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Development of Electronic Student Worksheets Assisted with Wizer.me on Redox Reactions Learning

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Abstract

Student worksheets serve as valuable teaching materials facilitating students' learning processes by expanding information on the targeted study topics. In the context of learning redox reactions, Depok 1st State Senior High School exclusively utilizes printed student worksheets. This research focuses on developing electronic student worksheets assisted by the Wizer.me platform for redox reaction material in class, aiming to enhance the efficacy of the learning materials. The research employs a Research and Development (R&D) method, utilizing the 4D development model modified to 3D. Instruments such as interview sheets, validation sheets, and questionnaires were employed, with a sample comprising 10 students from 10th grade. Data analysis was conducted descriptively. The results of the research indicate that 4D models were instrumental in developing electronic student worksheets due to their clearly directed steps or procedures. The developed product exhibits high validity, scoring an average of 84% for both the media and material aspects, with a content validity coefficient exceeding 0.8. Students responded positively to the student worksheet products, rating them high in design (82%), operational and visual communication (83%), resulting in an overall average score of 83%, classified as very practical. The developed product proves effective in supporting the learning of redox reactions.

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INTRODUCTION

Learning is a dynamic interaction taking place between teachers and students within a specific learning environment. It represents the concerted efforts of teachers to facilitate students' acquisition of knowledge, skills mastery, and the development of habits, attitudes, and beliefs. In essence, learning is a purposeful process designed to ensure optimal comprehension and retention of information, fostering a well-rounded educational experience for students (Suardi, 2018). As a teacher, it's essential not only to master the material but also to enhance the learning process, making it engaging rather than dull. Harnessing the power of evolving and sophisticated technologies is effective approach to achieve this. According to Fathulain et al. (2018), leveraging advancing technologies not only maximizes efficiency but also facilitate easier completion of tasks. Through interviews with chemistry teachers at State Senior High School (SMAN) 1 Depok, it was revealed that certain chemistry topics pose challenges due to their abstract nature. One such complex topic is oxidation-reduction reactions. For instance, students often struggle to differentiate between oxidation numbers of free elements and ions, leading teachers to revisit and explain the material at a slower pace.

In a study conducted by Tonapa & Pamenang (2022), challenges faced by students in comprehending redox and electrochemical subjects were identified. These difficulties material from the absence of appropriate instructional modules that could assist students in differentiating between oxidation reactions, reduction reactions, oxidizing agents, and reducing agents. Additionally, the learning process involves the use of printed student worksheets provided by the school. However, this traditional approach may contribute to some students feeling less enthusiastic and having a limited understanding of the learning material. According to Ginting et al., (2022), it is known that teachers use printed chemistry books which are dominated by writing and are only slightly available in schools. The available student worksheets are also not optimal because in these learning activities there are no learning instructions and activity stages that enable students to understand the concepts on the topic. As a result, during learning activities students are not actively involved. The low level of student learning activity can affect understanding of concepts (Ismanto et al., 2019).

Efforts to enhance the learning process often involve the use of teaching materials, which play a crucial role in facilitating effective education. These materials come in various forms, such as reading books, workbooks, presentations, newspapers, digital content, photos, instructions, written assignments, cards, and discussion materials between students (Mithans & Grmek, 2020). The diversity of teaching materials contributes to enriching students' knowledge and experiences. According to Cristy & Pamenang (2023), to enhance the interactivity of students' worksheets, technology can be employed. The LiveWorksheets application, for example, has the capability to convert traditional printed worksheets into interactive digital exercises that students can engage with online. Through this application, students have the convenience of submitting their answers directly to the teacher and receiving prompt feedback.

Beside of LiveWorksheets, among the innovative platforms available for creating interactive student worksheets is Wizer.me. Wizer.me is an online software that offers a free downloadable basic feature for academics. The Wizer.me worksheet builder enhances teachers' experience and creativity by enabling the swift creation of diverse question types such as open-ended questions, multiple-choice, matching pairs, fill in the blank, fill in an image, and tables. The visually appealing Wizer.me worksheets serve as a source of inspiration for students, encouraging them to delve deeper into their learning and invest more time in thoughtful engagement. These worksheets are splendid, providing teachers with the option to select from a variety of backgrounds and themes. Wizer.me also empowers users to incorporate rich media, into their worksheets. Videos, in particular, have the ability to captivate the mind and facilitate the learning or practice of new skills and imaginative tasks (Wizer.me, 2023).

