

CTDBT Instruments to Measure the Critical Thinking Disposition Based on Gender in Biology Education Student

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Abstract: Critical thinking disposition is an important part of someone's critical thinking. This study aims to determine the differences in critical thinking dispositions of students in biology education based on gender. This research was conducted at Muhammadiyah of Bengkulu University involving 73 biology students as respondents, which is consisting of 19 male and 54 female. This research is a quasi-experimental type with one group. The instrument used in this study was the Critical Thinking Disposition in Biology Test (CTDBT), which is the first test instrument developed to see the critical thinking disposition in biology. The data obtained were analyzed through non-parametric statistics, namely the Mann-Whitney test with the help of the SPSS version 20 application. The results showed that in general there was no significant difference in the disposition of biological critical thinking among male and female male and female students, except for the analyticity indicator. The results of this study can contribute to lecturers and stakeholders in making decisions to improve the quality of graduates at the University

Keywords: CTDBT; Critical Thinking Disposition; Gender; Biology Education

Introduction

The vision of science education is to prepare students to have an understanding of science and technology, through the development of thinking skills, attitudes, and skills to understand themselves, so they can manage the environment and overcome problems in their environment (Rustaman, 2005). Besides, Zubaidah (2010) revealed that science learning is an effort to develop higher-order thinking skills, especially critical thinking.

Critical thinking consists of two components, namely critical thinking disposition and critical thinking skills. Yuksel and Alci (2012) reveal that a person's disposition is a necessary prerequisite for critical thinking, and disposition can be said to be a component that greatly affects critical thinking skills. According to Facione et al., (1996) critical thinking disposition is a consistent internal motivation to get into problems and make decisions. This is in line with the statement of Facione & Giancarlo (2013) that a person with a strong

disposition to think critically has a consistent internal motivation to get into problems and make decisions using critical thinking. Facione (2011) explains that there are several characteristics of someone who has a critical thinking disposition, namely: clarity in stating statements, the discipline of working with complex problems, diligence in looking for relevant information, rationality in choosing and applying criteria, diligence in facing various difficulties, and be thorough in various situations.

Facione et al., (1995) explained that critical thinking disposition consists of seven indicators, namely: 1). truth-seeking, the tendency for someone to be honest, have a strong curiosity, can ask questions, and look for evidence, 2) open-mindedness, have a sense of tolerance for different ideas and views, 3). Analyticity, a person's tendency to be careful in solving problems, 4). Systematicity, the tendency to always be organized, focused and diligent in conducting investigations, 5). Self-confidence, self-confidence in reasoning and one's own ability to make decisions, 6). Inquisitiveness,

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curiosity in learning various things, 7). Maturity, the tendency to be mature and careful in solving problems.

Thus, the effort to see and develop a person's critical thinking disposition is very important as an initial step in producing a generation capable of higher-order thinking. with the critical thinking disposition, a person will tend to be motivated to use the skills they have. Yucel & Kogak (2010) revealed that the education process in higher education should support students 'critical thinking, especially student teacher candidates, because the teacher plays an important role in developing critical thinking dispositions and students' critical thinking skills. Therefore, knowing, identifying and developing the dispositions and critical thinking skills of prospective teachers are very important to do in an effort to produce effective education. Foluso (2014) states that an educator who has a strong critical thinking disposition can encourage students to be able to use and develop the quality of thinking they have at the time of the learning and teaching process. Davies (2015) explains that critical thinking is one type of skill development in expressing opinions and skills in conducting assessments and decisions. Critical thinking skills are very important skills for someone to have, especially in the academic field at Higher Education (Profetto, 2003). Higher education plays a very important role in preparing individuals who have good capacity in the social environment. It is stated that in general, someone who has skills without a tendency or disposition to use them will cause the skills they have to not develop properly. Based on this statement proves and explains that the two components of critical thinking, namely dispositions and skills, influence and are related to one another.

