



Validity of Structured Assignment Sheet to Train Argumentation Skills on Buffer Solution

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Abstract

The purpose of this study was to produce structured task sheets to practice argumentation skills on buffer solution material. This research is a development research to produce products with the ADDIE development model which is limited to the design and development analysis stage. The developed structured assignment sheet contains enriched questions to practice argumentation skills on buffer solution material. The data obtained in this study is the feasibility of the validity aspect. The instruments used to obtain content and construct validity data were validation sheets assessed by three validators. Learning devices are declared to meet the validity criteria (based on content and construct) if they get a minimum rating mode (Mo) of 4 (valid) from the range 1 to 5 on a Likert scale. The results showed that according to the assessment component, both content and construct validity got an assessment mode (Mo) of 5 (very valid). The developed structured task sheets are declared valid to train argumentation skills.

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INTRODUCTION

21st century learning applies creativity, critical thinking, cooperation, problem solving, communication skills, community and character skills (Mardhiyah et al., 2021). Schools as educational institutions are also required for students to have important skills in the 21st century, including creative thinking, critical thinking and problem solving, communication, and collaboration or commonly referred to as the 4Cs (Kivunja, 2015; Septikasari & Frasandy, 2018). 21st century skills should be focused on real problems and solution seeking to encourage learner engagement (Trilling & Fadel, 2009).

Ennis (2011) defines critical thinking as reasonable and reflective thinking that focuses on deciding what to believe. Every person has the ability to become a reliable critical thinker, learning that emphasizes on critical and analytical thinking process to seek and find their own answers to a questionable problem (Novayani et al., 2016; Suryati & Hatimah, 2015). The US-based Partnership for 21st Century Skills (P21) (2015) defines communication skills as conveying thoughts and ideas effectively using oral, written and nonverbal in various forms and contexts, so that learners have effective communication skills (Najamuddin, 2022). Critical thinking skills and communication skills can be trained in argumentation argumentation skills (Devi et al., 2018). Through argumentation skills, students can communicate reasonable opinions and critical thinking in evaluating evidence (Osborne, 2011; Osborne et al., 2015).

Argumentation skills are the ability a person has to express and defend their arguments or statements with corroborating evidence so that people believe and accept these arguments, with argumentation skills students can convince others because their opinions are accompanied by corroborating evidence (Rahayu et al., 2018). Argumentation-based learning is an approach for students to provide reasons accompanied by consideration, evaluation, opposition, and supported by data from various sources (Yildirim & Turk, 2018). Zohar & Nemet (2002) suggest that teaching good argumentation skills can be achieved when learning focuses on real problems that occur in learners' daily lives, the result is that learners become more engaged in argumentation activities and scientific discourse.

Based on previous research that has been conducted to determine the argumentation skills of students in several regions, it shows that students' argumentation skills are at low to moderate criteria. This is reinforced by the results of research conducted by Devi et al (2018), that the argumentation of class X students in a state high school is mostly at level 2 (48.1%) and level 1 (51.9%). Furthermore, research from Sudarmo, Lesmono, & Harijanto (2018), that the level of scientific argumentation of high school students in SMA A is classified as moderate (51.98). The argumentation ability of students is influenced by various factors this might be because some students have different prior knowledge about subjects, therefore the role of teachers is very important in developing argumentation skills (Demircioglu et al., 2022).

Permendikbud RI Number 36 of 2018 concerning changes to the Regulation of the Minister of Education and Culture Number 59 of 2014 concerning the 2013 Curriculum for Senior High School / Madrasah Aliyah, the learning load for structured assignments and independent activities, a maximum of 60% of the face-to-face activity time of the subject concerned. Based on the obligations of students in Permendikbud RI Number 36 of 2018, learning tools are needed that can support structured assignment activities in chemistry subjects so that students explore the material more deeply. Therefore, the researcher attempted to develop an Argumentation Ability Structured Assignment Sheet which was hereinafter given the acronym LPT-KA. LPT-KA developed by researchers contains practice questions to train students' argumentation skills on buffer solutions.

