Salud, Ciencia y Tecnología. 2025; 5:2490
doi: 10.56294/saludcyt20252490

ORIGINAL

Portabel edukit based on Ethnoscience in electrochemistry material integrated with multiple social media as a learning medium: quality and validation

Kit educativo portátil basado en etnociencia en electroquímica, material integrado con múltiples redes sociales como medio de aprendizaje: calidad y validación

Hayuni Retno Widarti[1], Nahadi[2], Ari Syahidul Shidiq[3], Sumari[1], Munzil[1], Deni Ainur Rokhim[1], Berliana Panulatsih[1], Ghaitsa Putri[1], Nafisah Khairunnisa[1]

[1]Universitas Negeri Malang, Chemistry. Malang, Indonesia.
[2]Universitas Pendidikan Indonesia, Chemistry Education. Bandung, Indonesia.
[3]Universitas Sebelas Maret, Chemistry Education. Surakarta, Indonesia.

Cite as: Widarti HR, Nahadi, Shidiq AS, Sumari, Munzil, Rokhim DA, et al. Portabel edukit based on Ethnoscience in electrochemistry material integrated with multiple social media as a learning medium: quality and validation. Salud, Ciencia y Tecnología. 2025; 5:2490. https://doi.org/10.56294/saludcyt20252490

Submitted: 22-07-2025 **Revised:** 02-09-2025 **Accepted:** 06-11-2025 **Published:** 07-11-2025

Editor: Prof. Dr. William Castillo-González

Corresponding Author: Hayuni Retno Widarti

ABSTRACT

This study addresses the need for effective educational tools to facilitate learning of electrochemical ethnoscience concepts in chemistry. It focuses on developing a portable educational kit integrated with various social media platforms to enhance student engagement and understanding. The development process followed the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model, with this study covering up to the development phase. Qualitative data included expert feedback, while quantitative data were obtained through validation questionnaires and Likert-scale readability tests. The study analyzed six components: voltaic cell kit, electrolysis cell kit, corresponding guidebooks, and learning videos for both concepts. Results from validation and readability tests indicated that the educational kit is user-friendly, effective, and relevant for teaching ethnoscience-based electrochemistry. The learning media met quality standards in content accuracy, design appeal, and social media integration, suggesting its potential to improve students' conceptual understanding and motivation in chemistry learning.

Keywords: EDUKIT; Ethnoscience; Electrochemistry; Social Media; Learning.

RESUMEN

Este estudio aborda la necesidad de herramientas educativas eficaces para facilitar el aprendizaje de conceptos de etnociencia electroquímica en química. Se centra en el desarrollo de un kit educativo portátil integrado con diversas plataformas de redes sociales para mejorar la participación y la comprensión del alumnado. El proceso de desarrollo siguió el modelo ADDIE (Análisis, Diseño, Desarrollo, Implementación y Evaluación), abarcando este estudio hasta la fase de desarrollo. Los datos cualitativos incluyeron la opinión de expertos, mientras que los datos cuantitativos se obtuvieron mediante cuestionarios de validación y pruebas de legibilidad con escala Likert. El estudio analizó seis componentes: un kit de celda voltaica, un kit de celda de electrólisis, guías didácticas y vídeos didácticos para ambos conceptos. Los resultados de las pruebas de validación y legibilidad indicaron que el kit educativo es fácil de usar, eficaz y pertinente para la enseñanza de la electroquímica basada en la etnociencia. El material didáctico cumplió con los estándares de calidad en cuanto a precisión del contenido, atractivo del diseño e integración con redes sociales, lo que sugiere su potencial para mejorar la comprensión conceptual y la motivación del alumnado en el aprendizaje de la química.

Palabras clave: EDUKIT; Etnociencia; Electroquímica; Redes Sociales; Aprendizaje.

INTRODUCTION

Chemistry constitutes one of the fundamental branches of science that significantly contributes to the advancement of applied disciplines, including agriculture, health, fisheries, and technology. Among its core topics, electrochemistry occupies a critical position, as it examines the relationship between chemical reactions and the flow of electrical currents. The principles of electrochemistry have extensive applications in real-world applications, such as in batteries,[1] electroplating, and water purification systems.[2] Mastery of this field is crucial not only for technological progress but also for promoting environmental sustainability. Nevertheless, misconceptions regarding electrochemical concepts remain prevalent among students.[3] These misconceptions may stem from both internal and external factors, emphasizing the need for innovative pedagogical strategies to enhance conceptual understanding.[4]

As a process of transmitting and internalizing cultural values, education now faces challenges arising from the rapid evolution of science and technology.[5] When effectively utilized, technological advancement can optimize the educational process by facilitating adaptive and interactive learning environments. Prior studies indicate that digital technologies, particularly social media, hold considerable potential to improve learning engagement and accessibility.[6,7,8]

Data from the Central Statistics Agency reveal that 94,16 percent of Indonesians aged 16–30 use the internet, with 84,37 percent actively engaging with social media platforms such as Instagram, TikTok, and YouTube.[9] Educational content delivered through these platforms, incorporating visual, auditory, and interactive elements, has been shown to enhance both student motivation and learning outcomes.[10,11] Although existing research on the integration of social media into chemistry education remains limited, available evidence supports its effectiveness in improving students' cognitive and affective learning dimensions.[12]

Combining social media–based learning with an ethnoscience approach may further strengthen pedagogical effectiveness. Ethnoscience integrates scientific concepts with local cultural knowledge, thereby contextualizing learning materials and increasing their relevance to learners' everyday lives. Furthermore, this approach contributes to the preservation of cultural values that are increasingly undermined by modernization. Despite the promotion of ethnoscience-based education since the 1970s, instructional practices among educators frequently overlook locally embedded scientific knowledge. A typical example includes the traditional water purification technique employing alum, which can be correlated with modern chemical concepts such as colloidal systems.[13]

Laboratory activities in chemistry education often involve the use of hazardous chemicals that may negatively affect the environment. The implementation of small-scale laboratory practices supports the principles of green chemistry by minimizing chemical consumption while maintaining pedagogical integrity and learning effectiveness. This practice is consistent with the objectives of education for sustainable development, which seeks to balance learning quality with environmental stewardship.[14]

In response to these challenges, the present study aims to develop and evaluate an ethnoscience-based portable EduKIT designed for the instruction of electrochemical materials, integrated with social media platforms such as YouTube, Instagram, and TikTok. This EduKIT is expected to foster student engagement, enhance motivation, and improve learning outcomes by synthesizing sustainable practices, cultural contextualization, and digital innovation within the framework of chemistry education.

