



## **Improving Junior High Schools' Critical Thinking Skills Based on Test Three Different Models of Learning**

### **Nur Miftahul Fuad**

Biology Department, Universitas Negeri Malang, Indonesia, [kiyut2008@yahoo.com](mailto:kiyut2008@yahoo.com)

### **Siti Zubaidah**

Prof., Biology Department, Universitas Negeri Malang, Indonesia, [siti.zubaidah.fmipa@um.ac.id](mailto:siti.zubaidah.fmipa@um.ac.id)

### **Susriyati Mahanal**

Dr., Biology Department, Universitas Negeri Malang, Indonesia, [susriyati.mahanal.fmipa@um.ac.id](mailto:susriyati.mahanal.fmipa@um.ac.id)

### **Endang Suarsini**

Dr., Biology Department, Universitas Negeri Malang, Indonesia, [endang.suarsini.fmipa@um.ac.id](mailto:endang.suarsini.fmipa@um.ac.id)

The aims of this study were (1) to find out the differences in critical thinking skills among students who were given three different learning models: differentiated science inquiry combined with mind map, differentiated science inquiry model, and conventional model, (2) to find out the differences of critical thinking skills among male and female students. This study is a quasi-experimental research with pretest-posttest nonequivalent control group design. The population in this research is the seventh grade students of junior high schools in Kediri, Indonesia. The sample of the research is in the number of 96 students distributed in three classes at different schools. The data of critical thinking skills are gained from test scores and then analyzed using descriptive and inferential statistics through ANCOVA. The results of research revealed that there are different skills in critical thinking in different models. The highest skills in critical thinking are reached by students who were given differentiated science inquiry model combined with mind map in their learning. There are also differences in critical thinking skills between male and female students.

Key Words: differentiated science inquiry, mind map, critical thinking, gender, learning

### **INTRODUCTION**

There has been a significant and rapid advancement in science and technology in the 21<sup>st</sup> century. In regard to this significant and rapid advancement of science and technology,

educational stakeholders have to be able to anticipate it in order that they can prepare the future generations that are ready and adaptive to respond to all demands. In this very rapid era, students need to possess the thinking skills that can assist them in making strong decision to acquire new knowledge quickly (Lau, 2011). The dominant thinking skill that is strongly needed in this 21<sup>st</sup> century is critical thinking skills (Kharbach, 2012).

Critical thinking means reflective thinking that focuses on deciding the believed act or something done (Ennis, 2013). Another idea which was stated is that critical thinking is the skill in examining assumptions, discerning hidden values, evaluating evidence, and assessing conclusions (Myers, 2003). Critical thinking is a skill needed to foster students' thinking skill (Hashemi, 2011).

Teacher as a frontier in education should be able to carry out the mandate in training critical thinking for students. Nevertheless, based on the preliminary study conducted, it revealed that the critical thinking skills of junior high school in Kediri, Indonesia are still at the low level. Further, the proof showed that test score of critical thinking in the scale of 0 – 100, obtained the average score is 21.89. Questionnaire evidenced that the low of students critical thinking skills is because learning strategies applied by teachers is still teacher centered, and have not involved students actively during the learning (Fuad, et al., 2015). In accordance to those aspects, there has to be well designed plan of learning that trains students' critical thinking.

The learning of natural science should focus and emphasize more on students' involvement actively through inquiry (Olson & Horsley, 2000; Wyatt, 2005). Some research showed that inquiry learning can train the skill of critical thinking (Prince & Felder, 2006; Kazempour, 2013). Hence, inquiry learning can assist students to formulate or construct question and search for the answers as well as develop students' activity that train students' not only minds-on activity but also hands-on activity (Arends, 2012).

Viewed from teacher and student roles, inquiry can be divided into 4 types: demonstrated inquiry, structured inquiry, guided inquiry, and self-directed inquiry (Llewellyn, 2013). In common, teacher prefers one of the four to apply to all students in a topic during the learning. For this reason, it has been promoted Differentiated Science Inquiry (DSI) model that offers a type of different inquiries in accordance to students need to gain the same opportunities for them to improve (Llewellyn, 2011). The availability of the same opportunities for students would exist when students experience the learning process that suits to their readiness, learning interest, and learning style. These, in turn, would enable them to maximize their skills (Tomlinson, 2001).

Besides, in order to develop students' thinking skill, it is necessary to use mind map learning model (Keles, 2012). Mind map can be used together with other techniques that suit to the philosophy of constructivism. This technique relies on images or graphics and their interrelationship with pictures, words, numbers, logics, and colors forming it a unique way. Mind map is a technique that stimulates the left and right brains that functions to make thinking process more visible, to give comprehensive and detail

illustration of a thing all together, to ease in organizing and understanding information effectively and systematically, and to develop creative and innovative thinking skills as well as strengthening memories (Buzan, 1993).

