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Validity of Electronic Worksheet (E-LKPD) Based on PBL Model to Train Creative Thinking Skills on Acid-Base Material

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Abstract

Creative thinking skills are important to train students to face the challenges of the 21st century and include higher order thinking skills. In addition, the independent curriculum provides freedom to think and innovate in learning. Therefore, one of the efforts to train creative thinking skills is to use relevant learning media, namely E-LKPD based on the Problem Based Learning (PBL) model. The purpose of this research is to produce PBL-based E-LKPD to train the creative thinking skills of grade XI students on acid-base material that is feasible to use, in terms of validity. This research model is guided by Thiagarajan's 4D model (Define, Design, Develop, and Disseminate). However, the research only reached the development stage (Develop) to determine the validity of the product because there were limitations in time, funds, and energy. Validation was conducted by 3 validators to measure the content and construct validity of the developed E-LKPD. The results showed that the validity of the E-LKPD was considered valid based on the median score of content validity of 4 with a valid category and construct validity of 5 with a very valid category. This indicates that the E-LKPD developed is valid and can be used to train students' creative thinking skills on acid-base material.

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INTRODUCTION

Chemistry is a science that studies theories, facts, and has the characteristics of processes and attitudes. Abstract concepts in chemistry will be difficult for learners to understand without help from facts that occur in everyday life. Therefore, it is important to help learners construct concepts and train appropriate 21st century thinking skills in chemistry learning. These 21st century skills include critical thinking, creativity, communication, and collaboration (Redhana, 2019). One of the important things to train in learning is the creative thinking skills of students. Creative thinking skills train learners to develop many ideas, ask questions, and even make learners able to be open and responsive to different perspectives

(Munandar, 2009). However, The Global Creativity Index states that Indonesia's creative thinking skills are in 115th position out of 139 countries (Florida, Mellander, & Stolarick, 2015).

Creative thinking is an important ability to be developed in education, including chemistry (Mayasari & Yonata, 2019). One of the chemistry materials in high school is acid-base, which in the learning outcomes of the independent curriculum, students are expected to be able to use the concept of acid-base in everyday life. Based on the results of pre-study of 16 11th grade students in one of the Gresik Regency High Schools, 50% of the students stated that learning on this acid-base material was mostly done by listening to explanations from the teacher and lacked links to problems in everyday life, so they tended to focus on acid-base theory and pH calculations. In addition, the results of the students' creative thinking skills test showed a value of less than 50%, namely in the fluency aspect of 24.1%, the flexibility aspect of 29.8%, the originality aspect of 22.3%, and the elaboration aspect of 16.7%. Therefore, it is important to train students' creative thinking skills on acid-base material.

According to Zubaidah (2018), creative thinking is a skill by using the latest thinking to solve a problem. Thus, one of the appropriate ways to train creative thinking skills in chemistry learning is to use a problem-based learning (PBL) model. PBL or Problem Based Learning model is a model that presents problems in real life and then integrates students to solve these problems (Komalasari, 2013). By giving problems, it will give learners the opportunity to interpret, review solutions, and draw conclusions to train their creative thinking skills. According to Arends (2004), the PBL model has a relationship with creative thinking, where this PBL model provides authentic problems, namely students develop their own understanding and practice higher-level thinking skills. This is in line with the research of Cahyani, Nasrudin, & Yonata (2019) that problem solving learning is related to acid-base material, where students are given the opportunity to solve problems and find solutions, while in this acid-base material there are many applications in everyday life (Hulyadi & Muhali, 2023).

In addition to the appropriate learning model, learning also requires teaching materials that can support the learning process. Teaching materials that are often used and needed are LKPD. LKPD is teaching material that helps in learning activities, such as practicum, observation, and asking questions (Lathifah, Hidayati, & Zulandri, 2021). Along with the times, it is important to utilize technology in various fields, including education (Indarta, et al., 2022). According to Lase (2019) educational activities by utilizing technology or e-learning are expected to produce individuals who are able to face the times well, so it is necessary to innovate teaching materials in the form of LKPD in electronic form or called E-LKPD. Research conducted by Nurjanah (2022) states that PBL-based E-LKPD is valid, practical, and effective to be used as teaching materials in learning and able to train critical thinking skills.

According to the information above, it is very important for an educator to develop an innovative PBL-based E-LKPD, as well as being able to train students' creative thinking skills. The E-LKPD developed is then stored on the liveworksheet website so that it is easily accessible to students. Based on the background described above, a study was conducted entitled “Validity of Electronic Worksheet (E-LKPD) Based on PBL Model to Train Creative Thinking Skills on Acid-Base Material”.

