

Analysis of students' critical thinking skills with reflective and impulsive cognitive styles on conservation and environmental knowledge learning

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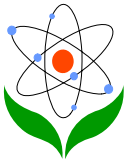
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Abstract

Critical thinking skills, as well as cognitive style, are important aspects that must be considered in assessments of the learning process. This research aims to describe the critical thinking skills of the students with reflective versus impulsive cognitive styles through an explorative study on conservation and environmental knowledge learning. The benefits of this research are: (1) obtaining information about critical thinking based on reflective versus impulsive cognitive styles and (2) using the above as the basis for a learning model attentive to reflective versus impulsive cognitive styles. The research subjects were 26 students of the biology education class in 2013; 13 students had a reflective cognitive style and 13 students an impulsive cognitive style. Critical thinking skills were measured by using a test that refers to the



standardization. Cognitive styles were measured by using the MFFT. Since the data from the assessments of students' critical thinking skills were non-parametric, they were analyzed using the Mann-Whitney test. The results indicate that 13 students, or 36.1%, each have reflective and impulsive cognitive styles. The results showed significantly higher critical thinking assessments in the students with reflective versus impulsive cognitive styles. It can be concluded that the critical thinking of students with reflective cognitive style is better than the students with impulsive cognitive style

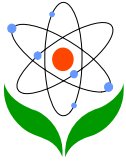
Keywords: cognitive style, critical thinking, impulsive, reflective.

Introduction

The most important part of the implementation of learning processes is their ability to develop the thinking skills of students. Critical thinking skills are essential in life. The problems that will occur in someone's life can be overcome with critical thinking skills at their disposal (Galbreath, 1999; Trilling & Hood, 1999; Johnson, 2009). Especially in this era of knowledge, critical thinking is indispensable to follow the progress of modernization. A critical thinker will be open to new ideas, ask questions, analyze, and use their critical thinking strategies to discover new meanings. Marzano (1992) creates an outline of the importance of learning to think, in which thinking is required for activities such as (1) developing the attitudes and perceptions that support the creation of positive classroom conditions, (2) integrating knowledge, (3) expanding the horizons of knowledge, (4) actualizing the meaningfulness of knowledge, and (5) developing favorable behavioral thinking. The critical thinking skills of each are not the same. Critical thinking is a skill that must be taught because they are seen as a basic competence of the individual, like reading and writing (Fisher, 2008).

Critical thinking can be intentionally developed in students by educators. A learning process that is intentionally designed and properly implemented in a lesson plan will improve critical thinking. Critical thinking can develop if it is practiced, and there needs to be enough time in the learning process. One way to develop thinking skills in the learning process is by training the students to search and find the problem, analyze the problem, make hypotheses, collect data, test hypotheses, and determine the settlement alternatives.

Critical thinking is one of the skills that must be possessed by all graduates of universities. In general, teaching practices to develop critical thinking in students only pay attention to/accommodate students' achievement, gender, race, and other

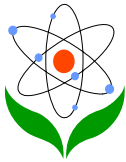


factors, but do not accommodate student differences such as cognitive style or learning style. The way students learn is influenced by cognitive style. If an individual's cognitive style is different, the way they learn and think are different as well. According to Acharya (2002), if the students' style in learning is accommodated, it can increase learning attitudes as well as increase thinking skills, academic achievement, and creativity.

Cognitive style, or thinking style, is a term used in cognitive psychology to describe the way how individuals think, perceive, and remember information (Mahdavinia & Molavizadeh, 2013). According to Ellis (1990), cognitive style is a term used to describe how people receive, conceptualize, organize, and recall information. Cognitive style is also a characteristic of different individuals in terms of feeling, remembering, and thinking, as well as distinguishing, understanding, saving, transforming, and using information. According to Lucas-Stannard (2003), cognitive style is a characteristic that tends to remain in one's personality.

The categories of cognitive style focused on in this study are those proposed by Kagan (1965), namely: reflective and impulsive cognitive style. Reflective and impulsive cognitive styles become the focus because several research results have noted that individuals with these styles are present in more than 50% of the population (Cintamulya, 2014b, 2016). A person who has a reflective cognitive style is very careful before responding to something and examines all alternatives. Thus, time is needed to respond, but the errors made are small whereas someone who has an impulsive alternative style assesses alternatives spontaneously and quickly to select something. They use a short time in responding, but they tend to make more mistakes because they do not examine all alternatives (Rahman, 2008). According to Teng (2000), ideally, the way lecturers/teachers teach must be by the way how students learn. This study focuses on cognitive styles that are distinguished based on the speed of time in responding to stimuli, which, as noted above, distinguish the reflective and impulsive cognitive styles.