DSI model combined with mind map is expected to be able to improve thinking skills. Nevertheless, there are some other factors that influence thinking skill. That factor is gender. The differences on biological growth especially in term of gender causes significance between critical thinking skills of students (Ramdiah & Corebima, 2014). In other research result, it has been reported that the difference on gender influences the score of students' critical thinking significantly (Ricket & Rudd, 2004; Thompson, et al., 2002; Azizmalayer, et al., 2012).

### **Theoretical Background**

#### *Critical Thinking Skill*

Many definitions about critical thinking are presented by some experts. Ennis (2013) states that critical thinking is a way of reflective thinking that makes sense or that is based on logic focusing on determining what to believe and to do. Critical thinking is a process that is based on the steps to analyze, examine, evaluate the arguments (Proulx, 2004). Meanwhile, Walker (2005) states that critical thinking is an intellectual process in creating concept, applying it, analysing it, synthesizing it, and evaluating much information gained from observational results, experiences, and reflections all of whose processes are used as a base in determining further action. Based on those definitions, critical thinking is a thinking that involves reasoning and logic to solve the problems (Page & Mukherjee, 2006).

Scoring rubric to assess critical thinking with a scale of 0-5 has been developed by Zubaidah, et al. (2015). That rubric is modified from Illinois Critical Thinking Essay Test that is developed by Finken & Ennis with the format of minimal structure. This modified assessment can be used to assess students' skill in critical thinking through essay test. This assessment format is arranged based on some considerations; one of which is due to the fact that this test format has been widely used among educators in Indonesia. This rubric can be developed in order to be used easily, practically, and be able to accommodate each indicator of critical thinking effectively and efficiently.

#### *Differentiated Science Inquiry (DSI)*

DSI model is the development of Differentiated Learning (DI). In DI, the differences on the needs of students to achieve maximum learning goals becomes primary considerations. By designing learning activities that are based on students' need, students' problems in learning can be solved. Therefore, they will have high motivation in learning.

In natural science based learning, Llewellyn (2011) developed DI based on inquiry learning. This is mainly based on the fact that teachers, in common, prefer one of the four types of inquiries to apply to all students in a topic during the learning. Whereas, each kind of inquiry has their strengths and weaknesses. As a response, DSI model has been promoted since it offers kinds of different inquiries in accordance to students need.

In DSI, class is divided into four big groups. Each class represents one inquiry level. Referring to Llewellyn (2013) level of inquiry, the characteristics of students and teacher are showed in Table 1 below.

Table 1

The characteristics of students and teacher in each level of inquiry

	<i>Demonstrated Inquiry</i> (Level 1)	<i>Structured Inquiry</i> (Level 2)	<i>Guided Inquiry</i> (Level 3)	<i>self-directed Inquiry</i> (Level 4)
Posing the question	Teacher	Teacher	Teacher	Student
Planning the procedure	Teacher	Teacher	Student	Student
Analyzing the results	Teacher	Student	Student	Student

There are six phases in an inquiry cycle: (1) inquisition, beginning from a question to investigate, (2) acquisition, brainstorming for possible answers, (3) supposition, selecting statement to assess, (4) implementation, designing a plan, (5) summation, collecting evidence and drawing conclusion, and (6) exhibition, sharing and communicating findings (Llewellyn, 2011).

There are some researches about inquiry learning that encompass critical thinking as a variable. Some research results have reported that the implementation of inquiry learning have developed the skills of students' critical thinking significantly (Wyatt, 2005; Azizmalayer, et al., 2012; Mahanal, 2012).

#### *Mind Map*

Mind map is an effective graphical technique and becomes a universal key to unlock the potency of all brains. This is due to the fact that mind map activates all brain skills in neocortex or left and right brain (Buzan, 2002). Long and Carlson (2011) states that the utilization of mind map during the learning assists students make connection of information of previous materials toward materials being learned. Wheeldon (2011) also states that respondent utilizing mind map are able to remember, organize, and frame the reflection of their own past experiences.

There are many experts who recommend the utilization of mind map in learning. The use of mind map was intended to develop the students' critical thinking skills (Eppler, 2006; D'Antoni, et al., 2010; Pudelko, et al., 2012).

#### *Gender*

Gender is a common term that refers to male and female (Fin & Ishak, 2012). Gender is a grammatical classification for a noun and in general refers to both sexual categories. The word "gender" is derived from English, gender means "sexual category". The term gender refers to psychology dimension and socio-cultural of a male and female. Gender relates to the way male and female to think, to act, and to feel or sense (Santrock, 2011).

Based on the research, it has been revealed that female students showed lower performance on math (Isa & Balarabe, 2009). However, female students showed better performance on science and technology (Thomas & Stockton, 2003). Based on the

research, results of Vural (2013) reported that female students have higher learning achievement compared to the male students. This report was different from the research conducted by Gok (2014). It was reported that there was no difference in the concept understanding between male and female students, yet the difference was found on the problem solving. Male has better ability in solving problem than female. As a result, there are various research results related to the gender difference and its contribution to the variables of learning achievement and problem solving.

