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THE DEVELOPMENT OF BW-EXPORT MODEL ON SCIENTIFIC LEARNING DEVICES TO IMPROVE CRITICAL THINKING SKIILS OF JUNIOR HIGH SCHOOL STUDENTS

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Abstract

This study aims to produce a valid, practical, and effective learning materials with the BW-ExPort learning model to improve the critical thinking skills of junior high school students on heat material. The development of the device uses a modification of the 4D development model with the research design of One Group Pretest and Posttest Design. The research data analyzed were the validity, practicality and effectiveness of learning materials and analyzed quantitatively and qualitatively descriptively. The trial sample was class VII students of SMP Negeri 4 Mojokerto in the odd semester of the 2021/2022 school year, totaling 96 students. The results showed that (a) the learning tools developed had an average syllabus validity of 3.65, lesson plans of 3.63, LKPD of 3.75, teaching materials of 3.75 and test instruments of 3.61 which were categorized as very valid; (b) practical developed learning materials with an average score of 3.68 learning implementation which is in the very good category and student activities in the very good category; (c) the learning materials developed are effective, with the N-Gain value of students' critical thinking skills of 0.71 which is in the high category, the results of the paired t-test from the three experimental classes have a p-value of less than 0.05, and the results of the p-value are less than 0.05. The one-way ANOVA test value is 0.809; (e) the percentage of student responses is 92% with a very good category. The conclusion of learning materials with the BW-ExPort model that was developed properly (valid, practical, and effective) can be used to improve students' critical thinking skills.

Keywords: Bw-ExPort, Critical Thinking Skills

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INTRODUCTION

The learning process in the world of 21st century education has developed, learning does not only teach concepts but also teaches skills for students, one of which is through science learning. The skills needed to face the 21st century include critical thinking skills, skills to utilize Information and Communication Technology (ICT), and skills to solve problems ((Adilla & Jatmiko, 2021)).

In line with this, according to Supardi and Qomariah (2021) critical thinking skills are one of the most important goals in all levels of education.

Critical thinking is a skill that must be developed and trained to students because this skill is needed in everyday life. Critical thinking skills are detailed descriptions of a number of characteristics related to skills of analysis, interpretation, inference, explanation, evaluation, and self-regulation (Facione, 2011).

Science learning emphasizes providing direct experience for students in order to develop their competencies, so that they can learn more about themselves and their surroundings scientifically. Science learning has focused on what students need *to do* and *to know* through the training process during learning. *To do* is the process of building knowledge and skills involving the acquisition of data and the use of principles and evidence to make explanations and predictions that represent reasoning about nature that involves critical thinking and communication skills. Therefore, students are expected to have skills in critical thinking (Nirwana & Wilujeng, 2021).

In fact, from the results of research conducted by *the Program for International Student Assessment* (PISA) show that students' science performance in Indonesia scores below the OECD average score. The results of the PISA research in 2018 showed that Indonesia was ranked 72 out of 78 participating countries (OECD, 2018). Around 40% of Indonesian students compared to the OECD average of 78% who meet the achievements of the ability to reason scientifically, identify phenomena, develop arguments based on facts using critical analysis and draw conclusions based on data (OECD, 2018).

Based on a preliminary study at SMP Negeri 4 Mojokerto, one of the science learning materials that are considered difficult by students is heat material. The critical thinking skills of students on heat material are classified as very low with an average percentage of 26.95%. Critical thinking skills measured include formulating problems, formulating hypotheses, deciding an action, evaluating and providing arguments. Based on the results of the preliminary study, it can be seen that students' critical thinking skills are low. This is supported by the absence of learning devices that are used specifically to improve critical thinking skills. In addition, students rarely do experimental practicum in science learning. In addition, students tend to be trained to work on questions so that it is difficult for students to develop their mindset and make the learning carried out by students less meaningful.

The research problem in this study is "How is the feasibility (validity, practicality, and effectiveness) of *the Based on Writing Experimental Report* (BW-ExPort) learning device to improve students' critical thinking skills?" Practicality includes the implementation of learning devices and student activities in trials, while effectiveness includes improving critical thinking skills and student responses to learning.

