JURNAL PENDIDIKAN KIMIA (JPKIM)
ISSN: 2085-3653| e-ISSN: 2549-3116

J. Pendidik. Kim 2023, 15(2), 182 – 190
DOI 10.24114/jpkim.v15i3.51211

Research Article

Development of ethnoscience-based student worksheets of redox reactions, volta cells, and corrosion using liveworksheets

Liana Vinca Rosea Cristy and Fransisca Ditawati Nur Pamenang

Department of Chemistry Education, Universitas Sanata Dharma, Yogyakarta 55281, Indonesia

Received 09 October 2023 ♦ **Revised** 09 November 2023 ♦ **Accepted** 22 November 2023

Citation: Cristy, L.V.R., & Pamenang, F.D.N. (2023). Development of ethnoscience-based student worksheets of redox reactions, volta cells, and corrosion using liveworksheets. Jurnal Pendidikan Kimia (JPKIM), 15(3), 182–190. https://doi.org/10.24114/jpkim.v15i3.51211

Keywords

Corrosion
Ethnoscience
Redox reaction
Students' worksheets
Voltaic cell

Corresponding author:
E-mail: fransiscadita@usd.ac.id
(Fransisca Ditawati Nur Pamenang)

Abstract

Learning about ethnoscience can help students better understand chemistry because it connects to their daily experiences. However, students often struggle with redox and electrochemical concepts due to a lack of appropriate learning materials and difficulty grasping these ideas. This research aims to achieve the following objectives: (1) develop ethnoscience-based student worksheets on redox reactions, Volta cells, and corrosion using Liveworksheets, following the 4D development model modified to 3D; (2) create ethnoscience-based student worksheets on these topics that are valid, effective, and practical. The research employed validation sheets and questionnaires as instruments, with a sample of six students from the 12th grade. Data was analyzed descriptively. The results indicate that (1) the modified 4D development model was suitable for creating the student worksheets due to its systematic stages and adaptability to researchers' needs; (2) both the media and material showed high validity percentages, averaging 88% and 89%, respectively. The worksheets were considered quite effective, with an average percentage of 66%, and practical, with an average percentage of 78%. Overall, the developed product can be effectively used to teach redox reactions, voltaic cells, and corrosion in chemistry using Liveworksheets.

Introduction

The rapid advancement of technology is expected to have a significant impact on developments in various fields, especially education. In the 21st century, education is tasked with preparing future generations equipped with both strong hard skills and soft skills to play a crucial role in the era of globalization. In Indonesia, education follows the 2013 curriculum, which aims to cultivate a productive, creative, innovative, and affective generation (Dalle et al. 2021). Therefore, the expected learning must be ideal, effective, and meaningful for students.

One of the approaches employed in the 2013 curriculum is the contextual approach, which integrates learning materials with real-life situations, enabling students to connect their knowledge with their daily lives (Komalasari, 2017). Integrating education with the local culture is intended to enrich students' understanding of concepts. Engaging in ethnoscience learning positively impacts learning outcomes and cultivates proficiency in science literacy skills (Mahyuny et al. 2022). Ethnoscience learning is closely related to everyday life, allowing students to easily grasp concepts because they are directly engaged with real-life experiences. This aligns with research conducted by Martawijaya et al. (2023), which demonstrates an increase in higher-order thinking skills and decrease in misconceptions on several topics related to students' activities.

Chemical topics such as oxidation-reduction reactions (redox) and electrochemistry are part of the curriculum for class XII, 2nd semester, and are known to be relatively challenging to understand (Rahayu et al. 2011). Research by Tonapa & Pamenang (2022), identified problems encountered by students when learning about redox and electrochemical materials. These issues are because of the lack of suitable teaching modules that can help students distinguish between oxidation reactions, reduction reactions, oxidizing agents, and reducing agents. Another study conducted by Gyamfi & Ampiah (2019), revealed that students encountered challenges in grasping conceptual aspects, including alternative conceptions and issues related to understanding oxidizing agents through the combined concepts of oxidation and ionic charge. Additionally, Suryati et al. (2022) pointed out that the abstract nature of electron exchange in redox and electrochemical reactions, which cannot be directly observed, adds to the difficulties faced by students in comprehending these materials. To address these challenges, effective teaching materials are essential.