The critical thinking skills development of students of the biology education class in 2013 was assessed, based on their learning process in acquiring conservation and environmental knowledge. Conservation and environmental knowledge here is the study of environmental issues, particularly the issue and management of pollution, damage to the environment, natural resources, and conservation. The nature of these materials is suitable to train learners to conduct activities such as: finding the problem, analyzing the problem, making hypotheses, collecting data, testing hypotheses, and determining an alternative solution. Learning is carried out by using cooperative learning model-based assignments to develop the skills of critical thinking. Thus, this type of conservation and environmental knowledge was useful



for exploratory research focusing on how well students who had either reflective or impulsive cognitive styles used and developed critical thinking skill work during learning processes.

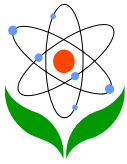
Methods

The research types used in this study included (1) pre-experimental research using a One-Shot Case Study design, referred to in Sugiono (2008). One-Shot Case Study is a single treatment design; an experiment is carried out without a comparison group and also without initial tests. To develop students' critical thinking skills, we carried out a learning process on conservation and environmental knowledge by a using group investigation model based on a contextual approach. They also included (2) descriptive exploratory research, to describe students' critical thinking skills with reflective versus impulsive cognitive styles; (3) comparative research, to see the difference between the critical thinking skills of students with reflective versus impulsive cognitive styles. The research subjects were 26 students of the biology education class in 2013: 13 students had a reflective cognitive style, and 13 students had an impulsive cognitive style.

This research is conducted in two stages: the first stage of the research to measure cognitive style and the second phase of research to measure critical thinking skills.

The instrument used to measure cognitive style is MFFT, developed by Warli (2010). The MFFT instrument includes one standard image and eight variation images. Through this instrument, the student is instructed to select one of eight variation images and the same with the standard image. The observed variables are the time required by students to answer the question for the first time and the frequency of answers until the correct answer is produced. According to Warli (2010), the four groups of students found using this test include: (1) the group of students who have characteristics to answer quickly the problem carefully/thoroughly so the answer is always right; (2) the group of students who have characteristics to answer quickly the problem carefully/meticulously so that answers are always right (reflective student); (3) the group of students who have characteristics to answer quickly but with less accuracy/less precision so that the answers are often wrong (impulsive student); (4) the group of students who have the characteristics of slowly answering the problem with less accuracy/less precision so that the answers are often wrong.

Specifically, the MFFT process used here involved: (1) calling the students one by one to complete the cognitive style test through the instrument MFFT by seeking a variation of images corresponding to the standard image; (2) recording the time used



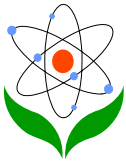
by the student to answer the question for the first time; (3) recording the frequency of answering until the participants obtain the correct answer; (4) calculating the amount of time and frequency of errors then dividing them by the number of items to obtain the average; (5) looking for the median of time (t) and the frequency (f) and then drawing the chart line, which is parallel to the axis t and axis f, to make the four groups of students.

The instrument used to measure critical thinking skills was an essay test measuring the ability of critical thinking with a total of six questions:

1. Please identify the number of possibilities that will occur in the environment if limestone mining in some Tuban sub-districts is not limited.
2. What is on your mind if a reclamation is carried out along the northern coast of Tuban?
3. What are the causes of the accumulation of waste in the Tuban district, and what are the consequences of this garbage pile?
4. Is it wise for us to use plastic equipment without regard to symbols/codes as a place for daily food and drinks?
5. Do you agree if the number of four-wheeled vehicles or two-wheeled vehicles continues to increase for the sake of people's welfare?
6. What should we do if this environment is maintained?

Those questions are used to measure the critical thinking that refers to the sub-indicators (Ennis, 1996), which include: (1) identify or define criteria for consideration of possible answers; (2) provide an explanation; (3) identify the inaccuracy; (4) show the ability to give a reason; and (5) select the criteria to consider possible solutions. Also, to determine the score of critical thinking skills refers to the standardization, we use Paul and Elder's (2007) assessment criteria, which include: clarity, accuracy, precision, depth, breadth, and logic, which are adjusted to learning conservation and environmental knowledge.

