



JPPS (Jurnal Penelitian Pendidikan Sains)

p-ISSN: 2089-1776

e-ISSN: 2549-1597

Volume 9, No. 1, November 2019

<https://journal.unesa.ac.id/index.php/jpps/index>

INVESTIGATING STUDENT'S CRITICAL THINKING DISPOSITION BASED ON GENDER IN PHYSICS TEACHING WITH INTERACTIVE MULTIMEDIA

G. Gunawan^{*1}, A. Harjono², L. Herayanti³, S. Husein⁴, dan F. Fathoroni⁵

^{*1,2}Faculty of Teacher Training and Education, Universitas Mataram, Indonesia

³Faculty of Mathematics and Science Education, Universitas Pendidikan Mandalika, Indonesia

⁴Sciences Education Master Program, Universitas Mataram, Indonesia

⁵Indonesian Publication Center, Mataram, Indonesia

e-mail: gunawan@unram.ac.id

Abstract. Interactive multimedia is able to combine various kinds of representations into one whole media unit. These representations are in the form of visual, auditory, and procedural representations. Interactive multimedia capabilities can directly stimulate the development of students' critical thinking skills. This research has explored the increasing tendency of students to think critically or called critical thinking disposition. In particular, this study compared the increasing levels of critical thinking disposition of male and female students. Field trials employed a quasi-experiment with a pretest and posttest control group design. The subject consisted of 16 male and 16 female students in senior high school at Mataram, Indonesia. The research instrument used description problem that has been adapted to the indicators of critical thinking disposition, namely truth-seeking, open-mindedness, analyticity, systematic, and inquisitiveness. The results indicate that of N-gain research for male students were 35.5 and female 36.4. This shows that the use of interactive multimedia has a positive effect on improving critical thinking disposition in both male and female students.

Keywords : *Critical Thinking Disposition, Gender, Interactive Multimedia*

©Jurnal Penelitian Pendidikan Sains (JPPS)

INTRODUCTION

In the 21st century, critical thinking is one of the skills that is highly needed in the field of education. This skill greatly influences one's cognitive development. Several attributes are required for success in developing critical thinking skills. One of the attributes in theory is the disposition of critical thinking skills Facione et al. (1995). When we think of courage (character), patience, and trust, it is the disposition of one's character. Disposition of characters can show the real character of thinking Facione (2000). For example, a professional soccer player can be an attacking character (preferring to score) or defensive (preferring to prevent opponents from scoring), their character will undoubtedly be expressed in their game. Understanding a person's character will make it easier to understand their daily behavior and comprehend dispositions (inclination of character) can provide better opportunities to predict the way someone reacts or reacts to something, in this case, critical thinking skills. Thus, critical thinking disposition is important as capital in developing and understanding critical thinking skills.

Some scholars stated that disposition is a tendency of behavior due to the knowledge possessed, such as John Dewey described aspects of the disposition of thinking as personal attributes Dewey (1933). In social psychology, disposition is an attitude, character or tendency to something Cronbach (1990), whilst, in physics, disposition is the molecular aspect that an object has due to specific treatments. For example, at certain pressures and temperatures, water tends to boil or freeze. In this research, disposition is better understood in the social side of science in Dewey's view, namely the tendency of students to do something as an expression of their character or in this case commonly known as critical thinking skills.

In addition, the topic of gender differences has long been an attention-grabbing research topic. The different approaches taken by male and female students in learning provide a wealth of exciting knowledge for further study. Better understanding will provide a better perspective as well so that we can plan to learn according to the character and disposition of each gender. Kenway & Gough (1998) observed that the intellectual skill of female students had not been further studied. Moreover, the development skills of male students in the world of

science are higher than female students need to be studied more deeply (Hazari, Tai, & Sadler, 2007).

