

Development of Students' Worksheet Based on Quantum Learning to Improve Students' Critical Thinking Ability in 5th Grade Elementary School

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Abstract

The research and development is aims to develop and describe the effectiveness of worksheet based on Quantum learning to improve the ability of critical thinking students. The type of research used is research and development that refers to the theory of Borg & Gall. The population of this research is the students of 5th grade of Elementary School in North Metro. The sample of this research was 33 students in 5th grade class A of Elementary School 1 North Metro. Data were collected used questionnaires, observation sheet and test questions. Data were analyzed using N-Gain effectiveness test. The results showed that worksheet based on Quantum learning is feasible to use and effective to improving the ability of critical thinking students.

Keywords: student worksheet, quantum learning , critical thinking

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1. Introduction

Education is a very important thing for the progress of the nation. The role of education in efforts to form future generations, demand teachers as part of the education element to be proactive in improving the quality of learning in the classroom. Success in learning depends on the ability of the teacher in planning, determining the objectives of students, through the use of teaching materials and supporting tools and learning models to develop the potential of students. Basic education plays an important role in developing the potential of students, because basic education is the initial foundation for students to open their insights. The implementation of learning at the primary education level needs to be adjusted to the level of development and the needs of elementary school students.

The ability of critical thinking is one of the abilities that must be owned by students to be able to solve various problems. Having the ability of think critically the participants must analyze their thoughts to make them have choices and make conclusions. According to Scriven M, & Paul in Sumarna (2017, p. 1) critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. This statement emphasizes that the ability to think critically is an intellectual process that guides a person in action. According to Saiz (2008, p. 131) critical thinking is a process involving a search for knowledge through reasoning skills, problem-solving and decision-making that will allow us to achieve the desired results more efficiently. Meanwhile Ennis in Fisher (2009, p. 5) states that critical thinking is a process aimed that the students can make logic decision, and so what they are thinking is the best thing of the truth which can be done correctly. Futhermore, Ennis in Susanto (2014, p. 125) divides indicators into critical thinking skills into 5 groups, by (1) elementary clarification, (2) basic support, (3) inferring, (4) advanced clarification, and (5) strategies and tactics.

The efforts to facilitate students to get used to solve problems and to develop their creativity are through a structured and varied activities. These activities can be arranged in such a way in a teaching materials in the form of Student Worksheet. According to Prastowo (2015, p. 204) Student Worksheet is a printed material in the form of sheets of paper containing materials, summaries, and instructions on the implementation of learning tasks to be done students, which refers to the basic competencies that must be achieved. Student Worksheet can be useful in many ways including academic achievement. For example, as a supplement to books, providing additional information for a particular class, can help students construct knowledge, otherwise Student Worksheet will be able to attract students when combined with specific teaching methods (Lee 2014, p. 96).

One of the ways to improve the ability of critical thinking is students worksheet based on quantum learning model. As it is stated by Suryani (2013, p. 56) the quantum learning is a learning activity in a pleasant atmosphere. Quantum learning is one of the teachings requiring freedom, relaxing, amazing, enjoyable, and stimulating conditions. The Quantum Learning Model is more student centered in its nature. In this model, students are actively and creatively involved in learning process, so that learning becomes more meaningful and able to increase the student achievement. One of the reasons why students are able to learn better is because they feel happy in taking part in such learning-teaching process. The quantum learning focuses the attention on excellent and meaningful interaction, so that it gives emphasis on the importance of interaction, frequency and accumulation of excellent

and meaningful interaction and therefore communication becomes very important in quantum learning. Furthermore, DePorter in Zeybek (2017, p. 18) quantum learning model occurs of six stages that are enroll, experience, label, demonstrate, review and celebrate. With this framework learning becomes dynamic, easy and lasting. This design encourages student success; enables learners to make their learning experience life, practice and makes content meaningful for learners.

Therefore, the alternative used to improve the ability of critical thinking is by (1) producing student worksheet based on quantum learning that is feasible to improve the ability of critical thinking in 5th grade Elementary School students. (2) Knowing the effectiveness of student worksheet based on quantum learning to improve the ability of critical thinking in 5th grade Elementary School students.

2. Methods

The type of research used is Research and Development (R & D) model of Borg & Gall. Research and Development (R & D) model of Borg & Gall (1983, p. 781) with steps consisting of (1) Preliminary Information Collection (2) Planning, (3) Develop Preliminary Form of Product, (4) Preliminary Field Testing, (5) Product Revision, (6) Main Field Test, (7) Product Revision, (8) Conducting final product trials, (9) revising the final product, and (10) Disseminating and implementing the product. From those ten steps the researchers set to implement until the seventh step.