Several studies on critical thinking dispositions based on gender have been carried out by previous researchers both domestically and in Indonesia, including research conducted by Demirhan and Kokluya (2014) which states that there is a significant difference between critical thinking disposition scores between male science teacher candidates and women 'on the subscales of curiosity and systematicity. The instrument used in this study was CCTDI. Furthermore, the CCTDI instrument is also used in other research related to critical thinking dispositions based on gender, namely research conducted by Zeliha et al., (2014) which states that there are no significant differences in critical thinking dispositions based on gender.

When viewed in terms of the instruments used by several previous researchers, it can be seen that the instrument used in seeing critical thinking dispositions is using instruments with a Likert scale. As stated by Spincer and Hanks (1995) that there are seven measurement instruments in critical thinking, and only one instrument that measures critical thinking disposition is known as the California Critical Thinking

Disposition Inventory (CCTDI). There has been no research related to critical thinking disposition based on gender using the CTDBT instrument, which is a test of critical thinking disposition in biology which was first developed by Syahfitri (2019a) with a multiple-choice format based on biological cases. This study the researchers used the CTDBT instrument to see whether there were differences in the disposition of critical thinking in biology based on gender.

Method

This research was quasi-experimental research and has been conducted at the University of Muhammadiyah Bengkulu involving 73 biology education students consisting of 19 male students and 54 female students. The main sample was grouped into two sections based on gender, namely women and men. The existence of this grouping aims to see how differences in the critical thinking disposition of students' biology are based on gender. The instrument used is CTDBT which is a test instrument in the form of multiple choice. After the primary data is obtained, the researcher first performs a prerequisite test, namely the normality test with the Kolmogorov-Smirnov test. The results of the normality test show that the data is not normally distributed, with a significance value less than 0.05, so that the data needs to be analyzed through non-parametric statistics, namely the Mann-Whitney test with the help of the SPSS version 20 application.

The interpretation of the critical thinking disposition score is done by looking at the three categories in the grouping of critical thinking disposition scores for each disposition indicator. The four criteria can be seen in the table below.

Table 1. Criteria for Interpretation of Critical Thinking Disposition Score (Syahfitri, 2019)

Range Score	Critical Thinking Disposition
$\bar{X} > 50$	High
40 - 50	Medium
$X < 30$	Low

Result and Discussion

The data obtained were tested for normality using the Kolmogorov Smirnov test with the results presented in Table 2.

Table 2. Normality Test

Gender	Kolmogrov-S			Shapiro-Wilk			
	Statistic	df	Sig.	Statistic	df	Sig.	
CTD	Male	.115	19	.200*	.973	19	.831
	Female	.136	54	.014	.954	54	.036

Based on the normality test presented in Table 2, The significance value of less than 0.05 was obtained. This explains that the data are not normally distributed, so it is assumed that the data cannot be continued with parametric statistical tests. Thus, the statistical test was carried out with a non-parametric test using the Mann-Whitney test. The result of Mann-Whitney test presented on Table 3.

Table 3. The Results of Mann-Whitney Test

	TS	OM	AN	SIS	SC	IN	MA
Mann-Whitney U	476.5	473.0	330.0	506.5	484.0	390.0	393.5
Wilcoxon W	666.5	663.0	520.0	1991.	1969.	580.0	583.5
Z	-.483	-.522	-	-.084	-.375	-	-
Asymp. Sig. (2-tailed)	.629	.601	.018	.933	.708	.108	.122

a. Grouping Variable: Gender

Table 3 describes the non-parametric statistical results of the Mann-Whitney test, that from these data it can be seen that there is no significant difference in the critical thinking disposition of biology students based on gender. This is indicated by the significance value of each indicator of critical thinking disposition which is more than 0.05 (Truth Seeking= 0.629, Open Mind = 0.601, Sistematicity= 0.933, Self Confidence= 0.708, Inquisitiveness = 0.108, and Maturity = 0.122), only on the Analicity indicator of the seven indicators which have a significant difference from male and female students, namely the Asymp-Sig value ($p < .05$).

Furthermpre, data collection in this research is to see how the differences in critical thinking disposition of biology of students based on gender at universities. This study presents students' critical thinking disposition skills in biology on each indicator, namely TS, OM, AN, SIS, SC, IN, and MA. The results of the CDTB implementation test on 73 students at biology universities are shown in the CTD average score in the Figure 1.

