learning Characteristics	0.872	8
3.	School Characteristics	0.793	5
4.	Student Characteristics	0.845	13
5.	Learning Problem	0.829	6

Source: Data Estimate Results, 2024.

According to the findings of data estimate for the reliability test, all question items are considered reliable because the Cronbach's Alpha coefficient value exceeds 0.60.

3.3. Data Estimation Results Using the Frequency Distribution Method

In this study, respondents divided their answers into large groups, namely **Positive Statement** (Strongly Agree, Agree) and **Negative Statement** (Disagree, Strongly Disagree). The results of the data frequency test using the SPSS program, obtained data descriptions for each indicator, are:

Table 3. Description of Respondent Answer Indicator Data Related to Perceptual Response

No.	Question	Answer the Respondent			
		SS	S	TS	STS
Learning Facilities					
1.	The school building is sturdy, clean, and well-maintained.	40 44.9%	46 51.7%	3 3.4%	0 0%
2.	The classroom has windows and ventilation, which allows a lot of light and air to come in and makes it easier for me to study.	30 33.7%	46 51.7%	12 13.5%	1 1.1%
3.	The school already has an adequate laboratory for chemistry practicum.	29 32.6%	52 58.4%	7 7.9%	1 1.1%
4.	The school has an adequate library for complete reading sources for chemistry subject matter.	26 29.2%	57 64%	4 4.5%	2 2.2%
5.	Learning aids and school chemistry teaching materials are in good working order.	25 28.1%	56 62.9%	6 6.7%	2 2.2%

6.	The school has prepared a complete student handbook to support learning activities.	18 20.2%	68 76.4%	3 3.4%	0 0%
Learning Characteristics					
7.	Your learning activities are carried out interactively or communicatively.	13 14.6%	71 79.8%	4 4.5%	1 1.1%
8.	When delivering lesson material, teachers always provide examples and motivation for their students.	34 38.2%	51 57.3%	3 3.4%	1 1.1%
9.	Learning activities in class are fun and encourage students to actively participate.	25 28.1%	61 68.5%	2 2.2%	1 1.1%
10.	The teacher delivers learning material according to current conditions.	26 29.2%	59 66.3%	4 4.5%	0 0%
11.	In the school laboratory, teachers always accompany students on chemistry experiment activities.	24 27%	57 64%	6 6.7%	2 2.2%
12.	Teachers provide freedom to build student creativity in the learning process.	22 24.7%	64 71.9%	2 2.2%	1 1.1%
13.	Teachers tailor learning material to students' abilities and encourage student interest.	31 34.8%	53 59.6%	4 4.5%	1 1.1%
School Characteristics					
14.	Your learning activities are carried out interactively or communicatively.	27 30.3%	57 64%	4 4.5%	1 1.1%
15.	SMAN 1 Sungai Pinang is able to develop the potential that exists in every student.	32 36%	52 58.4%	5 5.6%	0 0%
16.	SMAN 1 Sungai Pinang frequently provides solutions to problems that students encounter.	28 31.5%	51 57.3%	10 11.2%	0 0%
17.	SMAN 1 Sungai Pinang has adequate internet access to support chemistry learning.	30 33.7%	54 60.7%	5 5.6%	0 0%
Student Characteristics					
18.	I am interested in studying chemistry.	17 19.1%	55 61.8%	16 18%	1 1.1%
19.	I will continue to try as hard as possible, focus, and be serious about studying chemistry learning material.	24 27%	56 62.9%	8 9%	1 1.1%
20.	I am motivated to study chemistry because the subject matter is interesting and easy to understand.	14 15.7%	55 61.8%	18 20.2%	2 2.2%
21.	I comply with the rules or regulations determined by the school and educational unit.	26 29.2%	61 68.5%	2 2.2%	0 0%
22.	I am aware of the tasks and obligations that I must carry out in the process of learning chemistry material.	25 28.1%	62 69.7%	2 2.2%	0 0%
23.	Success in studying chemistry depends on my own efforts.	32 36%	53 59.6%	1 1.1%	3 3.4%
24.	I don't easily depend on, be influenced by, or follow other people when completing tasks.	21 23.6%	64 71.9%	3 3.4%	1 1.1%
25.	I do not hesitate to ask questions and communicate with the teacher if I feel that I do not understand the material presented.	26 29.2%	53 59.6%	10 11.2%	0 0%
26.	I respect and always say polite things to all of my school's teachers.	41 46.1%	46 51.7%	1 1.1%	1 1.1%
27.	I don't like copying assignments from friends because I am very confident in my own abilities.	18 20.2%	64 71.9%	7 7.9%	0 0%
Answer the Respondent					
No.	Question	SS	S	TS	STS
28.	I prefer to find reading materials in books.	16 18%	58 65.2%	15 16.9%	0 0%
29.	I prefer to search for reading sources via the internet (electronic).	35 39.3%	46 51.7%	8 9%	0 0%
Problems in Learning					
30.	I have difficulty understanding abstract chemical concepts.	19	61	8	1