METHOD

Type of Study

This research is categorized as a **technological innovation development study** that focuses on creating and validating an ethnoscience-based learning media integrated into social media platforms. The approach follows the Instructional Design and Development (ADDIE) model proposed by Robert Maribe Branch.[15] The study emphasizes the stages of analysis, design, and development, without advancing to the implementation and evaluation phases. The third step will be explained in depth and discussed as follows:

The first stage is analysis, which includes identifying the needs of small-scale laboratory learning media based on ethnoscience that will be used by students and teachers in electrochemistry material. This process analysis is carried out using a survey method using Google Form and interviews. The needs for ethnoscience-based laboratory learning media in electrochemistry were identified using a structured survey and semi-structured interviews. The survey was collaboratively developed with chemistry educators and media experts, and covered topics such as learning objectives, laboratory challenges, and preferences for integrating ethnoscience and technology. To ensure validity, the instrument was reviewed by independent experts and piloted for clarity and accessibility. The finalized survey was distributed online to a diverse group of teachers and students, while interviews provided deeper insights into laboratory practices and learning needs. This systematic and validated approach ensured that the analysis captured the relevant educational requirements of the target users. In addition, the concept of analysis is carried out to determine the appropriate learning media content to be included in social media as a learning platform.

The second stage is design, which includes the creation and preparation of learning media designs in the form of ethno-electro catalyst KIT. In addition, video content was also designed for the Instagram, YouTube, and TikTok platforms. To maintain consistency and neatness, a template design was created first as a guide for the overall learning media. The Instagram and TikTok feed designs are designed with images that are relevant to the topic material and use attractive typography. For the video reel, the clips used are selected according to the electrochemical materials and practicum using the KIT ethno-electro catalyst. This design process takes into account aesthetics, readability, and alignment so that the information presented on the Instagram feed or reel is easy to understand. Furthermore, Instagram, TikTok, and YouTube accounts are created so that content can be uploaded regularly and easily accessed by students.

The third stage is the development of learning media based on Instagram, TikTok, and YouTube based on the initial planning. In this process, researchers take several steps, including creating Instagram feeds and learning videos for the three social media platforms. Content will be uploaded gradually following the sequence of topics that have been set. This learning media will undergo validation and readability tests by a team of experts in the field of media and materials to assess its feasibility. Based on input and suggestions from the validator team, researchers will make improvements to the media and materials presented, so that it is expected to produce quality learning content.

Universe and Sample

The study was conducted during the odd semester of the 2024/2025 academic year, from July to November 2024. The research involved participants from various educational institutions, including SMAN 1 Sidoarjo, SMAN 2 Sidoarjo, SMAN 3 Sidoarjo, SMAN 4 Sidoarjo, SMAN 1 Taman, SMAN Olahraga, MAN Sidoarjo, SMAN 2 Malang, MAN 1 Malang, Yogyakarta State University, and Sebelas Maret University. The sample consisted of chemistry teachers, lecturers, and students who engage in laboratory-based learning in electrochemistry.

Data Collection Instrument

This study uses instruments that help in collecting the necessary research data. The instruments used are the analysis of the validation test questionnaire and the readability test in each aspect, namely the voltaic cell KIT, the electrolysis cell KIT, the voltaic cell guidebook, the electrolysis cell guidebook, the voltaic cell video, and the electrolysis cell video.

Data Analysis Technique

This study uses qualitative and quantitative data analysis techniques. Qualitative data were obtained from input and suggestions from expert validators, while quantitative data came from validation test questionnaires and readability tests distributed to assess voltaic cell KITs, electrolysis cell KITs, voltaic cell guidebooks, electrolysis cell guidebooks, and voltaic cell and electrolysis cell learning videos.

The data collected was processed to provide an overview of the research results. These results are a benchmark for the success and achievement of the research and are used as guidelines for further improvements. Feasibility analysis was conducted on teachers and lecturers through a learning media questionnaire designed in a semi-open format. The questionnaire structure includes the title, researcher's statement, respondent identity, filling instructions, and question items.

Table 1. Assessment Scores for The Questionnaire Answer Choices[16]

Quantitative Analysis	Those enrolled
Strongly agree	5
Agree	4
Neither agree or disagree	3
Disagree	2
Strongly disagree	1

Table 2. Percentage Interval[17]

Persentage	Category
$75 \leq x \leq 100$	Valid/Very Good
$50 \leq x \leq 75$	Quite valid/Good
$25 \leq x \leq 50$	Not valid/less good
$0 \leq x \leq 25$	Invalid/Not good

Quantitative data from the questionnaire were measured using a Likert scale, which was then converted into a percentage value. This scale consists of five levels of answers in the form of gradations. Quantitative analysis was carried out by processing the scores of each answer, as summarized in table 1 and table 2.

RESULTS

Volta Cell KIT

In the Small Scale Laboratory KIT-Etno-volta there are tools and chemicals to carry out the volta cell practicum, for example salt bridges, sandpaper, electrodes, sensors, cables, and several standard solutions as well as ethnoscience solutions in the form of lapindo mud solutions and batik waste. This kit is designed to support the learning of electrochemistry effectively, inexpensively, and contextual by utilizing the materials that are around us. In classroom implementation, teachers and students can experiment with using ethnoscience solutions around them. So it is not limited to using a solution of lapindo mud and batik waste. So, indirectly, this can increase students' creativity and critical thinking.

Table 3. Small Scale Laboratory KIT Ethno-volta Validation Result by Validator

Assessed aspects	Percentage	Criteria
A complete range of tools is available, according to the needs of the practicum	90	Valid/Very Good
Each component of the appliance is in good condition and can work according to its function	86	Valid/Very Good
The solution provided is in accordance with the needs of the practicum	78	Valid/Very Good
Electrodes can function well in channeling electrical flows	88	Valid/Very Good
The sensor range on the tool can be easily analyzed and operated with existing software	78	Valid/Very Good
Consistent and easy-to-observe sensor data	72	Quite Valid/good
The results of the practicum are in accordance with the reference	86	Valid/Very Good
The results of the practicum are consistent with the same variables	86	Valid/Very Good
Include a name on each material to facilitate the practicum process	83	Valid/Very Good
Provide supporting tools and materials, such as sandpaper and calibration equipment	78	Valid/Very Good
The range of tools can be easily arranged and operated	88	Valid/Very Good
Media can support electrolytic cell learning	96	Valid/Very Good
Media can be used repeatedly	96	Valid/Very Good
Average percentage Score	85	Valid/Very Good

Based on the validation results above, the average validation score for the Small Scale Laboratory KIT Ethno-volta is 85 % which can be valid. So, this KIT can be implemented and tested for students to find out its effectiveness in learning chemistry.