Teaching materials serve the purpose of facilitating the delivery of content by educators. One such valuable teaching tool is students' worksheets, which provide exercises and assignments to help students understand the material better. The primary goal of students' worksheets is to offer students opportunities to develop their skills and critical thinking abilities (Sarita et al. 2020). Traditionally, students' worksheets have been presented in printed form, but this method is less effective and interactive (Nurbayani et al. 2021). Rahayu et al. (2011) emphasized the importance of engaging and innovative teaching materials to boost student motivation and create an enjoyable learning experience. To make students' worksheets more interactive, technology can be utilized. One such technology is the Liveworksheets application, which can transform printed worksheets into interactive digital exercises that students can complete online. With this application, students can submit their answers directly to the teacher and receive immediate feedback. The use of Liveworksheets is not only motivating for students but also environmentally friendly, as it reduces paper usage (Liveworksheet, 2023). Accessing the Liveworksheets application is simple, requiring only the creation of a teacher or student account. Furthermore, teachers have the flexibility to choose from various question types, including drop-down menus, multiple choice, check boxes, joint with an arrow, drag and drop, and listening-speaking exercises (Hazlita, 2021). Recent research conducted by Suparwati et al. (2023) demonstrated that interactive students' worksheets combined with STEM-based Liveworksheets enriched with ethnoscience content can effectively enhance students' comprehension of chemistry concepts, particularly regarding reaction rate materials. Ethnoscience-Based Student Worksheets developed by researchers are designed to relate chemistry concepts to students' everyday experiences. These student worksheets are adapted to materials such as redox reactions, Voltaic cells, and corrosion. These materials are common chemical phenomena in daily life. According to Rumadan et al. (2023), by using ethnoscience-based worksheets, students can better relate to and understand these topics, making learning more engaging and relevant. Liveworksheets is a digital learning platform that allows students and teachers to interact with a variety of learning materials. Liveworksheets allows students to access these worksheets digitally, making learning more interactive and flexible (Ghaisani and Setyasto, 2023). In today's digital age, it is essential to adapt to new technologies and teaching methods. Using Liveworksheets enables students to access educational content remotely, which has become particularly important in the face of changing learning environments. Through the integration of these two tools, students can better understand chemistry concepts by connecting them to their everyday experiences, while leveraging digital technology for more engaging learning. This is expected to help increase the effectiveness of chemistry learning.

Method

The research methodology employed in this study is Research and Development (R&D). The research design used for the development of Ethnoscience-Based Learner Worksheets on Redox Reactions, Voltaic Cells, and Corrosion, using Liveworksheets, is based on the 4D model modified to 3D, which consists of three stages: Define, Design, and Develop (Thiagarajan et al. 1974). The sample for this research consists of students in the 12^{th}-grade science class at El Shadai High School. The sampling technique employed was purposive sampling, as defined by Cohen et al. (2007), which involves selecting participants based on specific criteria. In this study, the sample was chosen based on the teacher's discretion, totaling six participants. The research instruments used in this study included validation sheets and questionnaires. Data analysis was conducted using descriptive analysis to analyze validation results, and responses, and assess the readability of the product.

Results and Discussion

The research focused on the development of ethnoscience-based student worksheets covering chemical topics such as redox reactions, Volta cells, and corrosion, utilizing Liveworksheets. This research employed the 4D model by Thiagarajan et al. (1974), which was subsequently modified into a 3D model. The 3D model encompasses the stages of define, design, and develop, all crucial for creating a high-quality product. The choice of the 4D modified 3D development model was made due to its systematic nature, which allows for easy adaptation to researchers' specific needs. This adaptation not only saves valuable research time but also enables the execution of small-scale trials. This approach aligns with the research conducted by Halimah et al. (2020), where they also opted for a 3D development model due to time constraints. Similarly, Masdar and Lestari (2022) conducted research that employed a 3D development model to conserve researchers' time, energy, and finances. The outcome of this approach was student worksheets that were well-suited for use in the classroom. Below, we present an explanation of the results obtained at each stage of the analysis.