The BW-ExPort learning model according to Balulu (2017) consists of 5 phases, namely: the problem identification phase, the data processing phase, the follow-up process for writing experimental reports, the elaboration phase, and the process evaluation phase. Each phase has a relationship with each other which is equally important to achieve learning objectives.

The five phases are described (1) The problem identification phase, in this phase the main thing to do is to focus and motivate students to be involved in learning activities that are planned to solve the problems posed by the teacher. At this stage, the main learning activities rely on efforts to increase student interest while assessing students' initial understanding of the topics discussed, such as apperception activities. In the ongoing learning activities, students are first faced with instructional tasks and given the opportunity to identify. Motivation in learning aims to arouse curiosity and interest in learning and is usually easily raised in experimental learning through an inquiry approach, for example by providing provocative problem situations or *disecrepant events* (videos, animations, etc.). (2) Data processing phase, in this phase the teacher provides opportunities for students to be involved in experimental activities through group work to answer research questions posed in the experiment. Students are given the opportunity to learn how to design experiments. Learning takes place by utilizing various sources both inside and outside the school. Students design experiments, collect data, analyze data, ask research questions, propose hypotheses, and test hypotheses. According to Slavin (2006) *cognitive apprenticeship* is the process of students gradually gaining expertise through interaction with an expert, both adults and peers who are more competent. Information can be obtained by observing, recording, discussing the results of

observations, organizing information and working with groups. In data processing activities with the involvement of students, it can provide opportunities for more activities. The involvement of students in activities to obtain data and interpret data can provide opportunities to carry out activities such as discussions, clarifying problems, the investigation process and reviewing experimental results (Wu and Krajrik, 2006).

(3) The writing phase of the experimental results report, in this phase the experimental results reports are made independently by the students in written form with the contents of the report including an explanation of the experimental objectives, experimental methods, and research results accompanied by good conclusions and reasoning. Students are given special opportunities to develop critical thinking skills through report writing activities. The results of written reports made by students individually are discussed with group friends (other groups as *peer reviews*). The results of the discussion are used as a review to revise the experimental results report. Then the revised results are collected to the teacher and reviewed by the teacher to evaluate the quality of the research report. The report that has been reviewed by the teacher is then returned to the author. Reports that need to be revised are encouraged to rewrite the report based on reviewer feedback or teacher suggestions. The revised report is submitted back to the teacher to be re-evaluated for correctness. This step aims to provide opportunities for students to improve their experimental report writing skills and critical thinking skills. (4) The elaboration phase, this phase is an activity to train critical thinking. One of the ways to train critical thinking in learning can be done with an elaboration strategy. By using the elaboration strategy, students will more easily transfer new information from short-term memory to long-term memory with detailed information. The purpose of elaboration is to train critical thinking and problem solving for students. In elaboration activities, each student presents his work and other students criticize to determine which student is the most correct and acceptable.

(5) Evaluation phase, in this phase is evaluate the process, the results of writing experimental reports and critical thinking skills. In addition, this phase also aims for students to be able to provide feedback, encourage students to develop and use appropriate experimental report writing standards, and create an attitude that always values critical thinking with evidence in the classroom. At the end of this phase the teacher provides feedback by providing corrections and reinforcement to the results of problem solving and writing experiments that have been agreed upon.

Based on the explanation above, as an effort to improve critical thinking skills in science learning, researchers are interested in developing science learning devices using the BW-ExPort learning model with the title "The Development of BW-ExPort Model Learning Devices to Improve Critical Thinking Skills for Junior High School Students". The learning devices developed consist of a syllabus, lesson plans (RPP), student teaching materials, student activity sheets (LKPD), and tests of critical thinking skills on heat material.

METHOD

This is a development research which developing learning devices with the BW-ExPort model to improve the critical thinking skills of junior high school students. The aim of this research is to determine the validity, practicality and effectiveness of the learning devices that are arranged. The learning devices developed include the Syllabus, Lesson Plan (RPP), Student Teaching Materials, Student Worksheets (LKPD) and critical thinking skills tests.