Table 4. Readability Test Results of the Small Scale Laboratory KIT Ethno-volta

Aspects	Percentage	Criterion
Display of Learning Media		
Volta small scale laboratory (KIT) equipment is packaged in attractive containers	87	Very Good/Eligible
The layout of each component of the material is neat and clear	91	Very Good/Eligible
Equipped with supporting equipment, such as sandpaper, so preparations can be made easily	91	Very Good/Eligible
The selection of the type of solution and electrode is very helpful in exemplifying the variation of reactions in voltaic cells	91	Very Good/Eligible
Voltage changes can be easily seen with a voltmeter sensor, so that voltage data can be read automatically in the form of a graph	93	Very Good/Eligible
Material Content		
The material is presented in an interesting style, using ethnoscience solutions and standard solutions	89	Very Good/Eligible

The material is presented with a variety of reaction examples, making it easier to analyze various reactions in voltaic cells	90	Very Good/Eligible
Benefits		
The use of small scale laboratory (KIT) voltaic makes voltaic cell material easy to understand and enjoyable	89	Very Good/Eligible
Real examples of the materials used added to my interest in voltaic cell materials	89	Very Good/Eligible
The use of voltmeter sensors makes it easy to analyze the results of the reactions that occur and is a strong attraction	90	Very Good/Eligible
The practicum is presented in a simpler way, giving a new spirit because it seems more practical and effective	93	Very Good/Eligible
With the small scale laboratory (KIT) volta, it can help me in learning about voltaic cell materials	89	Very Good/Eligible
Average Percentage Score	90	Very Good/Eligible

The average readability test results for small scale laboratory KIT-ethno-volta are 90 % which is included in the very good/eligible category. Based on these tests, the KIT model developed has met the criteria of good or relevant. The results of expert research state that there are advantages to this KIT, namely practical and easy to use in practicum activities, can support learning needs with the integration of ethnoscience, and refer to a contextual approach that relates learning to students' daily lives.

Figure 1. Small Scale Laboratory KIT Ethno-Volta

Electrolysis Cell KIT

The two ethno-volta and ethno-electrolysis kits are packaged in a box made of plywood that contains practicum tools and materials and is equipped with their respective practicum manuals. The following are the results of the ethno-electrolysis KIT validation test where the KIT that has been developed has an average of 86 % which is included in the valid/very good category. This shows that the KIT media that has been developed can be implemented and tested to determine its effectiveness.

Table 5. Small Scale Laboratory KIT Ethno-electrolysis Validation Result by Validator

Assessed aspects	Percentage	Criteria
A complete range of tools is available, according to the needs of the practicum	86	Valid/Very Good
Each component of the appliance is in good condition and can work according to its function	90	Valid/Very Good
The solution provided is in accordance with the needs of the practicum	92	Valid/Very Good

Electrodes can function well in channeling electrical flows	80	Valid/Very Good
The sensor range on the tool can be easily analyzed and operated with *existing* software	74	Valid/Very Good
Consistent and easy-to-observe sensor data	76	Quite Valid/good
The results of the practicum are in accordance with the reference	86	Valid/Very Good
The results of the practicum are consistent with the same variables	90	Valid/Very Good
Include a name on each material to facilitate the practicum process	80	Valid/Very Good
Provide supporting tools and materials, such as sandpaper and calibration equipment	88	Valid/Very Good
The range of tools can be easily arranged and operated	86	Valid/Very Good
Media can support electrolytic cell learning	96	Valid/Very Good
Media can be used repeatedly	98	Valid/Very Good
Average Percentage Score	86	Valid/Very Good

Table 6. Readability Test Results of the Small Scale Laboratory KIT Ethno-electrolysis

Aspects	**Percentage**	**Criteria**
Display of Learning Media		
Volta small scale laboratory (KIT) equipment is packaged in attractive containers	90	Very Good/Eligible
The layout of each component of the material is neat and clear	88	Very Good/Eligible
Equipped with supporting equipment, such as sandpaper, so preparations can be made easily	88	Very Good/Eligible
The selection of the type of solution and electrode is very helpful in exemplifying the variation of reactions in voltaic cells	83	Very Good/Eligible
Voltage changes can be easily seen with a voltmeter sensor, so that voltage data can be read automatically in the form of a graph	85	Very Good/Eligible
Material Content		
The material is presented in an interesting style, using ethnoscience solutions and standard solutions	83	Very Good/Eligible
The material is presented with a variety of reaction examples, making it easier to analyze various reactions in voltaic cells	83	Very Good/Eligible
Benefits		
The use of small scale laboratory (KIT) electrolysis makes voltaic cell material easy to understand and enjoyable	85	Very Good/Eligible
Real examples of the materials used added to my interest in voltaic cell materials	83	Very Good/Eligible
The use of voltmeter sensors makes it easy to analyze the results of the reactions that occur and is a strong attraction	86	Very Good/Eligible
The practicum is presented in a simpler way, giving a new spirit because it seems more practical and effective	89	Very Good/Eligible
With the small scale laboratory (KIT) electrolysis, it can help me in learning about voltaic cell materials	88	Very Good/Eligible
Average Percentage Score	86	Very Good/Eligible

In addition, the results of the readability test by students showed that the average score was 86 % which was included in the category of very good/eligible. This readability test is carried out to find out whether the KIT that has been developed can be easily understood by students so that it makes it easier for students to do practicum and understand the concepts learned. In addition, this readability test is carried out to minimize errors that can lead to misunderstandings between KIT developers and users.[15]

Figure 2. Small Scale Laboratory KIT Ethno-electrolysis

Electrolysis Cell Guidebook

The electrolysis cell guidebook is prepared to support the use of the small scale laboratory KIT, which will later be included in the instructional videos and used directly in the learning process. This guidebook contains various information about electrolysis materials related to ethnosians and small-scale laboratories. In this book, the types of tools and materials included in the electrolysis KIT are also explained. In addition, because there are standard solutions and ethnoscience solutions, this book also shows the experimental steps using these types of materials and includes the types of electrodes that should be used. This book is also equipped with analysis questions that can serve as a guide for students to analyze the results of the experiments they have conducted. This book has been validated, with the following results:

