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Validity Test of E-LKPD to Improve Students' Argumentation Skills on Chemical Equilibrium Material

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Abstract
The development of argumentation skills plays a role in training students to enhance their cognitive abilities, thereby facilitating the growth of their understanding. In this study, the LKPD was created in electronic form, accessible at any time and from any location by individuals with an access link. This E-LKPD contains a series of questions pertaining to each aspect of argumentation skills, accompanied by learning videos that can be accessed without the need to open a new page. The objective of this research is to develop a valid E-LKPD to enhance students' argumentation skills in the context of chemical equilibrium. The methodology employed in this study is Research and Development (R&D) using the 4D development model proposed by Thiagarajan, which encompasses the following stages: define, design, develop, and disseminate. However, this study was limited to the development stage, with a limited trial conducted to assess the product's applicability. This limitation is based on several considerations, including time, energy, and limitations. Validation was conducted by three validators, comprising two chemistry education study program lecturers and one chemistry subject teacher. The validity score was then produced and analyzed using the mode method. Based on the results of the research conducted, it can be seen that the results of the validity of E-LKPD on content validity, obtained mode 5 with a very valid category and validity.

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INTRODUCTION

As Deane and Song (2014) posit, argumentation plays a pivotal role in the development of critical thinking patterns and a profound comprehension of an idea. Erduran (2008) in Argumentation in Science Education asserts that every student in a lesson truly requires argumentation, which aims to fortify a student's self-understanding. In accordance with the demands of the 21st century, one of the skills that students must possess is argumentation skills. These skills can enhance understanding of the scientific process (Kuhn & Udell, 2007). This is supported by Karisan (2015), who asserts that argumentation-based learning can facilitate the development of science concepts and provide argumentation-based learning experiences. In the context of chemistry learning, students are expected to develop their skills in accordance with the skills required in the 21st century.

In facing the challenges of the 21st century, developing critical and analytical thinking skills is crucial for students to navigate and tackle complex global issues (Almazroui, 2023; Baran et al., 2021). This theme explores the integration of computational chemistry into STEM

education through a project-based learning (PBL) approach (Saad & Zainudin, 2022). By utilizing computer simulations and hands-on projects, this method enhances students' understanding of scientific concepts and hones their problem-solving skills (Carlgren, 2013). The synergy between computational chemistry and PBL not only strengthens theoretical knowledge but also fosters collaboration, creativity, and real-world applications, preparing students to become innovative thinkers capable of addressing contemporary scientific and technological challenges (Hulyadi et al., 2024; Muhali, 2019).

One of the competencies of the 4C framework is critical thinking and communication skills. These critical thinking and communication skills are packaged into one unit in argumentation skills (Devi, 2018). This is also consistent with the findings of Prayitno, et al. (2018), which indicate that argumentation skills are crucial for effective science learning. They enable students to engage in logical reasoning, develop clear views, and provide rational explanations of the knowledge they have acquired. Critical thinking involves the ability to analyze information, evaluate evidence, and form well-reasoned conclusions. In the realm of science education, critical thinking allows students This involves assessing scientific claims, identifying assumptions, and discerning logical connections between ideas (Alsaleh, 2020; Behar-Horenstein & Niu, 2011; Billah et al., 2021). Students learn to articulate their thoughts coherently, ensuring their viewpoints are well-founded and supported by evidence. Critical thinking enables students to justify their understanding and interpretations of scientific phenomena, making their reasoning transparent and understandable to others (Akpur, 2020).

