Development of Science Student Worksheets Based on Contextual Teaching and Learning (CTL) to Improve Students' Critical Thinking Skills on Heat Transfer Materials

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Abstract. The purpose of this study was to determine the feasibility and effectiveness of the development of IPA based on Contextual Learning to improve critical thinking skills. The data analysis technique in this study is the N-Gain test. The results of the expert validation test were carried out on 6 experts, namely 2 Indonesian language experts, 2 material experts and 2 learning media experts. the average score obtained by Indonesian language experts is 42.5 with a percentage of 88.54% (very valid), then the average score by material experts is obtained by 56.5 with a percentage of 88.28% (very valid), then obtained the average score by learning media experts with a score of 88 with a percentage of 95.65% (very valid). The results of field trials were carried out on a small, medium, and large scale in this study, namely the total score obtained from 3 students, the average value obtained was 47.18 with a percentage of 83.37% (Very Valid). For the effectiveness test, the interpretation of the effectiveness of 71.58% is in the range of 56 - 75 so it can be concluded that the Science Student Worksheet Based on Contextual Learning is "quite effective" in increasing students' ability to think critically on heat transfer materials.

Keywords: IPA, Critical Thinking Skills.

1 Introduction

Education is very important for humans, because with education humans can gain knowledge and skills and can develop their abilities, attitudes and behavior. Some of the challenges in the 21st century are climate change (climatechange), global poverty (global poverty), population growth (population growth), wars in the 21st century (all out war), species extinction (losing species), creativity, transhumanism, and the divide between skills and wisdom (skills and wisdom gap) (Martin, 2007). To face these challenges, the quality of science education in Indonesia not only needs to be improved on the cognitive dimension, but also on the skills dimension in science learning. One of the skills needed in the 21st century identified by the Assessment and Teaching of 21st Century Skills (ATC21S), is the way of thinking (Griffin,

AISTEEL 2022, September 20, Medan, Indonesia

DOI 10.4108/eai.20-9-2022.2324548

McGaw, & Care, 2012). Ways of thinking include creativity, innovation, critical thinking, problem solving, and decision making

According to Wagner (2010) and the Change Leadership Group from Harvard University, the competencies and skills needed by students in dealing with life, the world of work, and citizenship in the 21st century are emphasized on the following seven skills: (1) critical thinking and problem solving skills, (2) collaboration and leadership, (3) dexterity and adaptability, (4) initiative and entrepreneurial spirit, (5) able to communicate effectively both orally and in writing, (6) able to access and analyze information, and (7) have a passion for know and imagination. Critical thinking skills have long been an ability that is developed explicitly in learning. Zubaidah (2016) suggests that students must be able to find various solutions from different perspectives in solving complex problems. Critical Thinking Skills can also be improved through the CTL (Contextual Teaching and Learning) approach. This is in line with the research of Sudarmiani (2020), Silvia druru, et al (2018), and Hasruddin, et al (2015) which concluded that critical skills can be developed through the CTL (Contextual Teaching and Learning) approach.

This opinion is in line with the research results of I Wayan Sadia (2008: 219) that according to the teacher, the learning model that is seen to make a significant contribution in developing students' critical thinking skills is contextual learning. CTL helps participants develop their intellectual potential by teaching directly the steps that can be used in critical and creative thinking and providing opportunities to use higher-level ways of thinking in the real world (Johnson, 2009: 182).

Another alternative is to improve critical thinking skills by using the learning model conducted by Duran and Dökme (2016), Fuad, Zubaidah, Mahanal, and Suarsini (2017), Ikayanti, Suratno, & Wahyuni (2017), Mahanal, Zubaidah, Bahri , and Syahadatud (2016), and Wannapiroon (2014). The results of these studies can improve critical thinking skills, but really like the interaction of students with teachers during learning.