Structured assignment sheets are worksheets designed to guide and assist students in understanding lessons with little help from the teacher to achieve learning objectives (Kundi, 2013). Structured assignments have several advantages, namely: (1) providing opportunities for students to do exercises and learn on their own, (2) structured assignments can stimulate students to learn more, (3) structured assignments can better convince students of what is learned from the teacher, (4) can provide a sense of responsibility and discipline of students, and (5) can provide the habit of students to find and manage the assigned tasks themselves (Damayanti, 2016), through structured assignments teachers can review learners' skills in communicating the results of thinking about the question.

Buffer solutions have the characteristics of conceptual material which means that students must understand the concepts well (Nurhujaimah et al., 2016). The development of successful conceptual understanding to solve buffer solution problems requires that students have factual knowledge, procedural knowledge, and conceptual knowledge about the topic (Salame et al., 2022). Buffer solution material also requires understanding and mastery of supporting materials, such as the concepts of moles, acid-bases, solutions, stoichiometry, and chemical equilibrium (Firdaus et al., 2021). Based on the research results, it was found that the level of student understanding in understanding the concept of buffer solution is classified as low with percentage of 32.3%, the number of students who do not understood the concept reached 38.1%, while 20.6% students experience misconceptions (Firdaus et al., 2021)

LPT-KA raises issues related to “How is the validity of Argumentation Ability Structured Assignment Sheet (LPT-KA) to train argumentation skills on buffer solution?” The purpose of this research is to produce LPT-KA that follows the standard of learning tools by valid for use as learning tool. LPT-KA needs to be tested for validity to determine its validity based on content and construct. By obtaining data related to validity, the developed LPT-KA is expected to train argumentation skills and make it easier for students to understand buffer solution material, can be a reference for assignment sheets, and a reference in developing chemistry learning tools to train argumentation skills.

METHOD

The type of research used in this study is development research. ADDIE stands for Analyze, Design, Develop, Implement, and Evaluation. ADDIE is a product development paradigm and not a model itself. The ADDIE concept is applied here to intentional learning environments (Branch, 2009). This research which is limited to the analysis, design, and development stages because this research was conducted to determine the validity of LPT-KA based on content and construct. The place and time of the research was conducted at Surabaya State University which was validated by two chemistry lecturers and at SMA Negeri 2 Bojonegoro by a chemistry teacher on April 17, 2023 to April 24, 2023. The target/goal of this research is that the draft LPT-KA meets the eligibility criteria based on validity.

The operational steps taken in achieving the research objectives are as follows: (1) formulating argumentation skill indicators, (2) developing the content of LPT-KA (containing questions and KA indicators), (3) developing participant validation sheets along with guidelines, (4) consulting the contents of LPT-KA and validation sheets to the supervisor, (5) validation process by three *experts* in the field of chemistry learning, (6) data organization and analysis, and (7) concluding the research results. Data collection techniques used through the validation method. Validation was conducted to determine the validity and quality of the LPT-KA developed based on content and construct aspects. Through the validation method, the LPT-KA developed was assessed by three experts.

The data obtained from the LPT-KA validation sheet by experts were analyzed descriptively quantitatively. In processing research data using a Likert scale to obtain research data on validation sheets filled in by three validators with the following criteria.

Table 1. Likert Scale

Criteria	Score/Value
Very Valid	5
Valid	4
Fairly Valid	3
Invalid	2
Very Invalid	1

(Source: Sugiyono, 2021)

Based on these criteria, the validity data (content and construct) of the LPT-KA is analyzed descriptively quantitatively using the frequently occurring score (Modus/Mo) obtained from the expert assessment on the validation sheet is at least 4 (valid) (Lutfi, 2021).

RESULTS AND DISCUSSION

Before being implemented in chemistry learning, the LPT developed needs to be tested, one of which is through feasibility on eligibility criteria including validity (construct and content) (Afni & Suyono, 2021; Nieveen, 2010). In the steps of product development, the ADDIE

development research model is considered more rational and more complete so this research uses the ADDIE model. Cahyadi (Cahyadi, 2019) provides further explanation of the stages of ADDIE development as follows:

Analysis and Evaluation Phase

The analysis stage is conducted to identify the problems that occur. At this stage, a learner needs analysis and curriculum analysis were conducted.

Needs Analysis

Needs analysis was conducted to determine the basic problems of the need for the development of Structured Assignment Sheets in practicing argumentation skills (LPT-KA). In the needs analysis, an interview was conducted with the chemistry teacher targeted for the implementation plan. In the interview, information was obtained that the learning carried out for grade XI students did not support the training of argumentation skills. Grade XI chemistry learning uses teaching materials, namely student books and is supported by other learning media to support learning, such as *power points*, but has not explicitly trained argumentation skills.

