

The Urgency of Small-Scale Laboratory Learning Media with Ethno-Electrochemical Contexts Based on Content Creators

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Abstract: The use of social media as a learning medium has not yet become a top priority for teachers. On the other hand, data from *Badan Pusat Statistik* (BPS) in 2023 shows that 94.16% of school-aged youth in Indonesia actively access the internet, with 84.37% using social media. In chemistry learning, especially on the topic of electrochemistry which is difficult for students to understand, engaging learning media is needed to enhance students' interest and learning outcomes. The integration of ethnoscience with the concept of small scale laboratory can be a solution to optimize the learning process of electrochemistry. This research aims to identify the needs for small-scale laboratory learning media on ethno-electrochemistry material based on content creators. The research was conducted using a survey method distributed online via Google Forms, as well as interviews with several respondents. The Google Forms survey gathered responses from 333 students and 71 university students. Based on the results of surveys and interviews, it is known that social media plays an important role in daily life, both for entertainment and education. However, small scale laboratory learning contextualized with ethno-electrochemistry materials is still rarely applied in current educational practices. This indicates an urgent need to develop innovative and interactive learning media that not only harnesses the potential of social media but also integrates local cultural values through an ethno-electrochemical approach. The implementation of this content creator-based learning media is expected to enhance student engagement and learning effectiveness, as well as enrich teaching methods in the digital era.

Keywords: Learning media, small scale laboratory, ethno-electrochemistry, content creator

1. Introduction

The use of social media as a learning medium has not yet become a top priority for teachers due to a lack of information and skills in creating learning media based on social media. According to data from the *Badan Pusat Statistik* (BPS) in 2023, 94.16% of school-aged youth in Indonesia (ages 16-30) have actively accessed the internet, and 84.37% of them use the internet to access social media. The high value poses a challenge for the education sector to prepare quality human resources with good digital skills (Widarti et al., 2022). Social media is an online platform that supports social interaction by utilizing web-based technology and applications that can transform communication into interactive dialogue (Calhoun., 2023). Digital technology, including social media, enhances student learning by making the process more engaging and interactive. To keep up with modern educational trends, teachers need to improve their digital skills.

The use of content creator-based learning media through Instagram, TikTok, and YouTube can motivate and improve students' learning outcomes. This is due to the alignment of the media with the interests and attractions of students today. In addition, this learning media can also enhance digital literacy for both teachers and students. By implementing content creator-based learning media, teachers will become accustomed to accessing and sharing various types of content, which can enrich their subject knowledge while also developing digital creativity (Ilma., 2023). Content creator-based media helps students find educational videos, boosts interest in lessons, and fosters creativity. Social media as a learning tool is applicable across all education levels, from high school to college (Widarti et al., 2023).

Electrochemistry, a vital branch of chemistry with educational and industrial applications, is often considered a difficult subject by students, according to several studies. In studying this material, the students experienced boredom and difficulty in developing the concepts of the subject. According to (Hairuddin., 2023), only 60% of students at SMAN 1 Gorontalo are able to complete the learning on electrochemistry material. The causes of misconceptions are due to several factors, such as teaching materials, teaching media, and the teaching methods of the teacher (Nadi., 2020). The lack of engaging learning media can lead to boredom and low motivation, which negatively impacts students' critical thinking and learning outcomes. Improved motivation is linked to better learning results (Sisca et al., 2024). Preserving regional culture is very important to prevent the influence of globalization that can erode it. One way to preserve it is by integrating local culture into science and ethnoscience learning. Ethnoscience teaches students to science material with local wisdom. An example of its application is in the manufacture of traditional herbal medicine, such as turmeric and tamarind, rice kencur, and chili puyang. This process involves chemical concepts, such as separation, purification, filtration, evaporation, and extraction.

Internships offer students practical experience, but lab waste can harm ecosystems and human health (Gyanendra et al., 2023). Green chemistry, including small-scale labs, addresses this by reducing chemical use and waste. These labs use tools like micro-drop pipettes and replace glass equipment with plastic for a safer environment (Muhajarah et al., 2020). The use of glass laboratory equipment is minimized with the use of plastic tools. This allows small scale laboratories to enable students to experiment in a safer environment.