The CTL approach is an approach that can help students relate the material studied to the real life of everyday students, both in the family, school, and community environment. Thus learning will be more meaningful. CTL can turn regular programs, programs that are not attractive to students, into programs that enable them to perform to high standards (Sepriyanti, et al (2017, 233)). The seven components in CTL learning are constructivism, finding (inquiry), asking (questioning), learning community (learning community), modeling (modeling), reflection (Reflection), and Authentic assessment (Sanjaya: 264-268). Contextual learning is learning that allows the learning process to occur in which students use their understanding and academic abilities in various contexts inside and outside school to solve problems that are simulative or real, either individually or together. *Contextual learning provide a stimulus to the brain for processing materials meaningfully* (Hasruddin, 2015: 11).

In addition to using various methods and strategies to achieve the expected learning objectives in the classroom learning process, teachers also use various teaching aids such as textbooks, learning media, and Student Worksheets (LKPD). Usually LKPD is used for each subject as a tool for teachers in providing concise material along with questions that students can do. Interviews conducted with several 5th grade science teachers in August 2020, showed that

learning with the 2013 Curriculum had been carried out smoothly but there were still obstacles related to the existence of LKPD based on the 2013 Curriculum.

LKPD is one of the teaching materials used as a tool to support learning objectives. Trianto (2009:222) defines that LKPD is a student guide used to carry out investigations and problem solving activities. LKPD can also be defined as printed teaching materials in the form of twin sheets of paper containing material, summaries, and instructions for carrying out tasks that must be done by students, which refers to the KD achieved (Prastowo, 2014: 204).

Each LKPD contains, among others: a brief description of the material, the purpose of the activity, tools or materials needed in the activity, work steps, questions to be discussed, conclusions from the results of the discussion, and rehearsals. So, LKPD can be interpreted as sheets that are used by students as a guide in the learning process, and contain tasks carried out by students in the form of questions and activities that will be carried out by students. This is in accordance with the definition of LKPD according to Andi Prastowo (2013: 204) where student worksheets are defined as printed teaching materials in the form of sheets of paper containing material, summaries, and instructions for implementing learning tasks that must be done by students. with reference to basic competencies (KD) that must be achieved.

From some of the definitions above, the author concludes that the LKPD is in the form of instructions or guidelines as well as steps to complete a task as well as a guide for developing cognitive aspects as well as a guide for developing all aspects of learning in the form of printed teaching materials/books containing summary material, questions Questions (questions) and are also a learning tool that can be used by teachers in increasing the involvement or activity of students in the teaching and learning process which contains student activities that allow students to carry out real activities with the objects and problems studied.

The existence of innovative and creative LKPD will make the learning process more enjoyable. Therefore, it is imperative that every educator or prospective educator be able to prepare and create innovative teaching materials. In preparing it, the teacher must be careful and have adequate knowledge and skills, because an LKPD must meet at least the criteria related to achieving or not achieving a basic competency mastered by students. Given the importance of creating a good LKPD, before creating your own LKPD, several steps should be taken. According to Alan (2012:23) the steps for making LKPD are: (1) The material must refer to the curriculum; (2) Paying attention to individual differences, because the 2013 Curriculum emphasizes competence, the LKPD must be able to measure the ability of students; (3) Activities to support concept understanding, activities in LKPD help understand the concepts being studied; (4) Activities are related to real activities and technology; (5) Have clear learning objectives; (6) Making main points and details; (7) Using sentences that are simple, clear and easy to understand; (8) Have a sequence that is in accordance with the abilities of students; (9) Encouraging students to study and work scientifically; (10)There is a match between the material and the time available; (11) Used to carry out activities or problem solving and drawing conclusions.

2 Research Method

This research is a development research (Development Research). According to Sugiyono (2008:407), research and development (research and development) is a research method used

in order to produce certain products and test their effectiveness. In this study, what was developed was teaching materials in the form of student worksheets based on the CTL approach. This research will be carried out at the Binjai Methodist Private Elementary School. The subjects in this study were Binjai Methodist Private Elementary School students consisting of 6 (students) class V for a trial with the ability to learn science evenly as many as 28 people.

