

Effectiveness of The Teaching Materials Based on Argument Driven Inquiry Learning Model for Practicing Students Critical Thinking Skills

Dwi Handayani*, Suyatno Sutoyo**, I Gusti Made Sanjaya**

Science Education Program
Post-Graduate of Universitas Negeri Surabaya

DOI:

dwihandayani.18014@mhs.unesa.ac.id

DOI: 10.29322/IJSRP.10.03.2020.p9957

<http://dx.doi.org/10.29322/IJSRP.10.03.2020.p9957>

Abstrak -This study aims to describe the effectiveness of the teaching materials based on argument driven inquiry model to train students critical thinking skills at SMAN 7 Surabaya, on the subject matter of reaction rate. The teaching materials was developed using the 4D model and the trial design used was One Group Pretest and Posttest Design. Data collection was carried out using validation techniques, critical thinking skills tests and questionnaires. The results of the teaching materials validation showed the following averages: Lesson plan (4), Student book (3), Student worksheet (3), and critical thinking skills test (4) which quite valid and very valid category. The results of critical thinking skills test showed the classical completeness of the students on class XI MIPA 6 was 74.71% with the n-gain score of 0.71 which was included in the high category. Students gave positive responses to the teaching materials developed by 89%. Based on the results of the study it can be concluded that the teaching materials based on argument driven inquiry learning model are declared effective in training students critical thinking skills.

Keyword: *Teaching materials, argument driven inquiry learning model, critical thinking skills, reaction rate*

I. INTRODUCTION

Learning activities is an educational process by providing opportunities for students to develop their potential is the ability of the progressively increasing

in attitudes, knowledge, and skills needed for life and society, nation, and contribute to the welfare of mankind today and in the future will come. The learning activities are expected to increase the student's third potential, especially potential students' skills.

Tony Wagner in his book "The Global Achievement Gap" states that there are seven major skills that are required students to master in order to survive and adapt to changes in the ability of critical thinking and problem solving, collaboration and leadership, agility and adaptability, initiative and spirited entrepreneur, able to communicate effectively either orally or in writing, is able to access and analyze the information, and have the curiosity and imagination. From the above seven skills, critical thinking skills are key skills required of the students. Critical thinking is an activity related to the use of reason to reach a logical conclusion. Learning to think critically means using cognitive processes such as attention, categorize, selection, assess, and decide (Fisher, 2008).

Michael Scriven and Richard Paul explains that critical thinking can be defined as the process as well as the ability, the ability to process and understand the concepts used separately, implement, analyze and evaluate the information obtained or generated information (Sudaryanto, 2007; Filsaime, 2008). The most important thing in teaching critical thinking is to create a spirit of critical thinking that encourages students to question what they hear and examine their own mind to ensure there is no logic to inconsistent or erroneous (Ibrahim and Nur, 2002).

But, in fact learning in school teachers rarely care about the potential of critical thinking skills of students, even in the era of the 21st century is still a lot of teachers use conventional learning where learning is more centered on the teacher, even though in this era of human beings underwent development of science in all fields, one of the most prominent is the field of technology and information. It seemed to make the world more cramped because of all the information from all over the world can be accessed instantly and quickly by anyone, anytime and anywhere, and of course it is so can be utilized teacher in the learning process by providing information that is interesting about the material that will be taught to encourage critical thinking skills of students.

Based on research of Hasung (2008), Argument Driven Inquiry (ADI) learning model is effective in improving critical thinking skills. The ADI learning model is a model of learning that focuses on learning through activities construction and validation of knowledge through the activities of inquiry (*inquiry*) driven by arguing activities. The argument can provide students opportunity to participate in learning and can encourage curiosity and responsibility for the accomplishment of the proper argument, with students as demanded to critically against the phenomenon that the teachers display is and then investigate the truth of the argument they ask. In the student learning model will develop a scientific approach to design and implement investigation, collect, analyze the data, develop arguments participate in the activities of argumentation and communicate discovery.

The ADI learning model is also suitable to be applied on the subjects of chemistry. According to Kumar (2004), in chemistry learning is expected to enhance the knowledge of students to understand themselves and their environment. Students not only gain knowledge of the principles and facts, but students should also be able to use these principles to understand their environment. Chemistry learning also demanding scientific attitude for students, such as honest, critical, objective, open, resilient, creative, and able to cooperate with others. Chemistry learning as well as a vehicle to foster thinking skills of students, so it is expected to be able to develop reasoning skills, critical thinking, and thinking is inductive and deductive analysis of the concepts and principles of chemistry.