In other research, it has been evidenced that the gender difference influences the scores in term of the respondents' critical thinking (Ricketts & Rudd, 2004; Mahanal, 2012; Crawford, et al., 2005). However, the different research showed that there was no influence on respondents' thinking skill in terms of gender differences (Thompson, et al., 2002; Rudd, et al., 2000; Cimer, et al., 2013).

#### *The aim of study*

The aims of this study were (1) to find out the differences of critical thinking skills among students who were given three different learning models: differentiated science inquiry combined with mind map, differentiated science inquiry model, and conventional model, (2) to find out the differences of critical thinking skills among male and female students.

## **METHOD**

### *Model of Research*

This study is a quasi-experimental research. The research began with the development of learning devices by referring to the model of Dick and Carey (Dick, et al., 2009). On the tenth stage, summative evaluation, conducted the quasi-experimental research.

This research uses pretest-posttest nonequivalent control group design. The independent variable of this research is learning models (DSI mind-map, DSI, and conventional) and gender. Meanwhile the dependent variable for this research is critical thinking skills of students. The factorial design is applied in this research implementing 3 x 2 factorial design as showed in Table 2.

Table 2  
Factorial design 3x2

		<i>Learning Model (M)</i>		
		DSI (M <sub>1</sub> )	DSI-mind map (M <sub>2</sub> )	Conventional (M <sub>3</sub> )
Gender (G)	Male (G <sub>1</sub> )	G <sub>1</sub> M <sub>1</sub>	G <sub>1</sub> M <sub>2</sub>	G <sub>1</sub> M <sub>3</sub>
	Female (G <sub>2</sub> )	G <sub>2</sub> M <sub>1</sub>	G <sub>2</sub> M <sub>2</sub>	G <sub>2</sub> M <sub>3</sub>

### *Sample of Research*

The population of the study was all junior high school (SMP) of seventh grade in Kediri, Indonesia. After the homogeneity test was done, the chosen samples were female and male students of SMP 2 Puncu Kediri as the control group, which then was treated by conventional model. The experimental groups were the students of SMP 1 Papar, Kediri treated by DSI combined with mind map model, and SMP 1 Ngadiluwih, Kediri treated by DSI model. The total samples of the study were 96 students, consisting of 48 male students and 48 female students. There were 16 male students and 16 female students involved in each of the four groups studied.

During the treatment, in each class, the students were divided into 8 groups in accordance to the order of pretest scores ranging from the lowest to the highest. The first two lowest groups were given structural inquiry student worksheet, the next four groups higher than that of the first two were given guided inquiry student worksheet, and the last two groups or the highest were given free inquiry student worksheet.

The research was conducted on August - December 2015 in the science subject. The teaching material applied in the study covers: Observing Objects, Microscope, Laboratory Safety, Characteristics of Living Things, and Classification of Living Things.

#### *Data Collection and Analysis*

The data in this research are obtained from the test scores of students' critical thinking skills. The scoring rubric is adapted from Zubaidah, et al. (2015) with the scale of 0 – 5. The data analysis of this research uses covariate analysis (ancova) preceded by normality test and sample homogeneity test.

### **FINDINGS**

The hypothesis tested in this study were: (1) there were a difference between students' critical thinking skills who were given three different learning models; (2) there were a difference between male and female critical thinking skills; (3) there were a difference between critical thinking skills of students in terms of the interaction learning models and gender. The data were obtained from the results of pretest and posttest of students critical thinking skills. The data were analyzed by the Statistical Package for the Social Sciences (SPSS) for windows version 22,0. The analysis was preceded by normality test using One-Sample Kolmogorov-Smirnov Test and homogeneity test using Levene's Test of Equality of Error Variances. The summary of the result of normality and homogeneity test are provided in Table 3.

Table 3

The summary of the result of normality and homogeneity test

Group of data	<i>Normality</i>		<i>Homogeneity</i>	
	N	Sig	Levene's Test Score	Sig
Pretest of critical thinking	96	0,586	0,661	0,654
Posttest of critical thinking	96	0,494	1,770	0,127

Based on Table 3, it can be stated that the data were normally distributed and all the variances were homogeneous (sig normality and homogeneity >0.05).

The result of Anova analysis about the critical thinking skills based on instructional models and gender can be seen in Table 4 and Table 5 below. Meanwhile, the result of size effect test is displayed in Table 6.