Figure 1 interprets that there is a difference in the average score of students' critical thinking disposition biology between the sexes of men and women. In interpreting the ability of thinking dispositions in biology, Syahfitri (2019b) classifies critical thinking disposition skills into 3 categories, namely high category more (more than 50), medium category (between 40-50), and low category (less than 40). It can be seen that the male gender is only the Open Mind (OM) indicator which is categorized as high, and the moderate category is for the indicators of systematicity, self-confidence, while the indicators of truth-seeking, analyticity, inquisitiveness, and maturity are still in the low category. Furthermore, the average value of the biology

critical thinking disposition of students in the female gender group shows that only the indicators of inquisitiveness are categorized as low, while the indicators of truth-seeking, analyticity, systematicity, self-confidence, and maturity are in the medium category, only on the Open mind indicator which is categorized as high. The picture also explains that in general the average value of the critical thinking disposition of biology students with female gender is higher than that of male students. Thus it can be concluded that female students generally have a biological moderate critical thinking disposition. On the other hand, students who are dominant males have a biological critical thinking disposition in the low category.

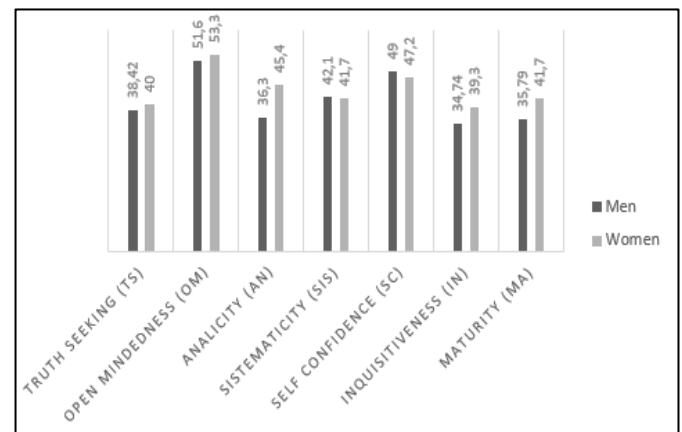


Figure 1. Critical Thinking Value Based on Gender

Based on the findings in this study, it is known that the average value of critical thinking disposition in the biology of female students is higher than that of male students. Although the difference between the two is not significant as evidenced by the significance value for the six indicators of critical thinking disposition, except for the indicator of analyticity. This is not much different from the results of research conducted by Marni *et al.*, (2020) which states that there is no significant difference between the critical thinking skills of male and female students. In line with the research results of Nazem *et al.*, (2013) that there is no significant difference between male students and female students in critical thinking dispositions. Sulaiman *et al.*, (2017) have also examined the differences in critical thinking dispositions between the Specials Education Integration Program (SEIP) teachers in Negeri Sembilan, Malaysia. In the research results indicate that there is no significant difference between male teachers and female teachers. In contrast to the results of research conducted by Yorganci (2016), the critical thinking disposition of male students and female students has a significant difference, especially in the indicators of inquisitiveness.

Truth-Seeking is the spirit to explore knowledge even when knowledge does not support one's personal

interests from one's point of view. Truth-seeking is a person's tendency to seek the best knowledge, dare to ask questions, be honest, and be objective in conducting investigations. A person who has a truth-seeking tendency will usually not immediately agree with an opinion, but will always seek the truth about a problem at hand, (Facione et al., 1995). In this indicator, it can be seen that male students have a relatively low disposition compared to female students, although the difference in average is not too significant. Profeto et al., (2003) reveal that the low critical thinking disposition of students on truth-seeking indicators is because students are still passive and tend to refuse to seek and analyze new knowledge. Furthermore, the researcher argues that the disposition of critical thinking in truth-seeking indicators needs to be developed. As it is known that critical thinking disposition is a very important part of developing critical thinking skills. This was also expressed by Fitriani et al., (2018) that a person can use critical thinking skills well if there is a development of critical thinking dispositions. Thus it is necessary to have careful and good planning in the learning process as an effort to develop higher-order thinking (including critical thinking dispositions and skills), for example by applying the right learning model.