Curriculum Analysis

Curriculum analysis was conducted to determine the curriculum used and determine the appropriate material to develop LPT-KA. Curriculum analysis is obtained from the results of interviews with the deputy principal of the curriculum at the target high school of the implementation plan. based on the results of the interview at the high school for class XI used the 2013 curriculum. The content of KD 3.12, which is to explain the working principle, pH calculation, and the role of buffer solution in the body of living things. The reason for using KD 3.12 as a vehicle for practicing argumentation skills, namely KD 3.12 is implicitly relevant and supports argumentation skills. In KD 3.12 there is an indicator of explaining which means explaining or providing a deeper explanation, in line with the indicators of argumentation skills in the Toulmin indicator of the warrant / reason part.

Evaluation and Revision Stage Analysis

Based on the results of the needs analysis and curriculum analysis, researchers conducted joint evaluation activities with the supervisor to ask for advice regarding the selection of buffer solution material as a vehicle for practicing students' argumentation skills. In this evaluation, the supervisor provided input to link KD 3.12 with the argumentation skills indicator, so that there was a relationship between the selection of buffer solution material and argumentation skills. The mentor provided an article on argumentation skills so that researchers could better understand what would be trained to students.

Design and Evaluation Phase

The design stage is carried out to facilitate the manufacture of LPT-KA. In making the initial design of LPT-KA on buffer solution material, several activities were carried out, namely

Draft LPT-KA

At this stage the researcher made an initial design of the LPT-KA to be developed, namely: (1) design the LPT-KA *cover* page that represents the content; (2) content format division LPT-KA buffer solution is in accordance with the sub-learning objectives to be achieved, which have five parts: (a) the first part (Part I) contains operational instructions for working with the LPT-KA and LPT-KA Indicators. (b) the second part (Part II) contains examples of LPT-KA work, used for the sub KD of understanding buffer solutions, (c) the third part (Part III) contains LPT-KA sub KD working principle of buffer solution, (d) the fourth part (Part IV) contains

LPT-KA sub KD calculation of pH of buffer solution, (e) the fifth part (Part V) contains LPT-KA sub KD the role of buffer solution in the body of living things; (3) collecting references to be used in the preparation of LPT-KA. The references used in this research are through journals and websites.

Draft LPT-KA Feasibility Instrument

The LPT-KA feasibility instrument design stage contains the design of the assessment that will be used to determine the feasibility of the LPT-KA developed, the feasibility is based on validity. The validity of the LPT-KA product that will be developed through the validation sheet is carried out by three validators, namely two chemistry lecturers and one chemistry teacher who will assess in terms of content and construct of LPT-KA.

Design Stage Evaluation and Revision

Evaluation and revision activities at the design stage with the supervisor have revisions related to the validation sheet instrument, namely the instructions for the page to be validated.

Development Stage

The LPT-KA development stage begins with the creation of a cover that represents the contents of the LPT-KA.