To empower critical thinking skills, the students used the group investigation model based on the contextual approach. Characteristics of conservation learning and environmental knowledge using a group investigation model based on contextual approaches included the following steps. 1) Learning is directed so that the students have the skills to solve real problems. The grouped students are assigned to the field to observe environmental problems according to their topic. 2) Learning provides opportunities for students to do meaningful tasks. In this case, the students are assigned to identify the causes of environmental problems by the topics that they



choose and may provide alternative solutions. 3) Learning is carried out by providing meaningful experiences to students. By being assigned to the field to observe environmental problems directly, it is expected that students will have a meaningful experience. 4) Learning is carried out through group work, discussion, and correcting each other at the presentation.

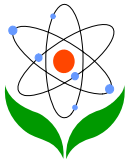
The overall assignment was organized using the six stages of the learning group investigation model, according to Slavin (2008). The first phase entails to identify the topics and form the groups with three to four students. The topics were environmental issues commonly familiar to the students. The second phase entails the students planning investigations conducted in groups based on their chosen topic. Phase three entails the students carrying out an investigation based on their chosen topic. The students are in groups, conducting investigations into the field to collect, analyze, evaluate, make conclusions, and apply new knowledge for solving the above problems examined by the groups. In this stage, each group takes approximately two weeks. Stage four entails the students to prepare the final report. In this stage, all students collect the results of the investigations at the same time. Stage five, the students make a presentation of the final report. Stage six of the evaluation is conducted at the end of the semester during the Semester Final Exam. This phase was used to obtain data on students' critical thinking skills.

Furthermore, the data on critical thinking skills of students with reflective and impulsive cognitive styles are analyzed through SPSS program version 19 by using the non-parametric Mann-Whitney test.

Results and Discussion

The measurement results of students' cognitive styles

The subjects were students of the biology education class in 2013 with reflective and impulsive cognitive styles. To obtain data on which students had which styles, measurements of cognitive styles on each student were carried out. The aspects were observed and recorded in the measurement of cognitive style, which includes the time (t) used by the student for the first answer and frequency (f) of students to respond to and obtain the correct answer. Average time (t) and frequency (f) for each student were calculated, followed by average time (t) and frequency (f) of all students being tabulated in tables to determine the median of time and frequency. The cognitive style measurement results are presented in Table I. The median of time data



t (intervals), and frequency data (frequency until the correct answer) were used to determine cognitive styles.

Table I. Statistical description of the cognitive style measurement results

Total of Students	Time(second)			Frequency			Total of Reflective Students	Total of Impulsive Students
	Max	Min	Med	Max	Min	Med		
36	0.749	0.046	0.186	5.692	1	2.50	13	13
Information: Min = Minimum Data Med = Median								
Max = Maximum Data								

The results of the measurement of MFFT, showing the four types of cognitive thinkers, are presented in Figure 1.

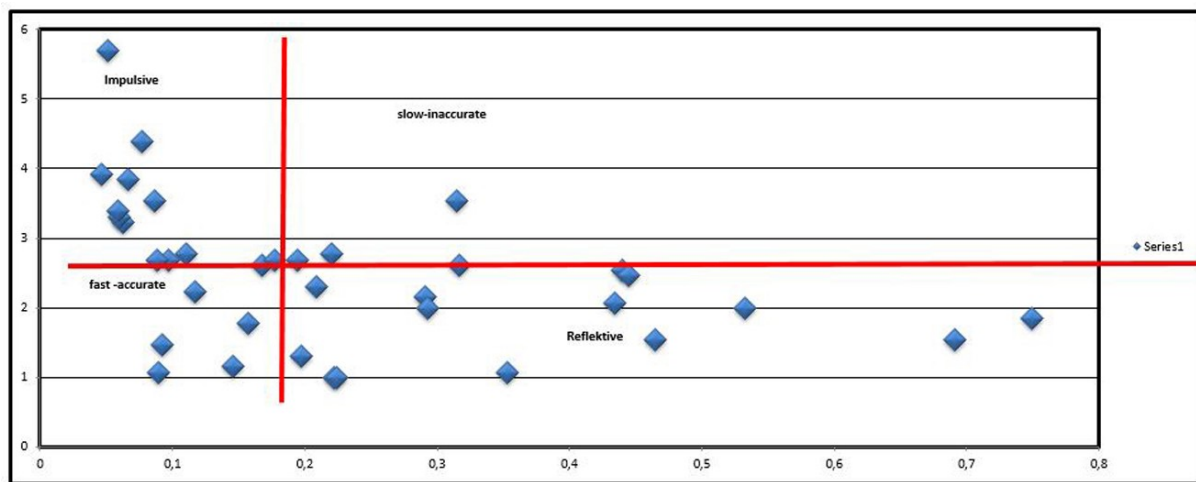
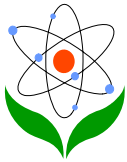


Figure 1. Plotted MFFT scores showing the four different types of cognitive thinkers.