The subjects of the trial in this study were 2 validator lecturers, 1 classroom teacher in 5th grade A, 10 students in 5th grade B as small trial group, 33 students in 5th grade A as big trial group. The teacher and the students are classroom teacher of grade 5th and the grade 5th students of Elementary School 1 North Metro.

The data collection through questionnaires was used to obtain student worksheet validity data through expert validation tests conducted by material expert lecturers, media experts, and teacher 5th grade. Observation sheets are used to determine the ability of critical thinking in the learning process. Critical thinking questions were used at pretest and posttest to obtain student worksheet effectiveness data in improving the ability of critical thinking through effectiveness testing.

2.1 Analysis Product

The feasibility analysis of Student Worksheet is obtained from the product validation result calculated using the formula:

$$\text{Final Score} = \frac{\text{obtained score}}{\text{Maximum Score}} \times 100$$

The final score is converted to the following assessment criteria.

Table 1. Category Product Validation Result

Value	Category
86 – 100	Very Good
71 – 85	Good
56 – 70	Good Enough
0 – 55	Less Good

2.2 Critical Thinking Ability

The values of critical thinking students on observation sheet is calculated using the formula:

$$\text{Final Score} = \frac{\text{obtained score}}{\text{Maximum Score}} \times 100$$

The final score is converted to the following assessment criteria.

Table 2. Category The Ability of Critical Thinking

Value	Category
86 – 100	Very Good
71 – 85	Good
56 – 70	Good Enough
0 – 55	Less Good

2.3 Analysis Effectiveness

The effectiveness of the use of Students Worksheet is determined by using the N-Gain formula as follows.

$$\text{N-Gain} = \frac{\text{post-test score} - \text{pre-test score}}{\text{maximum score} - \text{pre-test score}}$$

Interpretation of N-Gain calculations using the Hake in Sundayana (2015, p. 151) classification as follows.

Table 3. Interpretation of N-Gain Calculations

Percentage	Interpretation
$g \geq 0,70$	High
$0,30 \leq g < 0,70$	Medium
$g < 0,30$	Low

3. Results and Discussion

3.1 Research result

The results of this development study are student worksheet based on quantum learning. The material developed was the theme of 6 “Heat and Transferring”, the subtheme 1 is “Temperature and Heat” in 5th grade Elementary School. The results of each stage of the development procedure are as follows.

3.1.1 Preliminary Information Collection

The initial stage of the research was carried out by collecting data in the form of information on the learning process of Elementary School in north metro. This is used as material for consideration and basic principles in the development of student worksheet which is based on the acquisition of empirical data about how the profile and subject to be studied.

Based on the results of preliminary research conducted through questionnaire needs in September 2018 carried out on class teachers and 5th grade students in Elementary School North Metro Subdistrict, initial data obtained were learning is teacher centered, critical thinking ability are low, student worksheets developed have not supported students ability of critical thinking, many students still got difficulties in answering the teacher’s questions and to express their ideas, further the students do not take part actively in learning.

3.1.2 Planning

The planning of developing the student worksheet based on quantum learning, namely drafting the students worksheet, determining the steps of presenting the materials, planning the evaluation, and arranging the assesment instrument.

3.1.3 Develop Preliminary Form of Product

The next step of the framework that has been prepared previously is the development of student worksheets. The preparation of this student worksheets is based on aspects of presentation and content that have been planned in advance which consists : (a) cover, (b) introduction, (c) mapping of core competencies, basic competencies, indicators, and learning objectives, (d) instructions on using student worksheet, (e) material (f) bibliography.

3.1.4 Preliminary Field Testing

Preliminary field testing were carried out by validating student worksheet products on material experts, design experts, and teachers classroom. Product validation tests are carried out using questionnaires by material experts, media experts and field teachers classroom. Material validation obtained a value of 93.18 (very good category). Media validation obtained a value of 88,00 (very good categories) and validation by 5th grade teachers obtain a value of 91,48 (very good category). The validators also provide advice and input on student worksheet products based on quantum learning.