METHOD

This type of research is research and development (Research and Development) which is used to produce certain products, and test the feasibility of these products (Sugiyono, 2016). The development of this E-LKPD is guided by the development design according to Thiagarajan (1974), namely the development of the 4D model which consists of four stages, namely defining, designing, developing, and disseminating. However, this research was only carried out up to the development stage (develop) with expert validation to determine the feasibility of the product. This restriction is due to several reasons, namely limited time, energy, and funds. The stages carried out are defining which includes, front end analysis, learner analysis, task analysis, material concept analysis, and formulation of learning objectives. Then, the design stage which includes, media and format selection and making the initial design of E-LKPD so as to produce draft 1. At the development stage, reviews and revisions were carried out which resulted in draft 2. The results of draft 2 were then validated by 3 validators. The following is the design of the product development design.

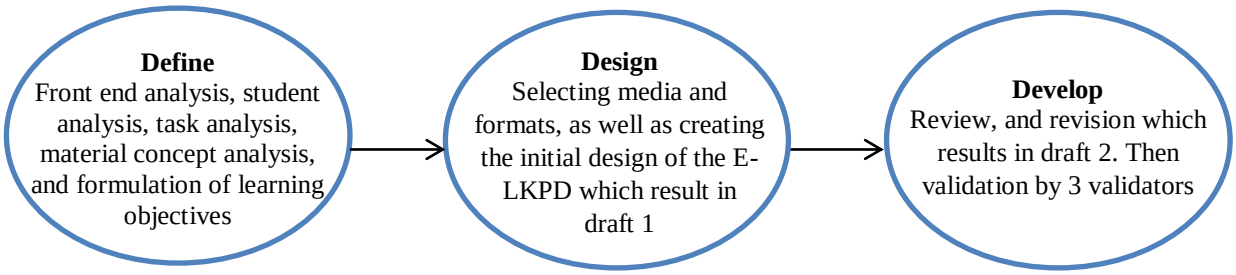

Figure 1. Design of product development

Validation is carried out on content feasibility, presentation feasibility, language feasibility, and graphic feasibility. This E-LKPD validation sheet is in the form of an observation sheet in the form of a checklist that can be filled in by giving a checklist to a score range of 1-5 with information from not good to very good. Data from the PBL-based E-LKPD validation sheet were analyzed descriptively quantitatively for each component on the validation sheet. The results are used to determine whether the E-LKPD is valid or not. Each validator will score each aspect with a Likert scale as shown in the following table.

Table 1. Likert Scale Score Validity

Category	Score
Very Valid	5
Valid	4
Moderately Valid	3
Less Valid	2
Very Invalid	1

(Adaptation from Riduwan, 2015)

Content and construct validity were analyzed based on the median value of the data. The E-LKPD developed is said to be valid if the median value is in the range ≥ 4 with valid to very valid criteria (Haladyna & Rodriguez, 2013).

RESULTS AND DISCUSSION

This study aims to produce a valid PBL-based E-LKPD used to train the creative thinking skills of grade XI students on acid-base material. This validation stage aims to provide an assessment of the E-LKPD product developed. The score 1 means the product is very invalid, score 2 means the product is less valid, score 3 means the product is quite valid, score 4 means the product is valid, and score 5 means the product is very valid. The validation process was carried out by 3 validators from 2 chemical education lecturers from Surabaya State University and 1 teacher from SMAN 1 Menganti. The following is the cover display of the E-LKPD results that have been developed.

(a) (b)

Figure 2. E-LKPD Cover Design (a) E-LKPD 1; (b) E-LKPD 2

Before validation, the product is first reviewed in the form of suggestions and comments which will be used as a reference for researchers to make revisions. The results of the review and revision of the E-LKPD developed can be seen in the table below.

Table 2. Results of Review and Revision of E-LKPD Development

No	Suggestions and Comments	Revision Result
1.	It is necessary to give directions for experimental activities after formulating the problem so that students do not feel confused.	A story is presented that directs learners about activities in the laboratory. The phenomenon is placed in phase 2 after students formulate the problem.
2.	In E-LKPD problem 2, which should discuss the problem of acid-base strength, but the example presented is only an acidic substance. It needs to be added to the basic substance	E-LKPD Problem 2 initially the substances that are exemplified are products containing HCl and CH_3COOH. Then examples of products containing NaOH and $NaHCO_3$ are added.
3	In the problem in phase 2, there is an instruction to read the literature first, so it is necessary to add an order to write a review of the literature used.	In the problem in phase 2, a command is added to write down the literature used.
4.	The tools and materials in the experiment should be determined by	In phase 3 of designing the experiment, instructions are given to write down the tools

No	Suggestions and Comments	Revision Result
	the students themselves.	and materials independently and are not available in the E-LKPD. However, students can use the knowledge gained from the phenomenon presented in phase 2.
5.	The observation table in phase 4 needs to add a command to analyze the type of substance.	Added a command to analyze the type of substance after students determine the color change in the experiment.
6.	In phase 5, the problem command given is to provide a solution, we should add a command to provide suggestions from the problem.	The addition of commands to the problem, namely the command to provide suggestions, so in addition to providing solutions, students also provide suggestions or recommendations from the problems presented.

