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Development of electronic student worksheets based on toulmin argumentation patterns to improve argumentation skills in basic acid materials

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Abstract: This research is part of a research project to help improve students' argumentative skills in chemistry subjects. This research is part of the development of argumentation-based teaching materials while other studies have developed learning models, teaching materials and a collection of argumentation questions. The purpose of this research was to determine the process of developing students' e-worksheets, the feasibility of students' e-worksheets based on concept and practitioner perceptions, and the effectiveness of students' e-worksheets that were developed as teaching materials based on the Toulmin argumentation pattern. Product trials were conducted at state senior high schools 11 Jambi City. The results of the practitioner's eligibility based on the teacher's response are in the very good category and students from both groups have a correlation in the "high" category. The effectiveness test is seen from the average N-Gain score of the experimental class in the quite effective category. There is a significant difference between the experimental class and the control class which can be seen from the difference in learning outcomes of the experimental class (using students' e-LKS based on the Toulmin argumentation pattern) higher than the control class (not using e-LKS).

Keywords: Acid-base, E-student worksheet, Toulmin's argumentation pattern

1. Introduction

Education in Indonesia has developed the 2013 curriculum and contains the demands of 21st century competencies, one of which is high-order thinking skills. As educators, they do not only update the concept of science but also learn how to involve argumentation in science learning, because the ability to argue is included in the category of higher order thinking skills.

Toulmin's argument component consists of claims, evidence, warrant, backing, qualifiers and reservation. There are indications that students can put forward claims, evidence and warrant that show students can be said to have argued. This argumentation can be considered as a constructivist teaching method. Arguments are used to strengthen a claim based on evidence and logical reasons. In facing the era of the industrial revolution 4.0 in the 21st century, there is a need for improvements in the field of education to improve the quality of learning (Yulianti and Saputra, 2019).

Based on the initial analysis in public senior high schools 11 in Jambi City, generally students have weaknesses in arguing because students are not used to it. This is also because the teacher has not trained students to argue. Arguments in learning have not received special attention from teachers. So far, teachers tend to test the abilities of students by choosing answers, knowing understanding, understanding simple concepts, providing short explanations, calculating formulas and concluding a topic.

One branch of science is chemistry which contains acid-base matter. This material has symbolic, macroscopic and microscopic aspects. This aspect is the main aspect in learning chemistry that can allow students to form their argumentative skills. There are many ways to improve argumentation skills. Previous researchers Saprizal (2020) have developed an e-module to improve argumentation skills. Afrianty (2020) developed argumentation test questions. Apriyanto et al. (2019) development of e-lkpd approach to saintific e-worksheets which is categorized as feasible for used in chemistry studies. Haryati (2019) Developed e-worksheets for students to practice argumentation but have not seen its effectiveness (Lukman et al. 2019). The results of other research on the effect of argumentation, Abbas and Sawamura (2009) use the partial argument negotiation and total argument negotiation learning model. Effendi-Hasibuan et al. (2019) uses an argument-based learning model. Acar (2015) uses a science writing heuristics (SWE) strategy.

According to Kristyowati (2018) the purpose of arranging LKPD includes presenting tasks that improve students' mastery of the material provided and train the learning independence of students. To complement the availability of argumentation-based teaching materials, the researchers developed teaching materials in the form of e-student worksheets. Then there will be representative teaching materials to be able to train students' argumentative skills. So that to complement the availability of argumentation-based teaching materials, it is necessary to develop teaching materials in the form of e-worksheets for students based on the toulmin argumentation pattern on acid-base material. Implication learning to develop argumentation skills of chemistry teacher candidates has provided opportunities for students to develop skills their arguments and provide learning experiences that can be implemented in the classroom next science (Amalia et al. 2019).

2. Methods

This research is a research development (Research and Development), using the ADDIE framework (Rusdi, 2018). The test subjects in this study were 11 MIPA th grade students in public senior high school of Jambi City. Determination of validation by media experts, material experts.

Quantitative data obtained in the form of an assessment of product development obtained from material experts, media experts, teacher response questionnaires and student response questionnaires, were analyzed and processed descriptively into interval data using a Likert scale. Qualitative descriptive analysis: In qualitative analysis, data obtained from teacher interviews and validator questionnaires were analyzed using a model (Miles and Huberman, 1984; Sinaga and Silaban, 2020). Quantitative descriptive analysis: In quantitative analysis the data were analyzed using descriptive statistics (mean, percentage, correlation and agreement). Then the data obtained from the test (pretest-posttest) were analyzed using the t-test.

3. Results and Discussion

One of the learning system design models that shows the basic stages of learning system design that is simple and easy to learn is the ADDIE framework. This model as the name implies, consists of five phases or stages, namely (a) Analysis (b) Design (c) Development (d) Implementation (e) Evaluation. The five stages of the ADDIE framework are carried out systematically and systemically (Alik, 2010; Manalu et al. 2016).