Table 7. Electrolysis Cell Guidebook Validation Results by Validator

Rated Aspect	Persentage	Criteria
The objectives of the practicum in this media are clearly conveyed	80	Valid/very good
The approach to the material is conveyed logically and is easy to understand.	90	Valid/very good
Contains adequate and interconnected theoretical and practical material	87,5	Valid/very good
The information and data presented have been accurate	90	Valid/very good
The practical steps are easy to understand and follow for the students	87,5	Valid/very good
A series of realistic practicals to be completed within the available learning time	90	Valid/very good
Using effective and efficient sentences	77,5	Valid/very good
The cover design attracts students' interest in learning. The selection of fonts, colors, illustrations, and layouts that are good and can attract the attention of students.	77,5	Valid/very good
Contains information on the usefulness of each component of the equipment used in a small-scale laboratory.	90	Valid/very good
Providing information about the materials needed for the practical.	95	Valid/very good
Providing illustrations of the equipment circuit that will be used in the practical session	75	Valid/very good
The provided questions can help students analyze practical data	82,5	Valid/very good
The questions provided are relevant to the competencies being taught.	87,5	Valid/very good
Average Persentace Score	88	Valid/very good

The validation results show that, out of 13 assessment aspects, this electrolysis cell guidebook received an average score of 88, which means the book is very well validated and can be used. However, there are several comments that can be used as references for revisions. Some of those comments include the use of better and more effective sentences, the design of the pages in the instruction manual, and clearer practical illustrations,

so that students can better understand the implementation of the practical work. In addition to the validation test, this book has also undergone a readability test with the following results:

Table 8. Readability Test Results of Electrolysis Cell Guidebook

Rated Aspect	Persentage	Criteria
Guidebook Views		
The home page of guidebook on the electrolysis cell material is interesting	89	Valid/very good
The layout of each content is appropriate and clear	87	Valid/very good
The language used is clear so that it is easy to understand	88	Valid/very good
The selection of fonts and color composition is appropriate	88	Valid/very good
The images and tables are presented clearly and are easy to understand	88	Valid/very good
Content of the material		
The material is approached in an attractive style that is clear and easy to understand	88	Valid/very good
presentation of material accompanied by various examples, thereby training analytical skills	89	Valid/very good
A well-structured table of contents that helps in understanding the concepts of the electrolysis cell material	88	Valid/very good
Practical steps that are easy to understand and can be practiced individually or in groups	87	Valid/very good
Equipped with questions to facilitate the data analysis process	87	Valid/very good
Reference lists help in providing reading material references.	89	Valid/very good
Usefulness		
The use of electrolysis cell guidebook helps with the use of the electrolysis KIT	91	Valid/very good
The approach and real-life examples used increase interest in the topic of electrolysis cells.	88	Valid/very good
Easily accessible materials boost enthusiasm in trying the guided practicum	89	Valid/very good
The practical steps presented in a simpler manner provide a new enthusiasm because they seem easy and practical.	87	Valid/very good
With the presence of this book, it can help in learning about electrolysis cells.	89	Valid/very good
Average percentage score:	88	Valid/very good

From 16 aspects of the readability test, the electrolysis cell guidebook received an average score of 88, which means it is very good. From these 16 aspects, all aspects were rated as very good. With these readability test results, the electrolysis cell guidebook can be used to test its effectiveness.

Figure 3. Electrolysis Cell Guidebook

Volta Cell Guidebook

The volta cell guidebook is prepared to support the use of the volta cell small scale laboratory KIT, which will later be included in the instructional videos and used directly in the learning process. This guidebook contains various information about volta materials related to ethnosains and small-scale laboratories. In this

book, the types of tools and materials included in the volta KIT are also explained. In addition, because there are standard solutions and ethnoscience solutions, this book also shows the experimental steps using these types of materials, which are divided based on the type of electrode used. The determination of the cathode and anode is not explained specifically here, so students must understand the relationship between the cell's potential energy and the implementation of this voltaic cell. This book is also equipped with analysis questions that can serve as a guide for students to analyze the results of the experiments they have conducted. This book has been validated, with the following results:

Table 9. Volta Cell Guidebook Validation Results by Validator

Rated Aspect	Persentage	Criteria
The objectives of the practicum in this media are clearly conveyed	80	Valid/very good
The approach to the material is conveyed logically and is easy to understand.	87,5	Valid/very good
Contains adequate and interconnected theoretical and practical material	92,5	Valid/very good
The information and data presented have been accurate	80	Valid/very good
The practical steps are easy to understand and follow for the students	80	Valid/very good
A series of realistic practicals to be completed within the available learning time	85	Valid/very good
Using effective and efficient sentences	77,5	Valid/very good
The cover design attracts students' interest in learning The selection of fonts, colors, illustrations, and layouts that are good and can attract the attention of students.	82,5	Valid/very good
Contains information on the usefulness of each component of the equipment used in a small-scale laboratory.	92,5	Valid/very good
Providing information about the materials needed for the practical.	95	Valid/very good
Providing illustrations of the equipment circuit that will be used in the practical session	87,5	Valid/very good
The provided questions can help students analyze practical data	82,5	Valid/very good
The questions provided are relevant to the competencies being taught.	97,5	Valid/very good
Average Percentage Score	84	Valid/very good

The validation results show that, out of 13 assessment aspects, this volta cell guidebook received an average score of 84, which means the book is very well validated and can be used. However, there are several comments that can be used as references for revision. Some of those comments include the use of better and more effective sentences, clearer steps for the materials used, and the relevance of ethnoscience to the presented content. In addition to the validation test, this book has also undergone a readability test with the following results:

Table 10. Readability Test Results of Volta Cell Guidebook

Rated Aspect	Persentage	Criteria
Guidebook Views		
The home page of guidebook on the voltacell material is interesting	85	Valid/very good
The layout of each content is appropriate and clear	85	Valid/very good
The language used is clear so that it is easy to understand	86	Valid/very good
The selection of fonts and color composition is appropriate	85	Valid/very good
The images and tables are presented clearly and are easy to understand	83	Valid/very good
Content of the material		
The material is approached in an attractive style that is clear and easy to understand	83	Valid/very good
presentation of material accompanied by various examples, thereby training analytical skills	85	Valid/very good
A well-structured table of contents that helps in understanding the concepts of the voltaic cell material	88	Valid/very good
Practical steps that are easy to understand and can be practiced individually or in groups	87	Valid/very good

Equipped with questions to facilitate the data analysis process	83	Valid/very good
Reference lists help in providing reading material references.	84	Valid/very good
Usefulness		
The use of electrolysis cell guidebook helps with the use of the volta KIT	83	Valid/very good
The approach and real-life examples used increase interest in the topic of electrolysis cells.	82	Valid/very good
Easily accessible materials boost enthusiasm in trying the guided practicum	80	Valid/very good
The practical steps presented in a simpler manner provide a new enthusiasm because they seem easy and practical.	86	Valid/very good
With the presence of this book, it can help in learning about electrolysis cells.	85	Valid/very good
Average percentage score:	86	Valid/very good

From 16 aspects of the readability test, the volta cell guidebook received an average score of 86, which means it is very good. From these 16 aspects, all aspects were rated as very good. With these readability test results, the volta cell guidebook can be used to test its effectiveness.