This research addresses the gap in the literature regarding the use of social media in chemistry education, particularly on the topic of electrochemistry, which has not been explored in depth in previous studies such as those conducted by Widarti et al. (2023). The novelty of this research lies in the use of a survey method through questionnaires directed at students at the high school and university levels, which has not been applied in similar studies before. In addition, this research enriches the literature by emphasizing the importance of applying small scale laboratory practices in electrochemistry education at various levels of education. The purpose of this research is to determine the needs for small-scale laboratory ethno-electrochemistry learning media based on social media, in order to enhance the motivation, learning outcomes, and digital proficiency of students. It is hoped that this research can serve as a reference in the development of small-scale laboratory ethno-electrochemistry learning media in the future.

2. Methodology

This study used a survey method with a questionnaire distributed online via Google Forms, as well as interviews. Data downloaded from Google Forms were analyzed descriptively using Google Sheets. This study involved students and college students using a questionnaire instrument consisting of 24 questions, covering 3 main components, namely respondents' views on the implementation of learning, ethno-electrochemical materials, and creator/social media content. The instrument grids used are presented in Table 1.

Table 1. *Grid of Instruments*

Main Components	Indicator	Number and Type of Questions
Learning Implementation	Digital learning media	3 choice questions and 2 closed questions
	Small scale laboratory learning media	3 choice questions and 2 closed questions
Ethno-electrochemistry	Knowledge	4 choice questions, 2 closed questions, and 2 open questions
Content creators/social media	Knowledge	6 choice questions
Total		24 questions

The respondents of the survey were 333 students and 71 university students. The data were analyzed using quantitative and qualitative data analysis methods. Demographic data of students and university students are shown in Table 2 and Table 3.

Table 2. *Demographic Data of Students Respondents*

No.	Demographic Data		Amount	%
1	Gender	Male	140	58,00%
		Female	193	42,00%
2	Education levels	Senior High School	327	98,20%
		Vocational High School	5	1,50%
		Islamic Senior High School	1	0,30%
3	Curriculum used	Independent curriculum	314	94,30%
		2013 curriculum	19	5,70%
4	School location	East Java	328	98,50%
		West Java	5	1,50%

Table 3. *Demographic Data of University Students Respondents*

No.	Demographic Data		Amount	%
1	Gender	Male	59	83,10%
		Female	12	16,90%
2	University	Malang State University	55	82,09%
		Sepuluh Nopember Institute of Technology	2	2,99%
		Gadjah Mada University	1	1,49%
		Sebelas Maret University	6	8,96%
		Semarang State University	3	4,47%
3	University location	East Java	57	80,30%
		Central Java	13	18,30%
		Yogyakarta	1	1,40%

The research flow to describe the stages and processes carried out in this research can be seen in Figure 1.

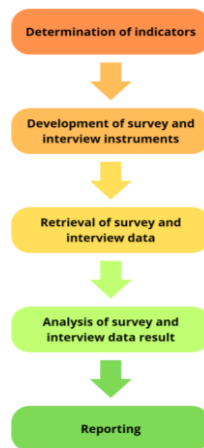


Figure 1. Research flow design

3. Result and Discussion

This study utilized Google Forms for data collection and Google Sheets for quantitative data analysis. Google Forms facilitated the creation of structured questionnaires and the collection of responses, while Google Sheets was used for descriptive analysis, such as calculating averages, percentages, frequency distributions, and generating charts. The questionnaire was distributed to groups of high school and university students across Indonesia. A total of 333 high school students from East Java and West Java participated, including respondents from Senior High Schools, Vocational High Schools, and State Islamic High Schools. Additionally, 71 college students from East Java, Central Java, and Yogyakarta were involved in the study.