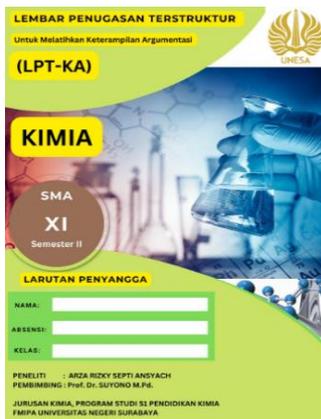


Figure 1. LPT-KA cover

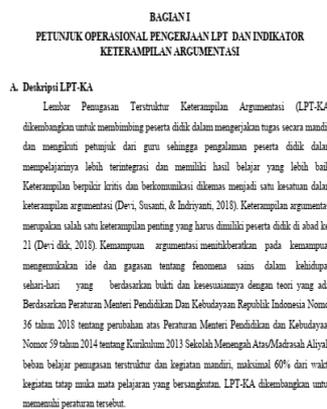


Figure 2. LPT-KA Part I

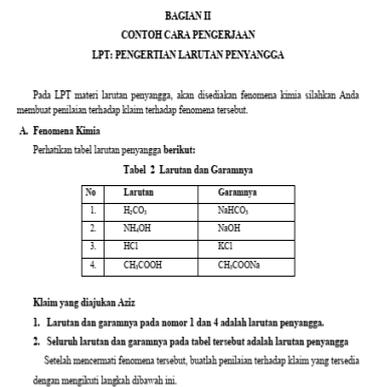


Figure 3. LPT-KA Part II

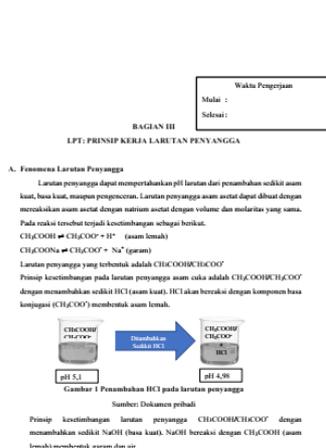


Figure 4. LPT-KA Part III



Figure 5. LPT-KA Part IV



Figure 6. LPT-KA Part V

Revision Stage

Table 2. Suggestion and Feedback for Revision

No.	Suggestions and Feedback	After Improvement
1.	The LPT-KA product in Part I entitled "Argumentation Skills Indicators and Operational Instructions for Working on the LPT" received the suggestion of the title "Operational Instructions for Working on the LPT and Argumentation Skills Indicators".	Title change in Section I to "Operational Guidelines for LPT and Argumentation Skills Indicators"
2.	In Section II Examples of How to Work on LPT: Definition of Buffer Solution, add a sentence that contains an order / appeal to read the phenomenon provided and direct learners to read examples of assessment work and proof of claims.	Addition of sentence "In the LPT of buffer solution material, chemical phenomena will be provided, please make an assessment of the claims on these phenomena" "After looking at the phenomenon, make an assessment of the available claims by following the steps below"
3.	In each section of the LPT, the title is annotated with "LPT:" indicating that the learner	The addition of "LPT:" to the titles of sections II, III, IV, and V of the buffer solution sub-material.
4.	Correction of grammatical errors contained in LPT-KA	Correction of grammatical errors contained in LPT-KA

LPT-KA Validation

At this stage, the researcher validated the LPT-KA product that had been developed to the validator to obtain an assessment related to the content validity and construct validity of LPT-KA. This research produces feasibility data on the validity aspect in terms of the content and construct validity of the LPT-KA product

Content Validity

Content validity, referred to as "definitional validity" and "logical validity", estimates the conformity of the items on the instrument to the content or subject matter that the instrument is intended to measure (Newman et al., 2013). The content validity eligibility criteria include the suitability of the LPT-KA developed with the content eligibility criteria. Content validity according to Rubio, Berg-Weger, Tebb, Lee, & Rauch (2003) contains assessment items in assessing how good the material/content in a work is, an instrument with good content validity should include only relevant and essential items that match the construct of the instrument. In the content validity assessment aspect, there are two components assessed by three validators. The LPT-KA developed has 5 parts, which will be described as follows.

Table 3. Results of Content Validation of LPT-KA

No.	Assessed Component	Modus (Mo)	Criteria
1.	The correctness of facts, concepts, principles, laws, and theories contained in LPT-KA.		
	a. Part 2	5	Very Valid
	b. Part 3	5	Very valid
	c. Part 4	5	Very valid
	d. Part 5	5	Very valid
2.	The content/topic has relevance to the argumentation skills set as the learning target.	5	Very valid

Based on Table 3, the results of validation by three validators on the 1st component points a, b, c, and d and the 2nd component get an assessment score with a modus (Mo) of 5 very valid

criteria. The first component of content validity related to the truth of facts, concepts, principles, laws, and theories contained in LPT-KA part II, part III, part IV, and part V all get an assessment mode from the three validators of 5 with very valid criteria. Based on the results of the assessment of the three LPT-KA validators, all parts have met the eligibility criteria in the aspect of validity because it gets mode 5 with very valid criteria in accordance with the facts, concepts, principles, laws and chemical theories in KD 3.12 stipulated in the revised 2013 curriculum.