Based on Table I, the number of reflective students is 13 (36.1%), while the number of impulsive students is 13 (36.1%); the proportion of students who were reflective and impulsive (72.2%) was higher than the percentage of quick and precise/accurate in answering or slower and less precise/less accurate in answering, namely 27.8%. These results are consistent with some the results found by previous researchers, such as Rozenchwajg and Corroyer (2005), who showed that the proportion of students with reflective-impulsive scores were 76.2%; Warli (2010), showing that the proportion of students with reflective-impulsive is 73.7%; Cintamulya (2014, 2016)



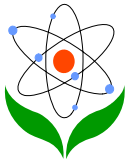
showing that the proportion of students with reflective-impulsive is 66.6%; and Fadiana (2016) showing that the proportion of students with reflective-impulsive is 73.7%.

The measurement of critical thinking skills in students with reflective versus impulsive cognitive styles

The measurement of critical thinking skills in students with reflective and impulsive cognitive styles was done at the end of the semester, after completion of learning conservation and environmental knowledge. Implementation of measurements was performed at the time of the Semester Final Exams by using critical thinking skills test instruments. The critical thinking skills test consists of six questions, with scores for each question with a range of 1–5 so that the highest possible score is 30. Measurement results of the critical thinking skills in students with reflective and impulsive cognitive styles of learning conservation and environmental knowledge are presented in Table II.

Table II. Measurement results of critical thinking skills in reflective and impulsive cognitive style of learning conservation and environmental knowledge students.

Reflective Cognitive Style		Impulsive Cognitive Style	
Scores of Critical Thinking	Frequency	Scores of Critical Thinking	Frequency
30	1	24	1
29	1	20	1
24	3	18	1
23	1	17	1
20	2	15	4
19	2	12	4
18	2	9	1
12	2		
Total	13	Total	13
Average Scores	21.54	Average Scores	15.08



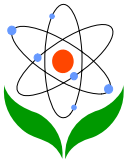
The difference between scores of students with reflective and impulsive cognitive styles was non-parametrically statistically analyzed using the Mann-Whitney test. The results of the data are shown in Table III.

Table III. The results of the Mann-Whitney test of scores of critical thinking skills between students with reflective and impulsive cognitive styles.

			Critical Score
Mann-Whitney U			24.500
Wilcoxon W			115.500
Z			-3.103
Asymp. Sig. (2-tailed)			.002
Exact Sig. [2*(1-tailed Sig.)]			.001 ^a
Sig.			.001 ^b
Monte Carlo Sig. (2-tailed)	99% Confidence Interval	Lower Bound	.000
		Upper Bound	.002
Sig.			.000 ^b
Monte Carlo Sig. (1-tailed)	99% Confidence Interval	Lower Bound	.000
		Upper Bound	.001

Based on Table III, the Asymp. Column Sig. (2-tailed)/Asymptotic significance for the two-sided test is 0.002 or probability below 0.05. Decision Mann-Whitney Test results were if the probability 0.05, then H₀ is accepted, and if the probability 0.05, then H₀ is rejected. Thus, because the probability is below 0.05, then H₀ is rejected. This means that the difference between the students with reflective versus impulsive cognitive styles on conservation and environmental knowledge learning is significant.

The average scores of the critical thinking skills of students with the reflective cognitive style are higher than the scores of students with the impulsive cognitive style, as shown in Table II. As explained by Rozencwajg and Corroyer (2005), the students with reflective cognitive styles have the characteristics of using a long time to answer the question carefully or meticulously so that the answers given tend to be correct. While the students with impulsive cognitive style have the characteristics of using a short time to answer the problem carelessly so that the answers tend to be incorrect. The answers sampled from the students with reflective and impulsive cognitive styles are shown in Figure 2 and 3.