3 Results And Discussion

Research result

a. The results of the Feasibility Test of the Science Student Worksheet Based on Contextual Teaching and Learning (CTL)

From the results of expert validation tests conducted on 3 experts, namely Indonesian language experts, material experts and learning media experts. the score obtained by the Indonesian language expert, Mrs. Dr. Elly Prihastuti Wuriyanti, M.Pd of 35 with a percentage of 72.92% (quite valid), then obtained a score by material expert Dr. Ridwan Abdul Sani, M.Pd where the score obtained is 55 with a percentage of 85.94% (Valid). Then the score obtained by learning media experts is 64 with a percentage of 69.75% (quite valid). Here's the table:

Table 1. LKPD expert test

No	Name of Expert	Kind of Expert	Score	Max. Score	P (%)	Category
1	Dr. Elly Prihasti Wuriyanti, M.Pd	Indonesian language	42	48	87,61	Very Valid
2	Ita Khairani, S.Pd, M.Hum.	Indonesian language	43	48	89,70	Very Valid
3	Dr. Ridwan Abdul Sani, M.Pd	material experts	58	64	83,75	Valid
4	Sabani, S.Pd, M.Si	material experts	55	64	91,25	Very Valid
5	Dr. Samsidar Tanjung, M.Pd	learning media	89	92	90,75	Very Valid
6	Dr. R. Mursyid, ST, M.Pd	learning media	87	92	89,84	Very Valid

The following is a comparison chart of experts in providing an assessment:

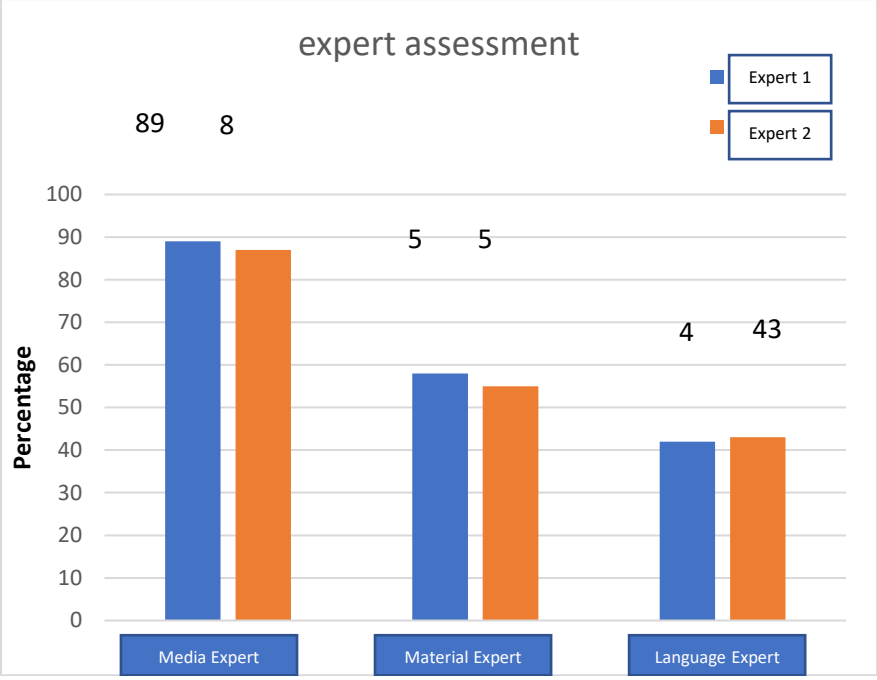

Figure 1. comparison chart of experts in providing an assessment

From the results of expert validation tests conducted on 6 experts, namely 2 Indonesian language experts, 2 material experts and 2 learning media experts. the first Indonesian language expert scored 42 with a percentage of 87.5% (very valid), the second Indonesian expert scored 43 with a percentage of 89.58% (very valid). Then the score was obtained by the first material expert where the score was obtained 58 with a percentage of 90.63% (Very Valid), obtained a score by the second material expert where the score was obtained by 55 with a percentage of 85.94% (Very Valid). Then obtained a score by the first learning media expert with a score of 89 with a percentage of 96.74% (very valid), obtained a score by the second learning media expert with a score of 87 with a percentage of 94.57% (very valid).