Volta Cell Learning Video

The voltaic cell learning video is designed as one of the supporting media to help students understand the concept of electrochemistry with an ethnoscience approach. This video presents a visual and interactive explanation of the material, including a demonstration of a voltaic cell experiment that is in accordance with the KIT developed. The main purpose of this video is to provide an easier, more interesting, and relevant understanding for students, so that the learning process becomes more effective.

This learning video is uploaded to various social media platforms, namely Instagram, TikTok, and YouTube. Instagram is used to share short videos containing core material or excerpts from experiments. TikTok presents content in a creative and interesting format that suits current student preferences. Meanwhile, YouTube provides videos with a longer duration that allows for in-depth and comprehensive discussion of the material.

After the video is finished, two types of evaluations are carried out to assess its quality, namely validation tests and readability tests. The validation test involves expert validators, both in terms of media and materials, to ensure that the video is suitable for use as a learning medium. Furthermore, the readability test is carried out by involving students as respondents to assess the level of understanding, attractiveness, and effectiveness of the video in conveying information. The input obtained from these two evaluation stages will be utilized to enhance the learning videos, ensuring that the resulting content meets students' needs in the most effective manner.

Table 11. Volta Cell Learning Video Validation Results by Validator

Rated Aspect	Persentage	Criteria
The learning objectives in this media are clearly conveyed	70	Quite valid/good
Using an ethnic science approach in the explanation material	75	Valid/very good
The concept of the material is conveyed clearly and precisely	92,5	Valid/very good
Providing examples of practical work with standard solutions	87,5	Valid/very good
Providing examples of practical work with material related to culture and representation of local wisdom	70	Quite valid/good
The information and data presented are accurate	82,5	Valid/very good
The practical steps are easy to understand and follow by students	90	Valid/very good
The cover design attracts students' interest in learning	82,5	Valid/very good
Use of sentences that are fun, effective, efficient, and easy to understand	95	Valid/very good
Taking videos from the right direction so that the video looks clear and contains aesthetic value	82,5	Valid/very good
Selection of fonts, color palettes, animations, and visual effects that are relevant and can attract students' attention	92,5	Valid/very good
Editing videos that can increase students' learning motivation	100	Valid/very good
The sound is heard clearly	85	Valid/very good
The video flow is coherent and can make it easier for students to understand the material	85	Valid/very good

Giving an invitation to the audience to play an active role in planting experiments and uploading them on social media	95	Valid/very good
Using special hashtags in uploading videos	97,5	Valid/very good
The video format is in accordance with the platform that used	100	Valid/very good
Include subtitles to expand audience reach	67,5	Quite valid/good
Encourage students to be active in using social media in the learning process, so that it can improve students' digital proficiency	100	Valid/very good
Average Percentage Score	86,8	Valid/very good

The validation test of the voltaic cell learning video was conducted to assess the feasibility of the learning media based on certain criteria. This analysis involves various aspects, including the delivery of material, visual quality, and the effectiveness of the media in supporting the learning process. Based on the assessment data, each component is evaluated to determine its level of validity, which is then used as a reference to improve the learning video.

In terms of delivering learning objectives, a score of 70 % indicates a fairly valid category, while the use of the ethnoscience approach scored 75 %, which is in the valid category. Both of these aspects can be improved, especially to strengthen the delivery of objectives and the integration of local wisdom. The clarity of the material concept scored high, namely 92,5 %, reflecting that the explanation of the electrochemistry concept was very precise and accurate.

In terms of visuals and design, the video was considered very valid with a score of 92,5 % for visual design elements and 100 % for editing. Clear sound (85 %) and a coherent video flow (85 %) support student understanding. In terms of interactivity, this video encourages students to actively participate, with a score of 95 % for the invitation to experiment and 97,5 % for the use of hashtags. However, the aspect of including subtitles scored 67,5 %, which is in the fairly valid category. This shows that subtitles already exist, but need to be improved to expand the reach of the audience, especially for students with special needs or non-native speakers.

Overall, with an average score of 86,8 %, the results of the validation test indicate that the voltaic cell learning video falls into the valid/very good category. Most aspects of the video were deemed effective in supporting students' understanding of ethnoscience-based voltaic cells.

Table 12. Readability Test Results of the Ethno-Volta Learning Media Platform

Rated Aspect	**Persentage**	**Criteria**
Social Media Views		
The home page of social media on the volta cell material is interesting	83	Valid/very good
The layout of each content is appropriate and clear	87	Valid/very good
The language used is clear so that it is easy to understand	86	Valid/very good
The subtitles are clear and in accordance with the sentences spoken	81	Valid/very good
The selection of fonts and color composition is appropriate	84	Valid/very good
The arrangement of content helps to understand the material better	88	Valid/very good
Content of the material		
The material is presented in an attractive style thatis clear and easy to understand	88	Valid/very good
Video content is accompanied by images and animations that are in accordance with the material	88	Valid/very good
Usefulness		
The use of social media makes the volta cell material light and fun	85	Valid/very good
Real examples in the video can increase my understanding of the electrolysis cell material	85	Valid/very good
The ease of interaction in the comments column makes it easy to discuss and share more new knowledge	86	Valid/very good
The invitation to experiment with ethnoscience materials increases competitiveness and curiosity	85	Valid/very good
With the existence of learning videos in the form of social media accounts, it can help me learn about the volta cell material	85	Valid/very good
Average percentage score:	85	Valid/very good

However, there are areas for improvement, such as better integration of local wisdom and the addition of subtitles. Despite these areas needing enhancement, the video remains an engaging and relevant learning tool for students.