Suggestions and input from material experts, namely supporting images are made by themselves and materials in the student worksheet are arranged from easy to difficult material. Suggestions and input from media experts, namely redesign the cover, display images that match the topic and adjust image size, layout, and color. After revising product based on the expert suggestion, the researcher did a trial on a small group consisting of 10 students in 5th grade class B of Elementary School 1 North Metro, in which they represent low, medium, and high in capability.

3.1.5 Product Revision

Based on the results the trial of students worksheet trial based on quantum learning, it can be stated that there is any increase on the students learning result and the improvement of the students critical thinking ability after the process of learning by applying the student worksheet based on quantum learning. Then, it can be concluded that the student worksheet based on quantum learning the student worksheet needs no revision anymore and it is representative to be tried out to bigger group.

3.1.6 Main Field Test

The main field testing were carried out by implementing student worksheet products based on quantum learning in the learning process carried out on January 07 2019 to January 12, 2019. The main field testing subjects were students in 5th grade A at Elementary School 1 North Metro which totaling 33 learners. Learning activities begin with working on the pretest. After the pretest was held, students carried out learning activities using student worksheet based on quantum learning until the sixth learning, and at the end of the sixth learning the students implemented the posttest. This is intended to see the effectiveness of student worksheet based on quantum learning whether it can improve the students critical thinking ability based on learning outcomes before and after the implementation of learning using student worksheet based on quantum learning.

Observation of critical thinking ability using the observation sheet that is carried out every learning meeting

takes place. The observation sheet is used to determine critical thinking skills in the learning process. The results observations of critical thinking ability showed that from 33 students in a large group there were 3 students (9.09%) with very good category, 21 students (63.64%) with good categories, 9 students (27.27%) with good enough category, and no students with less category. The data shows that students critical thinking ability are well during the learning process by using students worksheet based on quantum learning.

3.1.7 Product Revision

Product revisions are carried out based on the results of testing hypotheses and findings in the field when the product is tested. Based on the results of hypothesis testing that has been carried out, obtained data on the improve of students critical thinking ability seen from the learning outcomes of students who are increasing. Therefore, student worksheet products based on quantum learning are not revised and are feasible to be implemented.

3.1.8 Student Worksheet Effectiveness Test

The product effectiveness test is conducted to see a significant increase in students' critical thinking abilities seen from the learning outcomes of students before and after learning using student worksheet based on quantum learning. Recapitulation of student learning data shows an increase in learning outcomes which also shows the results of students' critical thinking skills after learning using student worksheet based on quantum learning theme 6 sub-themes 1. The average pretest learning outcomes of students in 5th grade A is 52,12 and posttest results increased to 78,67 with average N-Gain of 0,55 (medium category).

3.2 Discussion

(1) Development of Student Worksheet

Student worksheet is developed in accordance to the student worksheet framework that has been compiled. The preparation of the student worksheet draft consists of: (a) cover, (b) introduction, (c) mapping of core competencies, basic competencies, indicators, and learning objectives, (d) instructions on using student worksheet, (e) material (f) bibliography. Initial product testing is done by validating student worksheet on material and design aspects. Student Worksheet validation is done by lecturers of material experts, design experts, and teachers classroom.

The student worksheet material expert test aims to gain input on the appropriateness and correctness of instructional materials based on the developed student worksheet. The result of material validation by the material experts based on the aspect assessed obtained the value of 93,18 (very good category). Expert test design aims to get advice about the accuracy of student worksheet design. The result of design validation by the designer based on the assessed aspect earned 88,00 (very good category). The validation result by teacher classroom get the value 91,48 (very good category).

Based on the validity test results above, it can be seen that student worksheet products based on quantum learning for 5th grade Elementary School designed by referring to Curriculum 2013 and developed using steps of research and development Borg and Gall are feasible products based on suitability with quantum learning steps and quality of worksheet, conformity with didactic, construction, and technical requirements.

Student worksheets is one of the instructional learning resources that teachers can use in the learning process. Student worksheets is also a learning medium because it can be used with other learning resources simultaneously, depending on what learning activities are designed. According to Majid (2014, p. 176) argues that student worksheets is a sheet of work that must be done by students. Student worksheets usually contains instructions for students to carry out activities and aims to guide students to active activities during the learning process. Furthermore, Toman (2013, p. 174) student worksheets is one of the teaching methods that can be done individually or in group work and allows conceptual development. Whereas according to Celikler (2010, p. 43) student worksheets is defined as a basic tool that supports the steps of the process that are needed and helps students to understand knowledge and at the same time provide full participation of all classes in activities. Student worksheets is a guide in conducting investigations as well as one of the instructional learning resources which includes material, questions for practice and instructions for the implementation of tasks that students must do to understand the material learned and solve problems by referring to the competencies that must be achieved.