Research Design

The development of learning devices in this research is using the 4D development model. The development stage includes four stages, namely *define*, *design*, *development*, and *dessiminate*. In this study, the define stage, the design stage and the development stage were carried out, while the dissemination stage was carried out by participating in seminars. The design for developing learning devices with the BW-ExPort model can be briefly seen in Figure 1.

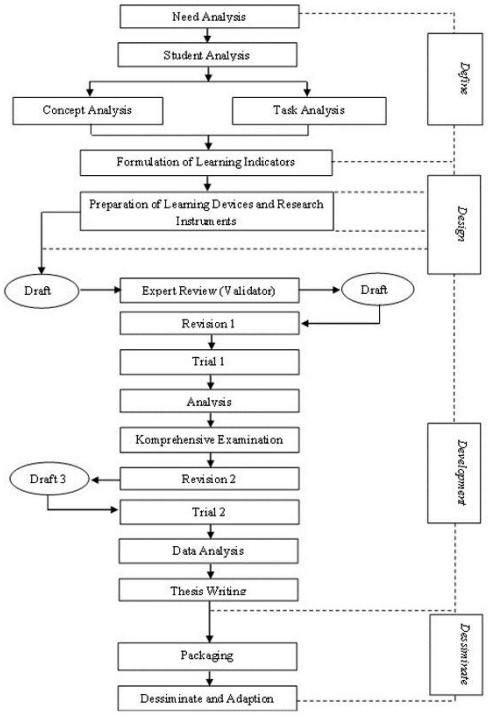

Figure 1. Flowchart of Learning Device Development 4D Model (Adapted from Tiagarajan, et al. 1974)

Research Object

The subject of this research is a learning device with the BW-ExPort model to improve critical thinking skills which was developed and conducted a limited trial on 32 students while the field trial was conducted on students in grades VII-G, VII-H, and VII-I. each of which numbered 32 people, bringing the total to 96 people at SMP Negeri 4 Mojokerto City in the Odd Semester of the 2021/2022 Academic Year.

Data Collection Technique

The procedure for collecting data on the implementation of the development of learning devices with the BW-ExPort model to improve critical thinking skills was carried out, among others, (1) Researchers made observations to schools to find out whether research could be carried out using science learning devices with the BW-ExPort model to improve participants' critical thinking skills students on heat material and seek information from teachers and students about the learning carried out in the classroom where the research will be conducted, as well as asking the principal's permission to conduct research. (2) After being permitted by the school, the researcher gave a written test to the students to determine the students' prior knowledge (*pretest*) on the heat material. (3) Observation data collection is carried out by two observers with the same instrument sheet. This is done to see reliability, before the observation takes place, the observer is given an explanation in advance how to use a good observation sheet, in order to obtain objective observation results. The research instrument used was an observation sheet on the implementation of the lesson plans, a student activity sheet, and a sheet of obstacles encountered during the learning process planned by the researcher. (4) Researchers implement learning devices that have been developed by carrying out teaching and learning activities for three meetings on temperature and heat material. During the learning process using the BW-ExPort model, researchers took the data needed for research including critical thinking skills through critical thinking skills test sheets. (5) At the end of the lesson, the researcher gives a final test (*posttest*) which will be calculated quantitatively which aims to determine the improvement of students' critical thinking skills. (6) Students are asked to fill out a questionnaire readability sheet of textbooks and student response sheets to the BW-ExPort learning that has been developed by the researcher.

The operational definitions of the variables in this study are as follows: (1) Learning Device Validity, learning device validity is the score of the instrument validity assessment results from the validator as measured by the validity sheet instrument. Validators are asked to provide input and suggestions for improving learning devices by means of *a checklist* in accordance with the validity assessment instrument. The developed BW-ExPort learning model is said to be valid if it has an adequate degree of validity if it is at least in the valid category. (2) Implementation of the Lesson Plan (RPP), the implementation of the learning implementation plan is the score obtained on the observation of the implementation of the syntax in the RPP which is measured by using the RPP implementation instrument sheet. The criteria for deciding that the BW-ExPort learning model developed is practical if at least it is in the good category. (3) Improving students' critical thinking skills, critical thinking skills are all activities carried out by students in critical thinking based on critical thinking indicators. The results of critical thinking skills are expressed in the form of values that are observed using instruments in the form of critical thinking skills questions. The improvement of critical thinking skills is declared effective if it meets the following criteria: (a) there is an increase in students' critical thinking skills which is statistically significant $\alpha = 5\%$, (b) the N-Gain of critical thinking skills is included in the minimally moderate category. (4) Student response, student response is the reaction of students during the learning process which

