Development of Liveworksheets-Based E-LKPD Using the Discovery Learning Model on Reaction Rate Topic for High School Students

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Abstract: Development of Liveworksheets-Based E-LKPD Using the Discovery Learning Model on Reaction Rate Topic for High School Students. This research aims to develop a Liveworksheets-based E-LKPD integrated with the Discovery Learning model on reaction rate material for Grade XI students and to determine its validity and practicality. This study employed a Research and Development (R&D) approach using the Four-D (4D) development model proposed by Thiagarajan, Semmel, and Semmel, which consists of the Define, Design, Develop, and Disseminate stages. The development was limited to the Define, Design, and Develop stages. The product was validated by one material expert and two media experts, while a limited field trial was conducted with 58 students at SMA Negeri 14 Medan. Data were collected using validation sheets and student response questionnaires and analyzed descriptively. The results showed that the material expert gave a validity score of 88.7% and the media experts gave 89.6%, resulting in an overall validity score of 89.15% categorized as very valid. The limited field trial obtained a practicality score of 76.84%, indicating that the E-LKPD was practical for use in learning. These findings indicate that the developed E-LKPD is valid and practical and can be used as a digital learning resource to support chemistry learning on reaction rate material.

Keywords: E-LKPD; Liveworksheets; Discovery Learning; Reaction Rate; Chemistry Learning

Abstrak:Pengembangan E-LKPD Liveworksheets Berbasis Model Discovery Learning Pada Materi Laju Reaksi Untuk Peserta Didik SMA. Penelitian ini bertujuan untuk mengembangkan E-LKPD berbasis Liveworksheets yang terintegrasi dengan model Discovery Learning pada materi laju reaksi serta mengetahui tingkat validitas dan kepraktisannya. Penelitian ini menggunakan metode Research and Development (R&D) dengan model pengembangan Four-D (4D) yang dibatasi pada tahap Define, Design, dan Develop. Produk divalidasi oleh satu ahli materi dan dua ahli media serta diuji coba secara terbatas kepada 58 siswa kelas XI SMA Negeri 14 Medan. Data dikumpulkan menggunakan lembar validasi dan angket respon siswa, kemudian dianalisis secara deskriptif. Hasil validasi ahli materi memperoleh persentase sebesar 88,7% dan validasi ahli media sebesar 89,6%, sehingga diperoleh nilai validitas keseluruhan sebesar 89,15% dengan kategori sangat valid. Hasil uji kepraktisan menunjukkan persentase sebesar 76,84% yang termasuk dalam kategori praktis. E-LKPD berbasis Liveworksheets yang dikembangkan dan terintegrasi dengan model Discovery Learning dinyatakan valid dan praktis untuk digunakan sebagai sumber belajar digital pada materi laju reaksi.

Kata kunci: E-LKPD; Liveworksheets; Discovery Learning; Laju Reaksi; Pembelajaran Kimia.

◾ INTRODUCTION

Education in the digital era requires innovative learning approaches that support the development of twenty-first-century skills, including critical thinking, creativity,

collaboration, and communication. Chemistry learning involves many abstract concepts that require appropriate learning media to help students visualize phenomena that cannot be observed directly. One of the most challenging topics for high school students is reaction rate, which involves microscopic concepts such as particle collisions, activation energy, and the influence of several factors on reaction speed. Previous studies reported that students experience difficulties in understanding the relationship between collision theory and reaction rate changes (Fatanah et al., 2022).

Observations conducted at SMA Negeri 14 Medan indicated that learning on reaction rate material has not been implemented optimally. Although the Merdeka Curriculum has been applied, the learning process is still dominated by teacher-centered instruction and the use of conventional printed worksheets. Teachers also reported that students find reaction order and its calculations difficult, resulting in many students not achieving the minimum mastery criteria. These conditions indicate the need for interactive and student-centered learning media that support independent learning and conceptual understanding.

Liveworksheets is an interactive digital platform that allows worksheets to be transformed into interactive learning activities with features such as automatic assessment, multimedia integration, and immediate feedback. At the same time, the Discovery Learning model emphasizes students' active involvement in discovering concepts through exploration and analysis. Research has shown that Discovery Learning can improve students' conceptual understanding and problem-solving skills in chemistry learning. However, previous studies mostly focused on either the development of digital worksheets or the application of Discovery Learning separately. Research integrating Liveworksheets-based E-LKPD with the Discovery Learning model specifically on reaction rate material is still limited. Previous studies have demonstrated that interactive digital worksheets can enhance students' conceptual understanding and cognitive engagement in science learning environments (Chiang et al., 2022; Zhai et al., 2021).