Additionally, Wizer.me proves to be a time-saving tool with features like automatic checking, grading, and the option to review responses individually for personalized feedback. This enables teachers to tailor their teaching methods to each student's needs, fostering a more personalized and effective learning experience in the classroom. As a result, teachers witness the enjoyment students derive from these activities during class sessions. Functioning as an online service, Wizer.me empowers educators to design engaging and interactive worksheets suitable for both in-class and remote learning. The platform offers a gallery of pre-made student worksheets while also allowing teachers to create their own assignments with diverse forms and question types (Olena & Anastasiia, 2022). Research conducted by Kopniak (2018) demonstrated that students, previously passive recipients of knowledge, became actively engaged in the learning process after using Wizer.me-assisted worksheets. This suggests a positive impact on students' participation and engagement, highlighting the potential of interactive platforms in education. Identifying the need for effective learning solutions, this study focuses on the development of interactive student worksheets.

Wizer.me's choice of media for learning redox reactions is based on the following reasons: interactivity, visual representation, adaptability across devices, instant feedback, and the ability to integrate practical applications. Wizer.me allows for the creation of interactive and engaging electronic worksheets. The redox concept, which involves understanding oxidation and reduction reactions, the transfer of electrons between substances, can be complex. Interactive elements such as quizzes, multimedia, and interactive simulations on Wizer.me can make the learning process more dynamic and engaging for students. Also, its capability to integrate visual elements, such as diagrams, animations, and images, aids in providing clear and visual representations. This visual support helps students grasp complex ideas and processes more effectively (Muslim et al., 2022; Rezeki & Kamaludin, 2023; Winarti et al., 2021).

In summary, the urgency of the research lies in the need to adapt to technological advancements, cater to diverse learning styles, address the shift to online learning, optimize knowledge transfer, contribute to continuous improvement in education, and prepare students for the challenges of the future. The use of Wizer.me-assisted student worksheets in teaching redox reactions to Class X students at Depok 1st Senior High School is expected to yield several benefits. It is anticipated that these teaching materials will enhance students' learning outcomes in the subject. This research aims to provide an alternative set of instructional materials for teachers conducting lessons on redox reactions, offering valuable support for students seeking to improve their understanding of the topic. Furthermore, the study is designed to be a valuable resource for students, contributing to their training and enhancing their experience, insight, and skills, particularly in the context of teaching materials.

METHOD

This research adopts the Research and Development (R&D) approach, focusing on the creation and evaluation of products with subsequent validation and effectiveness testing (Sugiyono, 2014). The scope of the research encompasses product development, validity testing, and feasibility testing. The study was conducted at Depok 1st State Senior High School, specifically targeting class X MIPA on redox reaction material, conducted between April and June 2023. The activities involved in the research include data collection, product development, validity testing, and product trials. The development process adheres to the 4D development model (define, design, develop, and disseminate) initially proposed by Thiagarajan et al. (1974). The decision to adopt the 4D model stemmed from its systematic organization, featuring a structured series of activities specifically designed for addressing relevant challenges in the context of instrument learning (Wardani et al., 2019).

This research focuses specifically on the development stage, with a modification to a 3D model. Data collection is done by using a questionnaire. This questionnaire was given to material experts, media experts, and students. This questionnaire was given at the validation step by material experts and media experts and assessed by students. This was formatted with open-ended questions to gather information requirements that align with the information theory of needs for the development of a model. The evaluation questionnaire for student worksheets was distributed to media experts, subject matter experts, and students to assess the viability of the worksheets. The tool employed in this research is a modified version of the student worksheet assessment. This questionnaire encompasses various aspects aimed at determining the feasibility of the developed student worksheets. Criteria for material experts involve evaluating the material's quality and its impact on learning, whereas media experts focus on the appearance and overall quality of the student worksheets (Ihsan et al., 2023).

RESULTS AND DISCUSSION

The development of worksheets for students, facilitated by the Wizer.me platform and focused on redox reaction material, follows the 4D development model modified to 3D. This modified model comprises the definition, the design, and the develop stage, as outlined by Thiagarajan et al. (1974). According to Sugiyono (2014), the 4D model, adapted to 3D, provides a clear and directed procedure for product development, making it a suitable choice for creating student worksheets with the assistance of the Wizer.me platform.