		21.3%	68.5%	9%	1.1%
31.	Students have difficulty solving complex chemistry problems.	17	59	11	2
		19.1%	66.3%	12.4%	2.2%
32.	The availability of interesting and interactive learning media is very lacking (inadequate).	15	53	20	2
		16.9%	59.6%	22.5%	2.2%
33.	The learning method used is very monotonous or does not vary.	13	51	23	2
		14.6%	57.3%	25.8%	2.2%
34.	The practicum is not in accordance with the teaching material.	17	64	5	3
		19.1%	71.9%	5.6%	3.4%

Source: Data Estimate Results, 2024

3.3.1 School Facilities

The survey results indicate that the school's infrastructure is generally well-prepared to support the development of online-based interactive learning media. Respondents overwhelmingly expressed positive views regarding the adequacy of school facilities, with most responses falling under the categories of *Strongly Agree* and *Agree*. This suggests that the availability of school resources and infrastructure can facilitate the smooth implementation of technology-enhanced learning. Given the readiness of these facilities, integrating online-based interactive learning tools is a feasible step toward improving instructional methods.

3.3.2 Learning Characteristics

Responses related to classroom teaching and learning activities highlight the reliance on traditional offline instruction. Teachers primarily conduct lessons through direct interaction, limiting students' ability to access additional information beyond what is presented in class. While offline learning is generally considered effective, survey results suggest the need for supplementary learning media, such as blended learning approaches, to enhance students' comprehension and broaden their knowledge base. The positive responses from participants indicate strong support for incorporating additional digital learning tools to complement conventional classroom instruction.

3.3.3 School Characteristics

The findings show that SMAN 1 Sungai Pinang actively engages with students not only within the academic setting but also in addressing personal challenges outside of school. A significant number of respondents acknowledged the school's role in offering guidance and problem-solving support. The responses, predominantly *Strongly Agree* and *Agree*, suggest that the school has successfully created a supportive learning environment. The institution's commitment to student welfare further strengthens its ability to foster effective teaching and learning experiences.

3.3.4 Student Characteristics

Survey results indicate that students at SMAN 1 Sungai Pinang exhibit strong personal and academic characteristics. Most responses to questions about student attributes were positive, suggesting that students possess a solid foundation for learning. However, continuous support is essential to ensure character development and to prevent potential challenges in students' academic and personal growth. Schools must sustain their efforts to maintain and enhance these positive student attributes.

3.3.5 Learning Challenges

Despite the overall positive findings in terms of school infrastructure, teaching methods, student engagement, and institutional support, learning challenges persist. The data indicate that students still encounter various difficulties in their studies, highlighting areas for improvement in instructional delivery and support systems. These issues emphasize the importance of ongoing evaluation and intervention from both the school and educational authorities. A thorough assessment of these challenges will significantly impact future learning strategies and contribute to the advancement of ICT-based education. The study reinforces the notion that infrastructure, facilities, and school support play a crucial role in the successful development of interactive, technology-driven learning media. As

schools continue to improve their resources, the integration of ICT-based learning methods is expected to become increasingly effective in enhancing student learning outcomes.

Discussion

The study findings indicate that the majority of respondents consider the school's facilities and infrastructure to be well-prepared to support the development of online-based interactive learning media. This positive response suggests that the necessary resources are in place to facilitate the integration of ICT in education. This aligns with research by Lestari (2018), which emphasizes the critical role of infrastructure in the successful implementation of ICT-based learning. The availability of comprehensive facilities significantly enhances the potential for digital learning media development in schools, ensuring smoother transitions to technology-integrated education.

