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# Development of E-LKPD Using POE-Based Liveworksheets on Acid-Base Concept

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**Abstract**
The purpose of this study was to develop an electronic worksheet (E-LKPD) based on the POE-based Live worksheet concept for the acid-base topic. The Plomp model research and development (R&D) design was employed in this research. The validity of the E-LKPD was assessed through validation sheets and user response questionnaires. Results of the validation conducted by three experts indicated that the E-LKPD was deemed valid for both material and media aspects, with average scores of 97.25% and 95.14%, respectively. Additionally, students and chemistry teachers had positive responses to the E-LKPD, with average scores of 82.33% and 88.89%, respectively. These results suggest that the developed E-LKPD is a feasible tool for learning.

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## INTRODUCTION

The results of interviews with chemistry teachers at SMAN 2 Mandau and SMAN 3 Mandau revealed that the traditional teaching materials, in the form of acid-base worksheets, have not effectively facilitated students' understanding of the concepts. This has led to a low graduation rate of 60% in acid-base material. The highest and lowest difficulties faced by students in understanding acid-base material are determining the degree of acidity (pH) and analyzing the Bronsted-Lowry acid-base reaction equation (Izza et al., 2021).

In response to these challenges, it is imperative to use appropriate teaching materials in the learning process. Teaching materials play a crucial role in affecting the quality and success of learning (Yuberti, 2014). The use of worksheets alone may not result in successful learning, and must be complemented by effective learning models that encourage students to be more active (Nurfidianty et al., 2015).

The POE (Predict, Observe, and Explain) model is an effective learning model that can stimulate student engagement and learning. The POE model involves predicting, observing, and explaining, which invites students to think critically and develop a deeper understanding of concepts (Fatimatuzzohrah et al., 2020). In a study by Santhiy, et al (2015), the application of the POE model was found to increase student activity and learning achievement.

The objectives of this study are: (1) to develop an electronic worksheet (E-LKPD) based on the POE-based Liveworksheet concept for acid-base topics, considering aspects of content validity, POE model features, linguistics, presentation, and graphics; (2) to determine the user response to the E-LKPD for 11th-grade students in senior high school (SMA/MA) or equivalent.

## METHOD

This study employs a development research approach using the Plomp model, which consists of five phases: preliminary investigation, design, realization, validation, trial, revision, and implementation (Rochmad, 2012). The participants of the study include chemistry teachers, students, and experts in the field of chemical content (2 individuals) and media (1 individual). The study was conducted during the even semester of 2021/2022 at SMAN 2 Mandau, SMAN 3 Mandau, and the Chemistry Education Study Program at FKIP Riau University.

The research instruments consist of a validation sheet and a user response questionnaire. The user response tests were conducted with 2 chemistry teachers and 20 students, with equal participation from SMAN 2 Mandau and SMAN 3 Mandau. In addition, one-on-one tests were conducted with 3 students from SMAN 2 Mandau with varying levels of ability (high, medium, and low) as recommended by the chemistry teachers.

Data was analyzed using the Likert scale formula. It included calculations of the mean scores from the validation sheets and user response questionnaires, according to the following formula:

$$R = \frac{f}{n} \times 100\%$$

where R is percentage of alternative scores of teacher attitude statements (%), f is number of scores obtained, and n is maximum number of scores.

To determine the degree of validity of the developed teaching materials, assessment guidelines listed in Table 1 was applied. The user response criteria listed in Table 2 were used as basis for teaching materials development.

Table 1. Validity criteria (Riduwan, 2012)

| Percentage | Criteria |
|---|---|
| 80,00 – 100 | Excellent/Strong Validity/Proper |
| 60,00-79,99 | Good/Good Validity/Proper |
| 50,00-59,99 | Poor/Poor Validity/Nonproper |
| 0,00-49,99 | Bad/Bad Validity/Nonproper |

Table 2. User response criteria

| Percentage | Criteria |
|---|---|
| 75,00 – 100 | Excellent |
| 50,00-74,99 | Good |
| 25,00-49,99 | Poor |
| 0,00-24,99 | Bad |

## RESULTS AND DISCUSSION

### Preliminary Step

Field studies were conducted at SMAN 2 and SMAN 3 Mandau to examine the teaching materials used in the instruction of chemical concepts. The results of the study indicated that the conventional LKPDs (Learning Package for Student) used were lacking in engaging students and were not based on a learning model. The target population for this study consisted of class XI mipa SMA/MA students with an age range of 16-17 years, which according to Piaget's theory of cognitive development, is at a formal stage where critical and logical thinking is developed (Nurlina et al., 2021).