Beyond its directed procedure, the 3D development model is known for its detailed stages, ensuring a relatively swift product development process. This model is considered effective, systematic, and concise (Ihsan et al., 2023). The development process involves the following stages. Figure 1 shows modified 4D development model.

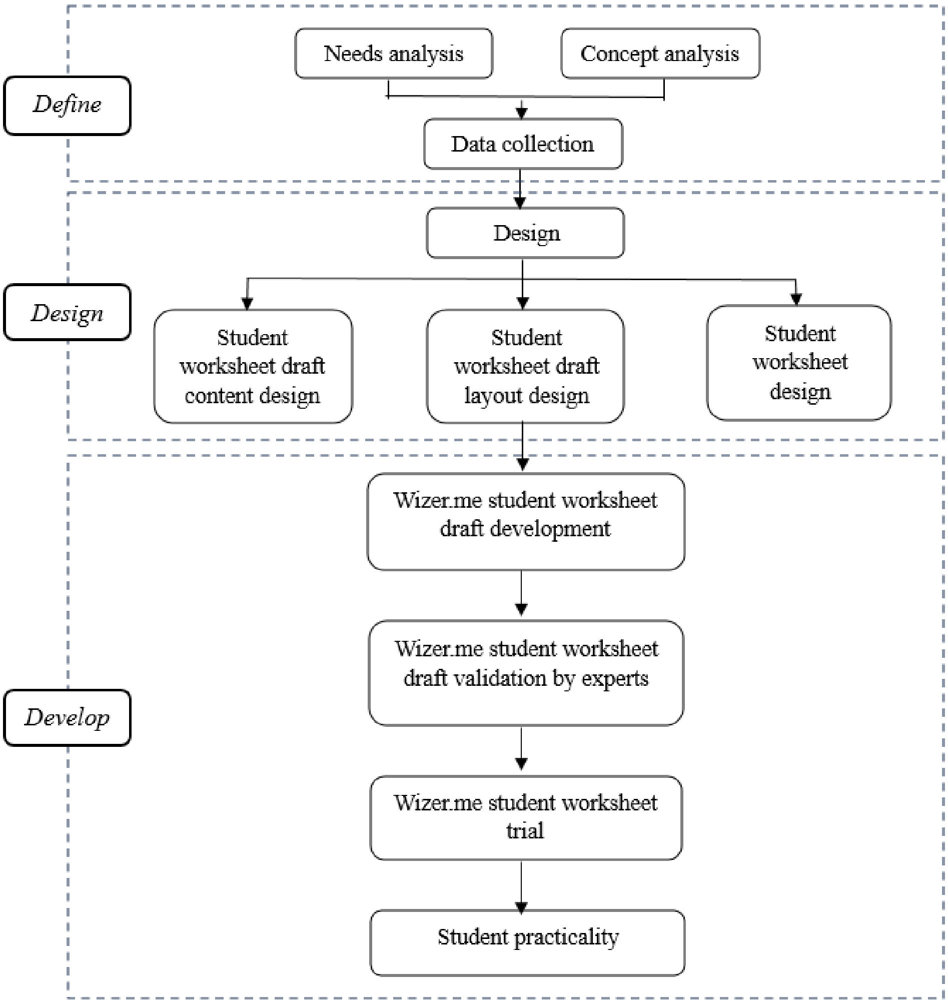

Figure 1. Modified 4D development model

Define Stage

The define stage serves to identify the needs related to the development of student worksheets using the Wizer.me platform. This phase involves concept and needs analysis. As described by Lili et al. (2021), needs analysis is the process of collecting and analyzing data to understand the requirements for product development.

Concept analysis results in the selection of the chemistry topic of redox reactions. This key concept involves identifying reduction and oxidation reactions using the concept of element oxidation numbers. Further, based on the key concept, the content is broken down into 6 learning objectives, which are 1) students can analyze oxidation numbers, the concept of reduction-oxidation reactions in terms of oxygen binding and release, 3) the concept of reduction-oxidation reactions in terms of electron binding and release, 4) the concept of reduction-oxidation reactions in terms of the increase and decrease of oxidation numbers, 5) reducing agents, oxidation, reduction products, and oxidation in reduction-oxidation reactions, and 6) auto-redox reaction.