The analysis of the readability test of the voltaic cell learning video showed very positive results in almost all aspects assessed. The appearance of social media on the front page scored 83 %, indicating that the initial design of the material was attractive and effective enough to attract the attention of the audience. The layout of the content on each social media was considered quite clear with a score of 87 %, meaning that the content structure was well organized, although there was room for improvement. The language used in the video and social media content scored 86 %, indicating that the language chosen was clear and easy for the audience to understand. The video subtitles, with a score of 81 %, were clear enough, but improvements were needed to better match the sentences spoken in the video.

The selection of fonts and color composition scored 84 %, indicating that the visual design was quite good, but slight improvements could be made to make it more attractive and easy to read. The arrangement of the content was considered very good with a score of 88 %, indicating that the content was well organized so that it could help the audience understand the material more easily. In terms of material, the video was presented in an attractive and easy-to-understand style, scoring 88 %, with the support of relevant images and animations that helped explain the material more clearly.

The usefulness of social media in delivering material also obtained positive results, with a score of 85 % for making the material light and fun. The use of real examples in videos that increase understanding also scored 85 %, as well as the ease of interaction through the comments column that allows for more discussion, with a score of 86 %. The invitation to conduct experiments based on ethnoscience materials also scored 85 %, which shows the effectiveness of the invitation in increasing the curiosity and competitive spirit of the audience. Overall, the results of this readability test indicate that the voltaic cell learning video is very valid and effective in delivering material in an interesting and easy-to-understand way, with some minor elements that can still be improved to maximize readability and interactivity.

Electrolysis Cell Learning Video

The electrolysis cell learning video is designed to support students' understanding of the concept of electrochemistry, especially the electrolysis process, through digital media. This video will be uploaded on social media platforms such as Instagram, TikTok, and YouTube to expand the reach of users and utilize the interactive features available on these platforms. The video content combines theoretical explanations, visual animations, and simple practical examples using everyday materials to strengthen the connection between theory and application.

Unlike the voltaic cell learning video which emphasizes the principles of galvanic cells, the electrolysis cell learning video will focus on aspects such as the electrolysis process in electrolyte solutions, the use of electrodes, oxidation-reduction reactions, and examples of electrolysis applications in everyday life, for example in the metal plating process or water electrolysis. Before being widely used, this video will go through two important evaluation stages: validation testing and readability testing.

Table 13. Electrolysis Cell Learning Video Validation Results by Validator

Rated Aspect	Persentage	Criteria
The learning objectives in this media are clearly conveyed	70	Quite valid/good
Using an ethnic science approach in the explanation material	65	Quite valid/good
The concept of the material is conveyed clearly and precisely	97,5	Valid/very good
Providing examples of practical work with standard solutions	80	Valid/very good
Providing examples of practical work with material related to culture and representation of local wisdom	82,5	Valid/very good
The information and data presented are accurate	85	Valid/very good
The practical steps are easy to understand and follow by students	90	Valid/very good
The cover design attracts students' interest in learning	95	Valid/very good
Use of sentences that are fun, effective, efficient, and easy to understand	100	Valid/very good
Taking videos from the right direction so that the video looks clear and contains aesthetic value	87,5	Valid/very good
Selection of fonts, color palettes, animations, and visual effects that are relevant and can attract students' attention	100	Valid/very good
Editing videos that can increase students' learning motivation	100	Valid/very good
The sound is heard clearly	85	Valid/very good

The video flow is coherent and can make it easier for students to understand the material	85	Valid/very good
Giving an invitation to the audience to play an active role in planting experiments and uploading them on social media	92,5	Valid/very good
Using special hashtags in uploading videos	97,5	Valid/very good
The video format is in accordance with the platform that used	100	Valid/very good
Include subtitles to expand audience reach	70	Quite valid/good
Encourage students to be active in using social media in the learning process, so that it can improve students' digital proficiency	100	Valid/very good
Average Percentace Score	88,6	Valid/very good

The validation test of the electrolysis cell learning video aims to evaluate the feasibility and quality of the media based on the specified criteria. The aspects analyzed include learning objectives, material approach, conceptual clarity, visual quality, and effectiveness of delivery. This validation data provides direction for improving the video so that it can support the learning process most effectively.

The delivery of learning objectives scored 70 % (quite valid), while the ethnoscience approach scored 65 % (quite valid), indicating the need for increased emphasis on local wisdom. The clarity of the material concept reached 97,5 % (very valid), indicating precise and accurate delivery.

An example of a standard solution-based practicum scored 80 % (valid), and a local wisdom-based practicum scored 82,5 % (valid). The information presented was accurate with a score of 85 %, and the practicum steps were considered easy to follow with a score of 90 %. The visual design scored high, with a cover design of 95 %, fonts and visual effects of 100 %, and editing of 100 %, indicating Very Good visual quality. From the audio-visual aspect, the sound quality and video flow scored 85 % (very valid), and the video recording scored 87,5 % (very valid). Interactivity scored very well, with 92,5 % invitation to participate and 97,5 % hashtag usage. The video format according to the platform scored a perfect 100 %, while subtitles, with a score of 70 %, need to be improved for wider accessibility.

Overall, with an average score of 88,6 %, the results of the validation test indicate that the electrolysis cell learning video falls into the valid/very good category.

Table 14. Readability Test Results of the Ethno-Electrolysis Learning Media Platform

Rated Aspect	**Persentage**	**Criteria**
Social Media Views		
The home page of social media on the electrolysis cell material is interesting	100	Valid/very good
The layout of each content is appropriate and clear	82	Valid/very good
The language used is clear so that it is easy to understand	85	Valid/very good
The subtitles are clear and in accordance with the sentences spoken	83	Valid/very good
The selection of fonts and color composition is appropriate	80	Valid/very good
The arrangement of content helps to understand the material better	84	Valid/very good
Content of the material		
The material is presented in an attractive style that is clear and easy to understand	87	Valid/very good
Video content is accompanied by images and animations that are in accordance with the material	85	Valid/very good
Usefulness		
The use of social media makes the electrolysis cell material light and fun	84	Valid/very good
Real examples in the video can increase my understanding of the electrolysis cell material	84	Valid/very good
The ease of interaction in the comments column makes it easy to discuss and share more new knowledge	80	Valid/very good
The invitation to experiment with ethnocent materials increases competitiveness and curiosity	85	Valid/very good
With the existence of learning videos in the form of social media accounts, it can help me learn about the electrolysis cell material	82	Valid/very good
Average percentage score:	85	Valid/very good

Most aspects of the video, including content presentation, design, and interactivity, were deemed effective in supporting students' understanding of ethnoscience-based electrolysis. While some elements, could benefit from refinement, the video is considered an engaging and effective learning medium.