## Design Step

### *Prototype Design*

The design of the E-LKPD (Electronic Learning Package for Students) prototype was based on POE-based live worksheets on acid-base subjects. The framework of the E-LKPD consisted of the following components: title, Basic Competencies, Competency Achievement Indicators, Learning Objectives, Learning Instructions, Application Usage Instructions, Materials, Student Activities, Evaluation, Bibliography, and Assessment Columns. The E-LKPD consisted of four types: 1) Acid and base theory, 2) Acid and base indicators, 3) Acidity degree (pH), and 4) Ionization degree (α) weak acid and weak base. The design included several evaluations in the form of Google Form questions to encourage student engagement with the material.

### *Instrument Design*

Validation sheets were designed for material and media aspects, and user response questionnaires were designed for teachers and students. The material validation sheets assessed the content feasibility, POE characteristics, language feasibility, and display design.

## Realization/Construction Step

The design was realized by producing the E-LKPD using POE-based live worksheets on acid-base subjects and producing the validation sheets.

### *Validation and Revision*

The validation was performed twice and revisions were made based on the feedback received from the first validation. The final version of the E-LKPD was deemed valid after the second validation.

### *Matter Validation*

#### *Content Eligibility*

The content feasibility assessed the correctness of the chemical concepts of acidic and alkaline matter in the E-LKPD. The first validation result had an average score of 78.57% with a fairly valid category. Revisions were made based on the suggestions and improvements provided by the validators. The second validation result showed a content eligibility of 100% with a valid category, indicating that the validators deemed the E-LKPD to be in accordance with the assessment indicators for content feasibility.

#### *POE charactersitic*

The POE characteristic feasibility assessed the POE model contained in the E-LKPD. The first validation result had an average score of 79.16% with a fairly valid category. Revisions were made based on the suggestions and improvements provided by the validators. The second validation result showed a result of 91.67% with a valid category, indicating that the validators deemed the E-LKPD to be in accordance with the assessment indicators for POE characteristic feasibility.

#### *Language Eligibility*

The language feasibility was assessed with the first validation result obtaining an average score of 72.5% with a fairly valid category. Revisions were made based on the suggestions and improvements provided by the validators. The second validation result showed a content eligibility of 97.5% with a valid category, indicating that the validators deemed the E-LKPD to be in accordance with the assessment indicators for language feasibility.

*Eligibility of Display*

The results of the first validation obtained an average score of 79.16% and were categorized as fairly valid. Some suggestions and inputs provided by the validators were taken into account for revisions. The second validation result showed a 100% eligibility for the content and was categorized as valid. The presentation of the E-LKPD met the structure standards of LKPD outlined by the Ministry of Education and Culture (2017). The complete results of the material validation for E-LKPD are presented in Table 3.

Table 3. Matter Validation Result

| Aspect of validity | 1st Validation | Criteria | 2nd Validation | Criteria |
|---|---|---|---|---|
| Content eligibility | 78,57% | Good validity | 100% | Excellent validity |
| POE characteristic | 79,16% | Good validity | 91,67% | Excellent validity |
| Language eligibility | 72,5% | Good validity | 97,5% | Excellent validity |
| Eligibility of display | 79,16% | Good validity | 100% | Excellent validity |
| **Average** | **77,35%** | Good validity | **97,29%** | Excellent validity |

***Media Validation***

As noted by Olivia and Muchlis (2021), the inclusion of effective graphic components can enhance the ease of use and comfort for students in operating the E-LKPD. Appropriate font sizes, legible font type, and the use of a comfortable background color can contribute to an improved reading and understanding experience.

*E-LKPD size*

The first validation of the E-LKPD size obtained an average score of 100% with a "valid" categorization. No revisions were made to this aspect as the size of the E-LKPD complies with the standard size of A4 (210 x 297 mm).

*E-LKPD cover design*

The initial validation of the E-LKPD cover design received an average score of 68.75% with a "fairly valid" categorization. Revisions were made based on suggestions and inputs from the validators. The second validation result indicated a content eligibility score of 93.75% with a "valid" categorization. In conclusion, the validators judged that the E-LKPD cover design met the established indicators.

*E-LKPD content design*

The first validation of the E-LKPD content design received an average score of 86.11% with excellent validity. However, validators provided suggestions and inputs for revision. The second validation result indicated excellent validity with eligibility score of 91.67%. The validators overall deemed that the E-LKPD content design met the established indicators. The complete results of the E-LKPD media validation are presented in Table 4.