The subject matter of reaction rate is suitable to be applied to the ADI learning model because in this subject matter students are required to be able to

analyze by way of experiment, as well as many hooks with everyday life. Based on research of Nikmah (2019), Argument Driven Inquiry (ADI) learning model is valid in chemistry study, which is in solution of both electrolyte and non-electrolyte materials, because it demands that learners be able to analyse by conducting experiments in the same way that the reaction rate material is. the Basic Competency in the syllabus. The reaction rate requires students to be able to analyzes the factors that influence the reaction rate and determine the order of the reaction is based on experimental results. The lawsuit applies not only to the students but also for teachers, where teachers should make learning so that these demands can be achieved and as attractive as possible so that students enjoy participating in lessons.

From the observation result in SMAN 7 Surabaya was found that daily test of reaction rate topic at the academic year 2018/2019 only 32% of students achieve the classical completeness so many students who take remedial. Moreover, from the results of a preliminary studies, it was found that 98% of SMAN 7 Surabaya students dis not have the critical thinking skills. While it is known that the learning model that is often used is the teacher learning model directly with lectures, so that students master the concept correctly but just memorize. Of course it is a demand for teachers how to make students truly understand and interpret the concept. Sadiman (2008) stated that understanding or comprehension can be defined at something with the mind. Therefore, learning must be understood as meaning and philosophy, intent and implications as well as its applications, causing the students to understand the situation. This will be achieved if students have the critical thinking skills are high, so the teacher must be able to create a classroom atmosphere in ways that can stimulate the spirit of critical thinking in students that encourages students to question what they hear and what they see.

Based on the fact that the importance of practicing critical thinking skills for students, in this study we developed the teaching materials based on the ADI learning model at the reaction rate topic and we reported their effectiveness.

II. RESEARCH METHODS

The type of reasearch is the developmental research (Plomp,2010). Development of teaching materials refer to the 4D-model (Thiagarajan, *et al*, 1974). There are four teaching materials developed based on the ADI learning model to practice the

students critical thinking skills namely lesson plan, students book, students worksheed, and test of critical thinking skills. All teaching materials was validated by experts before implemented in chemistry learning. The teaching materials were tested to the students of XI MIPA 6 class at SMAN 7 Surabaya, by involving 36 students using the One Group Pretest-Posttest Design. Data collection methods used were validation, tests, and questionnaires. The research data were analyzed descriptively.

III. RESULT AND DISCUSSION

3.1 Validity of teaching materials

Linn and Gronlund (2013) stated that one of the quality of the teaching materials is validity. All teaching materials are validated by experts before they are used in chemistry learning. The results of the validation of the theaching materials based on the argument driven inquiry learning model could be presented at Table 1.

No.	Type of Teaching Materials	Validity Score	Category
1.	Lesson Plan	4	Very Valid
2.	Student Book	3	Valid
3.	Student Worksheet	3	Valid
4.	Critical Thinking Skills Test	4	Very Valid

Table 1. Validation results of the teaching materials

Based on the data at the Table 1, the teaching materials based on argument driven inquiry learning models developed had a valid and very valid category. Therefore they could be used to train students critical thinking skills in chemistry learning for reaction rate topic.

3.2. Students critical thinking skills

The indicators of critical thinking skill measured were identify or define criteria for consideration of possible answers, presenting argument, identifying the reasons stated, identifying the reasons stated, give a simple explanation, the ability to give a reason, hypothesized, drawing conclusions from the results of the investigation, create and determine the outcome of the consideration

of the facts, and identifying and dealing with a deliberate untruth (Ennis, 2008).

The ADI learning model that is applied in the learning activity can allow students to interact directly with what they learn. Laboratory activities designed using the ADI learning model consist of eight stages or steps that require students in a collaborative group to develop a procedure or process to answer a given problem, which is followed by an initial opinion that states and justifies an explanation for the problem researched. The eight stages or steps of the ADI learning model include 1) identification of tasks, 2) generation of data, 3) production of tentative arguments, 4) argumentation sessions, 5) creation of a written investigation report 6) Double Blind Peer-Review, 7) Revision of the Investigation Report, and 8) explicit reflective discussion. In the following paragraphs, a presentation of activities covering the seven phases mentioned above and a breakdown of the activities of each phase in the ADI learning model will be given.(Walker, 2012; Kadayifci, 2016)

The relationship between the syntax and critical thinking skills could be seen at Table 2.

