Validity of E-LAPD Based on The Learning Cycle 7-E Model to Improve Critical Thinking Skills Oriented to Multiple Chemical Representations in Reaction Rate Factors Submaterial

Rahmania Fitrah Sari[*1], Salsa Sabrina Fajar Maulidiah[2], Liza Nurrahma Dwi Agustin[3], Dian Novita[4]

Chemistry Education Study Program, Faculty of Mathematic and Natural Science, State University of Surabaya, Indonesia

**Corresponding author: rahmaniafitrah.21034@mhs.unesa.ac.id*

Abstract. *This research aims to describe the validity of the Electronic Learner Activity Sheet (E-LAPD) for reaction rate to improve critical thinking skills with the 7-E learning cycle learning model developed. The development model in this research is ADDIE with four stages Analyze, Design, Development, and Evaluate. The validation results were analyzed based on the mode in each aspect. Based on the validation results, it was found that the developed reaction rate E-LAPD has a good category with a score of 3 on the content validity aspect and a good category with a score of 3 on construct validity. Furthermore, reaction rate electronic learner activity sheet can be used in the learning process in the classroom to determine the practically and effectiveness of the developed reaction rate electronic worksheet.*

Keywords: *E-Worksheet, Critical Thinking, Validity, Reaction Rate, Learning Cycle 7-E*

INTRODUCTION

Entering the 21st century, education in Indonesia has been faced with a number of demands, challenges and opportunities which are of course very different from previous times [1]. The change in the 21st century educational paradigm that is currently being felt is one of the characteristics of the era of globalization which is supported by the very rapid development of science and technology. In line with this, curriculum changes to the concept of the national education system are also carried out continuously. Currently, the newest curriculum implemented in Indonesia is the independent curriculum, where this curriculum is implemented with the aim of restoring learning through learning activities that are in accordance with the characteristics of the educational unit to create students with a Pancasila student profile who reason critically, creatively, independently, have faith in God Almighty and have noble character, work together, and have global diversity [2].

21st century education aims to encourage students to master 21st century skills that are important and useful for them to be more responsive to changes and developments over time. The 21st century skills that students must master are called "The 4C's 21st Century Skills" which include critical thinking skills [3]. One of the focuses of teachers in learning in the 21st century is developing critical thinking skills, where this skill is one of the most important skills for students to have.

Critical thinking skills are the ability to think actively, systematically, and follow logical principles and consider various points of view to understand and evaluate the information obtained. [4]. However, facts in the field show that students' critical thinking skills are still in the low category, this is supported by data from pre-research results conducted by researchers on students in class XI-7 SMA Negeri 7 Surabaya on February 21 2024 which shows that students' critical thinking skills in interpretation were 50%, analysis was 16.4%, evaluation was 10.9%, inference was 21.09%, explanation was 33.59%, and self-regulation

was 68.75%. Students' critical thinking skills can be trained in all subjects, including with the aim of discovering concepts in a subject such as chemistry. Based on these data, the problem of low critical thinking skills among students must be minimized. Critical thinking skills are a reflective thinking process that focuses on deciding what to believe or do [5]. Critical thinking skills can be improved in all subjects at school, one of which is chemistry [6].

Apart from understanding the concepts, studying chemistry also requires the ability to apply and relate it to everyday life in accordance with the concepts that have been understood, of course in this case critical thinking skills are needed that students must have. In chemistry learning, factors that influence reaction rates are sub-material of the main discussion of reaction rates which can be used to train students' critical thinking skills. The basic competencies in this sub-material are explaining the factors that influence the reaction rate based on collision theory, designing, carrying out, and concluding and presenting the results of experiments on factors that influence the reaction rate, so that these basic competencies are closely related to indicators of critical thinking skills. which will be improved for students.

Multiple representation is a method used to explain material or chemical concepts by depicting macroscopically, submicroscopically and symbolically, for example through images, text, diagrams, equations and others [7]. Several concepts of reaction rate factor sub-materials can be built through experimental activities and also using macroscopic, microscopic and symbolic depictions.

One learning model that is appropriate to use to support the improvement of students' critical thinking skills is the Learning Cycle 7-E model. The Learning Cycle model or what is usually called the learning cycle is a model that makes it easier to master new concepts and to reorganize the initial understanding that students already have [8]. The stages of the Learning Cycle 7-E model consist of the stages of elicit, engage, explore, explain, elaborate, evaluate, and extend aims to emphasize the importance of eliciting students' initial understanding and expanding (transferring) concepts [9].