Define Stage

The initial analysis stage addresses the primary issues in chemistry learning, which form the foundation of this research. During this stage, the researcher conducted a comprehensive literature review to identify prevalent problems in high school chemistry education. The findings from the literature review revealed several issues, including the blending of content representation levels, commonly referred to as macroscopic, submicroscopic, and symbolic. This blending occurs without adequate explanation or emphasis, with a tendency to prioritize the macroscopic and symbolic levels, neglecting the submicroscopic level (Bandriet and Bretz, 2014). The next stage is students' analysis. In this stage, a student analysis was carried out to assess students' characteristics through product design and development. Student characteristics were derived from their academic performance and interactions with the teacher. These assessments provided insights into students' proficiency in chemical topics, specifically redox reactions, Volta cells, and corrosion. These assessments served as the foundation for the development of ethnoscience-based student worksheets.

Fig.-1. Ethnoscience content

The concept analysis stage focuses on the key concepts that will be integrated into the teaching materials. In developing these student worksheets, the topics covered include redox reactions and electrochemistry, with a specific focus on subtopics related to redox reactions, Volta cells, and corrosion. The steps involved in this stage include identifying essential competencies and learning objectives related to these topics, selecting ethnoscience content relevant to the subject matter, and organizing learning activities in the form of items that will be included in the student worksheets.

To align with the learning objectives, local wisdom content is incorporated into the materials. Examples of local wisdom include 'nginang,' 'keris,' and 'jamasan keris.' Nginang' is a cultural practice among elderly women, involving the chewing of betel leaves, lime, and gambier leaves until they become soft and are then spat out (Sundari, 2017). 'Keris' refers to a distinctive asymmetrical dagger from Indonesia, considered both a weapon and a spiritual object, believed to possess magical properties (Kemdikbud, 2005). 'Jamasan Keris' is a tradition involving the care and appreciation of keris heirlooms passed down by ancestors to their successors (Khairunnisa, 2019). The ethnoscience content is presented in Fig.-1. A detailed description of basic competencies, learning objectives, and ethnoscience content is presented in Table 1.

Table 1. Basic competencies, learning objectives, and local wisdom content

Basic Competencies (BC)		Learning Objectives (LO)		Ethnoscience Content	
3.3	Balance the chemical equations for redox reactions and predict the reactions that can occur based on electrode potentials	3.3.1.1	Students can determine the oxidation number of each element	3.3.1.1.1	'Nginang' tradition
				3.3.1.1.2	Fermented cassava
		3.3.2.1	Students can determine the oxidizing and reducing agents based on oxidation changes that occur	3.3.2.1.1	'Nginang' tradition
				3.3.2.1.2	Fermented cassava
		3.3.3.1	Students can explain the meaning of redox reactions	3.3.3.1.1	Fermented cassava
		3.3.4.1	Students can balance redox reaction equations using the half-reaction method and oxidation states	3.3.4.1.1	'Keris' rusting
				3.3.4.1.2	Utilization of water hyacinth as a traditional medicine for mumps
3.4	Analyze the processes that occur and perform calculations of substances or electricity involved in a Voltaic cell and its application in life	3.4.1.1	Students can identify the reactions that occur in Voltaic cells	3.4.1.1.1	'Keris' rusting
		3.4.2.1	Students can calculate the cell potential value based on standard potential	3.4.2.1.1	'Keris' rusting
		3.4.3.1	Students can determine Voltaic cell notation	3.4.3.1.1	'Keris' rusting
3.5	Analyze the factors that influence the occurrence of corrosion and how to overcome them	3.5.1.1	Students can identify the factors that cause corrosion	3.5.1.1.1	'Jamasan keris' tradition
		3.5.2.1	Students can explain how to prevent corrosion	3.5.2.1.1	'Jamasan keris' tradition