The relevance component of the content/topic to the argumentation skills set as the learning target received a rating mode of 5 from the three validators with very valid criteria. The results of the assessment by the three validators show that LPT-KA can support learning targets, namely students can provide claims, collect data (evidence), provide reasons (warrant), provide support (backing), show qualifications (qualifiers), and provide rebuttal with the vehicle KD. 12 in the revised 2013 curriculum which contains explaining the working principles, pH calculation, and the role of buffer solutions in the bodies of living things with indicators of KD 3.12 achievement, namely, students can: 1) explain the meaning of buffer solution, 2) explain the working principle, 3) explain the calculation of the pH of buffer solution, and 4) explain the role of buffer solution in the body of living things in everyday life.

Thus, the content of LPT-KA can be accounted for scientifically correct from a scientific point of view (Sadjati, 2012) and in accordance with the background of the development of LPT-KA, related to argumentation skills is one of the main objectives of science learning, because students must be able to provide scientific explanations of natural phenomena and use them to solve problems (Hardini & Alberida, 2022).

Construct Validity

Construct validity relates to the ability of LPT-KA to guide learners to practice KA. Basically, construct validity must provide evidence on all criteria that build the construct. The evidence will then be confirmed, resulting in the conclusion of the construct validity test (Cronbach & Paul, 1995). Construct validity is also related to validity by definition, which is when an instrument can measure certain symptoms as defined, the instrument has met construct validity (Hidayati, K. & Caturiyati, 2004). The LPT-KA eligibility criteria based on construct validity is based on the suitability between the substance administered in the LPT-KA and the argumentation skills indicators. The following are the results of the LPT-KA construct validation by three validators.

According to Table 4, the validation of the LPT-KA construct obtained the results of all aspects that have been assessed by the three validators getting an assessment mode with a score of 5 on each aspect with very valid criteria except for statement number 4 point a) getting an assessment mode with a score of 4 with valid criteria. The first component related to the LPT-KA cover gets mode 5 very valid criteria. The results of the assessment from the validator show that the cover of the LPT-KA developed has represented its contents, so that students get information on the material to be learned by looking at the LPT-KA cover.

According to Gunawan, Hagijano, and Pratama (2014), the cover is not only useful as an attention grabber, but as a communication tool that provides information about the contents of the book. The second component related to the place to provide a place to provide answers to questions received an assessment of 5 from three validators, then got a mode of 5 very valid criteria. The assessment results from the three validators show that LPT-KA has provided a place for students' answers in section III, section IV, and section V, so that after working on LPT-KA. A place to provide answers is important to provide, because the questions given on the LPT-KA are in the form of essays, so a place to provide students' answers is important for researchers to be able to assess and analyze the results of students' answers.

Table 4. Results of LPT-KA Construct Validation

No.	Assessed Component	Modus (Mo)	Criteria
1.	LPT-KA cover represents the content	5	Very Valid
2.	There is a place to provide answers to questions	5	Very Valid
	The completeness of the components presented in the LPT-KA is present:		
	1) Cover	5	Very Valid
	2) Foreword	5	Very Valid
3.	3) Table of Contents	5	Very Valid
	4) Table List	5	Very Valid
	5) List of Images	5	Very Valid
	6) KA Indicator	5	Very Valid
	7) Parts 1, 2, 3, 4, and 5	5	Very Valid
4.	Provide direction on assessing claims	5	Very Valid
5.	Provide direction to show evidence/data.	5	Very Valid
6.	Provide direction on drafting warrants/reasons.	5	Very Valid
7.	Provide direction show backing/support	5	Very Valid
8.	Provide direction to show qualifiers	5	Very Valid
9.	Provide direction on drafting rebuttals	5	Very Valid

The third component related to the presentation component of LPT-KA each received a rating of 5 from three validators, so it got a mode of 5 very valid criteria, except for the third component point a which received a rating of 5 from two validators and a rating of 4 from one validator, so it got a mode of 5 very valid criteria. There are already complete components of the LPT-KA presentation, namely: 1) there is a cover, 2) there is a preface that contains an expression of gratitude and the purpose of making LPT-KA, 3) a table of contents to make it easier for students to find the part they want to learn, 4) a list of tables to make it easier for students to find tables in LPT-KA, 5) a list of pictures to make it easier for students to find pictures in LPT-KA, 6) indicators of argumentation skills (KA) that contain indicators, This KA indicator is expected to provide an overview of argumentation skills, so that it is hoped that students will find it easy to work on LPT-KA, 7) sections I, II, III, IV, and V which are components that will be studied by students.