No.	Syntax ADI	The Indicators of Critical Thinking Skills
1.	Fase 1: Identification of Task	1. Identify or formulate criteria to consider possible answers 2. Keep the state of mind or stay focused on the problem.
2.	Fase 2: Generation of Data	1. Identify and formulating questions 2. Stating a hypothesis 3. Designing experiments 4. Draw conclusions from the investigation
3.	Fase 3 Production of Tentatif Argument	1. Presenting arguments 2. Identifying the stated reason 3. Identifying reasons not stated
4.	Fase 4 Argumentation Session	1. The ability to provide a simple explanation 2. The ability to reason
5.	Fase 5 Creation of a Written Investigation Report	Make the results of considerations based on facts

No.	Syntax ADI	The Indicators of Critical Thinking Skills
6.	Fase 6 Double Blind Peer-Review	
7.	Fase 7 Revision of the Investigation Report	Identifying and handling untruths on purpose
8.	Fase 8: Explicit Reflective Discussion	

Table 2. The Relationship of the ADI model to critical thinking skills

Based on the Table 2, students are expected to be able to use critical thinking skills in reasoning based on first hand experience.

Critical thinking skills tests are used to determine the effectiveness of the teaching materials developed in practicing the students critical thinking skills. The test is done before or called the pretest and the test after learning is posttest. Pretest is done before learning which aims to determine the students' initial ability in aspects of critical thinking skills while the posttest is done at the end of learning using argument driven inquiry models to train critical thinking skills that aim to find out the extent of students' final knowledge after teaching and learning activities are carried out. The results of the pretest and posttest scores are used to calculate the n-gain score (Hake, 1999). The N-gain score is used to determine the types of critical thinking skills categories between before and after learning by using the argument driven inquiry learning model.

Based on the results of this study, the value of students critical thinking skills increased with the implementation of argumen driven inquiry learning models. The value of students critical tinkng skills at the grade XI MIPA 6 class in the pretest activities of students obtained an average of 12.48 with incomplete criteria (IC). After learning activities using the argument driven inquiry learning model the results of the students posttest score increased by an average of 74.71 with the completion criteria (C) and the n-gain of the class average of 0.71 with high category. However there were six students who still incomplete. So they were given possible solutions in the form of remedial learning to achieve the completeness of critical thinking skills. The results of achieving

students critical thinking skills could be seen at Table 3.

Aspect	Achievement of Pretest (%)	Achievement of Posttest (%)
Identify or define criteria for consideration of possible answers	13.19	56.25
Presenting argument	7.64	47.92
Identifying the reasons stated	26.39	74.92
Identifying the reasons stated	8.33	72.92
Give a simple explanation	0.69	79.17
The ability to give a reason.	23.61	76.39
Hypothesized	20.83	83,33
Drawing conclusions from the results of the investigation	18.06	86.81
Create and determine the outcome of the consideration of the facts	0.00	88.89
Identifying and dealing with a deliberate untruth	0.00	63.89

Table 3. Achievement of critical thinking skills of students of XI MIPA 6 class

Based on the data at Table 3, students were able to think critically so there was an increse of students scritical thinking skill from the pre test score to the post test score. The results of increasing students' critical thinking skills could be linked to constructivism which seen cognitive development as a process when children actively form meaningful systems and interpreted reality through their experiences and interactions (Arend, 2009). This results of study also were supported by Hasung (2008) which stated that application of argument driven inquiry learning models could improve the students critical thinking skills.

3.3. Student response

Student response data related to chemistry learning with reaction rate topic using the argument driven inquiry learning models to train students' critical thinking skills. Student responses to the teaching materials developed were seen from students'

interest in student book, student worksheets, subject matter of reaction rate, how teachers teach, the learning atmosphere, and the questions of critical thinking skills. The results obtained, the average student filled out by expressed interest with a percentage of 89%. The results stated that most students were interested in the teaching materials used by the teacher. From this interest the teacher was easier to take the attention of students so they were eager to carry out learning activities. Tafsir (2008) prove that interest was the key in teaching. If students were interested in learning activities, it could be ensured that the learning process would be better .