(Baccarani & Bonfanti, 2015) repots effective communication skills are essential for expressing complex ideas clearly and persuasively. In the context of argumentation, communication skills help students. Students learn to present their arguments in a structured and logical manner, making their case compelling and easy to follow. Effective communication facilitates meaningful dialogue among peers, allowing for the exchange of ideas and collaborative problem-solving (Morreale et al., 2000; Savithri, 2010). Good communication ensures that students can explain their reasoning and conclusions, making their knowledge accessible to a broader audience. Through argumentation, students practice constructing and deconstructing arguments, honing their ability to reason logically and critically. Argumentation encourages students to refine their thoughts and develop well-defined perspectives on scientific issues. The process of argumentation requires students to back up their claims with evidence and rational explanations, fostering a deeper understanding of scientific concepts (La?cu, 2023)

Integrating argumentation into science education involves creating opportunities for students to practice these skills regularly (Guilfoyle et al., 2023; Mikeska & Lottero-Perdue, 2022). This can be achieved through. Facilitating classroom debates and discussions on scientific topics encourages students to articulate their arguments and engage with differing viewpoints. Implementing problem-based learning scenarios where students must use argumentation to propose and defend solutions to scientific problems. Assigning tasks that require students to write scientific essays or reports, emphasizing the need for clear, evidence-based arguments. In summary, critical thinking and communication skills are fundamental components of argumentation skills, which are crucial for effective science learning (Chang et al., 2022). By developing these skills, students are better equipped to engage in logical reasoning, articulate clear views, and provide rational explanations of scientific knowledge. Integrating argumentation into science education not only enhances students' understanding of scientific concepts but also prepares them to navigate and address complex real-world issues (Martins, 2024).

Based on the results of preliminary research conducted at SMAN 1 Menganti on Monday, June 19, 2023, which took 16 respondents from class XI as a sample, it was found that 68.75% of respondents believed that students' understanding of the concept of chemical equilibrium

material was still lacking and too much memorization of factors that affect the direction of chemical equilibrium. The difficulty of students in understanding chemistry learning is because chemistry is abstract and complex concepts that require a deep understanding to learn (Sariati, 2020). Some of the difficulties experienced by students in learning chemistry tend to be caused by students who do not know how to learn, have difficulty making connections between concepts, and require the ability to utilize logic, mathematics, and language skills (Zakiyah, 2018). Training in argumentation skills is expected to improve students' understanding of chemistry, especially chemical equilibrium materials. The argumentation structure in this study was adapted from Toulmin, which consists of six components, namely (1) statement (claim), (2) data (evidence), (3) justification (warrant), (4) support (backing/support), (5) qualification (qualifier), and (6) refutation (rebuttal). One of the materials taught in the independent curriculum is chemical equilibrium material. Irreversible reaction is a reaction that occurs in one direction. (Sulastri & Susila, 2010). Chemical equilibrium is included in reversible reactions (Chang, 2005). According to Chang (2005), there are several factors that affect the direction of the equilibrium shift, namely concentration, pressure and volume, and temperature.

In order to facilitate the learning process, it is necessary to have media that is considered feasible and valid in this context. The media in question is the Electronic Learner Worksheet (E-LKPD). According to Dhari and Haryono (1998), the Learner Worksheet is defined as a sheet that contains guidelines for students to carry out programmed activities. The selection of LKPD in electronic form is based on technological developments that teachers are expected to improve the quality of learning, namely by utilizing computer and Android-based learning resources. In addition, according to sources in the preliminary study, in the field there is still limited learning media in the form of student worksheets that focus on argumentation skills. In the development of a learning device, there are several indicators that must be achieved, one of which is validity.

The utilization of data instruments that have undergone rigorous testing for validity can enhance the strength of the research results (Devon, 2007). In general, there are three primary approaches to examining the validity of a measuring instrument: 1) content validity, 2) construct validity, and 3) criterion validity (Suryabrata, 2005). Validity testing pertains to the interpretation of scores derived from research instruments (Cook, 2006). Content validity is a form of validity that concerns itself with the elements present within the measure in question (Coaley, 2010). In the context of measurement, criterion validity refers to the ability of a measuring instrument to be linked with other measuring instruments as criteria. This is achieved by demonstrating that the measuring instrument can be explained by the results of its correlation with its criteria, based on existing theory (Devellis, 2003). Construct validity, on the other hand, is a description that shows the extent to which the measuring instrument produces results that align with the theory (Azwar, 2005). However, the validity measured in this study is limited to content and construct validity. In light of the aforementioned background, the author conducted a study entitled "E-LKPD Validity Test to Improve Students' Argumentation Skills on Chemical Equilibrium Material." The objective of this study was to ascertain the validity of the E-LKPD in improving students' argumentation skills on chemical equilibrium material.