Survey responses reveal that while traditional face-to-face instruction remains effective, there is a strong need for additional learning media, particularly blended learning, to enhance student comprehension and engagement. The positive feedback suggests that integrating online and offline learning methods can optimize educational outcomes. This is consistent with Masgumelar et al. (2019), who found that blended learning effectively balances instructional goals by improving efficiency, engagement, and accessibility. The approach allows for flexible learning, deeper student-educator interactions, and more engaging multimedia content. Additionally, interactive offline resources enhance student enthusiasm and learning convenience by presenting materials in a more appealing and interactive format. The synergy between blended learning components fosters a supportive learning environment that can improve academic achievement.

Findings suggest that SMAN 1 Sungai Pinang provides significant support to students in both academic and non-academic aspects. The school's role in student development extends beyond classroom instruction, offering guidance to address personal challenges. This aligns with White et al. (2017), who highlighted the crucial role of schools in character development. Schools serve as fundamental institutions that shape students' personal and academic growth, particularly in cases where parental guidance may be limited. By fostering personal, social, and emotional resilience, schools help students overcome learning barriers and develop essential life skills.

The results indicate that students at SMAN 1 Sungai Pinang exhibit positive behavioral and academic characteristics, reinforcing the importance of continuous school efforts in nurturing student development. Most respondents acknowledged the school's role in maintaining and enhancing student character formation. These findings are consistent with Nurfaiah (2016), who emphasized that schools provide a foundational framework for instilling discipline, responsibility, and ethical values. Beyond academic learning, schools play a vital role in shaping students' moral principles, integrity, empathy, and respect. By promoting these values, schools contribute to the development of responsible and ethical individuals who positively impact society.

Despite the overall positive assessment of the school's educational framework, respondents acknowledged the presence of learning challenges that require periodic evaluation and intervention. Chemistry, in particular, was identified as a subject where students face difficulties in understanding key concepts. This finding aligns with research by Adlim et al. (2017), which identified conceptual misunderstandings—such as difficulties in interpreting pH indicator tables and multi-concept problems—as major barriers to student comprehension in chemistry. To address these issues, it is recommended that teachers engage in professional development programs, including training in problem-solving models and the integration of enriched teaching materials. Additionally, collaborative discussions among chemistry educators (MGMP forums) can be utilized to identify and address areas of low student mastery, ultimately improving instructional effectiveness.

The research findings suggest that while SMAN 1 Sungai Pinang has a strong foundation in facilities, school support, and student development, the integration of blended learning and continuous pedagogical improvements are necessary to address learning challenges. By leveraging available

infrastructure, enhancing teacher training, and incorporating interactive learning media, the school can further improve student engagement and academic performance.

Based on the findings of this study, there are several implications that can be employed in school policies and technology-based learning strategies, including: a). Improving Technology Facilities in Schools. The results of the study indicate that school facilities are one aspect that influences the development of technology-based learning media. Therefore, schools need to enhance digital infrastructure with stable internet access, computer devices, and other devices to support the effectiveness of technology-based learning. b). Training and Strengthening Teacher Competence in Utilizing Technology. In order for interactive learning media to be used optimally, schools need to conduct regular training for teachers on the use and development of technology-based learning media. Teachers must be able to integrate technology into the learning process in order to increase the efficacy of delivering material to students. c). Implementation of More Interactive and Technology-Based Learning Strategies. d). With the need for learning media that better support the teaching and learning process, schools can implement technology-based learning strategies such as reversed classroom, blended learning, or gamification in learning.