The differences in the development of critical thinking skills in different genders have been investigated in several studies. A study conducted by Walsh & Hardy (1999) revealed that female students had the development of critical thinking skills better than male students. However, another study by Quitadamo & Kurtz (2007) argued that gender differences did not significantly influence critical thinking skills. The differences in the results of these studies illustrate that more substantive data is needed to understand the relationship between gender differences and the development of critical thinking skills. It is important to apprehend why the complexity of different research results was to understand the tendencies of male and female students in critical thinking. To this point, a good understanding of the initial skills will provide an opportunity for a better understanding of the final outcome.

Moreover, the development of a good critical thinking disposition is not enough just using an appropriate learning method. One of learning methods that most people tend to use is by immersing media in classroom activities. Good learning media plays an important role in shaping the character of knowledge in students. One of the media which has great potential is interactive multimedia. Interactive multimedia can combine various representations into one complete media. Figural representations (drawings, graphics, or charts), numerical representations, verbal representations (text and paragraphs), and procedural representations (simulations and virtual labs) can be combined in attractive interactive multimedia forms.

Utilization of computers in the learning process can take the form of interactive multimedia. According to Gunawan et al. (2017), multimedia is a system that supports teacher communication with students during the learning process through text, audio, images, animation, video, and graphics. The use of interactive multimedia combined with a problem based learning model can help students develop thinking skills. According to Hosnan (2014), problem based learning helps students develop critical thinking skills as well as problem solving abilities, and at the same time, it develops students' abilities to actively build their knowledge. This is in line with Pluck & Johnson (2011) that PBL-based interactive multimedia emphasizes the activeness of students in learning as indicated by an increase in student curiosity in learning. Interactive multimedia can explain complex and dynamic concepts more clearly, facilitate to remember content easily, improve understanding of topic content

through the perspective of students, and make students more interested in learning (Khan & Masood, 2015; Hwang & Wu, 2014). Thus, the combination of interactive multimedia and problem based learning models theoretically support each other in developing students' thinking skills, one of which is the ability to think critically.

Students' interest in learning to use interactive multimedia and the ability of the media itself becomes the basis in developing thinking abilities in learning physics. According to Apriyanti et al. (2014), one of the important thinking skills in physics is the critical thinking disposition. Halpern (1998) stated that, by developing critical thinking disposition, students are able to succeed in school and throughout their lives. Critical thinking disposition is one's tendency to behave in critical thinking. Walker (2003) stated that to develop critical thinking, one must possess and use specific critical thinking disposition characteristics. His statement was completed by Facione et al. (1995) which revealed that someone who thinks critically uses seven dispositions to shape and make decisions namely systematic, analyticity, open-mindedness, inquisitiveness, truth-seeking, self-confidence, and maturity.

Several studies on the use of multimedia have been carried out and produced positive responses to the mastery of concepts and the critical thinking disposition. Husein et al. (2017) suggested that the use of interactive multimedia influences the mastery of concepts and critical thinking skills. In line with this, Rahmatiah et al. (2013) suggested that increasing students' mastery of concepts and critical thinking skills by using interactive multimedia rather than conventional learning. Gunawan & Liliyasi (2012) found that the use of virtual physics labs can improve the disposition of critical thinking.

METHOD

This quasi-experimental study involved one group in senior high schools. The subjects were selected using a purposive sampling technique suggesting 16 males and 16 female students. Students were selected based on male-female students' conformity in their initial abilities to avoid numbers bias of both groups. Each student has a deal with preliminary and final tests. After the initial test was given, each class was treated with interactive multimedia-assisted learning. The final test was given after the lesson. The test, which was designed as an essay question, used to measure the level of critical thinking skills disposition, which was analyzed with five levels. The increase of skill

disposition is determined by a calculation finding score of N-gain. Testing the difference in improvement of critical thinking disposition in male and female students is done by independent sample t test. Previously the sample data was tested for normality as a prerequisite for testing the hypothesis. The normality test uses the Kolgomorov-Smirnov test

RESULT AND DISCUSSION

The normality test uses the Kolmogorov-Smirnov test and the results of the normality test are presented in Table 1. The normality test aims to meet the data prerequisites and assumptions of the hypothesis test using the independent sample t test.