Table 4  
The summary of Ancova results

Source	Df	Mean Square	F	Sig.
Pretest critical thinking	1	2380,335	400,048	0,000
Learning models	2	2044,424	171,797	0,000
Gender	1	35,519	5,969	0,017
Learning models*Gender	2	3,686	0,310	0,734

The analysis showed that the hypothesis (1) is accepted. It means that there are differences between students' critical thinking skills who were given three different learning models. The hypothesis (2) is also accepted. It means that there are differences between male and female students' critical thinking skills. However, the hypothesis (3) is rejected. It means that there is no difference between critical thinking skills of students' in terms of the interaction learning models and gender. Based on the results of those hypothesis testing, then the results were tested with Least Significance Difference (LSD) as shown in Table 5

Table 5  
The comparison of mean score of skills in critical thinking for all classes viewed from their gender

Learning Models	Pretest	Posttest	Difference	Cor	Notation
Conventional male	23,13	66,25	43,12	66,17	a
Conventional female	23,12	68,00	44,88	67,92	b
DSI male	23,02	74,27	51,25	74,29	c
DSI female	22,92	75,00	52,08	75,11	c
DSI mind-map male	23,33	77,81	54,48	77,54	d
DSI mind-map female	22,71	78,31	56,60	78,61	d

Table 6  
The calculation result of size effect test for Ancova test

Source	Eta Squared ( $\eta^2$ )	Effect Size
Learning models	0,78	High
Gender	0,014	Low
Learning models*Gender	0,0014	Low

Based on LSD test on Table 5, it can be seen that there is a different combination among groups. DSI model combined with mind map has the highest contribution to improve the scores of critical thinking skills compared to any other models. Furthermore, there are differences between critical thinking skills of male and female students.

Based on table 6 above, it can be seen that learning models give the higher effect toward the students critical thinking skills than gender.

## DISCUSSION

Based on the research conducted, it has revealed that there are different scores of critical thinking skills with different instruction models. DSI model gives higher contribution to improve the scores of skills in critical thinking than that of conventional model. Meanwhile, DSI combined with mind map model gives the highest potency to improve the critical thinking skills compared to the other two models.

Inquiry learning model that is implemented in the class during the research has proven to contribute significantly to the scores of critical thinking skills. The result of this research is in line with the statement of Lujan and Dicarlo (2006) which recommends teacher to focus on active learning, more specifically, on inquiry models as solutions to solve the low level of critical thinking skills. Llewellyn (2013) has also recommended to implement inquiry learning in order that students get involved in the exploration process actively by using skills of logical and critical thinking. There are some other researches that proved that inquiry learning improves the scores of critical thinking skills (Azizmalayer, 2012; Mahanal, 2012; Kazempour, 2013).

The contribution of inquiry learning model to the critical thinking skills of students is actually due to the fact that the syntax of DSI is in line with the nature of the critical thinking skills as presented by Proulx (2004) who states that critical thinking is a process that is based on a series of steps to analyse, to assess, and to evaluate argument. In addition, DSI model that is well-implemented can activate students in the classroom, give opportunities to students to study more on materials through exploring questions and studying how to develop hypothesis, assisting students to create learning based on their need, gaining the depth of the concept based on materials, becoming critical thinkers, and having high order thinking (Lane, 2007).

In this research, the students as the subjects ranged from 12 – 15 years. Based on the cognitive development by Piaget, these students are on the formal operational stage so that they have been able to think logically, critically, and abstract through systematic experiments (Slavin, 2006). However, the students' rapidity to think logically, critically, and abstract is different from one to another. The easiness of students in accessing curriculum that is suited to students' ability in DSI class has also contributed to the scores of students' skills in critical thinking. Slow learners are assisted more on the worksheet. This assistance decreases based on the high ability of students. DSI learning enables students to improve and maximize their ability because all students are facilitated to access class curriculum based on their need.

Inquiry combined with mind map in science learning has proven to give the highest contribution to improve students' critical thinking skills. This is resulted by that not only inquiry learning contribute to the critical thinking skills, but also mind map empowers and strengthens that contribution. Integrating mind map into each of inquiry steps will make students easy in organizing and understanding information effectively and systematically. The ability in organizing and understanding information plays key roles to achieve six elements of critical thinking. The six elements of critical thinking are focus, reason, inference, situation, clarity, and overview (Ennis, 1996).



The integration of mind map in inquiry syntax has been proven to be accurate to improve the students' critical thinking skills. Mind map is a potential technique to activate students to synthesize and to integrate meaningful information as well as to enrich learning experiences to develop the skills in critical thinking. (Zipp & Maher, 2013). The statement was supported by several previous research—showing that mind map was proven to be effective in developing the skills in critical thinking (Eppler, 2006; D'Antoni, et al., 2010; Santiago, 2011; Pudelko, et al., 2012).

Besides learning models, the difference on gender has also contributed to the different skills in critical thinking. In line with this, Ramdiah and Corebima (2014) state that biological growth that represents gender causes significant differences between learning achievement and the critical thinking skills.

Based on this research, it reveals that female students tend to acquire better in critical thinking skills compared to those male students. The results of this research are relevant to the statement of Mahanal (2012) who says that female students are more able to think critically and to arrange the way of their thinking than those of male students. The result of this research, indirectly, is similar with to the research conducted by Vural (2013) which showed that female students have better learning achievement compared to those male students. Female students are also better than male students in processing textual information (Yang, 2016). The research by Santrock (2001) showed that male students commonly have more problems in learning especially in learning language compared to female students. As a fact that learning achievement becomes primary modality for students to be able to think critically.