Needs analysis, derived from interviews with chemistry teachers, indicates a lack of development or utilization of electronic student worksheets. The current practice involves the use of printed books provided at school. Chemistry teachers also highlighted common difficulties faced by students in learning redox reactions, such as determining oxidation numbers and recognizing reduction and oxidation reactions. In response, the student worksheets are designed with a contextual approach to enhance students' understanding of redox reactions by relating them to everyday life.

Design Stage

This stage encompasses the design of the product. The student worksheet product design, assisted by the Wizer.me platform, involves summarizing the material using Canva and implementing it on Wizer.me. Figure 2 displays the designed student worksheet using the Canva application. The worksheet's content was created using Canva and integrated into the Wizer.me platform. Additionally, the material is presented in video format, accessible to students, as depicted in Figure 3. The worksheet includes practice questions created using Quizizz.

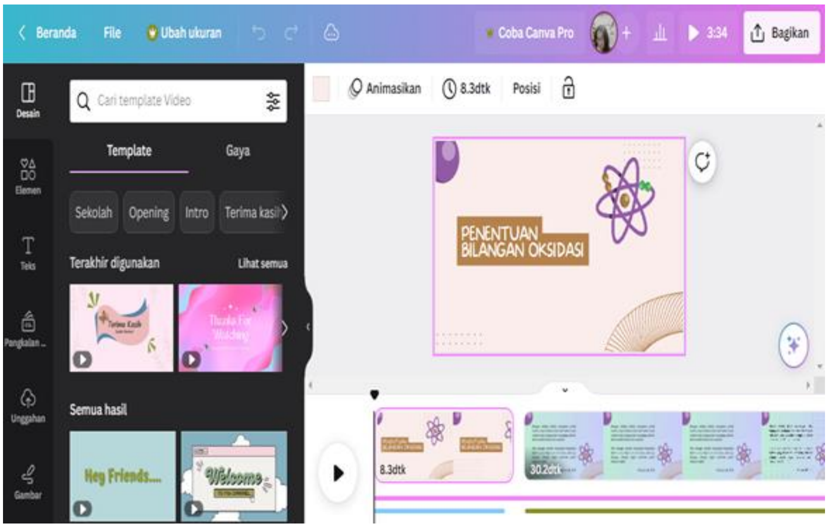

Figure 2. The student’s worksheet design using Canva

Furthermore, students engage in practice questions and ability tests, which come in various forms on the Wizer.me platform-multiple choice, description, image description, matching, crossword puzzles, classifying, and puzzles. The choice of this platform for developing student worksheet products is justified (Kumalasari & Julianto, 2021). This student worksheet features four types of questions: Multiple Choice, requiring students to select one or several correct answers and statements; Fill On an Image, prompting students to provide the correct answer by clicking on an image or statement; Matching, where students pair or match correct answers by connecting elements on the left to those on the right; and Sorting, asking students to group correct answers. The various question forms are illustrated in Figure 4. Several questions are designed using a contextual approach so that learning can be linked to students' daily lives (Komalasari, 2017).

Development Stage

The developed student worksheet products are created using the Wizer.me platform. According to Tegeh & Kirna (2013), the development stage involves preparing a product and gathering all materials for its creation. The designed parts of the student worksheet are then consolidated using the Wizer.me platform. The student worksheets, assisted by the Wizer.me platform, are saved as an https link. Due to the link's length, the researchers shorten it using the bit.ly site for easier student access.