a. Developmental Testing

At this stage, the researcher conducted a field trial using the LKPD Draft II. Field trials were carried out in two stages, namely limited field trials (readability tests) and operational field trials. The legibility test aims to determine the readability level of the LKPD Draft II before being used in operational field trials. The purpose of the operational field trial is to determine the improvement of students' critical thinking skills after using the developed LKPD. Based on the data from the trial, the researchers conducted an evaluation to improve the LKPD Draft II so that the final product (LKPD Draft III) was produced. The following are the results of the field test consisting of small, medium and large field trials. The results of the moderate group trial obtained as Table 2 below:

Table 2. Small Group Trial

Name	Scor	Persentase
R1	38	67.86
R2	46	82.14
R3	44	78.57
SUM	**128**	
Average	**42.67**	
Persentase	**73.56**	

The results of field trials on a small scale in this study were the total scores obtained from 3 students with a total of 128 and the average value obtained was 42.67 with a percentage of 73.56% (quite valid). After being tested on a small scale, then continued with a medium scale trial. The following are the results of the moderate group trial obtained as Table 3 below:

Table 3. medium group trial

Name	Scor	Persentase
R1	46	82.14
R2	48	85.71
R3	49	87.50
R4	50	89.29
R5	52	92.86
R6	50	89.29
R7	48	85.71
R8	49	87.50
R9	44	78.57
Sum	**436.00**	
Average	**48.44**	
Persentase	**86.51**	

The results of field trials on a medium scale in this study were obtained by the total score obtained from 9 students with a total of 436 and the average value obtained was 48.44 with a percentage of 86.51% (Very Valid). After being tested on a medium scale, a large scale trial was continued, obtained as Table 4 below:

Table 4. large group trial

Name	Scor	Persentase
R1	43	76.79
R2	48	85.71
R3	49	87.50
R4	50	89.29
R5	52	92.86
R6	48	85.71

R7	48	85.71
R8	49	87.50
R9	44	78.57
R10	55	98.21
R11	54	96.43
R12	53	94.64
R13	49	87.50
R14	50	89.29
R15	43	76.79
R16	55	98.21
R17	54	96.43
R18	55	98.21
R19	54	96.43
R20	54	96.43
R21	52	92.86
Sum	**1059**	
Average	**50.43**	
Persentase	**90.05**	

The results of a large-scale field trial in this study were the total scores obtained from 21 students with a total score of 1059 and the average value obtained was 50.43 with a percentage of 90.05% (Very Valid). The results of the small, medium, and large group trials can be seen from Figure 2 below:

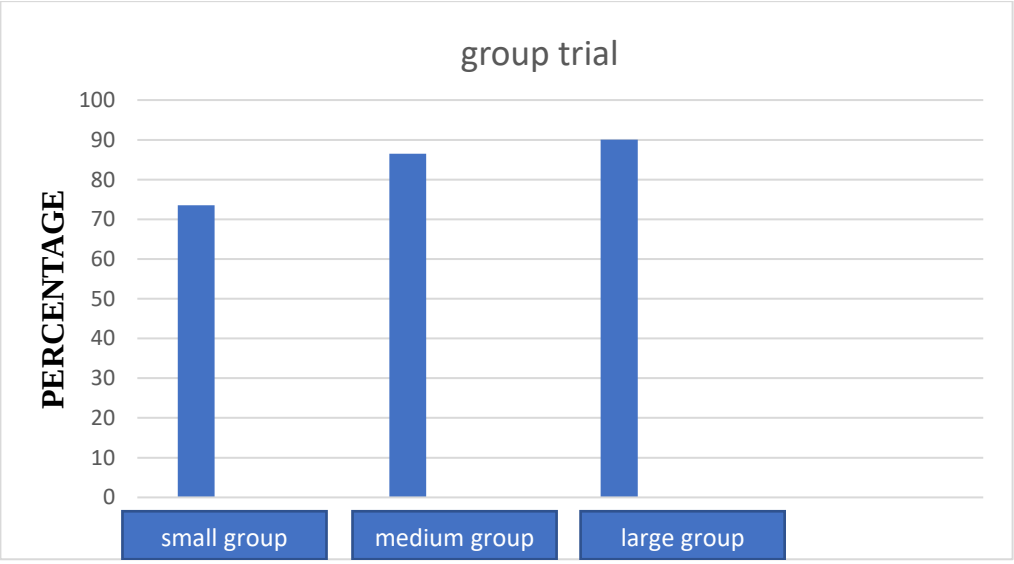

Figure 2. The results of the small, medium, and large group trials

The final product above after going through several development processes ranging from product manufacture, field trials, operational trials to see the effectiveness to revisions from experts.

b. Results of the Effectiveness of the Science Student Worksheet (LKPD) Based on Contextual Teaching and Learning (CTL)

The second problem formulation regarding the effectiveness test was carried out on 27 students, the following is the effectiveness test data in learning through LKPD**:**

Table 5. the effectiveness test data in learning through LKPD

Name	Pre Test (X1)	Post Test (X2)
R1	53	85
R2	55	85
R3	50	90
R4	60	85
R5	62	82
R6	40	78
R7	60	95
R8	42	74
R9	40	85
R10	38	78
R11	42	82
R12	60	90
R13	60	92
R14	53	88
R15	38	78
R16	50	78
R17	50	85
R18	62	88
R19	55	92
R20	50	95
R21	65	98
R22	62	92
R23	65	98
R24	40	82
R25	62	90
R26	40	74
R27	55	82
Sum	**1409**	**2321**
Average	**52,18**	**85,96**

Based on the table above, the learning outcomes obtained before using the student worksheets based on contextual learning obtained an average score of 52.18. While the learning outcomes obtained after using the student worksheets based on contextual learning obtained an average score of 85.96. Test the effectiveness of student worksheets based on contextual learning can be calculated using the gain score contained in Table 6 below:

Table 6. Test the effectiveness of student worksheets based on contextual learning

Name	Pretes	Postes	Postes-pretes	Skor ideal-pretes	N-Gain	N-Gain%
R1	53	85	32	47	0,6808	68,08
R2	55	85	30	45	0,6666	66,66
R3	50	90	40	50	0,80	80
R4	60	85	25	40	0,625	62,5
R5	62	82	20	38	0,5263	52,63
R6	40	78	38	60	0,6333	63,33
R7	60	95	35	40	0,87	87,5
R8	42	74	32	58	0,5517	55,17
R9	40	85	45	60	0,75	75
R10	38	78	40	62	0,6451	64,51
R11	42	82	40	58	0,6896	68,96
R12	60	90	30	40	0,75	75
R13	60	92	32	40	0,80	80
R14	53	88	35	47	0,7446	74,46
R15	38	78	40	62	0,6451	64,51
R16	50	78	28	50	0,56	56
R17	50	85	35	50	0,70	70
R18	62	88	26	38	0,6842	68,42
R19	55	92	37	45	0,8222	82,22
R20	50	95	45	50	0,90	90
R21	65	98	33	35	0,9428	94,28
R22	62	92	30	38	0,7894	78,94
R23	65	98	33	35	0,9428	94,28
R24	40	82	42	60	0,70	70
R25	62	90	28	38	0,7368	73,68
R26	40	74	34	60	0,5666	56,66
R27	55	82	27	45	0,60	60
Sum	140	232				