3.1 Analysis

Analysis of the needs of students and teachers**:** From the results of the teacher interview, not all students understood the material. Of the 26 students, 22 students with a percentage of 84.61% can be categorized as having problems with the explanation of the material by the teacher. So that here it can also be possible to be able to make teaching materials that can help teachers explain the material.

Analysis of the characteristics of students**:** In fact, when asked to argue, there are no students who are able to make claims, evidence, warrant based on Toulmin's argumentation pattern. Material analysis**:** The syllabus is the initial basis for developing e-worksheets designed by students. Will contain material on the development of the concept of acids and bases, indicators and pH of weak acids and bases and pH of strong acids and bases. Environmental analysis**:** Based on the results of the documentation, it is possible to develop e-worksheet teaching materials for students to be implemented in state high schools 11 Jambi City.

3.2 Design

This electronic student worksheet is designed using the scientific approach required in the 2013 curriculum, which consists of observing, asking questions,

gathering information, processing information and communicating. According to Trianto (2010) student worksheets are sheets containing tasks that must be done by students. According to Toulmin (2003) argumentation consists of the following elements: a) Claim, is a statement that is presented in response to a problem, b) Data, including evidence or support at the time the claim is made, c) Warrant / guarantee, which supports the relationship between the claim and data, d) Backing / support, known as the support of a warrant, e) Qualifier, which is a term that indicates the potential nature of a claim, and f) Reservation, refers to a condition where the warrant will not survive and cannot support a claim. These elements form the basis of argumentative writing and the framework for writing argumentative essays.

The process of observing is presented on the video, asking questions is presented in the form of questions, gathering information occurs when after giving questions (student activities) which are guided by the teacher, processing information occurs when the data has been collected, then students will communicate answers to questions. At the time of the learning process to observe and ask questions, there will be demands for students to claim, collect information there will be evidence, process information and communicate that students will make a warrant. The arrangement of e-worksheet teaching materials design activities for students based on the Toulmin argumentation pattern: determine the development team, determine the development schedule, making flowcharts and making a storyboard.

3.3 Development

At this stage the storyboard design that has been previously made becomes a benchmark in development. The resulting product is an e-worksheet of students developed using professional Pagelip 3D software on acid-base material with an increase in conceptual perception by material experts. Teaching materials that have been revised according to material expert suggestions Fig 1.

Judging from the percentage value of the first material expert validation interval scale with a percentage of 88.57% and after revision there was an increase in the percentage of perceptions by material experts to 97.14%, so that the e-LKPD based on the Toulmin argumentation pattern could be continued to the next stage.

The results of conceptual perceptions by media experts also increased the percentage. Revised according to the suggestions so that e-worksheets of students based on the Toulmin argumentation pattern are worth trying out, can be seen from Fig 2.