The fourth to ninth components present information on the construct validity of the LPT-KA as a guide for learners' argumentation skills. The argumentation skills used are based on the Toulmin Argumentation Pattern (TAP) which consists of six indicators (1) claim, (2) evidence, (3) warrant, (4) backing, (5) qualifier, (6) rebuttal (Toulmin, 2004). According to Lazarou's research (2009) that learning using Toulmin's argument pattern (TAP) approach showed a positive improvement of argumentation skills skills that can be observed through teaching.

The fourth component is related to arrange directions to students to provide an assessment of the claims on the LPT-KA construct. The fourth component of LPT-KA part II gets an assessment mode of 4 valid criteria. The fourth component of LPT-KA part III and V gets an assessment mode of 5 very valid criteria. The fourth component of LPT-KA part IV gets an assessment mode of 5 valid criteria. The purpose of using direction sentences so that students know the meaning of the questions asked. The direction sentence used is "how do you evaluate the claim? Assessing the claim can state that you agree if the claim is theoretically correct and in accordance with the phenomenon." According to the assessment of the three validators, they have been able to direct students to provide answers in the section assessing claims.

The fifth component is related to giving directions to learners to show facts or data that have been presented on the phenomenon to strengthen the claim (showing evidence/data). The direction sentence used in LPT-KA is "How do you show evidence to strengthen your claim?"

Evidence that you can against the statement above calculations or data shown in the phenomenon above." Based on the assessment of the three validators on the fifth component of LPT-KA part II, it gets a mode of 5 very valid criteria. The fifth component of part III gets an assessment mode of 5 very valid criteria. The fifth component of part IV gets an assessment mode of 5 very valid criteria. The fifth component of part V gets an assessment mode of 5 very valid criteria. The results of the assessment of the three validators on the fifth component show that LPT-KA in all parts has provided directions for students in showing the data is appropriate, so that students can write answers in the evidence / data section.

The sixth component is related to giving directions to learners to formulate statements (reasons) that connect data and claims. The direction sentence used to construct learners is "How do you formulate reasons for the claims and evidence you have provided? Reasoning is a product of your argumentation skills. When you give an AGREE/DISAGREE claim and provide data, then you can link the two together. Write the reasons you agree in the warrant column and write the reasons you disagree in the rebuttal column." The direction sentences used in all sections of the LPT-KA received a mode of assessment from the three validators of 5 very valid criteria.

The seventh component is related to giving directions to learners to provide supporting statements to strengthen the reasoning (support/backing). The direction sentences used in all sections of the LPT-KA received a mode of assessment from the three validators of 5 very valid criteria. The directive sentence used in LPT-KA "How do you show support for the reasons you give? Support is a reference or theory that you use so that the reason you give has a correct basis."

The eighth component is related to giving directions to students to provide problem limitations that claims are not for all situations (showing qualifiers / qualifications). The eighth component of part II, part III, part IV, and part V received a rating mode of 5 very valid criteria. The direction sentence for learners to answer used "How do you provide qualifications for the argumentation you provide? The qualification can be in the form of a conclusion from the assessment of the claim to the support you provide."

The ninth component is related to giving directions to students to include reasons for rejection or disagreement with claims that are considered inaccurate (compiling a rebuttal). In the ninth component, all of part on LPT-KA received a rating of 5 from three validators, so it got a mode of 5 very valid criteria. The direction sentence for students to answer that is used "How to compile a rebuttal/refutation of the claim? Refutation/denial of a claim. When you reject or disagree with a claim submitted by someone else, then you must include/ write a rebuttal in the form of evidence and reasons for the rejection of the claim.

The LPT-KA construct has met the eligibility criteria based on construct validity in terms of expert assessment through expert judgment getting mode 5 from the assessment of the three validators with very valid criteria. The argumentation-based learning process can encourage students to be involved in providing appropriate facts, data, and theories to support claims to a problem (Sumarni et al., 2017), so that LPT-KA is considered to be able to guide students to construct knowledge about argumentation skills in buffer solutions.

CONCLUSION

The developed LPT-KA was declared valid both in content (relevance) and construct (consistency). The developed LPT-KA is believed to be used to train the argumentation skills of high school students who learn the chemical content of buffer solutions.

RECOMMENDATIONS

Based on this conclusion, it is recommended that further research be carried out to test the feasibility of LPT-KA from the criteria of practicality and effectiveness.

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