includes: learning methods, teaching materials, student worksheets, classroom atmosphere and the way the teacher teaches. The criteria used are that at least students give a good response with a percentage of 51%-75% after participating in learning activities using the BW-ExPort model.

RESULT AND DISCUSSION

The validation results can later be used as the basis for improvements before the device will be tested. The validated learning devices are the Syllabus, Lesson Plan (RPP), Student Activity Sheets (LKPD), Student Teaching Materials (BAPD), and Critical Thinking Skills Test. The learning devices have been reviewed and validated by two experts, namely Nadi Suprapto, Ph.D. and Dr. Mohammad Budiyanto, M.Pd. The results of the validation of learning devices are described as Table 1.

Table 1. The Result of Learning Devices Validation

Learning Devices	Average Score		Category
	V1	V2	
Syllabus	3.62	3.69	Very Valid
Lesson Plan (RPP)	3.50	3.75	Very Valid
Student Activity Sheet (LKPD)	3.81	3.69	Very Valid
Student Teaching Materials (BAPD)	3.69	3.81	Very Valid
Critical Thinking Skills Test	3.78	3.44	Very Valid

Noted: V1=Validator 1; V2=Validator 2

Based on Table 1 shows the learning devices based on the BW-ExPort model that were developed, it can be concluded that they are in the very valid category from the results of the assessments of the two validators, the learning devices are said to be valid if they meet the criteria for content validity and construct validity (Meilinda, Martini, & Susiyawati, 2021).

The syllabus is developed based on the Graduate Competency Standards and Content Standards for primary and secondary education units according to the learning pattern in each academic year. The syllabus is used as a reference in developing lesson plans (Kemendikbud, 2016). In the lesson plan, several principles in preparing the lesson plan are paying attention to individual differences of students, encouraging active participation of students, developing a culture of reading and writing, providing feedback and follow-up, linkage and integration, and applying technology and information (Akbar, 2013) The student activity sheet (LKPD) is a printed teaching material in the form of a sheet of paper that includes a summary of the material and instructions for implementing student assignments that refer to the basic competencies that must be achieved (Prastowo, 2015). Practical teaching materials are teaching materials that can be used and make it easier for teachers and students to use these teaching materials. The validated teaching materials have met the feasibility in the aspect of book presentation, the main material in accordance with the indicators and the material presented can be used as a guide for both students and teachers in learning and the language used is in accordance with the level of development of students so that the results of the analysis of the validation of teaching materials learners (Putri, Fahmi, & Wahyuningsih, 2021). The test instrument developed in this study was to determine students' critical thinking skills in the form of essay test questions consisting of 15 questions. The development of items is arranged based on indicators of critical thinking skills, including formulating problems, giving arguments, conducting inductions, evaluating, and deciding on an action (Arifin, 2019).

The implementation of learning using the BW-ExPort learning model was observed by two observers in grades VII-G, VII-H, and VII-I for three meetings. Observations were made using learning implementation instruments. The results of observing the implementation of learning can be seen in Table 2.

Table 2. The Implementation of BW-ExPort Learning

Learning Activity	VII-G			VII-H			VII-I		
	P1	P2	P3	P1	P2	P3	P1	P2	P3
Introduction	3,67	3,75	3,67	3,63	3,67	3,75	3,63	3,75	3,88
Main activity									
Phase 1:Problem Identification	3,67	3,75	3,50	3,67	3,50	3,50	3,67	3,67	3,83