4. CONCLUSION

This study, conducted using a needs analysis method, confirms that school facilities, learning characteristics, school characteristics, student characteristics, and learning challenges all support the development of online-based interactive learning media. The research findings indicate that the questionnaire used in this study demonstrated high reliability, with all question items validated and a Cronbach Alpha value exceeding 0.6. The results show that integrating technology-enhanced learning tools can improve teaching effectiveness, boost student motivation, and enhance comprehension, ultimately leading to better academic performance. However, the study has several limitations. First, it was conducted in only one high school, limiting the generalizability of findings. Second, the use of closed-ended questionnaires restricted respondents' ability to provide detailed, qualitative insights. Third, while interviews were conducted, they primarily informed the study's conceptual framework rather than serving as core data. Lastly, the analysis relied solely on frequency tabulation, preventing an in-depth exploration of variable interactions. Future research should expand the sample size by including multiple schools across different regions to improve representativeness. Employing mixed-method approaches, such as qualitative interviews and observations, could offer deeper insights into the learning media needs. Additionally, more advanced statistical techniques, such as regression or correlation analysis, could explore relationships between student characteristics and learning media effectiveness. Further studies should also focus on designing and testing interactive learning media tailored to students' needs and assessing its long-term impact on academic achievement through longitudinal research.

REFERENCES

- Adlim, M., Wilyta, I., & Hasan Fakultas Keguruan Dan Ilmu Pendidikan Universitas Syiah Kuala Banda Aceh, M. (2017). Model Analisis Penyebab Rendahnya Penguasaan Konsep Yang Diuji Dalam Ujian Nasional (Kajian Pada Materi Ilmu Kimia Pada Siswa SMA/MA Sekitar Kampus Unsyiah). *Jurnal Pencerahan*, 11(1), 1693–1775.
- Agustina, A. (2016). Pembelajaran Konsep Ikatan Kimia Dengan Animasi Terintegrasi Lcd Projector Layar Sentuh (Low Cost Multi Touch White Board). *JTK (Jurnal Tadris Kimiya)*, 1(1), 8–13.
- Ali, M. K., & Sukardi, S. (2021). Pengembangan Model Evaluasi Pembelajaran Daring Di Sekolah Menengah Kejuruan. *JRTI (Jurnal Riset Tindakan Indonesia)*, 6(2), 161.
- Arthur, R., Luthfiana, Y., & Musalamah, S. (2019). Analisa Kebutuhan Pengembangan Media Pembelajaran Pada Mata Kuliah Mekanika Bahan Di Universitas Negeri Jakarta. In *Jurnal*