The student worksheet based on quantum learning has the design frame of quantum learning popularly known as "TANDUR": Tumbuhkan = grow, Alami = experience, Namai = give the name, Demonstrasi = demonstrate, Ulangi = repeat and Rayakan = Celebrate. On its learning process, the quantum model takes the base on cognition conditioning at the real world context. According to Anita and Noerhadi in Suryani (2013, p. 56) state that its conditioning into the real world context means that: (1) The tasks are not separated, but constituting part of a bigger context in which the teachers play the roles in establishing the understanding showing the larger context, relevant to the problems being encountered. (2) The real context is mostly referred to the tasks of the learners based on the information and ambient environment. (3) Environmental context is very important (either inside or outside the classroom environment) because development of learning environment is able to stimulate and increase the active participation of students in establishing the understanding and the concept. The six steps are, then applied on thematic learning activity for the students through developing the student worksheet based on quantum learning which can make the students activity more active so that it can improve the students' critical thinking ability It is

in line to what Dewey has stated in Dinuta (2015, p. 789) that critical thinking is an active process in which the children do certain things for themselves through some questions to relevant information. In addition, according to Demircioglu and Kaymaki (2011, p. 200) student worksheet can make learning more interesting and enjoyable, and provide feedback and can promote higher-order thinking skills.

Although this student worksheet only contains one theme and one sub-theme in 5th grade, but it does not reduce that student worksheets based on quantum learning are one solution or alternative of good teaching materials, feasible and can be used in learning. This student worksheets development is suitable for use as a reference and companion for the development of teaching materials contained in student books and the latest 2017 edition of the 2013 curriculum book.

(2) *The effectiveness of Student Worksheet*

Field product trials were conducted in 5th grade Elementary School 1 North Metro. The subjects were 33 students. Before implementing the first lesson, students performed the pre-test. After studying using student worksheet based Quantum Learning, students did post-test. It is intended to determine the effectiveness of student worksheet based Quantum Learning by looking at whether or not improvement of learning outcomes before and after implemented learning using student worksheet based on Quantum Learning.

Based on the recapitulation of learning data of large group students, it is known that there is an increase of pre-test and post-test result with average N-Gain of 0,55 (medium category). The average score on pre-test is 52,12 and it increases in post-test to 78,67. Based on these calculations, the accepted hypothesis is "Student Worksheet based on Quantum Learning effective to improve students' critical thinking ability".

The effectiveness test was conducted to determine the effectiveness of student worksheet based on quantum learning in the learning process that has been carried out based on the learning outcomes of students who refer to critical thinking skills. The effectiveness of a teaching material can be seen from the increasing or not learning outcomes of students after using the instructional materials provided. As the opinion of Sugiyono (2013, p. 413) suggests that measuring the effectiveness of materials / learning media seen from 1) the ease of learning materials or media is implemented, 2) the learning atmosphere becomes conducive, and 3) learning outcomes are increased. Therefore, to determine the effectiveness of using student worksheet based on quantum learning on the ability to think critically by looking at the learning outcomes of students before and after using student worksheet based on quantum learning. student worksheet based on quantum learning can be said to be effective to improve students critical thinking ability if the learning outcomes of students after using student worksheet based on quantum are higher than before using student worksheet based on quantum learning.

According to the research conducted by Bakirci (2011, p. 1469) these findings indicate that the use of simulations and developed worksheets has an impact on the hypothetical, correlational and critical thinking abilities of students who are among their formal stage features. The results of the analysis showed that the average ranking and the number of scores of differences between the pretest and posttest were realized that the increase in students to remember their knowledge. Furthermore, Zeybek (2017, p. 25) results of the researches, it is seen that the quantum learning model has helped learners to improve learning achievement skills, has affected students' attitudes towards the lessons positively, has increased their readiness levels and made learning more enjoyable because of organizing the learning environment to address multiple learning senses.

4. Conclusion

The conclusion of this research and development is that student worksheet products based on quantum learning for 5th grade Elementary School designed by referring to Curriculum 2013 and developed using steps of research and development Borg and Gall are feasible products based on suitability with quantum learning steps and quality of worksheet, conformity with didactic, construction, and technical requirements. Student worksheet products based on quantum learning is feasible to use and effective to improve the ability of critical thinking students.

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