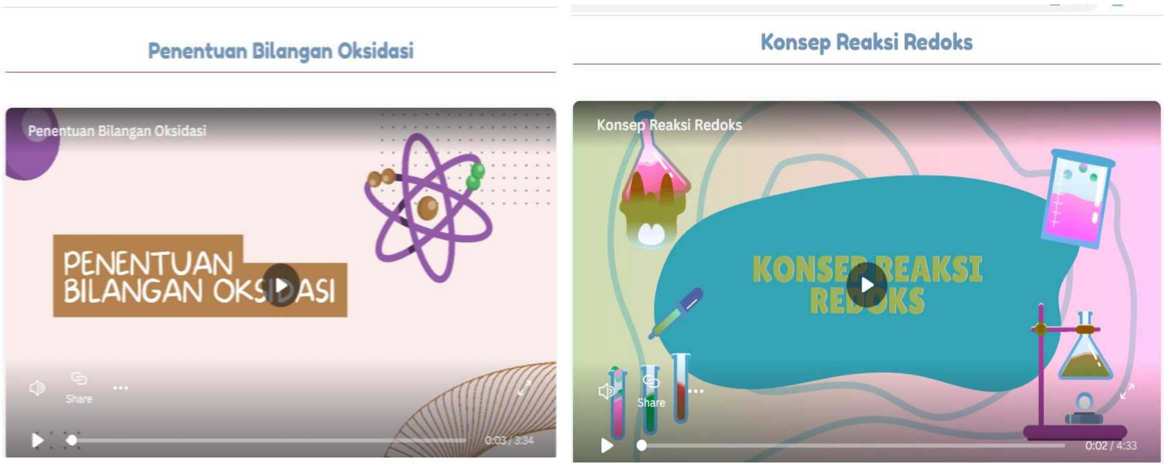

Figure 3. Learning video on student worksheets

During the development stage, validation of research products and instruments is conducted to measure validity and assess the quality of the products and instruments. As stated by Cook & Hatala (2016), validation aims to gather assessments, comments, and suggestions for the product. In line with Ruel et al. (2016), teaching materials are revised before being tested on respondents. Subsequently, trials are conducted to measure the product's feasibility and gauge students' responses, thereby obtaining the required data.

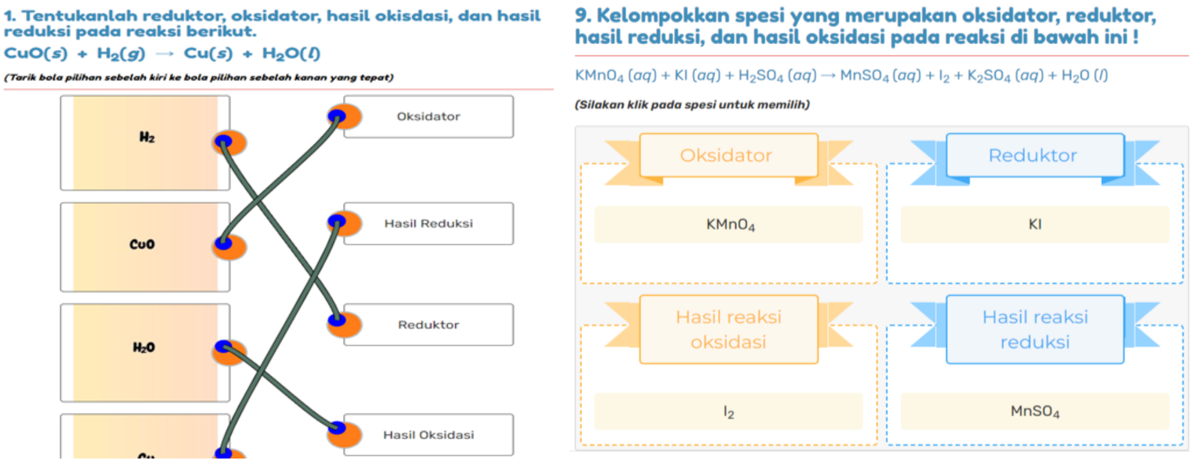

Figure 4. Questions in student worksheets

Validation involved three experts, including two chemistry education lecturers and one chemistry teacher, aiming to test the feasibility and quality of student worksheet products. Validators assessed two aspects: the media and material aspects. The results, presented in Table 1, indicate that the student worksheet products assisted by the Wizer.me platform achieved an average score of 84% in both the media and material aspects, placing them in the very valid category. The validity of test items, assessed using the Gregory formula, demonstrated high validity with an overall average value of 0.95. Following the validity test, the researchers incorporated comments and suggestions from validators, ensuring the product's suitability for testing on students.

After validating and making revisions to the product, the subsequent step includes carrying out a trial test. This phase aims to assess the practicality and effectiveness of the developed products. A limited trial aimed to assess the feasibility of using student worksheet products assisted by Wizer.me in class X redox reaction material. The sample comprised 10 students (5 men and 5 women) selected based on varying cognitive abilities: high, medium, and low. Post-product testing, students completed a questionnaire to gauge their responses. The average score across all aspects was 83%, falling into the very practical category. Analysis of student response questionnaires revealed that the design, ease of use, and visual communication aspects were considered very practical. The product is designed to motivate students to learn redox reactions and enhance their understanding of the material. The questions available on Wizer.me can effectively train students' abilities. The product is user-friendly, operating seamlessly on laptops, computers, and Android and iOS-based devices. Students perceive electronic worksheets as a innovative approach to learning chemistry.