The results of the PBL-based E-LKPD validation to train creative thinking skills on acid-base material can be seen in the following table.

Table 3. Data on the Results of PBL-Based E-LKPD Validation to Train Creative Thinking Skills on Acid-Base Material

No	Objective	Aspect Assessment	Median	Category
Content Validity				
1	Suitability of Learning Outcomes and Flow of Learning Objectives with the curriculum	The suitability of learning outcomes in the E-LKPD developed with the independent curriculum. (Page: V)	4	Valid
		The suitability of the flow of learning objectives in the E-LKPD developed with the independent curriculum. (Page: V)	4	Valid
2	The suitability of acid-base material with learning outcomes and the flow of learning objectives	The material presented is in accordance with the learning outcomes. (Page: VI)	5	Very Valid
		The material presented is in accordance with the flow of learning objectives. (Page: VI)	5	Very Valid
3	The suitability of the formulation of activities with the level of development of students	The formulation of the material activities asked is in accordance with the grade level of the learners. (Page: 3-10)	4	Valid
4	The suitability of the formulation of activities	The formulation of activities presented in the E-LKPD is in	4	Valid

No	Objective	Aspect Assessment	Median	Category
	with PBL learning	accordance with the PBL learning syntax. (Page: 2-10)		
5	The suitability of the formulation of activities with creative thinking skills criteria	The content of the developed E-LKPD contains aspects of fluency. (E-LKPD 1 page 3 and 7) (E-LKPD 2 page 3 and 6)	4	Valid
		The content of the developed E-LKPD contains aspects of flexibility. (E-LKPD 1, pages 4, 7, 8) (E-LKPD 2, pages 4, 6, 7)	4	Valid
		The content of the developed E-LKPD contains aspects of originality. . (E-LKPD 1, pages 7, 9, 10) (E-LKPD 2, pages 6, 9, 10)	4	Valid
		The content of the developed E-LKPD contains aspects of elaboration. (E-LKPD 1, pages 9, 10) (E-LKPD 2, pages 8, 10)	5	Very Valid
Construct Validity				
		Language Criteria		
6	Uses good and correct Indonesian language rules	The language used is in accordance with grammar and EYD (Refined Spelling)	5	Very Valid
7	The language used is easy for learners to understand	Sentence delivery is straightforward and straightforward	4	Valid
		The language used is easy to understand and does not cause multiple interpretations	4	Valid
		The language used is in accordance with the level of development of students' thinking	4	Valid
8	The sentence structure used is appropriate	The combination of interrelated sentences reflects the order and interconnectedness of the content.	5	Very Valid
		Presentation Criteria		
9	The presentation of E-LKPD components is	The formulation of activities in E-LKPD contains title, instructions,	5	Very

No	Objective	Aspect Assessment	Median	Category
	structured	introduction, summary of material, and assignments.		Valid
10	E-LKPD writing is consistent	The formulation of E-LKPD activities presented is consistent and systematic.	5	Very Valid
11	Presentation of supporting illustrations of E-LKPD is interesting	Presentation of pictures, tables, videos, and graphs is clear and interesting	5	Very Valid
12	Presentation of supporting illustrations E-LKPD has a complete identity and includes references	The presentation of pictures, tables, videos, and graphs supporting the E-LKPD has a complete identity and includes references.	4	Valid
		Graphics Criteria		
13	Display as teaching material in learning	The developed E-LKPD is interesting and not monotonous	4	Valid
		The cover is attractive and presents the contents of the E-LKPD	5	Very Valid
		The harmony of the layout of text and images on the E-LKPD	5	Very Valid
14	The use of illustrations is able to clarify and facilitate understanding	The use of images, graphics, videos, and photos that facilitate understanding	4	Valid
15	Typography	The use of font types and text sizes used makes it easier for readers to use E-LKPDs	5	Very Valid

Based on the table, it can be seen that the validation results of PBL-based E-LKPD to train creative thinking skills on acid-base material are in accordance with aspects of content validity and construct validity. Content validity includes the suitability of learning outcomes with ATP, acid-base material with learning outcomes and ATP, formulation of activities with the level of development of students, formulation of activities with PBL learning, and formulation of activities with creative thinking skills. The content validity of E-LKPD obtained a median score of 4 with valid criteria. Construct validity includes language criteria obtained a median score of 4 with valid criteria, presentation criteria obtained a median score of 5 with very valid criteria, and graphic criteria obtained a median score of 5 with very valid criteria. This is in line with the research of Ardiani, Rudibyani, & Efkar (2018) which states

that the development of LKPD is said to be valid seen from the results of expert validation of aspects of content suitability, construction, and readability.