Learning Activity	VII-G			VII-H			VII-I		
	P1	**P2**	**P3**	**P1**	**P2**	**P3**	**P1**	**P2**	**P3**
Phase 2: Data Processing	3,50	3,50	3,75	3,50	3,63	3,67	3,57	3,64	3,64
Phase 3: Follow-up Process for Writing Experimental Reports	3,75	3,75	3,67	3,75	3,75	3,75	3,50	3,70	3,70
Phase 4: Elaboration	3,75	3,50	3,75	3,50	3,50	3,75	3,50	3,75	3,75
CLOSING									
Phase 5: Evaluation	4,00	3,75	4,00	3,67	3,75	3,75	3,63	3,63	3,75
Time Management	3,75	4,00	3,75	3,75	3,50	3,50	3,00	3,50	3,50
Class Situation	3,50	3,50	4,00	4,00	3,50	3,50	3,50	4,00	4,00
Average Score of Observer	3,76	3,71	3,76	3,68	3,62	3,66	3,50	3,71	3,76
Total Average	3.74			3,65			3,65		
Percentage of agreement	96,73%			95,52%			95,42%		
Category	Very Good			Very Good			Very Good		

Noted: P1=Meet 1, P2=Meet 2, P3=Meet 3

Based on Table 2, the trial of learning devices based on the BW-ExPort model is in the very good category. Writing experimental reports is very necessary for students to build critical thinking skills, conceptual understanding and develop research skills. In addition, writing experimental reports can help active students make connections between past and present experiences (Slavin, 2003).

In the main activities, there are four phases of the BW-ExPort model. The phases of the BW-ExPort model are: (1) Problem identification. In this phase, the teacher presents physical phenomena that are often seen by students. Students not only observe but also give opinions about what they see and are given the opportunity to identify problems by asking questions about the phenomena they see. Learning in schools should be meaningful, not always abstract so it must be problem-centered (Nur, 2008; Suhandi & Wibowo, 2021). (2) Data processing. In this phase, students are given the opportunity to be involved in experimental activities through group work to answer research questions posed in the experiment. Students are given the opportunity to learn how to design experiments. Students design experiments, collect data, analyze data, ask research questions, propose hypotheses, and test hypotheses. In data processing activities with the involvement of students, it can provide opportunities for more activities. The involvement of students in activities to obtain data and interpret data can provide opportunities to carry out activities such as discussions, clarifying problems, the investigation process and reviewing experimental results (Wu and Krajrik, 2006). (3) Writing experimental results reports. In this phase, the experimental results report is made independently by the students in written form with the contents of the report including an explanation of the objectives of the experiment, experimental methods, and research results accompanied by good conclusions and reasoning. Students are given special opportunities to develop critical thinking skills through report writing activities. The results of written reports made by students individually are discussed with group friends (other groups as *peer reviews*). The results of the discussion are used as a review to revise the experimental results report. Then the revised results are collected to the teacher and reviewed by the teacher to evaluate the quality of the research report. This step aims to provide opportunities for students to improve their experimental report writing skills and critical thinking skills. (4) Elaboration. In this phase, critical thinking skills are trained. By using the elaboration strategy, students will more easily transfer new information from short-term memory to long-term memory with detailed information. The purpose of elaboration is to train critical thinking and problem solving for students. In elaboration activities, each student presents his work and other students criticize to determine which student is the most correct and acceptable.

In the closing activity, there is one phase of the BW-ExPort model, namely evaluating. In this phase the teacher provides feedback by providing corrections and reinforcement to the results of problem solving and writing experiments that have been agreed upon.

To find out the activities of students during the learning process which took place three times, the meeting was carried out by observing the activities

of students every five minutes according to the student activity instruments which can be seen in Appendix 3b. The results of the analysis of the percentage of activities observed during the learning process using the BW-ExPort model for classes VII-G, VII-H, and VII-I are presented in Table 3.