Table 1. One-Sample Kolmogorov-Smirnov Test

		Critical Thinking Disposition N-Gain
N		32
Normal Parameters ^{ab}	Mean	39.2591
	Std. Deviation	9.11009
Most Extreme Differences	Absolute	0.076
	Positive	0.067
	Negative	-0.076
Kolmogorov-Smirnov Z		0.427
Asymp. Sig. (2-tailed)		0.993
a. Test distribution is Normal.		
b. Calculated from data.		

Based on Table 1, the significance value of 0.993 is greater than the assumed value of 0.05. Data analysis showed that the data were normally distributed, so that different test requirements using independent t-test samples were met.

Data assumptions have been met statistically, ie the number of samples above 30 and the data are normally distributed. Whether or not there are differences in the increase in male and female students will be tested using an independent t test. The test results are presented in Table 2.

Table 2. Independent Sample T-Test

		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	Sig. (2-tailed)	
Critical Thinking Disposition N-Gain	Equal variances assumed	1.029	0.319	0.682	

Table 2 shows some data that provided information about the research sample. Levene's Test for Equality of Variance shows a value of 0.319 which is greater than 0.05, this means that the study sample is a homogeneous variant (additional prerequisites are met). The significance value of the t-test showed a value of 0.682 which was far greater than 0.05. This data shows that there is no significant difference in the increase in the average score of critical thinking disposition between male and female students. That is, the average increase in the disposition of critical thinking male and female students is relatively the same, that male students are no better than female students in terms of critical thinking disposition in this study.

Critical thinking disposition is the tendency of thinking to act positively according to certain abilities possessed. Indicators of critical thinking disposition measured in this study include truth-seeking, open-mindedness, analyticity, systematic, and inquisitiveness. The difference in improvement in each indicator is compared based on gender, as in Figure 1.

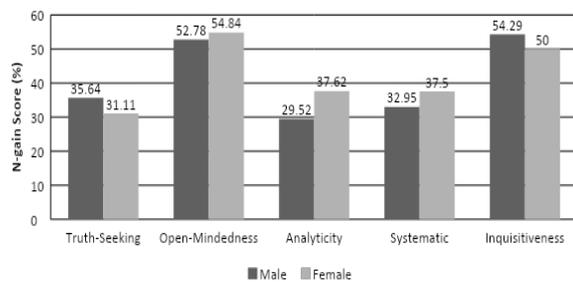


Figure 1. The Differences Disposition of Critical Thinking Skills Based on Gender in Each indicator

Based on Figure 1, male and female do not differ significantly in terms of disposition of critical thinking skills. This is evidenced by the N-gain scores of male and female students not much different on each indicator. Critical thinking disposition is very important to be trained in students because disposition is one of the higher-level thinking skills. According to Irani et al. (2007) stated that a high disposition tends to produce meaningful critical thinking and lead to problem solving solutions, and decision making. Disposition exercises that are trained in physics learning are assisted by interactive multimedia, and the aim is to facilitate students in the thought process. Also, Husein et al. (2017) identified that interactive multimedia is a tool that can facilitate the learning process and can be used anywhere and anytime. Therefore, there are five indicators trained in this research, namely truth-seeking, open-mindedness, analyticity, systematic, and inquisitiveness. These five indicators are divided into each sub-concept of thermodynamic law.

On the Truth-seeking indicator, male students have a higher improvement score than female students. The

truth-seeking indicator is the ability that shows the effort in analyzing problems based on experience and knowledge possessed to arrive at the right solution. The problem which students have to find in the concept of thermodynamics is about the balance of objects. Students are required to be able to explain the balancing process and be able to make PV graphs and provide alternatives that can be done to deal with thermodynamic problems. This means that male students have a higher ability than female students in thinking of finding solutions based on their experiences.