Design Stage

This stage is undertaken to create ethnoscience-based student worksheets focusing on the chemical topics of redox reactions. The development of the product addressing the subjects of redox reaction chemistry, Volta cells, and corrosion involves the utilization of various media applications, including CapCut, Canva, Google Forms, and Liveworksheets. The initial step entails compiling the materials using the Canva application, which are subsequently uploaded to the Liveworksheets platform. This material preparation is divided into three distinct sections: redox reaction content, Volta cell content, and corrosion content.

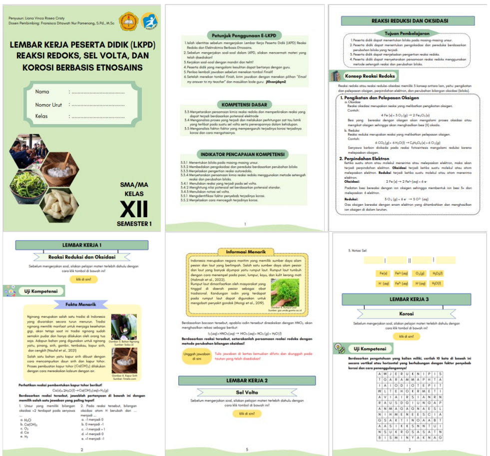

Fig.-2. The student’s worksheet design

The subsequent step involves creating a video on the local wisdom of cassava tape fermentation. The video's content showcases the cassava tape-making process through fermentation. Additionally, provision is made for students to upload responses to descriptive questions that require lengthy, handwritten answers. For this purpose, Google Forms serves as the medium for students to upload images of their responses. The final step encompasses the layout design of the student worksheets using the Canva application. After the initial preparation, the student worksheets are further refined and developed using the Liveworksheets application until they are finalized.

The format used for developing these student worksheets is based on the modified student worksheets format. This format includes the title, instructions for use, Basic Competencies (BC), Learning Objectives (LO), brief material, ethnoscience content, and tasks for students to complete. This format was also employed in research conducted by Fitriani et al. (2016), where they developed student worksheets on buffer solution material, comprising titles, BC, LO, brief material, and questions. The student worksheet design is presented in Fig.-2.

Develop Stage

During the development stage, two crucial steps are undertaken: expert assessment and product trials. In the first step, product validation and testing are conducted, which are vital to determine the product's feasibility (Sugiyono, 2013). This stage involves the evaluation of the developed student worksheet products to assess their suitability. Expert assessments and trials have been carried out to validate the student worksheets. Validation was conducted by two lecturers in Chemistry Education at Universitas Sanata Dharma and one chemistry teacher. The validation process covered material, media, and also the assessment of items, and questionnaire sheets to evaluate product readability.

Table 2. Score of assessment quality and student response

Assessment of Product Quality/Student Response	Assessment Aspects	Score	Average	Category
Media Expert	Cover design	92%	88%	Valid
	Content design	91%		
	Illustration	82%		
Material Expert	Content eligibility	94%	89%	Valid
	Presentation feasibility	86%		
	Language feasibility	88%		
Student	Display	76%	78%	Quite Practical
	Content	79%		
	Language	77%		

The second step involves product trials with six students from El Shadai Magelang High School. According to Wulandari and Syafri (2021), these trials aim to gauge students' responses to the developed student worksheet products. When developing educational materials, it is essential to meet specific criteria, including validity, effectiveness, and practicality (Akker et al. 1999). A product can be considered valid if it receives positive assessments from validators across various aspects. Effectiveness can be determined by analyzing student responses when they use the product, while practicality can be evaluated through questionnaires completed by students after using the product.