Open-mind is open-minded to different world views and tolerant and has a sensitivity to the possibility of happening (Facione, 2015). In this indicator, male and female students have critical thinking dispositions that are not significantly different, namely high. This is indicated by the average value and significance value. The results showed that all students were able to be open to the problems at hand. Gunawan et al., (2019) also revealed that male and female students were able to be open-minded in solving problems. Ordem (2017) reveals that students are able to have a sense of mutual respect and tolerance between one another. In addition, students show tolerance for a variety of different views that exist in the classroom environment. This is different from the results of research conducted by Facione & Giancarlo (2001) which states that there is a significant difference between male students' critical thinking disposition scores which are higher than female students' disposition scores (especially on open-mindedness and maturity indicators).

Furthermore, the analyticity indicator is reasoning in solving problems and tends to expect results (Facione, 2000). Based on the findings, it can be seen that female students have a critical thinking disposition on the analyticity indicator which is significantly different from male students. The critical thinking disposition on the indicator of analyticity in female students is better (higher) than that of male students. Similar results are also shown from the research of Gunawan et al., (2019) those female students have better critical thinking dispositions on indicators of analyticity than male

students. This shows that female students are better at identifying, socializing, reasoning, having the ability to solve and overcome problems at hand.

Also, the results also show that the significant value on the indicators of systematicity, self-confidence, inquisitiveness, and maturity also shows that there is no significant difference between male and female students. However, on average, on this indicator, female students were lower than male students on indicators of systematicity and self-confidence. This is inversely proportional to the average score on the indicators of inquisitiveness and maturity, namely that female students are better than male students.

Zalizan et al., (2005) explained that several factors can influence the differences in students' critical thinking, including the learning styles used by female students and male students. Besides that, there is a teacher's perception of male students who often think negatively compared to female students in every learning process. Not only that, the factors that can affect students' critical thinking dispositions are how the learning model is applied, whether it can improve critical thinking skills or not. Therefore, it is necessary to have a good curriculum design that can improve students' critical thinking with problem-solving orientation.

Zaidi (2010) explains that men and women have different anatomical, functional and biochemical brain structures that occur at each stage of life. In addition, Sulistiyawati & Andriani (2017) reveal that from a biological perspective there are differences between several brain structures between men and women, where this may be the cause of differences in abilities possessed by male and female students such as in ability. respond to, process and store information in the long term. This is supported by the opinion of Sasser (2010) which reveals that men and women have different structural areas in the limbic system. Women are said to have a larger hippocampus than men, therefore this is what causes women to have the potential to increase their memory for longer information retention. Furthermore, women and men also have differences in other parts of the brain such as the cerebral cortex which functions as a control in thinking, making decisions and intellectual function. It was also explained further that women have brains that are able to receive about 20% more blood flow and have a better nervous system. According to Moir (1989) several studies show that women generally use parts of the brain that function verbally and emotionally, on the other hand men use parts of the brain that function partially and mechanically. In line with this, Witelson et al., (1995) concluded that this is the reason why women are better at processing and responding more quickly to existing information.

Conclusion

Based on the findings in the study, it can be concluded that gender does not significantly influence the critical thinking disposition of biology education students. However, although it does not appear to have a significant effect in general, it is known that differences in critical thinking dispositions occur in the analytic indicator. This shows that basically gender can affect learning outcomes. In addition to several factors related to the learning model that is applied during the learning process, it is also important to study how the gender roles of students in the learning process are studied from a biological perspective. In detail, it is known that with the application of an active learning process it can improve students' memory abilities and skills.