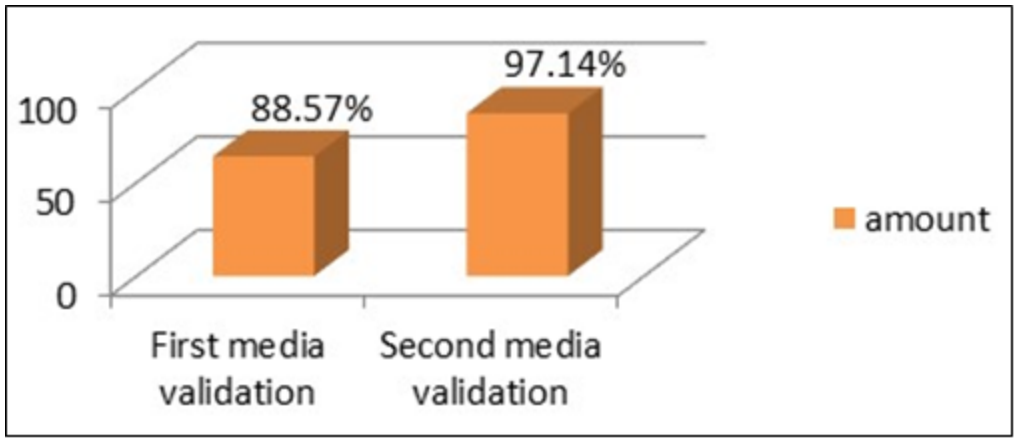

Fig 1. The assessment of e-worksheets of students by material experts

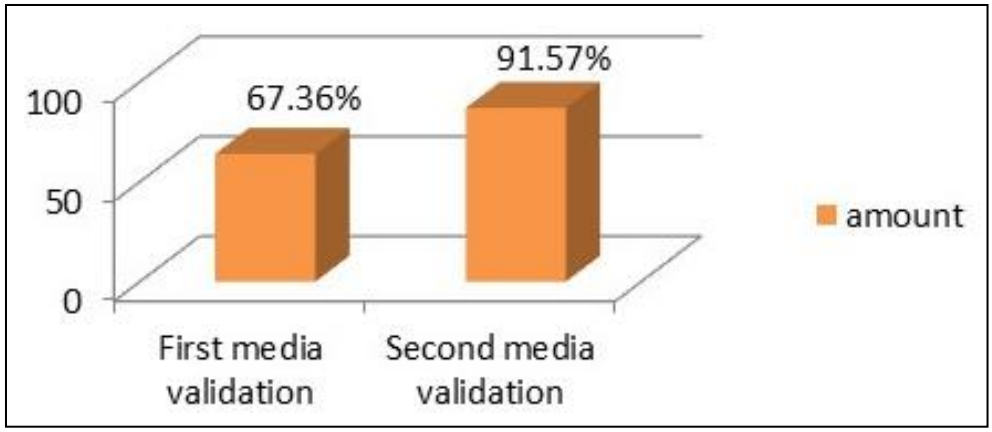

Fig 2. The assessment of e-worksheets of students by media experts

Judging from the percentage value of the first media expert validation interval scale with a percentage of 67.36% and after revision there was an increase in the percentage value of the interval scale to 91.57%, so that the expert's perception of e-LKPD based on the Toulmin argumentation pattern by media experts had increased so that can be continued to the next stage.

3.4 Implementation

Small group trials: The small group trial procedure is asking expert practitioners (teachers and students) to use e-student worksheets based on the Toulmin argumentation pattern. Then give a questionnaire on the responses of teachers and students. The results of teacher perceptions with the very good category. The result of the percentage response of students with high academic scores was 89.33%, medium academic scores were 85.33% and low academic scores were 73%. Judging by the percentage of student responses grouped by academic value, it can be concluded that the e-worksheet teaching materials of students based on the Toulmin argumentation pattern are feasible based on the perception equation at each

student's cognitive level. Students who have the same academic value have the same response.

For the response of students from two groups with the results of the questionnaire correlation test that the value of Sig. (2-tailed) 0.016, then there is a correlation, then for the agreement test the value of the intaclass correlation coefficients is 0.629 in the "high" category. It can be concluded that there is a high agreement with very good criteria (SB) for e-worksheet teaching materials based on the Toulmin argumentation pattern on acid-base material.

Large group trials: The effectiveness test was conducted to determine whether the e-worksheet teaching materials of students were based on the Toulmin argumentation pattern on acid-base material that had been developed to improve the argumentation skills of state senior high school students 11 Jambi City. Based on the results of the calculation of the N-Gain score test, it shows that the average N-Gain score for the experimental class is 0.4908 which is included in the "quite effective" category. According to Jamil (2013) learning is basically a process of changing behavior along with experiences. The formation of this behavior includes changes in skills, habits, attitudes, knowledge, understanding and appreciation. Therefore, learning is an active process that reacts to all situations and is directed at a goal, the process of acting through experience. The effectiveness test was conducted at SMA Negeri 11 Jambi City in class XI MIPA1 as the experimental class with the average N-Gain value in Table 1.

Table 1
N-Gain Analysis (preetest-posttest)

	Average	Category	Minimum	Maximum
Experiment class	0.4908	Effective enough	0.21	0.81

Based on the results of the calculation of the N-Gain score test, it shows that the average N-Gain score for the experimental class is 0.4908 which is included in the "quite effective" category with a minimum score of 0.21 and a maximum of 0.81. To continue the analysis, namely the independent t test, the normality test is required, with the results in Table 2.

Table 2
Normality test

	Class	Kolmogorov-Smirnov[a]		
		Statistic	Df	Sig.
Postest	experimental class	.208	35	.001
	control class	.182	34	.006

Based on the results of measuring normality using SPSS, it is obtained data that the experimental class and control class with a significance value <0.05. Then the data is not normally distributed. The t-test cannot be done because the data is not

normally distributed, so a nonparametric test is carried out, namely the Mann Whitney U-Test the results of statistical data are in Table 3.

Table 3
Test Data Statistics

	Value of learning outcomes
Mann-Whitney U	270.500
Wilcoxon W	865.500
Z	-3.961
Asymp. Sig. (2-tailed)	.000

Based on the results of the Statistical Test, it is known that the Asymp value. Sig. (2-tailed) 0.000 <0.005. So it can be concluded that H0 is rejected and Ha is accepted. So it can be concluded that there are differences in the learning outcomes of the experimental class (using e-worksheets based on the Toulmin argumentation pattern) and the control class (not using e-worksheets for students based on the Toulmin argumentation pattern). In line with the opinion Kaniawati and Suhandi (2014) the skill to argue is significantly related to the ability cognitive students.

4. Conclusion

The procedure development of teaching materials for student worksheets based on the Toulmin argumentation pattern follows the stages of developing the ADDIE framework, The conceptual feasibility by media experts and material experts the validation results worth trying out, practitioners in the results of teacher responses and student responses with categories of very good proportions, and effectiveness The n-Gain result of the experimental class had a mean of 0.4908 in the "quite effective" category.

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