METHOD

This research is a development research project with the aim of developing an E-LKPD to improve argumentation skills on chemical equilibrium material for class XI SMA based on the independent curriculum. Research and development is a research method used to produce certain products and test their effectiveness (Sugiyono, 2016). The development of this E-LKPD is guided by the development design according to Thiagarajan (1974) in Ibrahim (2002), namely 4D development, which includes define, design, develop, and disseminate. However, this study was limited to the development stage with a limited trial to determine the applicability of the product. This restriction is based on several considerations, including limited time, energy, and funds. Consequently, it is not feasible to conduct research on a large scale or across a broad spectrum (Sari, 2016).

The research instrument utilized is the E-LKPD validity sheet, which is employed in the assessment activities conducted by validators on the content and construct validity of E-LKPD with the objective of enhancing argumentation skills. The E-LKPD validity sheet can be completed by providing a checklist of the score range assigned. The E-LKPD validity sheet contains seven statements regarding content validity and seven statements regarding construct validity. Each aspect is scored on a scale of 1 to 5, with 1 representing invalid information and 5 representing highly valid information (Riduwan, 2015). The data analysis technique used to assess the validity of E-LKPD is the mode method (Gulo, 2002). In the event that the mode value is not identified, the median method may be employed. The scoring of validators for each aspect is based on the following table.

Table 1. Likert Scale Score Validity

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

(Adapted from Riduwan, 2015)

Table 1 indicates that the developed E-LKPD is valid if the mode or median value is ≥ 4 with valid criteria.

RESULTS AND DISCUSSION

The research conducted represents a development study designed to ascertain the validity of the E-LKPD in enhancing students' abilities to construct logical arguments on the subject of chemical equilibrium. The study yielded data in the form of E-LKPD validity.

A. Validity of E-LKPD

The data analysis technique employed in the E-LKPD validity assessment instrument is the E-LKPD validation sheet. The validity of the E-LKPD is determined by the assessment provided by three validators, comprising two chemistry education study program lecturers and one chemistry teacher. The results of the validity assessment of the E-LKPD, which have been analyzed, indicate that the overall validity assessment aspects score 4 and 5 in the very valid category. This indicates that the E-LKPD, developed for this purpose, is included in the LKPD, which has been demonstrated to be effective in improving students' argumentation skills.

Table 2. Validity Result of E-LKPD

No.	Components Assessed	Modus	Category
Content Validity			
1.	The material in the E-LKPD is in accordance with the Learning Outcomes (CP) and Learning Objectives (TP)	5	Very Valid
2.	E-LKPD improves argumentation skills in the aspect of claims in students	5	Very Valid
3.	E-LKPD improves argumentation skills in the aspect of data in students	4	Valid
4.	E-LKPD improves argumentation skills in the warrant aspect in students	5	Very Valid
5.	E-LKPD improves argumentation skills in the backing aspect for students	5	Very Valid
6.	E-LKPD improves argumentation skills of qualifier aspects in learners	4	Valid
7.	E-LKPD improves argumentation skills in the rebuttal aspect of learners	5	Very Valid
Construct Validity			
8.	E-LKPD uses simple sentences that are easy for students to understand.	5	Very Valid
9.	The words or terms used in the E-LKPD are appropriate and consistent	5	Very Valid
10.	E-LKPD uses the right font type and size	5	Very Valid
11.	The color composition used in E-LKPD is appropriate	5	Very Valid
12.	The combination of text and image arrangement in E-LKPD is interesting and harmonious	5	Very Valid
13.	E-LKPD used in electronic form that can be accessed via laptop, computer, or smartphone	5	Very Valid
14.	There is an informative menu for collection and going to other pages	5	Very Valid