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References

- Davies, M. (2015). *A Model of Critical Thinking in Higher Education*. Higher Education: Handbook of Theory and Research. Melbourne Graduate School of Education, University of Melbourne Australia: Springer International Publishing Switzerland. https://doi.org/10.1007/978-3-319-12835-1_2.
- Demirhan, E., & Koklukaya, A. N. (2014). The critical thinking dispositions of prospective science teachers. *Journal Procedia - Social and Behavioral Sciences*, 116, 1551-1555. <https://doi.org/10.1016/j.sbspro.2014.01.433>
- Facione, P.A., Giancarlo [Sanchez], C.A., Facione, N.C. & Gainen, J. (1995). The disposition toward critical thinking. *Journal of General Education*, 44, 1-25. <https://doi.org/10.22329/il.v20i1.2254>
- Facione, P. A., Facione, N. A., & Giancarlo, C. A. (1996). *The motivation to think in working and learning: Defining Expectations for student learning*. San Fransisco, CA: Jossey-Bass Inc.
- Facione, P. A., Facione, N.C, & Giancarlo, C.A (2000). The disposition toward critical thinking: Its character, measurement, and relation to critical thinking skill. *Informal Logic*, 20, 61-84. Retrieved from https://ojs.uwindsor.ca/index.php/informal_logic/article/view/2254
- Giancarlo, C.A., & Facione, P.A. (2001). A Four Year Look at the Disposition toward Critical Thinking Among Undergraduate Students. *The Journal of General Education*, 50 (1), 29-55. <https://doi.org/10.1353/jge.2001.0004>
- Facione, P. A. (2011). *Critical thinking: what it is and why it counts*. Millbrae, CA: The California Academy Press.
- Facione, P. A., dan Giancarlo, C, A. (2013). *Think Critically*. Prentice-Hall.
- Facione, P. A. (2015). *Critical Thinking: What It Is and Why It Counts*. www.insightassessment.com.
- Fitriani, H., Asy'ri, M., Zubaidah, S., & Mahanal, S. (2018). Critical thinking disposition of prospective science teachers at IKIP Mataram. *IOP Conf. Series: Journal of Physics: Conf. Series* 1108 (2018) 012091. <https://doi.org/10.1088/1742-6596/1108/1/012091>
- Foluso, O. (2014). Critical thinking dispositions of nursing faculty in Southwestern Nigeria *International Journal of Research in Applied , Natural and Social Sciences (IMPACT:IJRANSS)*, 2, 127-134. <http://www.impactjournals.us/download/archives/2-14-1409551634-16.Applied-Critical%20Thinking%20Dispositions%20Of%20Nursing%20Faculty%20In-Ojewole.pdf>
- Gunawan, G., Harjono, A., Herayanti, L., Husein, S., & Fathoroni, F. (2019). Investigating student's critical thinking disposition based on gender in physic teaching with interactive multimedia. *Journal Of Science Education Research*, 9 (1), 1766-1771. <https://doi.org/10.26740/jpps.v9n1.p1766-1771>
- Marni, S., Aliman, M., Soeyono, Roekhan., & Harsiati, T. (2020). Students' critical thinking skills based on gender and knowledge. *Journal of Turkish Science Education*. 17(4), 544-560. Retrieved from <http://tused.org/index.php/tused/article/view/1246>
- Moir, A., J., D. (1989). *Brain sex: the real difference between men and women*. New York: Dell Publishing.
- Nazem, I. G., Abu, K. B. Hayati, N. A., & Talib, O. (2013). Gender Analysis of Critical Thinking Disposition Instrument among University Putra Malaysia undergraduate students. *Recent Technological Advances in Education*. https://www.academia.edu/47504679/Gender_Analysis_of_Critical_Thinking_Disposition_Instrument_among_University_Putra_Malaysia_undergraduate_students?from_sitemaps=true&version=2
- Ordem, E. (2017). Developing Critical-Thinking Dispositions in a Listening/Speaking Class. *English Language Teaching*, 10 (1), 50-55. DOI: 10.5539/elt.v10n1p50
- Profetto, MG, J., Hesketh, K. L., Lang, S., & Estabrooks, C. A. (2003). A study of critical thinking and research utilization among nurses. *Western Journal of Nursing Research* 25 (3) 322-337. <https://doi.org/10.1177/0193945902250421>