Table 1. Score of assessment quality and student response

Assessment of Product Quality/Student Response	Assessment Aspects	Score	Average	Category
Media Expert	Didactic	83%		
	Illustration	88%	84%	High validity
	Content Design	82%		
Material Expert	Presentation feasibility	79%		
	Language feasibility	90%	84%	High validity
	Content eligibility	83%		
Student	Design	82%		
	Ease of use	83%	83%	High practicality
	Visual communication	83%		

These results come as no surprise and reflect global research on the characteristics and inherent connections between a standard student and mobile technology (Kurkovsky, 2013). Certainly, when regarded as a digital teaching tool, Wizer.me receives favorable feedback from the majority of students. The utilization of resources like the Wizer.me application has enhanced participation and interaction in the classroom, thereby fostering an increase in overall class engagement. Students agreed that the engaging design and diverse question formats in the worksheets enhanced learning motivation and comprehension of redox reaction material.

Table 2. Results of analyzing students' answers

Student’s code	Final Score (%)	Category
A1	96%	Very high
A2	44%	Low
A3	96%	Very high
A4	76%	High
A5	56%	Low
A6	80%	High
A7	88%	Very high
A8	16%	Very low
A9	92%	Very high
A10	84%	Very high
Average	70%	High

After completing their worksheets, the results of students' answers were analyzed, and a summary is presented in Table 2 to determine the effectiveness of the student worksheets. The analysis reveals that students with codes A1, A3, A7, A9, A10 achieved very high scores, ranging from 84% to 96%. Codes A4 and A6 fall into the high category with scores of 76% and 80%, while codes A2 and A5 are in the low-level category with scores of 44% and 56%. Code A8 is classified as low, with a score of 16%. The overall average student score is 70%, placing it in the high category.

Consistent with Araafi et al. (2023) research findings, it was demonstrated that students' cognitive learning outcomes were influenced by the use of the Wizer.me website. The interactive components of digital worksheets actively engage students during the learning process. Through a hands-on approach, technology captures students' attention, prompts them to comprehend tasks, and facilitates a deeper understanding of the subject matter. Digital worksheets frequently incorporate elements that inspire and motivate students (Argawati & Suryani, 2020).

Identifying both advantages and disadvantages based on student responses, it was noted that the worksheets excelled in design attractiveness but faced challenges in accessibility and multimedia quality. Student feedback serves as valuable evaluation material for refining product quality, emphasizing the importance of clear sound quality and a stable internet connection during worksheet access.

Research conducted by Kaliappen et al. (2021) indicates that, due to the use of Wizer.me, an interactive online platform for educational activities, students exhibited a positive attitude and maintained emotional well-being. Additionally, students demonstrated sincerity and engaged in rational communication. Therefore, it can be concluded that employing Wizer.me is a strongly recommended approach for technology-enabled teaching and learning. The use of electronic student worksheets play a crucial role as a medium for delivering educational content from educators to students during the learning process. It serves as instructional material designed to reduce the teacher's role and enhance the active participation of students in the learning process. This is important because active mental engagement of students is essential for effective absorption of the lesson material (Purba, et al., 2021).

The Wizer.me application is recognized as a valuable tool for comprehending and internalizing concepts. It has made it possible for individuals to become aware of their expertise in an engaging manner. Teachers can employ the Wizer.me application to implement innovative teaching methods within their instructional processes.

CONCLUSION

The development of electronic student worksheets, facilitated by the Wizer.me platform for the redox reaction concept, has been executed appropriately and successfully. Employing a modified 4D development model adapted to 3D (Define, Design, and Develop), the product has garnered an impressive overall average score of 84% in media and material aspects, categorizing it as highly valid. Students' responses to the product, with the assistance of the Wizer.me platform, have demonstrated high practicality in the learning process. This is evidenced by student response questionnaires that evaluate learning design, operational aspects, and visual communication, resulting in an impressive overall average score of 83%. The developed product proves to be effective in supporting the learning of redox reactions in high school.

RECOMMENDATIONS

This developmental research can be effectively employed according to specific needs by conducting broader studies to assess the efficacy of utilizing student worksheets assisted by Wizer.me. Additionally, this research can serve as a valuable reference for conducting similar studies, particularly those focused on developing student worksheets for other chemistry concepts.

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