The aspects evaluated during the media product validation process included cover design, content design, and content illustration. A summary of the results of the media and material on product validation is presented in Table 2. According to the validation results, the cover design aspect achieved an average score of 92%, placing it in the valid category. Similarly, the content design aspect received an average score of 91%, classifying it as valid. The content illustration aspect received an average score of 82%, which also falls within the valid category. Consequently, the overall validation results for the media aspect categorize it as valid, with an average score of 88%. The next step involves revising the product based on feedback from the validators. Following these revisions, the product can proceed to testing with students.

The aspects assessed in material product validation include content, presentation, and language feasibility. According to the validation results, the content feasibility aspect achieved an average score of 94%, placing it in the valid category. Similarly, the presentation feasibility aspect received an average score of 94%, also classifying it as valid. The language feasibility aspect obtained an average score of 82%, which was also considered valid. Consequently, the overall validation results for the material aspect categorize it as valid, with an average score of 89%.

The next step is to revise the product based on feedback from the validator. There are specific comments from the validator regarding the material that requires revision. Once the necessary revisions are made, the product can proceed to testing with students. For material product validation, the assessment is conducted by considering aspects such as content feasibility, presentation feasibility, and language feasibility (Sugiyono, 2013). The analysis of all these aspects resulted in an average percentage of 89%. According to Riduwan (2008), products with a percentage within the range of 80 - 100% are deemed valid. Consequently, ethnoscience-based student worksheets are declared valid in terms of both media and material, making them suitable for use in learning.

Following the validation and revision of the product, the next stage involves conducting a trial test. This phase aims to assess the practicality and effectiveness of the developed products. The product was tested on a limited scale with students from the twelfth-grade science class at El Shadai Magelang High School, involving a total of 6 students. The selection of these 6 participants was based on a purposive sampling technique, relying on teacher recommendations. Among these learners, there were 4 males and 2 females, each selected based on teacher recommendations and with varying levels of academic achievement.

The level of practicality of ethnoscience-based students' worksheets, developed using the Liveworksheets application, was assessed based on students' responses to the product readability questionnaire. The questionnaire analysis encompassed several aspects, including the appearance, content, and language of the students' worksheets (Hafifah et al. 2020). The analysis yielded an average percentage of 78%. In line with Riduwan (2008), products within the range of 60% to 80% are considered quite practical. Therefore, ethnoscience-based students' worksheets are categorized as quite practical.

Based on the analysis results, the aspect related to the students' worksheets display obtained an average score of 76%, categorizing it as practical enough. Similarly, the content aspect of the students' worksheets received an average score of 79%, also classifying it as practical enough. The language aspect obtained an average score of 77%, falling into the practical enough category as well. Consequently, the results of the analysis of the product readability questionnaire sheet categorize the product as quite practical, with an overall average aspect score of 78%. The results of students' answers are obtained after students have completed the students' worksheets. A summary of the analysis of students' answers is presented in Table 3.

Table 3. Results of analyzing students' answers

Learner Code	Final Score (%)	Category
A1	58	Fair
A2	45	Fair
A3	68	High
A4	65	High
A5	85	Very high
A6	75	High
Average	66	High

The results for code A1 students show a percentage of 58%, categorized as sufficient. For code A2 learners, the percentage of answers is 45%, also categorized as sufficient. Code A3 learners achieved a final score categorized as high with a percentage of 68%. Code A4 learners recorded a percentage of answers at 65%, placing them in the high category. Code A5 learners achieved a very high final score with a percentage of 85%. Code A4 learners also achieved a high category with a percentage of 75%.