One effort to improve students' critical thinking skills based on multiple chemical representation concepts combined with the Learning Cycle 7-E model is learning using teaching materials which contain these components. The use of teaching materials such as Student Activity Sheets (LAPD) while still utilizing existing digital technology can offset these efforts. In this case, one form of implementation is to develop e-LAPD (Electronic LAPD). e-LAPD is a learning media created using digital technology, in the form of brief material descriptions and question sheets that must be completed digitally within a certain time period. In developing e-LAPD, a live worksheet platform was used as the medium used to access this LAPD.

So, with the e-LAPD based on Learning Cycle 7-E, it is hoped that it can help improve students' critical thinking skills in the sub-material of factors that influence reaction rates. Based on the explanation above, the researcher is interested in conducting research with the title "Validity of E-LAPD Based on The Learning Cycle 7-E Model to Improve Critical Thinking Skills Oriented to Multiple Chemical Representations in Reaction Rate Factors Submaterial".

METHOD

This research is research and development research. The development of e-LAPD Learning Cycle 7E is multi-oriented chemical representation referring to the ADDIE model which includes five stages including analysis, design, development, implementation and evaluation. However, this research was only limited to the development stage, but limited trials or pilot tests were still carried out.

Research Procedure

The research procedures are as follows.

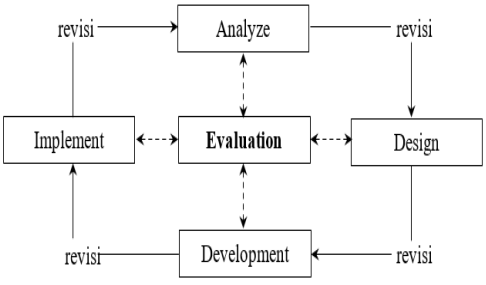

Figure 1. Stages of the ADDIE Development Model

The following are several development stages carried out.

Analyze Stage

In this analysis stage, there are several steps carried out.

Initial Analyze

The initial analysis aims to obtain information related to the chemistry learning process in schools, the availability of teaching materials and media, the learning methods and models applied, as well as the condition of students during learning activities.

Student Analyze

Student analysis aims to find out the problems experienced by students during the chemistry learning process. Problems can be seen from students' responses to chemistry lessons, chemistry material that is considered difficult and the reasons, as well as the learning materials that students have.

Material Analyze

Material analysis aims to determine what materials are needed in developing teaching materials.

Design Stage

This stage aims to design e-LAPD Learning Cycle 7E oriented towards chemical representation in reaction rate material. The steps taken at this stage are:

1. Look for references for material on factors that influence reaction rates as material discussed in the e-LAPD that will be developed.
2. Prepare the format or initial design of e-LAPD then consult with the supervisor so that it can then be developed according to the suggestions and input that have been given.
3. Selection of supporting features to be included in e-LAPD learning media. Before developing the product, researchers determined several features that would be provided in the e-LAPD being developed.

Development Stage

At this stage the researcher develops the product according to the results of the design at the design stage. Next, a feasibility assessment or validity test of the initial product development results is carried out by an expert validator using a validation sheet instrument.

Method of collecting data

The data collection method used in this research is the questionnaire method, including a review questionnaire and a validation questionnaire. The instruments used in data collection are:

Review Sheet

The review sheet is used to obtain input and suggestions from reviewers as improvements to the e-LAPD which will be developed and then revised to produce an appropriate e-LAPD. The review sheet was carried out by lecturer.

Validation Sheet

The validation sheet is used in e-LAPD validation activities which have been developed including content and construct validity. The purpose of providing this instrument is to obtain an assessment from media experts and material experts to find out whether the module is valid or not. The validation sheet was filled in by three validators including two chemistry education lecturers and one chemistry teacher.

Technique of Data Analysis

The research results that have been obtained still need to be analyzed. The data analysis technique used in this research uses quantitative methods.

Analysis of Reviewed Data

The data obtained was analyzed descriptively regarding suggestions and input based on the results of data reviewed by two chemistry lecturers and one chemistry teacher to improve the e-LAPD being developed. The components that will be studied include content, presentation and linguistic components.

Analysis of Validation Data

The data used to determine product validity was obtained based on filling out

validation sheets by experts and analyzed descriptively quantitatively with criteria adapted from the Likert scale as in the following table.

Table 1. Likert Scale Score

Score	Criteria
1	Not Good
2	Quite Good
3	Good
4	Very Good

Based on this score, e-LAPD is declared valid if it gets a score mode > 3 with good to very good criteria.