Table 2 indicates that each assessment criterion on E-LKPD has a minimum mode of 4, thus categorizing it as valid and very valid. In this case, two components were categorized as valid, while twelve other components were categorized as very valid. The validation sheet developed consists of content validity and construct validity. Content validity is reviewed from several components, namely:

- The suitability of the E-LKPD content with learning outcomes and objectives gets mode 5 with a very valid category.
- The suitability of E-LKPD content with argumentation skills in the claim aspect gets mode 5 with a very valid category, which indicates that the developed E-LKPD can

train students to provide opinions or statements that are believed to be true (Toulmin, 2003).

- The suitability of the E-LKPD content with the data aspect argumentation skills gets mode 4 with a valid category, which indicates that the developed E-LKPD can train students in providing evidence to support claims (Toulmin, 2003).
- The suitability of E-LKPD content with warrant aspect argumentation skills gets mode 5 with a very valid category which indicates that the developed E-LKPD can train students in writing theories or principles related to claims and data (Chen & She, 2012).
- The suitability of E-LKPD content with argumentation skills in the support aspect gets a mode 5 with a very valid category which indicates that the E-LKPD developed can train students in providing support consisting of claims, and or with data or justification (Chen & She, 2012).
- The suitability of E-LKPD content with argumentation skills in the qualifying aspect gets mode 4 with the valid category, which indicates that the E-LKPD developed can train students in the qualifying aspect.
- The suitability of the E-LKPD content with argumentation skills in the rebuttal aspect gets mode 5 with a very valid category, which shows that the developed E-LKPD can train students in providing rebuttals to statements that anticipate the truth of claims (Toulmin, 2003).

While in construct validity there are several components, namely:

- The criteria for graphics include phenomena, writing, and/or images, as well as color combinations, which were rated as mode 5 with a very valid category.
- The criteria for language include clarity of information, the use of words or terms, and the ease of understanding by students. These criteria are met by the mode 5, which is therefore awarded a very valid category.

In terms of content validity, the suitability of E-LKPD content with learning outcomes and objectives is rated as mode 5 with a very valid category. This indicates that the material contained in the E-LKPD is consistent with the learning outcomes and objectives to be achieved. With regard to the suitability of the E-LKPD content with argumentation skills, it is rated as mode 4 and 5 with valid and very valid criteria. The argumentation aspects of this study are based on the argumentation structure according to Toulmin (2003) and adapted from a journal entitled The Impact of Recurrent Online Synchronous Scientific Argumentation on Students' Argumentation and Conceptual Change from Chen & She (2012), which consists of six aspects: claim, data, warrant, backing, qualifier, and rebuttal.

At this juncture, the researcher must implement improvements and suggestions as directed by the validator. These pertain to the initial claim, which consisted of two claims. Subsequently, improvements were made so that it only used one claim. This claim was then assessed by students with a statement of "agree" or "disagree." In the scientific phenomenon section, there have been improvements to replace the phenomenon with a more contextual approach and to apply chemical equilibrium. Subsequently, the problem formulation and hypothesis section was refined to eliminate it, thereby enabling students to concentrate on questions pertaining to argumentation skills. Furthermore, the data aspect, which initially comprised a distinct question regarding data, was enhanced to integrate it with data collection in the form of experimental or observational tables. In the warrant aspect, which was originally a question related to the relationship between the evidence submitted and the learner's statement, an improvement was made to replace it with a question about the guarantee in the form of principles or theories related to the

assessment of the claim. In the qualifier aspect, an improvement was made to add a simple narrative about the scientific phenomenon that has been presented. In the rebuttal aspect, an improvement has been made to include a narrative about other issues that can be refuted by students.