The effectiveness of ethnoscience-based students' worksheets is determined by the average percentage of students' scores on each question item. As shown in Table 4, question items 1-5, covering the ethnoscience content of the Nginang tradition, achieved an average of 83%, classified as effective. Similarly, question items 6-9, related to the ethnoscience content of cassava tape fermentation, achieved an average of 90%, also classified as effective. However, item number 10, focusing on the local wisdom of rusting on 'keris', obtained an average of 37% and is categorized as less effective. Likewise, question item number 11, dealing with ethnoscience traditional medicine for goiter, falls into the ineffective category due to an average result of 33%. Furthermore, question items 12-14, related to the ethnoscience of rusting on the kris, scored an average of 82%, classifying them as effective. Finally, item number 15, featuring the wisdom of the Keris Jamasan tradition, achieved an average of 82%, also classified as effective. The overall average, based on the analysis of students' answers, categorizes the product as quite effective, with a score of 66%. The questions answered by students have undergone validation by validators in terms of material, construction, and language (Retnawati, 2016). After testing these questions with students and analyzing their answers, the overall average was found to be 66%.

According to Riduwan (2008), products within the range of 60% to 80% are considered quite effective, hence the categorization of ethnoscience-based students' worksheets is quite effective.

Further item analysis revealed that students faced difficulties in answering question items 4, 10, and 11. This is evident from the low percentages for these items: item 4 scored 33%, item 10 achieved 37%, and item 11 received a 33% score. Item number 4 relates to BC 3.3, which concerns balancing chemical equations of redox reactions and predicting reactions based on electrode potential, and LO 3.3.2, which involves distinguishing oxidizers and reducers based on oxidation number changes. Similarly, items 10 and 11 fall under BC 3.3, focusing on balancing chemical equations of redox reactions and predicting reactions based on electrode potential, and LO 3.3.4, which centers on balancing redox reactions using the oxidation number change method and half-reactions. These findings suggest the need for further in-depth teaching on these topics.

Table 4. Percentage average for each ethnoscience content

Ethnoscience content	Item test	Average	Category
	1		
	2		
'Nginang' tradition	3	83%	Effective
	4		
	5		
	6		
Fermented cassava	7	90%	Effective
	8		
	9		
'Keris' rusting	10	37%	Ineffective
Traditional medicine for mumps	11	33%	Ineffective
	12		
'Keris' rusting	13	82%	Effective
	14		
'Jamasan Keris' tradition	15	82%	Effective

In this study, the sample comprised students with varying ability levels. The results of students' work on questions produced categories ranging from sufficient to very high, reflecting the diverse abilities of students. This variation aligns with the students' academic achievements as recorded by their teachers. For instance, students who achieved the highest score of 82 also attained the highest score of 85 when using ethnoscience-based students' worksheets. Conversely, students with the lowest class score of 62 likewise scored the lowest, achieving a score of 45 when using ethnoscience-based students' worksheets. This demonstrates the relevance of the developed students' worksheets to students' abilities.

The questionnaire results indicate that students who have used the students' worksheets are quite satisfied. Learners find the developed students' worksheets interesting and appreciate the ethnoscience content contained within them, as indicated by their agreement with the questionnaire responses. These findings align with research conducted by Anugrah (2021), which focused on the students' perspectives on chemistry-embedded STEM learning. Students showed a positive attitude towards the possibility of implementing STEM learning in high school chemistry.

Furthermore, the questionnaire results reveal that students feel assisted in understanding the material due to the inclusion of ethnoscience content in the students' worksheets. This is consistent with research conducted by Salamiyah et al. (2023) which found that students' worksheets with ethnoscience content can enhance students' understanding. Additionally, research conducted by Andayani et al. (2023) suggests that students' comprehension of ethnoscience-based students' worksheets falls within the good criteria.

Conclusion

The student worksheets which are based on ethnoscience and focus on chemistry topics such as redox reactions, Volta cells, and corrosion, were developed using a modified 4D model. It is valid, effective, and practical based on the research. The product's media validation score is 88%, material validation is 89%, and it's considered quite effective with a 66% score for student answers. In terms of practicality, it scored 78% in a student readability questionnaire, also classified as quite practical. In summary, the product created is a valuable tool for teaching students about redox reactions, voltaic cells, and corrosion through the use of Liveworksheets.

Conflict of Interests

The authors declare that there is no conflict of interest in this research and manuscript.