In content validity, the first aspect is the suitability of learning outcomes and the flow of learning objectives with the curriculum. The median of the validator's assessment is 4 so it is declared valid. This shows that the learning outcomes and the flow of learning objectives prepared are in accordance with the independent curriculum. This is because in the planning stage, a front-end analysis is carried out which digs up information related to the curriculum applicable in schools, analyzes the needs of students, analyzes tasks, analyzes material concepts, and formulates learning objectives based on the learning outcomes of acid-base material in the independent curriculum. The second aspect is the suitability of acid-base material with learning outcomes and the flow of learning objectives. This aspect received a median score of 5 which is included in the very valid category. This is because there is a summary of the material contained in the E-LKPD discussing three sub-materials, namely the definition of acid-base, acid-base strength, and acid-base identification, and there is a problem phenomenon that supports learning. This is in line with BNSP (2012) which states that the material presented meets the feasibility of content if it has the correctness of the concept, the accuracy of the facts, and is in accordance with the learning outcomes.

The third aspect is the suitability of the formulation of activities with the level of development of students. In this aspect, the median of the validator's assessment is 4 which means valid. This is because based on Piaget's cognitive development theory, that students aged 11 years - adulthood should have a more scientific level of thinking, be able to solve abstract problems through systematic experiments, develop concerns about social issues (Nainggolan, 2021). Therefore, students at this high school level are expected to have the ability to solve problems scientifically and through systematic experiments, and think creatively to solve the problems faced. The fourth aspect is the suitability of the formulation of activities with PBL learning. The median of the validator's assessment on this aspect is 4 or can be said to be valid. This is because the formulation of activities in the E-LKPD is adjusted to the syntax of problem-based learning according to Arends (2012). This is reinforced by research by Bakti & Santoso (2021) which states that learning by giving problems requires students to be actively involved in problem solving activities, as well as a basis for practicing creative thinking skills.

The fifth aspect is the suitability of the formulation of activities with creative thinking skills criteria. Based on the validation results obtained from the validators, the E-LKPD developed received a median score of 4 with a valid category. This indicates that the content of the E-LKPD is said to be in accordance with the criteria of creative thinking skills. The creative thinking criteria trained in the E-LKPD are creative thinking skills according to Filsaime (2008) which consists of four criteria, namely fluency, flexibility, originality, and elaboration. The developed PBL-based E-LKPD provides an opportunity for learners to analyze a problem from various perspectives and develop the latest solution to the problem. In line with this, learners are encouraged to practice their creative thinking skills.

In construct validity, the validator will provide an assessment of the structure of the preparation of PBL-based E-LKPD to train creative thinking skills. The assessment consists of 3 criteria, namely three criteria, namely language, presentation, and graphic criteria. Language criteria aims to determine the suitability of the language used in the developed E-LKPD. According to BNSP (2012), language criteria consist of six indicators, namely the liveliness of communication, the accuracy of the sentence structure, the standardization of the terms used, the accuracy of grammar in accordance with Indonesian language rules, the accuracy of spelling according to Indonesian language rules, and the consistency of writing

scientific / foreign names. Based on the results of the validation of language criteria carried out by three validators, a median score of 4 was obtained with valid criteria. In line with Kosasih's research (2021), where a good E-LKPD has language that is easy to understand, clear, and communicative, so that it can facilitate students.

The presentation criteria aims to determine the presentation of material, references, sources, completeness of identity in the developed E-LKPD. According to BNSP (2012), there are five indicators of presentation criteria, namely the suitability of material presentation techniques with model syntax, concept clarity, inclusion of references/sources, completeness of table identity, images, and accuracy of numbering and naming labels, images. Based on the results of the validation of presentation criteria carried out by 3 validators, a median score of 5 was obtained with very valid criteria. Graphics criteria aim to determine the typography, appearance, and graphical illustrations used in the developed E-LKPD. According to BNSP (2012), there are three indicators on the graphic criteria, namely typography of letters used, display design, color, size, and layout, as well as illustrations used in the developed E-LKPD. Based on the results of the validation of the graphic criteria carried out by three validators, a median score of 5 was obtained with very valid criteria.

CONCLUSION

Based on the results and discussion of the research, it can be concluded that the PBL-based E-LKPD to train the creative thinking skills of class XI students on acid-base material is valid based on the median score of content validity of 4 with a valid category and construct validity of 5 with a very valid category.

RECOMMENDATIONS

Based on the results and discussion, PBL-based E-LKPD to train the creative thinking skills of class XI students on acid-base material there are suggestions that need to be considered, namely this research is only limited to measuring the validity of E-LKPD, so it is hoped that further research can include the practicality and effectiveness of PBL-based E-LKPD to train creative thinking skills.

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