Table 3. Student Learning Activity

No.	Student Activity	Percentage Activity of Learners (%)			Average (%)
		VII-G	VII-H	VII-I	
1.	Listening/ paying attention to teacher/student explanations	10.89	12.60	12.89	12.13
2.	Reading teaching materials	11.02	13.25	14.71	12.99
3.	Expressing opinions	11.69	12.86	12.89	12.48
4.	Discussing with friends	14.71	14.66	14.71	14.69
5.	Asking to the teacher	7.42	7.53	7.42	7.46
6.	Conducting an experiment	15.58	16.88	16.41	16.29
7.	Analyzing data	14.32	14.16	13.15	13.88
8.	Presenting the results of the experiment	10.47	4.29	4.69	6.48
9.	Behaving irrelevant	3.90	3.77	3.13	3.60

The activities of students were observed by two observers during the learning process. Observation of student activities during the learning process is carried out by observing student activities every five minutes. Aspects observed during the learning process are: 1) listening/paying attention to teacher/student explanations, 2) reading teaching materials, 3) expressing opinions, 4) discussing with friends, 5) asking the teacher, 6) conducting experiments, 7) analyzing data, 8) presenting the experimental results and 9) behaving irrelevantly.

Based on Table 3, information is obtained that the highest activity is the aspect of conducting experiments with an average percentage of 16.29%. According to Azzahra (2019), students who are actively involved in the experiment will have the opportunity to prove concepts and theories so that they can develop high-level abilities, especially critical thinking skills. The second highest activity is discussing with friends with an average percentage of 14.69%, it shows that students are very enthusiastic to experiment and discuss with friends. This activity is higher when compared to other activities because in learning activities students are involved in exchanging information, expressing opinions, discussing, presenting so that students pay more attention to the explanations of friends. In line with the opinion of Slavin (2006) that by interacting with an expert, both adults and peers who have more competence, students can gradually acquire expertise.

The critical thinking skills of students were analyzed using *the pre-test* and *post-test* scores. *The pre-test* is carried out before students receive learning on heat material with the BW-ExPort model, which aims to determine the initial ability of students about critical thinking skills. While the *post-test* was carried out after the students received learning with the BW-ExPort model, which aimed to determine the critical thinking skills of students after the learning was carried out. Learning with the BW-ExPort model was carried out for 3 meetings. The pre-test and post-test questions used are oriented to 5 indicators of critical thinking skills, namely formulating problems, giving arguments, conducting inductions, evaluating and deciding on an action. The results of the students' critical thinking skills test are presented in Table 4.

Table 4. Completeness of Each Critical Thinking Skill Indicator

No	Critical Thinking Indicators	VII-G				VII-H				VII-I			
		Pre-test	K	*Post-test*	K	*Pre-test*	K	*Post-test*	K	*Pre-test*	K	*Post-test*	K
1.	Formulate the Problem	23,50	TT	88,70	T	26,50	TT	83,50	T	38,33	TT	88,75	T
2.	Give	22,17	TT	89,79	T	25,29	TT	84,17	T	22,92	TT	74,17	T

No	Critical Thinking Indicators	VII-G				VII-H				VII-I			
		Pre-test	K	*Post-test*	K	*Pre-test*	K	*Post-test*	K	*Pre-test*	K	*Post-test*	K
	Arguments												
3.	Conduct Induction	31,45	TT	83,17	T	30,24	TT	85,42	T	30,42	TT	89,79	T
4.	Evaluate	20,50	TT	83,50	T	17,75	TT	76,50	T	17,50	TT	63,85	T
5.	Decide an Action	23,48	TT	87,50	T	25,50	TT	83,17	T	22,84	TT	83,99	T

Noted: K= Note, TT= Not Finish, T= Finish

Based on the results of the analysis in Table 4, it shows that the average value of the *pre-test* is categorized as very low. The low value of *the pre-test* occurred because the students had never been trained on critical thinking skills. Therefore, learning activities are needed that aim to train critical thinking skills, namely the BW-ExPort model learning activities.

Based on the results of data analysis, it was revealed that after learning using the BW-ExPort model students' critical thinking skills increased each indicator. Based on Table 4.14, it is known that there was a significant increase in each indicator of students' critical thinking skills between before and after learning activities were carried out using the BW-ExPort model. Information obtained that students' critical thinking skills have increased after learning using the BW-ExPort model. In addition, the improvement of students' critical thinking skills is also supported by the implementation of learning in the very good category and activities during learning that have the largest percentage, namely the activity of conducting experiments. This is in line with research conducted by Balulu (2017) which showed that students who studied using the BW-ExPort model experienced an increase in critical thinking skills and experimental report writing skills in high school students.