The readability test of the electrolysis cell learning video aims to assess the extent to which the material presented in the video can be clearly and effectively understood by the audience, and how well the appearance and content on social media support the understanding process. Based on the assessment results, overall, this video received an average score of 85 %, indicating that this video is valid and very good in terms of readability.

In terms of social media appearance, the front page was considered very attractive with a score of 100 %, indicating an effective design in attracting the audience's attention. The content layout received a score of 82 %, indicating that improvements in readability and navigation are still needed. The use of language in videos and social media received a score of 85 %, indicating clear and easy-to-understand language. The selection of subtitles received a score of 83 %, indicating a need for improvement to better match the sentences spoken. The selection of fonts and colors received a score of 80 %, with room for improvement to be more striking and easy to read. The arrangement of the content was considered good with a score of 84 %, making it easier to understand the material.

The content of the video material is presented in an attractive and easy-to-understand style (87 %), with the support of appropriate images and animations (85 %). The use of social media makes the material lighter and more enjoyable (84 %), while real examples in the video increase audience understanding (84 %). Interaction through the comments column (80 %) allows for further discussion, and the invitation to conduct experiments based on ethnoscience materials scored 85 %, arousing audience curiosity.

Overall, the readability test of the electrolysis cell learning video showed very good results, with most aspects in the valid category. Some areas that can be improved are font selection, color composition, and slight improvements to the subtitles to make this video more accessible to a wider audience.

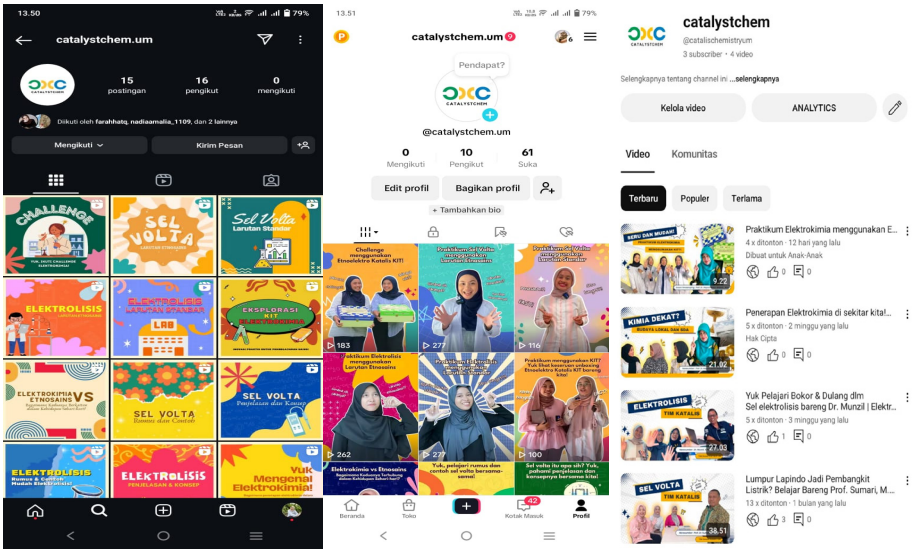

Figure 5. Instagram, Tiktok, and YouTube account catalystchem.um

The results section describes the obtained findings gathered from your research. Provide appropriate figures and tables to effectively illustrate your results. Figures are used to present data trends or other visual information while tables are particularly useful when the exact values are important.

DISCUSSION

The developed portable ethnoscience-based EduKIT for electrochemical material education integrates traditional knowledge with modern chemistry concepts through small-scale laboratory kits. The product includes the Voltaic Cell KIT and Electrolysis Cell KIT, both containing contextualized tools and materials such as salt bridges, electrodes, and ethnoscience solutions derived from local sources like lapindo mud and batik waste. This approach enriches the learning experience by connecting abstract electrochemical principles with culturally familiar and environmentally sustainable resources.[18,19] The EduKIT is complemented by guidebooks and multimedia content distributed via popular social media platforms (Instagram, TikTok, YouTube), designed to match contemporary students' digital consumption habits and enhance engagement through visual and interactive content.[20,21]

The kit's design emphasizes usability, safety, scalability for repeated use, and ecological consideration by supporting green chemistry principles with minimal chemical consumption. The learning media incorporate

localized cultural contexts, thereby fostering students' critical thinking, creativity, and appreciation of cultural heritage alongside scientific literacy. This ethnoscience integration aligns with current pedagogical trends advocating contextual and culturally responsive science education to improve relevance and motivation.[22]

The high validation scores across multiple assessment aspects—including completeness of components, functionality, and ease of operation—underscore the practical suitability of the kits for small-scale laboratory use. This offers a safer, more environmentally sustainable alternative compared to traditional laboratory methods that involve hazardous chemicals. The use of local ethnoscience materials such as lapindo mud and batik waste as electrolytes enriches students' learning experiences by contextualizing abstract scientific principles within familiar cultural and environmental phenomena, potentially boosting creativity and critical thinking.[23]

Readability tests conducted among students further affirm that the kits, guidebooks, and multimedia content are accessible and engaging, supporting independent and interactive learning. The integration of these learning resources across popular social media platforms such as Instagram, TikTok, and YouTube aligns well with students' digital habits, enhancing motivation and providing diverse formats suited for different learning preferences. However, minor improvements are needed in subtitle quality and instructional clarity to maximize inclusivity and comprehension.[24]

Moreover, the invitation to active participation through experimentation and social media interaction fosters a dynamic learning environment. This openness potentially promotes peer-to-peer knowledge exchange and helps consolidate students' understanding. The ethnoscience approach also contributes to the preservation and appreciation of local knowledge, blending scientific rigor with cultural relevance, thus addressing a common gap in traditional science curricula.

Despite the positive outcomes, future studies should explore the implementation and evaluation phases of the ADDIE model, focusing on long-term educational impacts, student performance, and engagement analytics on social media platforms. Additionally, enhancements in video subtitles and content arrangement could further improve accessibility for diverse learner populations.