The National Standards Agency (BSNP, 2012) stipulates that several aspects must be included in the development of LKPD. These include aspects of content feasibility, linguistic aspects, presentation aspects, and graphical aspects. The aspects assessed in this study were summarized into two criteria, namely graphic and linguistic criteria. In construct validity, the E-LKPD graphical criteria received a mode 5 with a very valid category. The existence of phenomena, the arrangement of text and images, and attractive color combinations are expected to motivate students to work on E-LKPD. However, in this case, there are improvements in the size and type of letters and the addition of images to each phenomenon. With regard to the linguistic criteria, the E-LKPD receives a mode 5 with very valid criteria, indicating that the E-LKPD developed contains information and the use of words or terms that are easily understood by students. This indicates that the E-LKPD developed is a satisfactory E-LKPD, as it fulfills several requirements for the feasibility of LKPD according to BSNP.

The assessment results of the three validators on the developed E-LKPD indicate that the E-LKPD is highly valid for use with modes 4 and 5, which have been classified as valid and very valid. In accordance with the suggestions and improvements from the three validators, the E-LKPD has been revised to obtain an E-LKPD with valid and very valid categories.

B. Discussion

The E-LKPD developed in this study leverages the Liveworksheet website to create interactive online worksheets for students. This innovative tool generates a link that students can easily access to engage with the content, without the need for cumbersome processes like logging in with a username and password or downloading specific applications. The E-LKPD is designed for easy access, eliminating the need for students to create accounts or remember login credentials. This simplicity encourages more frequent and spontaneous use. Since it is web-based, students can access the E-LKPD directly through their browsers, avoiding the hassle of downloading and installing additional software. The Liveworksheet platform allows educators to embed supplementary learning materials such as videos. These resources provde visual and auditory learning aids, helping students better understand the concepts and answer questions related to argumentation skills. Although the website restricts content to nine pages per worksheet, this limitation is cleverly managed by linking to subsequent pages at the bottom of each E-LKPD. This seamless navigation ensures that students can continue their learning journey without interruption (Ardiansah & Zulfiani, 2023).

The study's results indicate that the developed E-LKPD is valid, as evidenced by the evaluations from various validators. Each validator assessed the E-LKPD based on several validity components, ensuring its adherence to theoretical principles. The high scores received from these validators suggest that the E-LKPD is a reliable and effective educational tool. Ensures that the E-LKPD covers all necessary aspects of the argumentation skills curriculum comprehensively. Confirms that the structure of the E-LKPD accurately represents the theoretical constructs of argumentation skills. This theory emphasizes the structure of arguments, including components such as claim, data, warrant, backing, qualifier, and rebuttal (Ardiansah & Zulfiani, 2023). The E-LKPD integrates these elements to guide students in constructing well-rounded arguments. This framework

focuses on the pedagogical strategies for teaching argumentation skills. It advocates for interactive and engaging methods, which the E-LKPD supports through its multimedia features and interactive exercises. The E-LKPD not only aligns with theoretical frameworks but also provides practical benefits in the classroom (Setiawati et al., 2023).

The integration of multimedia elements like videos makes the learning experience more engaging and interactive, helping to maintain student interest and improve retention of information. By focusing on argumentation skills, the E-LKPD helps students develop critical thinking, logical reasoning, and effective communication skills (Baccarani & Bonfanti, 2015; Childs et al., 2015). These competencies are crucial for academic success and real-world problem-solving. The straightforward design and accessibility of the E-LKPD make it an efficient tool for teachers, allowing them to focus more on instruction and less on administrative tasks related to technology management. The E-LKPD developed in this study represents a significant advancement in educational technology, offering a user-friendly, accessible, and theoretically sound tool for enhancing students' argumentation skills. By leveraging the capabilities of the Liveworksheet platform, the E-LKPD provides a robust framework for interactive and engaging learning experiences, aligning with modern educational needs and pedagogical best practices (Savithri, 2010).

CONCLUSION

The developed E-LKPD has been validated based on the acquisition of a mode score of 5 for content validity, indicating that the criteria were highly valid, and a mode score of 5 for construct validity, indicating that the criteria were highly valid.

RECOMMENDATIONS

This research is limited to the validation of the E-LKPD, with the objective of improving the product development process by determining the practicality and effectiveness of the developed product.

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