3.1 Student Group

3.1.1 Digital Learning Media

Audiovisual-based digital learning media enhances students' motivation by making learning more interactive and flexible, allowing them to study anytime and anywhere. A survey on students' needs for content creator-based learning media revealed that 37.88% (126 respondents) find it very important, 34.8% (116 respondents) consider it important, 24.6% (82 respondents) see it as somewhat important, 2.1% (7 respondents) feel it is not important, and 0.6% (2 respondents) view it as very unimportant. High school students emphasized that this type of media helps them better understand the material. The survey results are shown in Figure 2.

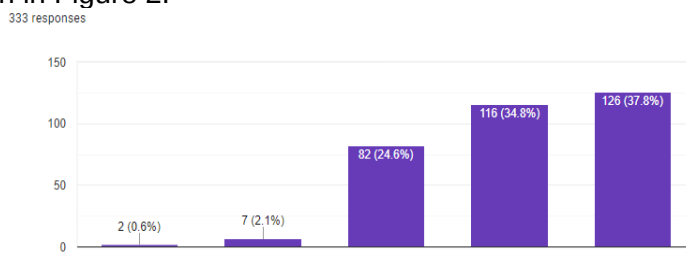


Figure 2. Frequency Graph of Digital Learning Media Usage by Students

The selection of appropriate learning media must be tailored to the type and characteristics of the material being taught. Content creator-based learning media that utilizes the culture of students as active users of social media can be optimized to enhance learning motivation (Syafuruddin et al., 2024), especially for topics considered abstract, such as electrochemistry. This is supported by survey data shown in the Figure 3, stating that

32.1% (107 respondents) of students have not received learning media for the delivery of electrochemistry material in school.

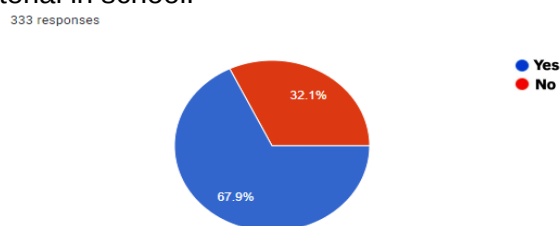


Figure 3. Diagram of Receiving a Learning Media For The Delivery Of Electrochemistry Material by Student

Additionally, data regarding students' difficulties in understanding electrochemistry material, as shown in the Figure 4, indicates that 15.6% (52 respondents) find it very difficult, 26.7% (89 respondents) find it difficult, 46.2% (154 respondents) find it somewhat difficult, 6% (20 respondents) find it not difficult, and 5.4% (18 respondents) find it very easy. In interviews with several high school students, they stated that the material on electrochemistry is quite difficult because there are many concepts that need to be understood and memorized, all of which are interconnected. Additionally, the application of this material is still hard to grasp and is considered less applicable, leading them to feel less motivated to study it.

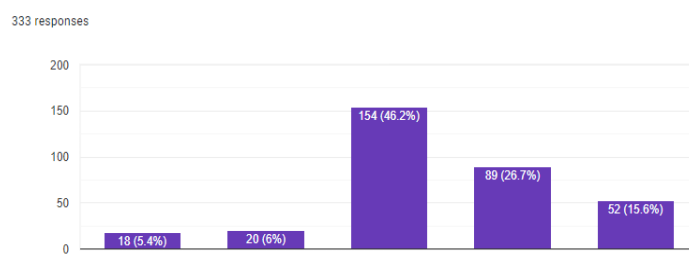


Figure 4. Frequency Graph of Difficulties in Understanding Electrochemistry Material by Student

3.1.2 Digital Learning Media Small Scale Laboratory

In an interview with a high school student, it was stated that practicum is very important in electrochemistry courses to understand the material. Group-based practicums encourage discussion and reduce the use of chemicals, but often students do not get the full opportunity to be involved. Therefore, the use of small-scale laboratory learning media is very necessary in electrochemistry education (Rokhim, et al., 2020). However, survey data shows that only 28.8% (96 respondents) of students have received learning with these media, while 71.2% (237 respondents) have not experienced it. The survey results can be seen in Figure 5.