- Educational Building* (Vol. 5, Issue 2, Pp. 38–44).
- Blonder, R., Feldman-Maggor, Y., & Rap, S. (2022). What Can Be Learned From Lecturers' Knowledge And Self-Efficacy For Online Teaching During The Covid-19 Pandemic To Promote Online Teaching In Higher Education. *Plos ONE*, 17(10 October), E0275459.
- Dasopang, M. D. (2017). Belajar Dan Pembelajaran. *Fitrah: Jurnal Kajian Ilmu-Ilmu Keislaman*, 3(2), 333–352.
- Emda, A. (2017). Laboratorium Sebagai Sarana Pembelajaran Kimia Dalam Meningkatkan Pengetahuan Dan Ketrampilan Kerja Ilmiah. *Lantanida Journal*, 5(1), 83–92.
- Irawan, R., & Sukarna, I. M. (2015). Pengembangan Media Pembelajaran Kimia SMA/MA Berbasis Android Dengan Mobile Learning Pada Materi Konfigurasi Elektron Dan Tabel Periodik Unsur. *Jurnal Kimia FMIPA UNY*.
- Kartini, K. S., & Putra, I. N. T. A. (2021). Pengembangan Media Pembelajaran Interaktif Berbasis Android Pada Materi Hidrokarbon. *Jurnal Pendidikan Kimia Undiksha*, 5(1), 37–43.
- Kolil, V. K., Muthupalani, S., & Achuthan, K. (2020). Virtual Experimental Platforms In Chemistry Laboratory Education And Its Impact On Experimental Self-Efficacy. *International Journal Of Educational Technology In Higher Education*, 17(1), 30.
- Kurniawan, B., K., I. B., Widiastuti, N. P. K., & Ahmad, R. A. R. (2022). Media Pembelajaran Multimedia Interaktif EPIC 5C Berbasis CBL. In *Jurnal Edutech Undiksha* (Vol. 9, Issue 2).
- Lestari, I. D. (2018). Peranan Guru Dalam Penggunaan Media Pembelajaran Berbasis Information And Communication Technology (ICT) Di SDN RRI Cisalak. *SAP (Susunan Artikel Pendidikan)*, 3(2).
- Masgumelar, N. K., Dwiyoogo, W. D., & Nurrochmah, S. (2019). *Modifikasi Permainan Menggunakan Blended Learning Mata Pelajaran Pendidikan Jasmani, Olahraga, Dan Kesehatan*. State University Of Malang.
- Moore, E. B., Chamberlain, J. M., Parson, R., & Perkins, K. K. (2014). Phet Interactive Simulations: Transformative Tools For Teaching Chemistry. *Journal Of Chemical Education*, 91(8), 1191–1197.
- Nurfalah, Y. (2016). Urgensi Nilai-Nilai Pendidikan Karakter. *Tribakti: Jurnal Pemikiran Keislaman*, 27(1), 170–187.
- Pribadi, B. A. (2009). *Desain Sistem Pembelajaran*. Jakarta: Dian Rakyat.
- Rahmawati, Y., & Sudarman. (2021). Analisis Kebutuhan Pengembangan Media Pembelajaran Interaktif Berbasis Android Menggunakan Model Discovery Learning Materi Matriks. *Jurnal Lentera Pendidikan Pusat Penelitian Lppm Um Metro*, 6(2), 148.
- Senawati, E. (2019). Implementasi Standar Tenaga Pendidik Menurut Permendiknas Nomor 16 Tahun 2007 Di Smp Muhammadiyah 3 Metro. In *Universitas Islam Negeri Raden Intan Lampung* (Pp. 1–9). UIN Raden Intan Lampung.
- Sugiyono. (2021). Metode Penelitian Pendidikan (Kuantitatif, Kualitatif, Dan R&D, Dan Penelitian Pendidikan). *Alfabeta*, 67, 1–440.
- Sukmawati, S. (2020). *Penerapan Penguatan Pendidikan Karakter (Ppk) Sebagai Implementasi Kurikulum 2013 Untuk Meningkatkan Sikap Spiritual Peserta Didik Di UPT SMAN 1 Sinjai*. Institut Agama Islam Muhammadiyah Sinjai.
- Suryadewi, I. D. T., Candiasa, I. M., & Natajaya, I. N. (2014). Analisis Pengelolaan Pembelajaran Ips Ditinjau Dari Permendiknas Nomor 41 Tahun 2007 (Studi Tentang Persepsi Para Guru Smp Negeri Se-Kecamatan Denpasar Selatan). *Jurnal Administrasi Pendidikan Indonesia*, 5(1).
- Swartz, M. (2024). Exploring Motivation And Math Apps: A Third Grader's Story. *Proceedings Of The 51st Annual Meeting Of The Research Council On Mathematics Learning*, 65.
- Syarifuddin, A. (2020). Penerapan Model Pembelajaran Cooperative Belajar Dan Faktor Yang Mempengaruhinya. *Jurnal Al-Qalam: Jurnal Kajian Islam & Pendidikan*, 7(1), 124.
- Tambunan, S. A. (2021). Analisa Kebutuhan Pengembangan Media Pembelajaran Pada Mata Pelajaran Konstruksi Dan Utilitas Gedung Di Kelas Desain Permodelan Dan Informasi Bangunan Smk Negeri 1 Percut Sei Tuan. *Jurnal Pendidikan Teknik Sipil*, 3(1), 23–27.
- Umi, Z., & Mujiyatun, M. (2021). Manajemen Pengelolaan Kelas Dalam Meningkatkan Mutu

Pembelajaran Siswa Di Madrasah Aliyah Hidayatul Mubtadiin Sidoharjo Kecamatan Jati Agung Kabupaten Lampung Selatan. *JURNAL AN-NUR: Kajian Ilmu-Ilmu Pendidikan Dan Keislaman*, 7(02), 131–141.

Wahab, A., Syahid, A., & Junaedi, J. (2021). Penyajian Data Dalam Tabel Distribusi Frekuensi Dan Aplikasinya Pada Ilmu Pendidikan. *Education And Learning Journal*, 2(1), 40.

White, C., Gibb, J., Lea, J., & Street, C. (2017). Developing Character Skills In Schools Qualitative Case Studies. *Qualitative Case Studies. Final Report–August*.