The differences between male and female can be inspected from the brain anatomy that influences the learning system and human brain activities (Gurian, et al., 2010). Male brains tend to develop and have more complex spatial such as in the ability of mechanism planning, measurement, direction decision, abstraction, and manipulation of physical things. The cortex area of male's brain works more on doing spatial functions and tend to give a few portion to produce and process words. The nerves that link left and right brain or corpus callosum of male's brain is quarterly smaller than female's brain. When male's brain merely uses right brain, female's brain use both of the parts maximally (Hines, 2004).

Although instructional model and gender give significant differences between critical thinking skills, the interaction of both sides showed no significant difference between the critical thinking skills. This absence of significant difference is supported by the very low eta square gender score on size effect test. As a result, the difference of skills in critical thinking is influenced much by learning model. Gender only makes a small contribution even though it is significant.

Again, based on this research, the researcher recommends to implement DSI combined with mind map model in science learning to train the critical thinking skills of students. The critical thinking skills should be trained because they are the key skills needed in the 21st century. Furthermore, critical thinking should be trained to students through the instruction as early as possible.

**CONCLUSION**

Based on the results of this research and the discussion, it can be concluded that:

- There is a difference on critical thinking skills among the students who were taught using DSI model combined with mind map, DSI instructional model, and conventional model. The highest critical thinking skills was obtained on the students who were taught using DSI model combined with mind map.
- There is a difference on the students' skills in critical thinking among male and female students. Female students' critical thinking skills is higher than male students.

This research is limited into science subject in the level of junior high schools. This will be much more interesting when it is applied in different subjects even in elementary or senior high schools. Further, the thinking skills involved only still majoring in critical thinking. Therefore, future researchers can do similar researches that focuses more on other thinking skills, such as creative thinking and problem solving.

**REFERENCES**

Arends, R.I. (2012). *Learning to Teach*. 9th. New York: McGraw-Hill.

Azizmalayer, K. et al. (2012). The Impact of Guided Inquiry Methods of Teaching on the Critical Thinking of High School Students. *Journal of Education and Practice*, 3 (10): 42-47.

Group Buzan, T. (2002). *How to Mind Map: The Ultimate Thinking Tool That Will Change Your Life*. London: Thorson

Çimer, A. et al. (2013). Critical Thinking Level of Biology Classroom Survey: CTLOBICS. *The Online Journal of New Horizons in Education*, 3 (1): 15-24.

Crawford, A. et al. (2005). *Teaching and Learning Strategies for the Thinking Classroom*. New York: International Debate Education Association.

Dick, W. et al. (2009). *The Sistematic Design of Instruction*. New Jersey: Pearson Education, Ltd.

D'Antoni, A. et al. (2010). Does the Mind Map Learning Strategy Facilitate Information Retrieval and Critical Thinking in Medical Students? *BMC Medical Education*, 10: 61-72.

Ennis, R.H. (1996). *Critical thinking*. Upper Saddle River, NJ: Prentice-Hall.

Ennis, R.H. (2013). *The Nature of Critical Thinking: Outlines of General Critical Thinking Dispositions and Abilities* (Online), Available: <http://www.criticalthinking.net/longdefinition.html>. (Accessed August, 2015).

Eppler, M.J. (2006). A Comparison between Concept Maps, Mind Maps, Conceptual Diagrams, and Visual Metaphors as Complementary Tools for Knowledge Construction and Sharing. *Inf Visualization*, 5, 202-210.