From this research, it can be seen the effectiveness of the use of argument driven inquiry models on learning tools to train critical thinking skills is very well. Researchers conduct research by examining in depth about library studies to determine the opportunities for effective use of argument driven inquiry learning models to practice critical thinking skills.

IV. CONCLUSION

Based on the research results obtained, the conclusion is that the teaching materials based on argument driven inquiry learning model at reaction rate topic are effective for training students critical thinking skills.

REFERENSI

- [1] Arends, R. (2009). Learning to Teach, 9th ed, New York: Mc Graw-Hill Companies, Inc.
- [2] Ennis, R.H. (2008). The Nature of Critical Thinking An Outline of Critical Thinking Disposition and Abilities. Chicago: University of Illinois.
- [3] Filsaime, D.K. (2008). Reveals the Secrets of Critical and Creative Thinking. Jakarta: Prestasi Pustaka
- [4] Fisher, A. (2008). Introduction of Critical Thinking. Jakarta: Erlangga.
- [5] Gronlund and Linn. (2013). Measurement and Assesment in Teaching. New Jersey: Prentice Hall
- [6] Hake, R.R. (1999). American Educational Research Association's Division D, Measurement and Research Methodology: Analyzing Change/Gain Scores. USA: Woodland Hills.
- [7] Hasung, K. (2008). Effectiveness of the argument driven inquiry (ADI) learning models in improving the students critical thinking skills. *Education Journal*. Vol 38(5).

- [8] Ibrahim, M. (2010). Basic of Teaching Learning Process. Surabaya: Unesa University Press.
- [9] Ibrahim, M. and Nur, M. (2000). Problem Based Learning. Surabaya: University Press.
- [10] Kadayifci, H.(2016). Implementation of argument-driven inquiry as an instructional model in a general chemistry laboratory course. *Science Education International Journal*.Vol 27(3), 369-390.
- [11] Kadayifci, H.(2012). The correlation between the flaws students define in an argument and their creative and critical thinking abilities. *Social and Behavioral Sciences*.Vol 47, 802-806.
- [12] Kumar, A. (2004). Assessment of Practical skills in Science. New Delhi: Central Board of Secondary Education
- [13] Nikmah, C. (2019). Validation of learning media using argument driven inquiry (ADI) Learning Model.*International Journal of Scientific and Research Publications*. Vol 11, 5.Issue 11
- [14] Plomp, T. (2010). *Educational Design Research: An Introduction* Tjeerd Plomp dan Nienke Nieveen (Ed.). *An Introduction to Educational Design Research*. Enschede: SLO. Netherlands Institute for Curriculum Development.
- [15] Sadiman, A. S. (2008). Educational Media. Jakarta: PT Raja Grafindo Persada
- [16] Sudaryanto. (2007). Critical thinking ability as a way to achieve clinical reasoning competence in medical education. <http://www.fk.undip.ac.id/index.php?option=combanner&task=click&id>. Accessed 20 June 2019.
- [17] Tafsir, A. (2008). Educaton in Islamic Prepective. Bandung: Rosda karya
- [18] Thiagarajan, S., Semmel, D.S. & Semmel, M.I. (1974). Insructional Development for Training Teacher Expectional Children. Minneapolis: Laedership Training Institute.
- [19] Walker, P. (2012). Argument-driven inquiry in undergraduate chemistry labs: the impact on students' conceptual understanding, argument skills, and Attitudes Toward Science. *Journal of College Science Teaching*.Vol 41(4), 254-292.

AUTHORS

First Author – Dwi Handayani, Science Education, Post Graduate, State University Of Surabaya, dwihandayani.18014@mhs.unesa.ac.id

Second Author – Suyatno Sutoyo, Science Education, Post Graduate, State University Of Surabaya , Suyatno@unesa.ac.id

Third Author – I Gusti Made Sanjaya, Science Education, Post Graduate, State University Of Surabaya, igmasanjaya@unesa.ac.id

Correspondence Author – Dwi Handayani, Science Education, Post Graduate, State University Of Surabaya, dwihandayani.18014@mhs.unesa.ac.id