An indicator of open-mindedness is a tolerant attitude towards different views. The openness of mind is very important for students to respect opinions or understanding of others because the thinker has a boundary between right and wrong. In addition, the new understanding received by students from open-mindedness provides new insights into students' thinking because, in reality, the understanding that is understood by students is not completely correct. People who tend to be open-minded are important to understand what other people think about other things because sometimes a person has an unconscious error. The results of the open-mindedness indicator in this study show that female are higher than male students. This means that female have more open sense of the problem and are able to stipulate suitable reasons. The result In line with the study conducted by Giancarlo & Facione (2001), Walsh & Hardy (1999), and Facione et al. (1995) stated that female have a higher ability on open-mindedness indicators than male.

Another indicator is analyticity, an attitude that tends to be cautious about events that will occur next (Gunawan & Liliyasi, 2012). This relates to anticipating the consequences of good or bad situations, choices, and plans. Analyticity is the main sub-indicator of disposition. On the analyticity indicator, the score of improvement of female students is higher than that of male. Male students have relatively low improvement scores. This shows that female's ability to identify better, associate with knowledge in solving problems that arise or can apply reasoning and evidence to overcome problems by anticipating the possibility of what will happen next.

On the indicator of systematic, the score of increasing the disposition of critical thinking skills of female students is higher than that of male. According to Facione (2000) systematic is a tendency to work hard in solving problems that are orderly, disciplined, and systematic. Female students have a better ability to organize systematically and thoroughly in solving problems, inquisitiveness is an attitude of high curiosity that students tend to have a high curiosity about everything and even those things are irrelevant to what they want to prove. Furthermore, in the indicator of inquisitiveness, male students have a higher improvement score than female students. This means that male students have a high attitude of curiosity about the problems faced to be resolved.

Overall, female and male students have the highest improvement scores in the open-mindedness and inquisitiveness indicators that were classified in the medium

category. This shows that male and female students have an open mind and high curiosity in finding the right solution to solve thermodynamic problems. Interactive multimedia that is used can increase the attitude of curiosity and openness in receiving the information presented. This is in line with the study by Gunawan et al. (2018) revealed that the use of virtual laboratories has a positive effect on the creativity of male and female students. In addition, according to Mashami & Gunawan (2018), animation media can improve the critical thinking skills of male and female students. However, in making decisions, female students have higher critical thinking skills than male students.

CONCLUSION

Based on the results of data analysis and discussion, it can be concluded that there are differences in the increase in critical thinking disposition that are not significant between male and female students. The increase in male and female students on average is in the category of moderate improvement. Male students have a higher increase in truth-seeking indicators and inquisitiveness while, female students are superior to indicators of open-mindedness, analyticity, and systematic. In general, the use of interactive multimedia has a positive effect on improving critical thinking disposition in both male and female students.