- Fin, L.S. & Ishak, Z. (2012). A Priori Model of Students Academic Achievement: The Effect of Gender as Moderator. *Procedia-Social and Behavioral Sciences*, 65: 1092-1100.
- Fuad, N.M. et al. (2015). Profil Hasil Belajar, Keterampilan Berpikir Kritis dan Kreatif Siswa serta Strategi Pembelajaran yang Diterapkan Guru SMP di Kabupaten Kediri, *Prosiding Seminar Nasional Biologi dan Pembelajarannya*, Jurusan Biologi FMIPA UM, Malang, 17 Oktober 2015. In Press.
- Hashemi, S.A. (2011). The Use of Critical Thinking in Social Science Textbooks of High School: a Field Study of Fars Province in Iran. *International Journal of Instruction*, 4(1): 63-78.
- Isa, H. & Balarabe, R.M. (2009). Analysis of the Participation and Performance of Males and Females in Nigeria in Science and Technology Programmes: A Case Study of Ten Years National Diploma in Nuhu Bamalli Polytechnic, Zaria. *Educational Research and Review*, 4 (9): 588-595.
- Kazempour, E. (2013). The Effects of Inquiry-Based Teaching on Critical Thinking of Students. *Journal of Social Issues & Humanities*, 1 (3): 23-27.
- Keles, O. (2012). Elementary Teacher's Views on Mind Mapping. *International Journal of Education*. 4 (1): 93-100.
- Kharbach, M. (2012). *The 21st Century skills Teachers and Student Need to Have*. Halifax: Creative Commons Attribution Mount Saint Vincent University.
- Kuhlthau, C.C. et al. (2007). *Guided inquiry: Learning in the 21st Century*. Santa Barbara, CA: Libraries Unlimited.
- Lane, J.L. (2007). *Inquiry-based Learning*. (Online), Available: <http://www.schreyerinstitute.psu.edu/pdf/ibl.pdf>, (Accessed August, 2015).
- Lau, J.Y.F. (2011). *An Introduction to Critical Thinking and Creativity*, John Wiley & Sons Inc, Massachuset.
- Llewellyn, D. (2011). *Differentiated Science Inquiry*. California. Corwin A Sage Company.
- Llewellyn, D. (2013). *Teaching High Science Through Inquiry and Argumentation*. California. Corwin A Sage Company.
- Long, D. & Carlson, D. (2011). Mind the Map: How Thinking Maps Affect Student Achievement. *Journal For Teacher Research*, 13 (2): 1-7.
- Lujan, H.L. & Dicarlo, S. (2006). Too Much Teaching Not Enough Learning: What is the Solution?. *Physiology Education*, 30 (1): 17-22.
- Mahanal, S. (2012). Strategi Pembelajaran Biologi, Gender dan Pengaruhnya Terhadap Kemampuan Berpikir Kritis. *Prosiding Seminar Nasional UNS*. 9 (1).
- Myers, D.G. (2003). *Exploring Psychology*. New York: Worth.

- Olson, S. & Horsley, S.L. (2000). *Inquiry and The National Science Education Standards, A Guide For Teaching And Learning*. Washington: National Academies Press.
- Page, D. & Mukherjee, A. (2006). Using Negotiation Exercises to Promote Critical Thinking Skills. *Business Simulation and Experimental Learning*, 30 (1): 71-78.
- Prince, M.J. & Felder, R.M. (2006). Inductive Teaching and Learning Methods: Definitions, Comparisons, and Research Bases. *Journal of Engineering Education*, 95 (2): 123-138.
- Pudelko, B. et al. (2012). Mapping as a Learning Strategy in Health Professions Education: A critical Analysis. *Medical Education*, 46: 1215-1225.
- Proulx, G. (2004). Integrating Scientific Method & Critical Thinking in Classroom Debates on Environmental Issues. *The American Biology Teacher*, 66 (1): 1-10.
- Ramdiah, S. & Corebima, A.D. (2014). Learning Strategy Equalizing Student's Achievement Metacognitive, and Critical Thinking Skills. *American Journal of Educational Research*, 2 (8): 577-584.
- Ricketts, J.C & Rudd, R. (2004). Critical Thinking Skills of FFA Leaders Journal of Southern Agricultural Education Research, 54 (1): 7-20.
- Rudd, R. et al. (2000). Undergraduate agricultural student learning styles and critical thinking abilities: Is there a relationship? *Journal of Agricultural Education*, 41(3): 2-12.
- Santiago, H.C. (2011). Visual Mapping to Enhance Learning and Critical Thinking Skills Santiago: *Optometric Education*, 36 (3): 125-129.
- Santrock, J.W. (2011). *Educational Psychology*. New York: McGraw Hill.
- Seyihoglu, A. & Kartal, A. (2010). The Views of Teaching about Mind Mapping Technique in Elementary Life Science and Social Science Lesson Based Constructivist Method. *Educational Science: Theory & Practice*, 10 (3).
- Thomas, J. & Stockton, C. (2003). Socioeconomic Status, Race, Gender, and Retention: Impact on Student Achievement. (Online), Available: [www.usca.edu/essays/vol72003/stockton.pdf](http://www.usca.edu/essays/vol72003/stockton.pdf), (Accessed Sept, 2015).
- Thompson, P.M. et al. (2002). Growth Patterns in the Developing Brain Detected by Using Continuum Mechanical Sensor Maps. *Nature*, 404 (1): 190-193.
- Tomlinson, C.A. (2001). *How to Differentiate Instruction in Mixed-ability Classrooms*. Virginia: Association for Supervision and Curriculum Development.
- Vural, S. (2013). Academic Procrastination and Gender as Predictor of Science Achievement. *Journal of Educational and Instructional Studies*, 3 (2): 64-68.
- Wheeldon, J. (2011). *Is a Picture Worth a Thousand Words? Using Mind Maps to Facilitate Participant Recall in*. The Qualitative Report.

Wyatt, S. (2005). Extending Inquiry-Based Learning to Include Original Experimentation. *The Journal of General Education*, 54 (1): 83-89.

Zip, G. & Maher, C. (2013). Prevalence of Mind Mapping as a Teaching and Learning Strategy in Physical Therapy Curricula. *Journal of the Scholarship of Teaching and Learning*, 13(5): 21 – 32.