RESULT AND DISCUSSION

In this research, the tool developed was the reaction rate Student Activity Sheet (E-LAPD) to improve students' critical thinking skills using the learning cycle 7E model oriented to multiple chemical representations. The research design used, namely the ADDIE development model, is limited to the development stage. The stages of the ADDIE development model are described as follows:

Analyze Stage

At this stage, an initial analysis was carried out to determine the basic problem of the need to develop E-LAPD learning cycle 7E oriented to multiple chemical representations. Based on pre-research results, students' critical thinking skills are still relatively low and lacking use of electronic learning media, so E-LAPD learning media is needed to improve students' critical thinking skills.

Design Stage

At this stage, researchers choose a platform to upload the E-LAPD that will be developed. The platform chosen is liveworksheet because it can be accessed easily via a link https://www.liveworksheets.com/.

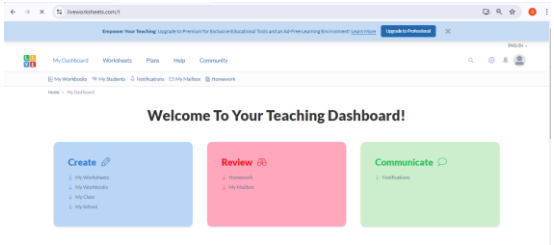

Figure 2. Liveworksheet Platform

The developed E-LAPD consists of 13-14 pages, where on the cover page there is the title E-LAPD, factors that influence the reaction rate (concentration, surface area, temperature, and catalyst), student names, and attendance numbers.

Figure 3. Design of E-LAPD Cover

The instructions for using E-LAPD explain the work and delivery stages, then there are learning achievements and the flow of learning objectives listed on pages 2-4.

Figure 4. Design Instructions and Introduction to E-LAPD

On the fifth page, E-LAPD contains phenomena in everyday life. On this page there is a 7-E Elicit syntax learning cycle learning model. Researchers practice critical thinking skills in interpretation. The image of the phenomenon at this stage is macroscopic.

Figure 5. The image of the phenomenon at this stage is macroscopic

On the sixth page of E-LAPD containing a practical video of factors that influence the reaction rate (concentration, surface area, temperature, and catalyst), students are asked to

interpret by observing the pictures and triggering questions presented. On this page there is a 7-E Engage syntax learning cycle learning model. Researchers practice critical thinking skills in interpretation. The practical video at this stage represents the macroscopic.

Figure 6. CTS Interpretation of E-LAPD Engage Phase

On pages seven-nine there is a learning model learning cycle 7-E Explore syntax. Researchers practice critical thinking skills, interpretation and analysis. Students are asked to interpret by making problem formulations, hypotheses/conjectures, variables, observation results, and chemical equations from the practicum observed or carried out. Then, students are asked to analyze the results of their observations by making graphs, analyzing the graphs, and answering several questions presented. Writing Chemical equations and graph making by students represent symbolic.

Figure 7. CTS Analyze of E-LAPD Explore Phase

On the tenth page there is a learning cycle 7E syntax explain learning model. Researchers practice explanatory critical thinking skills. Students are asked to answer several questions to explain the concept of reaction rate factors which are connected to collision theory based on the collision theory video presented. Collision theory videos represent submicroscopic.

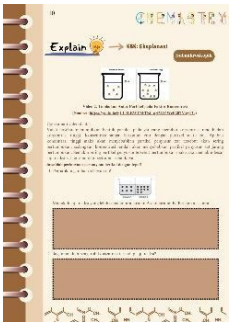

Figure 8. CTS explanation of E-LAPD Explain Phase

On the eleventh page there is a learning model learning cycle 7-E Elaborate syntax. Researchers practice inferential critical thinking skills. Students are asked to answer the trigger question in the first syntax and conclude the concept of the influence of factors that influence the reaction rate (concentration, surface area, temperature, and catalyst) on the reaction rate.

Figure 9. CTS Inference of E-LAPD Elaborate Phase

On the twelfth page there is a learning cycle 7-E Evaluate syntax learning model. Researchers practice critical thinking evaluation skills. Students are asked to assess the treatment in the picture of the application of factors that influence the reaction rate and include the reasons for this assessment based on the concept of reaction rate factors that have been obtained. The image presented represents macroscopic.