REFERENCES

- Apriyanti, L., Abdurrahman, A., & Viyanti, V. (2014). Pengaruh Disposisi Berpikir Kritis Terhadap Hasil Belajar Melalui Arias Terpadu Peta Konsep. *Jurnal Pembelajaran Fisika*, 2(4), 39-51.
- Cronbach, L. J. (1990). *Essentials of psychological testing*. New York: Harper Collins.
- Dewey, J. (1933). *How We Think: A Restatement of the Relation of Reflective Thinking to the Educational Process*. Lexington, MA: Heath Publishing. Originally published in 1910.
- Facione, P. A. (2000). The disposition toward critical thinking: Its character, measurement, and relationship to critical thinking skill. *Informal logic*, 20(1), 61-84.
- Facione, P. A., Sanchez, C. A., Facione, N. C., & Gainen, J. (1995). The disposition toward critical thinking. *The Journal of General Education*, 44(1), 1-25.
- Giancarlo, C. A., and Facione, P. A. (2001). A look across four years at the disposition toward critical thinking among undergraduate students. *J. Gen. Educ.* 50(1), 29-55.
- Gunawan, G., & Liliyasi, L. (2012). Model Virtual Laboratory Fisika Modern untuk Meningkatkan Disposisi Berpikir Kritis Calon Guru. *Jurnal Cakrawala Pendidikan*, 31(2), 185-199.
- Gunawan, G., Harjono, A., & Sutrio, S. (2017). Multimedia Interaktif dalam Pembelajaran Konsep Listrik bagi Calon Guru. *Jurnal Pendidikan Fisika dan Teknologi*, 1(1), 9-14.
- Gunawan, G., Suranti, N. M. Y., Nisrina, N., Herayanti, L., & Rahmatiah, R. (2018). The effect of virtual lab and gender toward students' creativity of physics in senior high school. *In Journal of Physics: Conference Series* 1108 (1), 012043.
- Halpern, D. F. (1998). Teaching critical thinking for transfer across domains: Disposition, skills, structure training, and metacognitive monitoring. *American psychologist*, 53(4), 449.
- Hazari, Z., Tai, R. H., & Sadler, P. M. (2007). Gender differences in introductory university physics performance: The influence of high school physics preparation and affective factors. *Science Education*, 91(6), 847-876.
- Hosnan, M. (2014). *Pendekatan saintifik dan kontekstual dalam pembelajaran abad 21*. (Scientific and contextual approach to 21 century learning) Jakarta: Ghalia Indah
- Husein, S., Herayanti, L., & Gunawan, G. (2017). Pengaruh Penggunaan Multimedia Interaktif Terhadap Penguasaan Konsep dan Keterampilan Berpikir Kritis Siswa pada Materi Suhu dan Kalor. *Jurnal Pendidikan Fisika dan Teknologi*, 1(3), 221-225.
- Hwang, G. J., & Wu, P. H. (2014). Applications, impacts and trends of mobile technology-enhanced learning: a review of 2008-2012 publications in selected SSCI journals. *International Journal of Mobile Learning and Organisation*, 8(2), 83-95.
- Irani, T., Rudd, R., Gallo, M., Ricketts, J., Friedel, C., & Rhoades, E. (2007). Critical thinking instrumentation manual. Retrieved August, 11, 2011.
- Kenway, J., & Gough, A. (1998). Gender and science education in schools: a review 'with attitude'. *Studies in Science Education*, 31(1998), 1-30.
- Khan, F. M. A., & Masood, M. (2015). The effectiveness of an interactive multimedia courseware with cooperative mastery approach in enhancing higher order thinking skills in learning cellular respiration. *Procedia-Social and Behavioral Sciences*, 176, 977-984.
- Mashami, R. A., & Gunawan, G. (2018). The Influence of Sub-Microscopic Media Animation on Students' Critical Thinking Skills Based on Gender. *In Journal of Physics: Conference Series* 1108 (1), 012106.

- Pluck, G., & Johnson, H. L. (2011). Stimulating curiosity to enhance learning. *GESJ: Education Sciences and Psychology*, 2(19), 24-31.
- Quitadamo, I. J., & Kurtz, M. J. (2007). Learning to improve: using writing to increase critical thinking performance in general education biology. *CBE—Life Sciences Education*, 6(2), 140-154.
- Rahmatiah, R., Gunawan, G., & Sutrio, S. (2013). Model Pembelajaran Berbasis Multimedia Interaktif (MMI) untuk Meningkatkan Penguasaan Konsep dan Keterampilan Berpikir Kritis Siswa pada Materi Optik. *Lensa: Jurnal Kependidikan Fisika*, 1(2), 86-94.
- Walker, S. E. (2003). Active learning strategies to promote critical thinking. *Journal of athletic training*, 38(3), 263.
- Walsh, C. M., & Hardy, R. C. (1999). Dispositional differences in critical thinking related to gender and academic major. *Journal of Nursing Education*, 38(4), 149-155