Zubaidah, S. et al. (2015). Asesmen Berpikir Kritis Terintegrasi Tes Essay. *Prosiding Simposium on Biology Education (Symbion)*, Jurusan Biologi FKIP Universitas Ahmad Dahlan Yogyakarta, 4-5 April 2015.

**Turkish Abstract****Öğrenmede Üç Aşamalı Test Modeline Dayalı Olarak Ortaokul Öğrencilerinin Eleştirel Düşünme Becerilerini Geliştirmek**

Bu çalışmanın amacı,(1) akıl haritalarıyla birleştirilmiş farklılaştırılmış bilim anketi, farklılaştırılmış bilim anketi modeli, geleneksel model olarak 3 farklı öğrenme modeli verilmiş: öğrenciler arasındaki eleştirel düşünme yeteneklerindeki farklılığı; (2) kız ve erkek öğrenciler arasındaki eleştirel düşünme yetenekleri arasındaki farklılığı anlamaktır. Bu çalışma öntest-sontest içeren eşdeğer olmayan kontrol grup deseni ile yarı deneysel olarak yapılmıştır. Araştırmanın popülasyonunda Endonezya Kediri'deki 7. sınıf öğrencileri kullanılmıştır. Araştırmanın örneklemini farklı okullardaki üç sınıftan alınan 96 öğrenci oluşturmaktadır. Eleştirel düşünme becerisi verileri test sonuçlarından ve tanımlayıcı ve çıkarımsal ANOVA analizlerinden elde edilmiştir. Araştırma sonuçları farklı eleştirel düşünme modellerinde farklı beceriler olduğunu göstermiştir. Eleştirel düşünmede en yüksek beceri öğrenmede akıl haritalarıyla birleştirilmiş farklılaştırılmış bilim anketi verilen öğrenciler tarafından gerçekleştirilmiştir. Ayrıca kız ve erkek öğrenciler arasında da eleştirel düşünme becerilerinde farklılık görülmüştür.

Anahtar Kelimeler: farklılaştırılmış bilim anketi, akıl haritası, eleştirel düşünme, cinsiyet, öğrenme

**French Abstract****Amélioration des Compétences Pensantes Critiques de Collèges Basées sur Test Trois Modèles Différents d'Apprentissage**

l'enquête de science différenciée combinée avec la carte d'avis(esprit), le modèle d'enquête de science différencié et le modèle conventionnel, (2) pour découvrir les différences de compétences pensantes critiques parmi le mâle et des étudiantes. Cette étude est une recherche quasi-expérimentale avec la conception de groupe témoin nonéquivalente pretest-posttest. La population dans cette recherche est les étudiants de cinquième de collèges dans Kediri, l'Indonésie. L'échantillon de la recherche est dans le nombre de 96 étudiants distribués dans trois classes aux écoles différentes. Les données de compétences pensantes critiques sont gagnées de scores au test et analysées ensuite utilisant la statistique descriptive et déductive par ANCOVA. Les résultats de recherche ont révélé qu'il y a des compétences de différence dans la pensée critique dans des modèles différents. Les compétences les plus hautes dans la pensée critique sont atteintes par les étudiants que l'on a donnés le modèle d'enquête de science différencié combiné avec la carte d'avis(esprit) dans leur apprentissage. Il y a aussi la différence de compétences pensantes critiques entre le mâle et des étudiantes.

Mots Clés: l'enquête de science différenciée, objectez à la carte, la pensée critique, le genre, l'apprentissage

**Arabic Abstract**

تحسين مهارات التفكير الناقد لمدارس الثانوية المبتدئة بناء على اختبار ثلاثة نماذج مختلفة من التعلم

وكانت أهداف هذه الدراسة (1) لمعرفة الاختلافات في مهارات التفكير الناقد لدى الطلاب الذين منحوا ثلاثة نماذج التعلم المختلفة: متباينة تحقيق العلم جنباً إلى جنب مع العقل خريطة والعلوم متباينة نموذج الاستفسار، والنموذج التقليدي، (2) للعثور من الاختلافات في مهارات التفكير الناقد لدى الطلاب والطالبات. هذه الدراسة هو البحث شبه التجريبي مع تصميم المجموعة الضابطة غير متكافئ لاختبار القبلي - البعدي . السكان في هذا البحث هو طلاب المستوى السابع من مدرسة إعدادية في كيبيري، اندونيسيا. عينة البحث هو في عدد 96 طالبا موزعين على ثلاث فئات في مختلف المدارس. يتم اكتساب البيانات من مهارات التفكير الناقد من درجات الاختبار ومن ثم تحليلها باستخدام الإحصاء الوصفي والاستدلالي من خلال ANCOVA. كشفت نتائج البحث أن هناك مهارات الفرق في التفكير النقدي في نماذج مختلفة. ويتم الوصول إلى أعلى مهاراتهم في التفكير النقدي من قبل الطلاب الذين منحوا متباينة نموذج الاستفسار العلم جنباً إلى جنب مع الخريطة الذهنية في التعلم. هناك أيضا اختلاف في مهارات التفكير النقدي بين الطلاب والطالبات.