References

Akker, J., Branch, R. M., Gustafson, K., Nieveen, N., & Plomp, T. (1999). *Design Approaches and Tools in Education and Training* (1 ed.). Springer Dordrecht. https://doi.org/10.100ghaisskhairukomalasari7/978-94-011-4255-7

Andayani, Y., Kastari, D., Junaidi, E., & Rahmawati. (2023). Persepsi Guru Kimia dan Siswa Kelas XI MIPA SMA/MA Kabupaten Lombok Tengah terhadap lembar kerja peserta didik bermuatan etnosains pada materi pokok asam dan basa. *Chemistry Education Practice*, 6(1), 141-146. https://doi.org/10.29303/cep.v6i1.3024

Anugrah, I. R. (2021). Students' perspectives on Batik Cirebon for high school chemistry embedded STEM learning. In Journal of Physics: Conference Series, 1957 p. 012030. https://doi.org/10.1088/1742-6596/1957/1/012030

Bandriet, A. R., & Bretz, S. L. (2014). Measuring meta-ignorance through the lens of confidence: examining students' redox misconceptions about oxidation numbers, charge, and electron transfer. *Chemistry Education Research and Practice, 15*(4), 729-746. https://doi.org/10.1039/C4RP00129J

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education*. Routledge. https://doi.org/10.4324/9780203029053

Dalle, F. A., Muharram, M., & Hasri, H. (2021). Analisis implementasi kurikulum 2013 terhadap pembelajaran kimia di SMA negeri se-Kabupaten Wajo. *Chemistry Education Review (CER)*, 4(2), 133. https://doi.org/10.26858/cer.v4i2.20064

Ghaisani, N. R. T., & Setyasto, N. (2023). Development of liveworksheets-based electronic student worksheets (E-LKPD) to improve science learning outcomes. *Jurnal Penelitian Pendidikan IPA*, 9(8), 6147–6156. https://doi.org/10.29303/jppipa.v9i8.4571

Gyamfi, K. A., & Ampiah, J. G. (2019). Chemistry students' difficulties in learning oxidation-reduction reactions. *Chemistry: Bulgarian Journal of Science Education, 28*(2), 180-200.

Hafifah, A., Kasrina, K., & Singkam, A. R. (2020). Desain dan validitas lembar kerja peserta didik berdasarkan keragaman ikan di SUNgai Pura Bengkulu Utara. *Diklabio: Jurnal Pendidikan dan Pembelajaran Biologi*, 4(2), 121–128. https://doi.org/10.33369/diklabio.4.2.121-128

Halimah, S. N., Irmayanti, E., & Prastyaningtyas, E. W. (2020). Pengembangan perangkat pembelajaran dengan model PBI melalui metode GI pada materi ekonomi bisnis kelas X. *PROMOSI (Jurnal Pendidikan Ekonomi)*, 8(2). https://doi.org/10.24127/pro.v8i2.3307

Hazlita, S. (2021). Implementasi pembelajaran dalam jaringan dengan menggunakan instagram dan liveworksheets pada masa pandemi. *JIRA: Jurnal Inovasi dan Riset Akademik, 2*(7), 1142–1150. https://doi.org/10.47387/jira.v2i7.195

Liveworksheet. (2023). *About Liveworksheet*. Retrieved from https://www.liveworksheets.com/about

Kemdikbud. (2005, November 25). Keris Indonesia. Retrieved from https://warisanbudaya.kemdikbud.go.id/?newdetail&detailICH=2

Khairunnisa, S. N. (2019, December 3). Melihat Tahapan Jamasan, Proses Pembersihan Keris pada Malam 1 Suro. Retrieved from Kompas: https://travel.kompas.com/read/2019/12/03/223500127/melihat-tahapan-jamasan-proses-pembersihan-keris-pada-malam-1-suro?page=all

Komalasari, K. (2017). Pembelajaran Kontekstual. Konsep dan Aplikasi. (N. F. Atif, Ed.) Bandung: Refika Aditama.