	9	1		
Average	52,18	85,96	0,7158	71,58
Keterangan				
			medium	**Quite effective**

Based on the results of the effectiveness test, it can be concluded that the use of the IPA Student Worksheet (LKPD) based on contextual learning is "quite effective" because the average percentage gain score for the interpretation of effectiveness is 71.58% in the range 56 - 75. The value The N-gain score obtained is 0.71 at g 0.7 which can be concluded in the "High" category. Thus the hypothesis states that the Science Student Worksheet (LKPD) Based on Contextual Learning is quite effective in increasing students' ability to think critically on heat transfer material in class V.

From the results of the calculation of the data above, it is obtained that tcount = 8.34. From the list of t-distribution by using probability 1-α = 0.95 with dk n-1 (27-1) = 26, the value of ttable = 4.25 is obtained. So that t count > t table is obtained, thus the hypothesis states "There is an effectiveness of the Science Student Worksheet (LKPD) Based on Contextual Teaching and Learning (CTL) on the material "Heat Transfer" in Class V SD Binjai Private Elementary School".

4 Discusion

a. The results of the Feasibility Test of the Science Student Worksheet (LKPD) Based on Contextual Teaching and Learning (CTL)

At this stage, the researcher developed an instrument used to assess the feasibility and effectiveness of the developed LKPD (validation instrument), and developed an instrument to assess students' critical thinking skills (test instrument). Instruments are listed in the appendix. The choice of format is adjusted to the content of the material and the basis used in the development of LKPD, which is adapted to the Contextual Teaching and Learning (CTL) approach. The purpose of selecting this format is so that the LKPD developed is in accordance with good and correct criteria so that it is suitable for use in science learning.

The results of field trials on a small scale in this study were the total scores obtained from 3 students, the average value obtained was 42.67 with a percentage of 73.56% (quite valid). The results of field trials on a medium scale in this study were obtained by the total score obtained from 9 students, the average value obtained was 48.44 with a percentage of 86.51% (Very Valid). The results of a large-scale field trial in this study were the total scores obtained from 21 students, the average value obtained was 50.43 with a percentage of 90.05% (Very Valid). From the results of expert validation tests conducted on 3 experts, namely 2 Indonesian language experts, 2 material experts and 2 learning media experts. the average score by the first Indonesian language expert was 3.5 with a percentage of 87.61% (very valid), the average score by the second Indonesian expert was 3.6 with a percentage of 89.7% (very valid). Then the score was obtained by the first material expert where the average score was 3.35 with a

percentage of 83.75% (Valid), the score was obtained by the second material expert where the average score was 55 with a percentage of 91.25% (Very Valid). Then the score obtained by the first learning media expert with an average score of 3.6 with a percentage of 90.75% (very valid), obtained an average score by the second learning media expert with an average score of 3.59 with a percentage of 89 ,84% (very valid).

Based on previous research journals on the development of LKPD, namely Nurul Hidayati's research (2014) So far, the process of teaching science in elementary schools has not provided optimal opportunities for students to improve science process skills. The science kit has not been used optimally because the teacher has not developed a science kit-based LKPD. This research is an R&D research with the results of LKPD based on the Science Kit. The development steps carried out were: (1) product analysis, (2) initial product development, (3) validation and revision, (4) small-scale field trials and revisions. The results of the quality feasibility study by material experts were in the "very good" category, by media experts it was in the "good" category, and the linguists were in the "good" category. The results of the small-scale trial showed an increase in basic science process skills in every aspect. This is in line with Rahayu (2021) who explains that the development of LKPd is very necessary.

b. Results of the Effectiveness of the Science Student Worksheet (LKPD) Based on Contextual Teaching and Learning (CTL)

Based on the results of the effectiveness test, it can be concluded that the use of the IPA Student Worksheet (LKPD) based on contextual learning is "quite effective" because the average percentage gain score for the interpretation of effectiveness is 71.58% in the range 56 - 75. The value The N-gain score obtained is 0.71 at g 0.7 which can be concluded in the "High" category. Thus the hypothesis states that the Science Student Worksheet (LKPD) Based on Contextual Learning is quite effective in increasing students' ability to think critically on heat transfer material in class V.