CONCLUSIONS

The development of social media-based chemistry learning media integrated with ethnoscience on electrochemical materials offers a promising approach to enhance student engagement and understanding. The integration of local cultural knowledge with scientific principles through small-scale laboratory kits and digital media supports meaningful and contextualized learning experiences. This approach not only facilitates the comprehension of complex electrochemical concepts but also promotes creativity, motivation, and connection to everyday life. The learning media demonstrated strong validity and readability, indicating its suitability for educational use. Future research should focus on implementing this media in authentic learning environments and evaluating its long-term effectiveness in improving students' chemistry learning outcomes.

BIBLIOGRAPHIC REFERENCES

1. Smith J, Jones A. Advancements in Lithium-Ion Battery Technology and Its Environmental Impact. Electrochem Adv. 2023;12(4):45-67.

2. Das S, Raj R, Das S, Ghangrekar MM. A sustainable approach for the production of green energy with the holistic treatment of wastewater through microbial electrochemical technologies: a review. Front Sustain. 2021;2:792028.

3. Nisa NA, Fitriza Z. Identifikasi Mikonsepsi Siswa Menengah Atas (SMA) Pada Pembelajaran Kimia Materi Redoks dan Elektrokimia: Studi Literatur. Edukatif J Ilmu Pendidik. 2021;3(4):1191-8.

4. Yamtinah S, Shidiq AS, Widarti HR, Mawardi M. Chemistry Learning Media Based on Social Media: Studentsâ€™ View. J Penelit Pendidik IPA. 2023;9(4):1713-9.

5. Mukti H, Suastra IW, Aryana IBP. Integrasi etnosains dalam pembelajaran IPA. J Penelit Guru Indones. 2022;7(2):356-62.

6. Mulyani F, Haliza N. Analisis perkembangan ilmu pengetahuan dan teknologi (Iptek) dalam pendidikan. J Pendidik Konseling. 2021;3(1):101-9.

7. Akbar MF, Anggraeni FD. Teknologi dalam pendidikan: Literasi digital dan self-directed learning pada mahasiswa skripsi. Indigenous J Ilm Psikol. 2017;2(1):28–38.

8. Olan F, Liu S, Neaga I, Chen H, Nakpodia F. How cultural impact on knowledge sharing contributes to organizational performance: Using the fsQCA approach. J Bus Res. 2019;94:313-9.

9. Yamtinah S, Shidiq AS, Widarti HR, Mawardi M. Chemistry Learning Media Based on Social Media: Studentsâ€™ View. J Penelit Pendidik IPA. 2023;9(4):1713-9.

10. Widarti HR, Anggraini T, Rokhim DA, Syafruddin AB. Learning Innovation Content Creators Social Media-Based Qualitative Analysis to Improve Motivation and Learning Outcomes of Professional Teacher Candidates: A Systematic Literature Review. Orbital Electron J Chem. 2022:267-75.

11. Widarti HR, Sriwahyuni T, Rokhim DA, Syafrudin AB. Social media-based learning in Chemistry learning: A review. Eclét Quím. 2023;48(2):17-21.

12. Widarti HR, Anggraini T, Rokhim DA, Syafruddin AB. Learning Innovation Content Creators Social Media-Based Qualitative Analysis to Improve Motivation and Learning Outcomes of Professional Teacher Candidates: A Systematic Literature Review. Orbital Electron J Chem. 2022:267-75.

13. Sumarni W. Etnosains dalam pembelajaran kimia: Prinsip, pengembangan dan implementasinya. Semarang: UnnesPress; 2018.

14. Syaadah RS, Mulyono HAM, Suhanda H. Implementation of Small-Scale Chemistry Lab to Improve Student Cognitive Abilities on the Subtopic of Colloid Properties. In: 6th International Seminar on Science Education (ISSE 2020). Atlantis Press; 2021. p. 224-8.

15. Branch RM. Instructional Design: The ADDIE Approach. New York: Springer; 2009.

16. Simamora B. Skala Likert, Bias Penggunaan dan Jalan Keluarnya. J Manaj. 2022;12(1):84-93.

17. Ningsih O, dkk. Validitas Instrumen Untuk Mengukur Kelayakan Modul Ajar Fisika di SMAN13 Padang Berbasis Kurikulum Merdeka Belajar. J Pendidik Tambusai. 2023;7(2):17879-86.

18. Soesilo A, Munthe AP. Pengembangan Buku Teks Matematika Kelas 8 Dengan Model ADDIE. Scholaria J Pendidik Kebud. 2020;10(3):231–43.

19. Nissa IC, Febrilia BRA, Pangga D. Uji keterbacaan buku ajar matematika dasar untuk mahasiswa program studi pendidikan fisika. PowerMathEdu. 2023;2(1):1-8.

20. Widarti HR, Rokhim DA, Yamtinah S, Shidiq AS, Baharsyah A. Instagram-based learning media: Improving student motivation and learning outcomes in reaction rate. J Ilm Peuradeun. 2024;12(1):165-82.

21. Sihombing AP, Munthe A. Pengembangan Buku Teks Matematika Kelas 8 Dengan Model ADDIE. Scholaria J Pendidik Kebud. 2020;10(3):231–43.

22. Rahmawati Y, Ridwan A, Baeti HR, Virginanti M, Faustine S. Improving students chemical literacy and cultural awareness through ethnopedagogy in chemistry education. AIP Conf Proc. 2021.

23. Firmansyah RA, Rohmatina I. Inexpensive electrolysis of batik waste water: Project-based learning (PjBL) in MA Salafiyah Simbang Kulon Pekalongan, Indonesia. AIP Conf Proc. 2017.

24. Arniza AE. Revolutionizing learning: leveraging social media platforms for empowering open educational resources. Int J Educ Lang Humanit. 2024.

FINANCING

The authors would like to thank the Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi (Kemendikbudristek) and the State University of Malang (UM) for their generous support through the KATALIS grant (No.2002.1/UN27.22/PT.01.03/2024). This funding was critical to developing and successfully implementing the ethno-electro catalyst kit project.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORSHIP CONTRIBUTION

Conceptualization: Hayuni Widarti.

Data curation: Berliana Panulatsih.
Formal analysis: Ghaitsa Putri.
Research: Nafisah Khairunnisa.
Methodology: Berliana Panulatsih.
Project management: Deni Rokhim.
Supervision: Hayuni Widarti.
Validation: Nahadi, Ari Shidiq, Sumari, Munzil.
Display: Nafisah Khairunnisa.
Drafting - original draft: Ghaitsa Putri.
Writing - proofreading and editing: Nafisah Khairunnisa.