Mahyuny, S. R., Nursamsu, N., Hasruddin, H., & Muslim, M. (2022). Development of students worksheet learning tools made by ethnoscience based on science literacy. *Jurnal Penelitian Pendidikan IPA*, 8(4), 2001-2007. https://doi.org/10.29303/jppipa.v8i4.1949

Martawijaya, M. A., Rahmadhanningsih, S., Swandi, A., Hasyim, M., & Sujiono, E. H. (2023). The effect of applying the ethno-stem-project-based-learning model on students' higher-order thinking skill and misconception of physics topics related to Lake Tempe Indonesia. *Jurnal Pendidikan IPA Indonesia, 12*(1), 1-13. https://doi.org/10.15294/jpii.v12i1.38703

Masdar, M., & Lestari, N. (2021). Pengembangan lembar kerja peserta didik berbasis problem-based learning pada mata pelajaran matematika materi penjumlahan kelas II SD. *Pedagogi: Jurnal Ilmiah Pendidikan*, 8(1), 16–21. https://doi.org/10.47662/pedagogi.v8i1.239

Rahayu, S., Treagust, D. F., Chandrasegaran, A. L., Kita, M., & Ibnu, S. (2011). Assessment of electrochemical concepts: A comparative study involving senior high-school students in Indonesia and Japan. *Research in Science & Technological Education, 29*(2), 169-188. https://doi.org/10.1080/02635143.2010.536949

Retnawati, H. (2016). *Analisis kuantitatif instrumen penelitian*. Yogyakarta: Parama Publishing.

Riduwan. (2008). *Skala Pengukuran Variabel-Variabel Penelitian*. Bandung: Alfabeta.

Rumadan, N. S., Asmaningrum, H. P., & Sumanik, N. B. (2023). Development of Student Worksheet with an Ethnoscience Approach to Wati Plants Through Liveworksheet Applications. *International Journal of Chemistry Education Research, 7*(1), 25-32. https://doi.org/10.20885/ijcer.vol7.iss1.art5

Salamiyah, S., Astutik, T. P., & Wicaksono, A. T. (2023). Efektivitas Lembar Kerja Peserta Didik (LKPD) berbasis kearifan lokal dengan pendekatan STEAM pada materi asam basa. *Orbital: Jurnal Pendidikan Kimia*, 7(1), 57–65. https://doi.org/10.19109/ojpk.v7i1.16137

Sugiyono, S. (2013). *Metode penelitian pendidikan pendekatan kuantitatif, kualitatif, dan R & D.* Bandung: Alfabeta.

Sundari, D. (2017, August 1). *Tradisi nginang kenali budaya Jawa*. Retrieved from https://www.dewisundari.com/tradisi-nginang-kenali-budaya-jawa/

Suparwati, N. M. A., Suja, I. W., & Tika, I. N. (2023). E-LKPD kimia berbasis STEM dengan muatan etnosains untuk meningkatkan model mental kimia pada materi laju reaksi. *Jurnal Pendidikan Kimia Undiksha*, 7(1), 1-10. https://doi.org/10.23887/jjpk.v7i1.60208

Thiagarajan, S., Semmel, D. S., & Semmel, M. I. (1974). *Instructional development for training teachers of exceptional children: A sourcebook*. Minneapolis: Indiana University.

Tonapa, N., & Pamenang, F. D. (2022). The development of discovery learning based teaching module to support student concept mastery on redox. *The 4th International Seminar on Chemical Education. 2645*, pp. 1-5. Yogyakarta: AIP Publishing. https://doi.org/10.1063/5.0113760

Wulandari, S., & Syafri, F. S. (2021). Development of students' worksheets based on a scientific approach for set concept in grade VII Junior High Schools 10 Bengkulu City. *Journal of Physics: Conference Series*, 1731(1), 012042. https://doi.org/10.1088/1742-6596/1731/1/012042