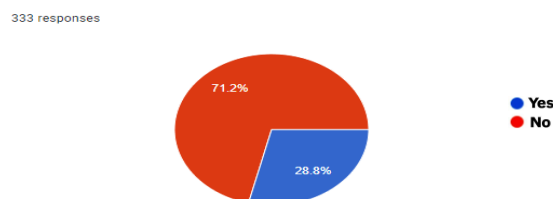


Figure 5. Student Knowledge Graph on Small-Scale Laboratory Learning Media

On the other hand, another source stated that the practical activities in the laboratory do not fully reflect the real-life application of the material in everyday life.

3.1.3 Ethno-Electrochemistry

Ethnoscience is a learning approach that connects modern scientific concepts with local cultural knowledge. In education, ethnoscience aims to integrate science with local culture, so that the material is more relevant and easier to understand. This approach also increases students' sense of belonging to local culture and motivation. Based on questionnaire data, 88.9% (296 respondents) of students have received learning that is linked to culture, but only 12.5% (37 respondents) of them often receive this approach in electrochemistry material. This is shown in Figure 7.

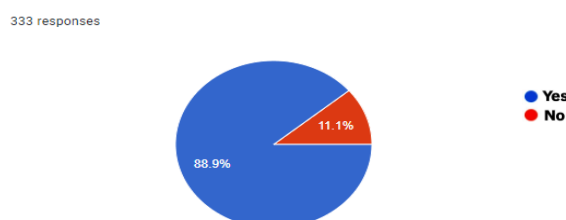


Figure 6. Graph of Student Experience in Getting Learning Related to Local Culture

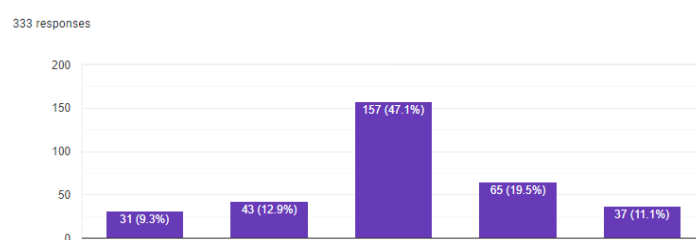


Figure 7. Frequency Chart of Relation of Electrochemistry Material to Daily Life by Chemistry Teachers

Based on the research conducted by Wahyudiati, D and Fitriani (2021), it is stated that the current factual condition of the integration of ethno chemistry with the curriculum, learning tools, and chemistry learning resources is still rarely implemented. The available learning resources today are still focused on abstract concepts without being integrated with everyday experiences. This has resulted in the integration of ethno chemistry in education not being widely applied, only a few teachers implement the concept of ethno chemistry.

3.1.4 The Role of Social Media (YouTube, TikTok, and Instagram) as Content Creator-based Learning Media

Interview results showed that 100% (333 respondents) accessed social media every day for 1-2 hours, indicating potential for education. Survey data showed that 19.5% strongly agreed, 27.3% agreed, and 42.6% somewhat agreed with the use of creator-based media. Informants supported the development of this media because it can improve student motivation and learning outcomes, with an emphasis on the important aspect of FYP (For You Page) for a more natural learning experience. This is shown in Figure 8.

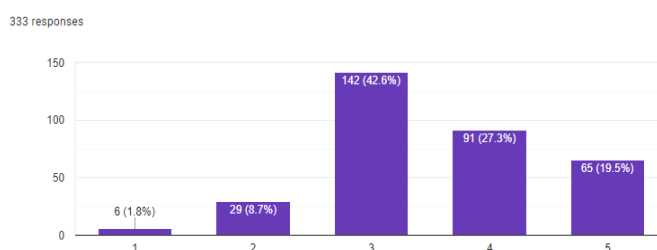


Figure 8. Frequency Graph of Digital Learning Media Usage by Students

Based on these aspects, the development of small-scale laboratory learning media based on ethno-electrochemistry and content creators is expected to increase students' motivation in understanding electrochemistry. The informant added that the combination of the ethnoscience approach with this media can increase students' curiosity and motivation, because it allows direct application of materials without waiting for practicums in the school laboratory.