To test the effectiveness of the learning devices developed by the researchers, a normality test was first conducted on the N-gain results to determine whether the data obtained were normally distributed or not. The normality test was carried out with the help of the SPSS 16 program. The results of the calculation of the normality test for classes VII-G, VII-H and VII-I can be seen in Table 5.

Table 5. Normality Test Results of Students' N-Gain Values

Critical Thinking Values	**Kolmogorov-Smirnov**			**Analysis**	**Conclusion**
	Statistic	**df**	**P-value**		
N-Gain VII-G	.131	32	.178	Sig=0,178<α=0,05	Normal distribution
N-Gain VII-H	.084	32	.200	Sig=0,200<α=0,05	Normal distribution
N-Gain VII-I	.141	32	.109	Sig=0,109<α=0,05	Normal distribution

Based on Table 5, the probability value or P-value of class VII-G, VII-H, and VII-I tested is greater than the significance level of 0.05, which means that Ho is accepted, so it can be concluded that the data used is from a normally distributed population. The next prerequisite test is the homogeneity test which is presented in Table 6.

Table 6. Results of Homogeneity Test of Students' N-Gain Values

	Levene Statistic	**df1**	**df2**	**p-value**
Average N-Gain of students in grades VII-G, VII-H, and VII-I	.802	2	93	.452

Based on Table 6, it is known that the p-value of 0.452 is greater than α 0.05 which means Ho which reads: "The average N-Gain variance of the three experimental classes is the same" is accepted. So, it can be concluded that the sample comes from a homogeneous population.

Because the data obtained were normally distributed and homogeneous, then paired t-test was carried out to determine the significance of

changes in students' critical thinking skills. Paired t-test was calculated using SPSS version 16 program. The results of paired t-test calculation are presented in Table 7.

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Table 7. Paired T-Test Results of Critical Thinking Skills

	Paired Differences							
				95% Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	p-val. (2-tailed)
Pretest-Posttest VII-G	-50.938	12.360	2.185	-55.394	-46.481	-23.313	31	.000
Pretest-Posttest VII-H	-52.469	9.487	1.677	-55.889	-49.084	-31.286	31	.000
Pretest-Posttest VII-I	-52.875	9.631	1.703	-56.347	-49.403	-31.056	31	.000

Based on Table 7, it is known that from the three experimental classes the P-value <0.05, so it can be concluded that H_0 is rejected, which means that there is a significant difference between *the pre-test* and *post-test* of students' critical thinking skills before and after learning by using BW-ExPort models. Because t is negative, it can be concluded that students' critical thinking skills have increased after learning using the BW-ExPort model.

The average similarity test of N-Gain for increasing students' critical thinking skills in the three experimental classes aims to determine the consistency of the effect of using the BW-ExPort model of learning devices, so *the One-way* Anova test is carried out. The results of *the One-way* Anova test in this study are presented in Table 8.

Table 8. *One-Way* Anova Test Result

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.005	2	.002	.213	.809
Within Groups	1.047	93	.011		
Total	1.052	95			

Based on Table 8, the p-value of 0.809 is greater than = 0.05 which means that H_0 is accepted, so that there is no difference in the average N-Gain of increasing critical thinking skills in the three experimental classes. So, it can be concluded that there was a consistent increase in critical thinking skills in the three experimental classes.

Based on data analysis, the results obtained: 1) Paired t-test presented in Table 4.19 reveals that from the three experimental classes there are significant differences between *pre-test* and *post-test*, so that it can be seen that students' critical thinking skills have increased. 2) The N-Gain value presented in Table 4.15 reveals that from the three experimental classes the average increase in *pre-test* and *post-test* is in the high category. 3) *The one-way* Anova test presented in Table 4.20 reveals an increase in students' critical thinking skills that is consistent in the three test classes. This shows that learning using the BW-ExPort model results in a significant increase in critical thinking skills and can be consistently used to improve students' critical thinking skills in the three experimental classes. If viewed as a whole, the results of the analysis of students' critical thinking skills show that report writing-based learning activities in the BW-ExPort model can improve students' critical thinking skills. This is in line with research conducted by Lyesmaya (2016) which shows that report writing-based learning makes learning more meaningful and can improve students' critical and analytical thinking skills.