- Rustaman, N. Y. (2005). *The development of inquiry learning research in science education. Paper presented in National Seminar II.* http://file.upi.edu/Direktori/FPMIPA/JUR._PEND._BILOGI/195012311979032-NURYANI_RUSTAMAN/PenPemInkuiri.pdf
- Sasser, L. (2010). Brain Difference Between Gender. *Gender Differences In Learning, Genesis*, 5, 1-2.
- Spincer, K. L., & Hanks, W. E. (1995). Multiple measures of critical thinking skills and predisposition in assessment of critical thinking. *Paper Presented at the Annual Meeting of the Speech Communication Association, San Antonio, TX.* (Eric Document Reproduction Services No. Ed 391 185).
- Sulaiman, T., Kumar, K. S., Fauzi, A.M.A., & Syrene, S.A.R (2017). Relationship between Critical Thinking Disposition and Teaching Efficacy Among Special Education Integration Program Teachers in Malaysia. *2nd International Conference and Workshop on Mathematical Analysis 2016 (ICWOMA2016) AIP Conf. Proc. 1795, 020027-1-020027-8*; <https://doi.org/10.1063/1.497217>
- Sulistiyawati & Andriani, C. (2017). Critical Thinking Ability and Biology Learning Outcomes Based on Gender Differences in Students. *Academic Discourse*, 1 (2), 127-142. Retrieved from <https://jurnal.ustjogja.ac.id/index.php/wacanaakademika/article/view/1289>
- Syahfitri, J. (2019a). *Pengembangan Tes Disposisi Berpikir Kritis dalam Biologi di Perguruan Tinggi.* Disertasi. Program Doktor Universitas Pendidikan Indonesia.
- Syahfitri, J., Firman, H., Redjeki, S., & Sriyati, S. (2019b). Profile of the disposition of critical thinking students of biology education in higher education. *Journal of Bioeduin*, 9 (1), 23-29. Retrieved from <https://journal.uinsgd.ac.id/index.php/bioeduin/article/view/4341>
- Witelson, S.F., Glezer, I.I., & Kigar, D.L. (1995). Women Have Greater Density of Neurons in Posterior Temporal Cortex. *The Journal of Neuroscience*, 15 (5), 3418-3428. Retrieved from <https://www.jneurosci.org/content/jneuro/15/5/3418.full.pdf>
- Yorganci, S. (2016). Critical Thinking Dispositions of Pre-Service Mathematics Teachers. *Participatory Educational Research (PER)*, 3(3), 36-46. Retrieved from <https://files.eric.ed.gov/fulltext/ED583489.pdf>
- Yucel, A., & Kogak, C. (2010). Determining the Critical Thinking Levels of Student Teachers and Evaluating Through Some Variables. *International Online Journal of Educational Sciences*, 2, 865-882.
- Yuksel, G., & Alci, B. (2012). Self-efficacy and critical thinking dispositions as predictors of success in school practicum. *International Online Journal of Educational Sciences*, 4, 81-90. https://iojes.net/?mod=makale_tr_ozet&makale_id=41232
- Zaidi, Z.F. (2010). Gender Differences in Human Brain: A Review. *The Open Anatomy Journal*, 2, 37-55. <https://doi.org/10.2174/1877609401002010037>
- Zalizan M.Z, Saemah R., Roselan B., Jamil A. (2005). Prestasi Akademik Mengikuti Gender, *Jurnal Pendidikan* 30. P. 93 -111. Fakultas Pendidikan Universiti kebangsaan malaysia.
- Zeliha, O.G., Ibrahim, G., Yasemin, D., & Fatma, G. K. (2014). The reflection of critical thinking dispositions on operational chemistry and physics problems solving of engineering faculty students. *Procedia - Social and Behavioral Sciences* 174, 448 - 456. Retrieved from <https://cyberleninka.org/article/n/533479>
- Zubaidah, S. (2010). Critical Thinking: higher order thinking skills that can be developed through science learning. In Paper of the National Science Seminar with the Theme of Optimizing Science to Empower Humans. *Unesa Postgraduate*, 16 (1), 1-14.