3.2 University Student

3.2.1 Digital Learning Media

Digital learning media is essential in university education, helping to enrich the learning experience and enabling flexible and interactive access to materials. The survey showed that 32.40% of students (23 respondents) felt that digital learning media was very important to use, 62.00% (44 respondents) felt that it was important, 4.20% (3 respondents) felt that it was quite important, 1.4% (1 respondent) felt that it was not important, and 0% (0 respondents) felt that it was very unimportant. Thus, 94.40% of respondents overall acknowledged the importance of using digital learning media, indicating that the majority of students appreciate the role of technology in supporting their learning process. The survey results are shown in Figure 9.

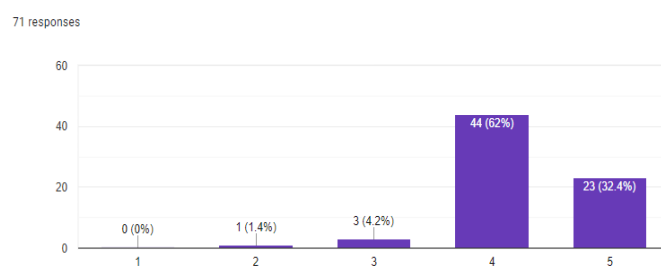


Figure 9. Frequency Graph of Digital Learning Media Usage by University Students

Interviews with five Malang State University students highlight the importance of digital learning media. One emphasized its value for low-motivation students, while two others noted how it aids material understanding. Another pointed out that interactive digital media is more effective than PowerPoint or books, and the last stressed its role in improving digital literacy and keeping up with modern trends.

3.2.2 Digital Learning Media Small Scale Laboratory

Small-scale laboratories are an innovation in learning media that offers experimental simulations with fewer materials and lower costs. The survey results showed that 66.20% of university students (47 respondents) did not know about small-scale laboratories, while 33.80% of university students (24 respondents) were familiar with the concept. These data indicate that knowledge and use of small-scale laboratories are still limited among university students, indicating the need for further efforts in the socialization and integration of this learning media. The survey results are shown in Figure 10.

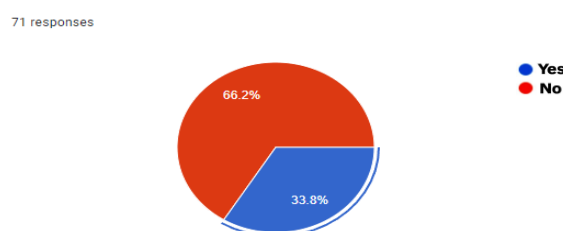


Figure 10. University Student Knowledge Graph on Small-Scale Laboratory Learning Media

Interviews revealed that while basic knowledge of small-scale lab media exists, practical and digital experience is limited. Two informants know the concept but haven't implemented it, and three are familiar with it but lack digital application experience. This gap highlights the need for more socialization and training.

3.2.3 Ethno-Electrochemistry

This graph shows how often students receive learning that is linked to local culture. This data provides an overview of the application of local cultural context in the teaching process, as well as how the integration of local cultural values and elements can affect university students' learning experiences. As many as 69% of university students (49 respondents) have received learning that is linked to local culture, while 31% (22 respondents) have not. This data indicates that the majority of university students have experienced learning that integrates local cultural context, although there is still a group of university students who have not experienced this approach in their education process. This is shown in Figure 11.

71 responses

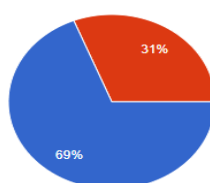


Figure 11. Graph of Student Experience in Getting Learning Related to Local Culture

This graph shows the frequency of chemistry teachers in the exposure of Electrochemistry material with the context of everyday life (ethnoscience). This data provides insight into the extent to which teaching about chemical theory with relevant practical applications can help university students understand and apply the concept of Electrochemistry in real situations. As many as 8.50% of university students (6 respondents) felt that they very often received learning that was associated with local culture (ethnoscience), 43.70% (31 respondents) felt often, 39.4% (28 respondents) felt sometimes, 8, 5% (8 respondents) felt rarely, and 0% (0 respondents) felt very rarely. The results of this survey are shown in Figure 12.