Although classically all students in the three classes experienced an increase in critical thinking skills, but there were 2 students who were declared incomplete. The incompleteness of the 2 students can be caused because there are differences in the ability of students to absorb the information provided by the teacher during learning, because each student has a different grasping speed. In accordance with the view of cognitive learning, students who are in the same class and at the same time can show different results because it depends on the cognitive processes that occur in the students' brains (Moreno, 2010, adapted by Suhartono, Ismayati & Nur, 2013). This shows that students

are actively building their own knowledge and there may be several influencing factors, so that these students do not give their best ability when working on the test instrument given. Teachers should be aware of these differences from the start and pay special attention.

Student responses were obtained after the learning activities had been completed by using the student response questionnaire instrument in attachment 3d which was given to 96 students. The response questionnaire contains 25 questions related to learning using the BW-ExPort model to improve critical thinking skills and then calculated using the Guttman scale. The results of student responses as a whole are presented in Figure 1.

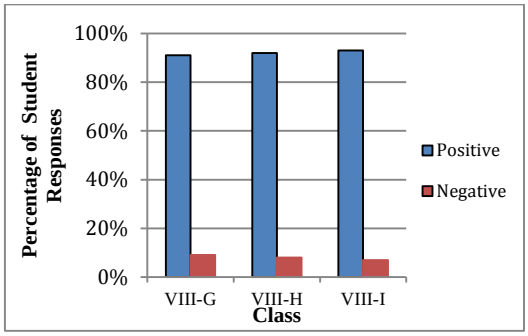

Figure 1. Responses of Third Grade Students

Student response is a response to the feelings of students after participating in learning. The results of student responses to learning using the BW-ExPort model were obtained by using a student response questionnaire. Response questionnaires were given to students after participating in learning for three meetings. The results of the average percentage of student responses are 92% with a very good category. This means that most students are very happy with the learning carried out using the BW-ExPort model. If students respond very well, then the learning provided using the BW-ExPort model is considered good for improving students' critical thinking skills on heat material.

According to Panjaitan (2016) there are several factors that influence student responses to learning, namely the relationship between students and teachers. Students who feel close to the teacher will tend to participate in learning activities in class. To build relationships with students, the teacher's attitude must reflect that the teacher respects and accepts the existence of students and ensures that students get the same treatment.

CONCLUSION AND SUGGESTION

Conclusion

Based on the results of research data analysis and discussion, it can be concluded that the BW-ExPort model of learning devices that have been developed meet the valid, practical and efficient categories. (1) The validity of the learning devices developed using the BW-ExPort model which includes the syllabus, lesson plans (RPP), LKPD, teaching materials and critical thinking skills tests are all in the very valid category. (2) The practicality of the BW-ExPort model of learning devices includes the implementation of learning that very good category, so that the learning devices developed are proven to be practical. (3) The effectiveness of the developed learning devices can be seen from the increase in the N-gain in the high category, the activities and responses of the students in the very good category. Therefore, it can be said that the learning devices developed are feasible (valid, practical and effective) can be used to improve students' critical thinking skills on heat material.

Suggestion

Based on the research that has been done on the development of learning devices for the BW-ExPort model, the suggestions that can be given by researchers include: (1) Based on the results of increasing students' critical thinking skills on heat material after participating in learning using the developed BW-ExPort learning model and the results of activities and student responses are categorized as very good so that teachers are expected to be able to apply the BW-ExPort learning model to other materials. (2) The next researcher or teacher should remind students to read each step of the work on the LKPD carefully when going to do practical activities. (3) Prior to learning activities, the next researcher or teacher arranges the time allocation needed during learning so that all learning activities can be carried out on time. (4) It is better if the next researcher or teacher first introduces laboratory equipment outside of hours before the start of learning using laboratory equipment. This is because students are not fully acquainted with laboratory equipment so that it results in less flexibility for students to use the devices and it takes a long time to be able to use these devices.

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