Figure 10. CTS Evaluation of E-LAPD Evaluate Phase

On the thirteenth and fourteenth pages there is a learning cycle 7-E Extend syntax learning model. Researchers practice critical thinking skills, evaluation and self-regulation. Students are asked to answer follow-up questions to assess students' understanding of the concept of factors that influence reaction rate. Students are also asked to check their respective understanding by answering yes/no to the statements provided.

Figure 11. CTS Evaluation and Self Regulation of E-LAPD Extend Phase

Development Stage

This stage is the process of developing the design that was created in the previous stage into an E-LAPD product that is ready to be used in a final trial. At this stage the LKPD and practical tools that have been designed will be tested for their validity.

Validation of the E-LAPD reaction rate to improve students' critical thinking skills using the 7E learning cycle learning model was obtained from a validation sheet that was filled in by 3 expert validators consisting of 2 chemistry lecturers and 1 chemistry teacher. The validation sheet in this research includes aspects of content validity and construct validity. The results of the E-LAPD validation of reaction rates for training students' critical thinking skills using the 7E learning cycle learning model were declared valid based on assessments from experts where the results of expert validation on the content aspect obtained mode 3 in the good category and the construct aspect obtained mode 3 in the good category. . The following is a data table of validator test results on content and construct aspects that have been assessed by 3 validators.

Table 2. Content Aspect Validity Test Data

Indicator	Mode	Criteria
The material in the product is in accordance with the Learning Outcomes and Learning Objectives	3	Good
Product suitability with the Learning Cycle 7-E Phase 1 (Elicit) learning model	3	Good
Product suitability with the Learning Cycle 7-E Phase 2 (Engage) learning model	3	Good
Product suitability with the Learning Cycle 7-E Phase 3 (Explore) learning model	3	Good
Product suitability with the Learning Cycle 7E Stage 4 (Explain) learning model	3	Good
Product suitability with the Learning Cycle 7E Stage 5 (Elaborate) learning model	3	Good
Product suitability with the Learning Cycle 7E Stage	3	Good

Indicator	Mode	Criteria
6 (Evaluate) learning model		
Product suitability with the Learning Cycle 7E Stage 7 (Extend) learning model	3	Good
The product trains students' critical thinking skills in aspects of interpretation	3	Good
The product trains students' critical thinking skills in analytical aspects	3	Good
The product trains students' critical thinking skills in the explanatory aspect	3	Good
The product trains students' critical thinking skills in inference aspects	3	Good
The product trains students' critical thinking skills in evaluation aspects	3	Good
The product trains students' critical thinking skills in aspects of self-regulation	3	Good
The product represents the macroscopic level	3	Good
Products represent the microscopic level	3	Good
Products represent a symbolic level	4	Very Good
Score Mode	3	Good

Based on the results of the content aspect validation in table 2, the mode (data that appears most frequently) is 3 with good criteria. This is in accordance with table 1 in the likert scale score category which states that electronic leaner activity sheet is declared good if it gets a mode ≥ 3.

Apart from being assessed based on content aspects, the validity of the e-LAPD being developed is also assessed based on construct aspects. Data from the validity test results on the construct aspect are presented in the following table.

Table 3. Construct Aspect Validity Test Data

Indicator	Mode	Criteria
Images and videos of the submaterial factors influencing the reaction rate in E-LAPD are clearly visible	3	Good
The words or terms used in the product are correct and consistent	3	Good
The combination of writing and images in E-LAPD is attractive and harmonious	3	Good
Score Mode	3	Good

Based on the results of the validation of the construct aspects in table 3, the mode (data that appears frequently) is 3 with a good criteria. This is in accordance with table 1 in the likert scale score category which states that electronic leaner activity sheet is declared good if it gets a mode ≥ 3.

CONCLUSION AND SUGGESTION

Based on the description of the results and discussion, it was found that the validity of the teaching materials developed to train critical

thinking skills was valid. This can be seen from the validation results in the content validation aspect which obtained mode 3 with the valid category and construct validation which obtained mode 4 with the very valid category. From these data it can also be concluded that the e-LAPD reaction rate to improve students' critical thinking skills using the Learning Cycle 7-E model is ready to be tested on students.

The author hopes that research into the development of reaction rate e-LAPD to improve students' critical thinking skills using the Learning Cycle 7-E model based on multiple chemical representations can be carried out again with a broader discussion by testing its effectiveness and practicality. The author is also willing to accept criticism and suggestions from any party that can make the product being developed more perfect. On this occasion the author would also like to thank fellow researchers from the same team, the supervisor of the student creativity week, and also to parties who I cannot mention one by one for their support so far..

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