71 responses

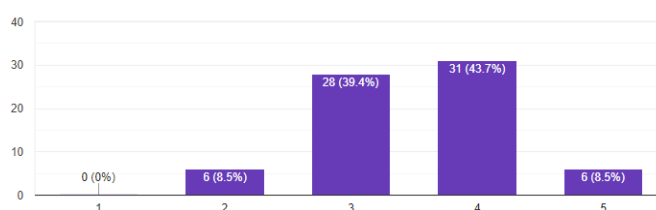


Figure 12. Frequency Chart of Relation of Electrochemistry Material to Daily Life by Chemistry Teachers

Interviews with five sources support using local materials in electrochemistry practicals to reduce costs and enhance learning. Despite the rarity of such practicals, all sources viewed the approach as innovative and beneficial. Familiar local materials can help students grasp electrochemistry concepts and spark curiosity. The sources agreed that Redox Concepts are the easiest to connect with ethnoscience, while other topics, such as Voltaic and Electrolysis Cells, require more effort to find local examples. Although Faraday's law poses challenges, they believe ethnoscience integration can significantly improve student understanding, especially in redox and applied electrochemistry topics.

3.2.4 The Role of Social Media (YouTube, TikTok, and Instagram) as Content Creator-based Learning Media

The questionnaire revealed that 52.10% of students (37 respondents) see content creator-based learning media as very important, and 45.10% (45 respondents) find it important. No students deemed it unimportant. This underscores the need to integrate creative media, particularly in small-scale, ethnoscience-based electrochemistry labs. The survey results are shown in Figure 13.

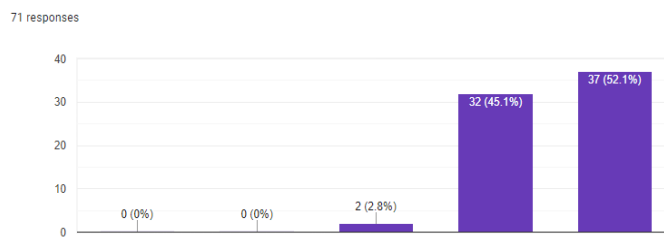


Figure 13. Frequency Graph of Digital Learning Media Usage by University Students

Integration of small-scale laboratory learning media with content creator-based ethno-electrochemistry offers benefits such as increased student engagement, preservation of local culture, and support for green chemistry with waste reduction. However, successful implementation depends on teacher readiness and adequate infrastructure. Teachers need to be skilled in planning, delivering, and using social media, while limitations in internet access content and devices in remote areas must also be addressed.

3.3 Small Scale Laboratory Technology and Learning Design

This study uses social media such as Instagram, YouTube, and TikTok to support electrochemistry learning in the context of STEM (Science, Technology, Engineering, and Mathematics). These platforms provide experimental videos, virtual simulations, and tutorials from educational creators, with a focus on small-scale laboratories using simple materials. Experimental videos utilize visualization and animation to explain chemical concepts, while social media offers an interactive learning space through quizzes, polls, and Q&A (Question and Answer). Evaluation is carried out with surveys and cognitive tests to measure the impact on students' motivation, learning outcomes, and digital skills.

The small-scale laboratory learning design involves four stages: first, students are introduced to the theory of electrochemistry through interactive educational videos. Second, they conduct simple experiments with local tools and materials, accompanied by videos or tutorials. Third, students share the results of the experiments and discuss them through social media to get feedback. Fourth, students reflect on their understanding of electrochemistry concepts with local culture, deepening scientific understanding and cultural knowledge.

4. Conclusion

Social media, which is closely tied to students' lives, the lack of introduction to Indonesia's native culture for students, and the insufficient adoption of small-scale laboratories in chemistry education are some important factors for the development of learning media that integrates these three aspects. Therefore, there is a need to develop small-scale laboratory learning media contextualized with ethno-chemical material based on content creators as a medium that supports the learning process to enhance students' motivation, learning outcomes, and digital proficiency.

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