الكلمات الرئيسية: تحقيق العلم المتباينة، خريطة العقل، والتفكير الناقد، والجنس، والتعلم

### German Abstract

#### Verbesserung der Fähigkeiten der kritischen Denken von Junior High School Basierend auf Test drei verschiedene Modelle des Lernens

Ziel dieser Studie war es, die Unterschiede der kritischen Denkfähigkeit unter den Studierenden, die drei verschiedene Lernmodelle erhielten, herauszufinden: differenzierte Wissenschaftsforschung mit Mind Map, differenziertem Wissenschaftsmodell und konventionellem Modell, (2) zu finden Heraus die Unterschiede der kritischen Denkfähigkeiten unter den männlichen und weiblichen Kursteilnehmern. Diese Studie ist eine quasi-experimentelle Forschung mit Pretest-posttest nicht-äquivalenten Kontrollgruppe Design. Die Bevölkerung in dieser Forschung ist die siebte Klasse Studenten der Mittelschulen in Kediri, Indonesien. Die Stichprobe der Forschung ist in der Zahl der 96 Studenten in drei Klassen an verschiedenen Schulen verteilt. Die Daten der kritischen Denken Fähigkeiten werden aus Testergebnissen gewonnen und dann analysiert mit deskriptiven und inferentiellen Statistiken durch ANCOVA. Die Ergebnisse der Forschung ergab, dass es unterschiedliche Fähigkeiten in kritischem Denken in verschiedenen Modellen. Die höchsten Fähigkeiten in kritischem Denken werden von Studenten, die mit differenzierten Wissenschafts-Anfrage-Modell mit Mind Map in ihrem Lernen kombiniert erreicht. Es gibt auch unterschiedliche kritische Denkfähigkeiten zwischen männlichen und weiblichen Studenten.

Schlüsselwörter: differenzierte wissenschaftsforschung, mind map, kritisches denken, gender, lernen

### Malaysian Abstract

#### Tingkatkan Kemahiran Berfikir Kritis Junior High Schools Berdasarkan Ujian Tiga Model Pembelajaran yang Berbeza

Tujuan kajian ini adalah (1) untuk mengetahui perbezaan kemahiran berfikir kritis dalam kalangan pelajar yang telah diberi tiga model pembelajaran yang berbeza: dibezakan pertanyaan sains digabungkan dengan peta minda, berbeza model inkuiri sains, dan model konvensional, (2)

untuk mencari perbezaan kemahiran berfikir kritis dalam kalangan pelajar lelaki dan perempuan. Kajian ini merupakan kajian kuasi-eksperimen dengan ujian pra-ujian pos menggunakan reka bentuk kumpulan kawalan. Sampel kajian ini adalah pelajar gred ketujuh SMP di Kediri, Indonesia. Sampel kajian adalah dalam bilangan 96 orang pelajar dibahagikan dalam tiga kelas di sekolah-sekolah yang berbeza. Data kemahiran pemikiran kritikal yang diperoleh daripada skor ujian dan kemudian dianalisis dengan menggunakan statistik deskriptif dan inferensi melalui ujian ANCOVA. Hasil kajian menunjukkan bahawa terdapat perbezaan dalam pemikiran kritikal dalam model yang berbeza. Kemahiran tertinggi dalam pemikiran kritikal dicapai oleh pelajar-pelajar yang telah diberi perbezaan model inkuiri sains digabungkan dengan peta minda dalam pembelajaran mereka. Terdapat juga perbezaan kemahiran pemikiran kritikal antara pelajar lelaki dan perempuan.

Kata Kunci: pertanyaan sains yang berbeza, peta minda, pemikiran kritikal, jantina, pembelajaran

#### **Russian Abstract**

#### **Улучшение Критических Навыков Мышления Учащихся Младших Классов Средней Школы Основанное на Модель Трехэтапного Теста**

Целью данного исследования является 1) выяснить различия навыков критического мышления среди учащихся, которым были даны три различные модели обучения: дифференцированная наука в сочетании с карта ума, 2) выяснить различия навыков критического мышления среди мужских и женских студентов. Это исследование является квази-экспериментальным исследованием предтестовой-посттестовых управлений неэквивалентной контрольной группы дизайнера. Объектом исследования являются учащиеся седьмого класса младших средних школ в Кедрин, Индонезия. Для исследования выбрано 96 учащихся распределенные в трех классах в разных школах. Данные по навыком были анализированы с использованием описательных методов и статистики через ANCOVA. Результаты исследования выявили, что существуют различные навыки критического мышления в различных моделях. Самые высокие навыки критического мышления достигли студенты, которым были даны дифференцированные модели науки в сочетании с картой ума в обучении. Существуют также различия в навыках критического мышления между мужчинами и женщинами.

Ключевые Слова: дифференцированная наука, карта ума, критическое мышление, пол, обучение