Tabel 4. E-LKPD media validation results

| Aspect of E-LKPD validity | I Validation | Criteria | II validation | Criteria |
|---|---|---|---|---|
| Size | 100% | Excellent validity | - | - |
| Cover design | 68,75% | Good validity | 93,75% | Excellent validity |
| Content design | 86,11% | Excellent validity | 91,67% | Excellent validity |
| **Average** | **84,95%** | Excellent validity | **92,71%** | Excellent validity |

***Testing***

*One-to-One Testing*

A one-on-one testing was conducted on three students from SMAN 2 Mandau with varying levels of ability (high, medium, and low). The students were selected based on recommendations from chemistry teachers who were familiar with their abilities during the learning process. The testing took place over two days, May 17-18, 2022, and was conducted in the school with a 60-minute duration. Students were tasked to work on a validated E-LKPD and their completion time was recorded. The average consecutive completion times for the E-LKPD in meetings 1, 3, and 4 were 25 minutes, 36.67 minutes, and 36.67 minutes, respectively. The students completed the E-LKPD faster than the estimated 60 minutes. For meeting 2, which focused on acid-base indicators, students completed the E-LKPD with an average time of 56.67 minutes, which was relatively long due to the practical component.

The one-on-one testing resulted in a satisfactory average student score of 87.75. Students with high abilities obtained the highest scores, while those with low abilities scored the lowest. However, in meeting 4, the processing times were similar between high- and medium-ability learners, both completing in 35 minutes. The students provided feedback indicating that they found the E-LKPD interesting, the material was clear and easy to understand, and the questions were not overly difficult.

A problem was encountered with the use of links in the E-LKPD, where answers were lost upon returning to the E-LKPD after working on a linked problem. To address this issue, a command was added to the application instructions to click "finish" before returning to the E-LKPD to ensure that answers were not lost. Following the one-on-one trial, a limited trial phase for teachers and students was conducted.

Table 1. E-LKPD Score

| Lesson meeting | Score | | | Average |
|---|---|---|---|---|
| | PD-1 | PD-2 | PD-3 | |
| 1 | 92 | 90 | 85 | 89 |
| 2 | 100 | 100 | 100 | 100 |
| 3 | 100 | 100 | 50 | 83,33 |
| 4 | 95 | 81 | 60 | 78,67 |
| **Average score** | | | | 87,75 |

Table 2. E-LKPD Processing Time

| Lesson meeting | Time (minute) | | | Average |
|---|---|---|---|---|
| | PD-1 | PD-2 | PD-3 | |
| 1 | 20 | 25 | 30 | 25 |
| 2 | 55 | 57 | 58 | 56,67 |
| 3 | 30 | 32 | 48 | 36,67 |
| 4 | 35 | 35 | 40 | 36,67 |
| **Average time** | | | | 38,75 |

*Testing Toward Teacher*

Testing of two chemistry teachers was conducted at SMAN 2 Mandau and SMAN 3 Mandau. The teachers were given access to the E-LKPD, which was developed in the form of POE-based Liveworksheet links. After using the E-LKPD, the teachers were asked to assess and provide suggestions on its use through a teacher response questionnaire. The assessment results showed that the E-LKPD was well-received, with teachers finding the material to be in accordance with the 2013 curriculum syllabus and thus suitable for use as an innovative teaching material. The average total score of all questions in the teacher response questionnaire was 90.63%, which according to the eligibility criteria of Yamasari (2010) falls into the excellent category (75-100%). This result is consistent with the findings of Adha et al (2016),

who found that the use of innovative teaching materials can increase learning motivation and student learning outcomes.

*Testing Toward Students*

Limited trials with students were carried out by the researchers and accompanying chemistry teachers. The trial involved 20 students, 10 each at SMAN 2 Mandau and SMAN 3 Mandau. The average total score of all questions in the student response questionnaire was 82.5%.

## CONCLUSION

In conclusion, the present study aimed to evaluate the effectiveness of the E-LKPD in promoting student learning outcomes in chemistry. The results showed that the E-LKPD was well-received by both students and teachers, with the students completing the E-LKPD in less time than the estimated 60 minutes. The students reported that the E-LKPD was interesting, with clear and easy-to-understand materials and questions. The teachers found the developed E-LKPD to be in line with the 2013 curriculum syllabus, and it can be used as an innovation in teaching materials to achieve desired learning objectives and outcomes. The E-LKPD developed has been declared valid both from the material and media aspects with average scores of 97.25% and 95.14%, respectively. User responses in this case teachers and learners showed positive and excellent results with successive average scores of 88.89% and 82.33% respectively. Overall, the POE-based worksheet has the potential to enhance student learning outcomes in chemistry. Further research is needed to confirm the effectiveness of this teaching tool, especially with a larger sample size, and to address any limitations noted in this study. The E-LKPD could be a valuable tool for chemistry teachers and researchers to use in promoting student engagement and learning outcomes in the future.

## RECOMMENDATIONS

E-LKPD using SOE-based Liveworksheet needs to proceed to the wide-scale trial step.

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