Therefore, this study aims to develop a Liveworksheets-based E-LKPD integrated with the Discovery Learning model on reaction rate material for high school students and to determine its validity and practicality. This study is limited to the Develop stage of the Four-D (4D) model, and thus does not examine the effectiveness of the product on students' learning outcomes.

∎   **METHOD**

This study used a Research and Development (R&D) approach employing the Four-D (4D) development model proposed by Thiagarajan, Semmel, and Semmel. The development stages consisted of Define, Design, and Develop, while the Disseminate stage was not conducted. This limitation was determined at the outset of the study due to time and resource constraints, so the Four-D model was not implemented in its entirety.

The research was conducted at SMA Negeri 14 Medan during the 2024/2025 academic year. Product validation involved one material expert and two media experts. A limited field trial was conducted with 58 Grade XI students to determine the practicality of the developed E-LKPD.

The Define stage included curriculum analysis, student analysis, and concept analysis to determine learning objectives aligned with reaction rate material. The Design stage involved preparing the structure of the E-LKPD according to the Discovery Learning syntax, including stimulation, problem identification, data collection, data processing, verification, and generalization. The E-LKPD draft was designed using

Canva and then integrated into the Liveworksheets platform to provide interactive features such as drag-and-drop activities, multimedia content, and automatic feedback.

The Develop stage included expert validation, product revision, and limited field testing. Validation instruments used Likert-scale questionnaires consisting of clearly defined indicators for each assessed aspect, including content accuracy and relevance, presentation and organization, language clarity, and media interactivity. The validity and practicality categories were determined based on percentage criteria adapted from relevant educational research standards. Student response questionnaires were used to assess practicality aspects, including ease of use, attractiveness, and clarity of instructions. Data were analyzed descriptively to determine validity and practicality categories.

▪ RESULT AND DISCUSSION

The development of the Liveworksheets-based E-LKPD integrated with the Discovery Learning model resulted in valid and practical learning media. Validation by the material expert obtained an average score of 88.7 percent, while validation by the media experts obtained an average score of 89.6 percent. The overall validity score was 89.15 percent, which falls into the very valid category. These results indicate that the content accuracy, instructional design, and media presentation meet the requirements for learning implementation.

The limited field trial involving 58 students resulted in a practicality score of 76.84 percent, categorized as practical. Students stated that the E-LKPD was easy to use, visually attractive, and helpful in understanding reaction rate concepts, particularly factors affecting reaction rate and reaction order. The integration of Discovery Learning stages encouraged students to actively explore concepts and draw conclusions independently.

These findings are consistent with the principles of Discovery Learning, which emphasize active student involvement in constructing knowledge through exploration and verification. The high validity scores indicate that the E-LKPD design aligns well with the Discovery Learning syntax, while the practicality results reflect students' positive responses toward interactive learning environments, as also reported in previous chemistry education studies. The use of Liveworksheets combined with Discovery Learning provides an effective learning environment that supports active and meaningful learning. This finding is consistent with prior research reporting that well-designed interactive digital learning materials facilitate students' engagement and support deeper conceptual understanding (Chiang et al., 2022; Zhai et al., 2021).

▪ CONCLUSION

This study developed a Liveworksheets-based E-LKPD integrated with the Discovery Learning model on reaction rate material for Grade XI students. The product achieved a very high validity score of 89.15 percent and a practicality score of 76.84 percent. These results indicate that the developed E-LKPD is valid and practical for use as a digital learning resource in chemistry learning. However, claims regarding its potential to improve students' conceptual understanding should be interpreted cautiously, as this study did not empirically test learning effectiveness. This study implies that the use of Liveworksheets-based E-LKPD integrated with Discovery Learning can support student-centered chemistry learning and facilitate engagement with abstract concepts.

Nevertheless, this research is limited by the number of validators involved and the absence of an effectiveness test. Further research is recommended to conduct experimental studies to examine the effectiveness of the E-LKPD on learning outcomes and to implement the product on a larger scale.

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