For related research that tests the effectiveness is research by Winda Pradika (2022). This study aims to (1) describe the design and development of interactive E-LKPD, (2) determine the feasibility of interactive E-LKPD, and (3) determine the effectiveness of interactive E-LKPD. The development model used is ADDIE. The data collection methods used were interviews, observations, questionnaires and tests. Analysis of the data used, namely, quantitative descriptive analysis, qualitative, descriptive statistics and inferential statistics. This interactive E-LKPD is feasible to use, this is evidenced by the results of the test of learning content experts 98.7%, learning media experts 98.6%, learning design experts 100%, individual tests by teachers 97.5%, students 93.3%, small group test 96.1%, 95% field test which qualified very well. The results of the effectiveness test show that the interactive E-LKPD based on local wisdom is effective in increasing the competence of Balinese language knowledge, as evidenced by the t-test results obtained tcount = 6.1665, ttable = 2.086. This means that tcount> ttable so that H0 is rejected and H1 is accepted. Thus, the interactive E-LKPD based on local wisdom in Balinese script material is effectively applied to the fifth grade students of SD Negeri 8 Banjar Anyar.

Wahyu Purwaningrum (2022) This development research has the aim of testing the feasibility of a product in the form of a digital-based student worksheet as an online learning innovation with Natural Science subjects. The results of the feasibility test from colleagues got a good response with an average of 90.4%, then in the one-on-one test (individual) with an average result of 90%, in small group testing an average of 87%, and in group testing big get 88%.

Based on the validation from the experts and the trials that have been carried out, the digital-based student worksheet as an online learning innovation is feasible to use in the learning process. From the results of this effectiveness test, it can be concluded that LKPD has a significant influence on students' critical thinking skills.

5 Conclusion

1. For the feasibility test in this development research, namely the results of expert validation tests conducted on 6 experts, namely 2 Indonesian language experts, 2 material experts and 2 learning media experts. the score obtained by the first Indonesian language expert is 42 with a percentage of 87.5% (Valid), the second Indonesian language expert scores 43 with a percentage of 89.58% (very valid), then the score is obtained by the first material expert where the score is 55 with a percentage of 85.94% (Valid), obtained a score by the second material expert where the score was obtained by 55 with a percentage of 85.94% (Very Valid). Then the score obtained by the first learning media expert was 92 with a percentage of 94.56% (Valid)., Then the score was obtained by the first learning media expert with a score of 89 with a percentage of 96.74% (very valid). The results of field trials in this study were obtained by the total score obtained from 28 students, the average value obtained was 49.07 with a percentage of 87.63% (Valid). The results of field trials on a small scale in this study were the total scores obtained from 3 students, the average value obtained was 42.67 with a percentage of 73.56% (quite valid). The results of field trials on a medium scale in this study were obtained by the total score obtained from 9 students, the average value obtained was 48.44 with a percentage of 86.51% (Very Valid). The results of a large-scale field trial in this study were the total scores obtained from 21 students, the average value obtained was 50.43 with a percentage of 90.05% (Very Valid).

2. For the effectiveness test, based on the results of the effectiveness test, it can be concluded that the use of the IPA Student Worksheet (LKPD) based on contextual learning is "quite effective" because the average value of the percentage gain score for the effectiveness interpretation is 71.58% included in the range 56 – 75. The N-gain score obtained is 0.71 at g 0.7 which can be concluded in the “High” category. Thus the hypothesis states that the Science Student Worksheet (LKPD) Based on Contextual Learning is quite effective in increasing students' ability to think critically on heat transfer material in class V.

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