LEMBAR JAWABAN

17. Banyak sekali dampak yang ditimbulkan jika penambangan batu kapur tidak dibatasi dan terus menerus dan eksploitasi khususnya di beberapa kecamatan di Tuban salah satunya dampak yang akan ditimbulkan baik ~~dan~~ dampaknya dalam jangka pendek maupun jangka panjang, yaitu kerusakan lingkungan yang akan dirasakan oleh manusia itu sendiri dan makhluk hidup sekitar, diantaranya yaitu merusak kesetabilan alam dan ekosistem hayati yang ada disekitar tambang, selain itu juga sangat mempengaruhi kualitas udara yang ada disekitar tambang, karena adanya truk-truk yang lalu lalang yang menyebabkan gangguan pernafasan masyarakat yang ada disekitar tambang, jika fenomena itu tetap terjadi bukan tidak mungkin musibah akan terjadi dan dirasakan oleh manusia sendiri, contoh longsor, penyakit pernapasan dll, karena adanya eksploitasi alam yg berlebihan oleh manusia.

5) Penyebab pencemaran sampah yg ada di kabupaten Tuban

Figure 2. Sample answer from a student who has a reflective cognitive style.

LEMBAR JAWABAN

Jawaban:

1). kemungkinan yang akan terjadi pada lingkungan penambangan batu kapur yang ada di kecamatan tuban.

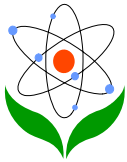
* Akan adanya terjadi pencemaran udara atau asap yang ditimbulkan disekitar lingkungan masyarakat.

2 * Kerusakan lahan perumahan apabila terus menerus dilakukan penambangan batu kapur.

Figure 3. Sample answer from a student who has an impulsive cognitive style.

Based on the sample answers of the reflective and impulsive students, some differences among them were: (1) the reflective students were better at understanding the problems, so their explanations are more detailed than the impulsive students; (2) the reflective students gave more detailed reason than the impulsive students, with evidence that was relevant to the problem; (3) the reflective student used more information compared to the impulsive student; (4) the reflective student provided more explanation and examples than the impulsive student.

From the differences shown in answering the questions, it can be said that the students with the reflective cognitive style fulfill more criteria of critical thinking than the impulsive students. This result is in accord with several studies reported by



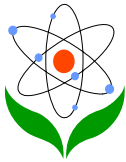
other researchers about critical thinking based on reflective and impulsive cognitive styles, such as Rahayu and Winarso (2018), Fridanianti et al. (2018), Arniwati and Cintamulya (2017), Muryani and Cintamulya (2018), and Rofi'ah and Masriyah (2018).

The criteria for critical thinking by Ennis (1985) include: (1) focus (indicator: understand the given problem); (2) reason (indicator: give reasons based on facts/evidence relevant at every step in making a decision or conclusion); (3) inference (indicator: make decisions based on the right reason to support the conclusions); (4) situation (indicator: use all the information in accordance with the problem); (5) clarity (indicator: provide further explanation of what is meant in the conclusions; explain the terms in the question; give examples of cases similar to the matter); and (6) overview (indicators: rechecking, overall, from beginning to end). The criteria for critical thinking by Paul and Elder (2007) are modified, which include: clarity, accuracy, precision, depth, breadth, and logic.

The differences in critical thinking skills of the students with reflective and impulsive cognitive styles are important for teachers to understand to deal with the implementation of learning processes. According to Griggs (1991), learning styles should be taken into consideration as a precondition to developing critical thinking. Every individual has a learning style. If the learning style is accommodated, the attitudes toward learning can improve with an increase in productivity, academic achievement, and creativity. In other words, cognitive style is a variable that affects the learning process (Rezaei et al., 2013). Cognitive style is an important aspect that must be considered by teachers in developing students' critical thinking skills (Forood & Farahani, 2013). The importance of learning styles in the learning process is shown by the results of the research of Heidari and Bahrami (2012) and Aliyari (2015), which indicates a strong positive relationship with critical thinking and the reflective cognitive style and a negative relationship with critical thinking with the impulsive cognitive style. Finally, the teachers can consider the differences in students' cognitive styles when they design the learning model that empowers critical thinking skills and accommodate the students' cognitive styles.

Conclusion

From the results of data analysis, it can be concluded that the critical thinking skills of students with a reflective cognitive style are better than critical thinking skills in students with impulsive cognitive style in conservation and environmental



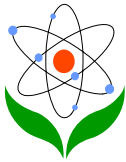
knowledge learning. The students with reflective cognitive style have characteristics of taking a long time to answer the question carefully/meticulously so that the answers given tend to be correct, while the students who have the characteristics of impulsive cognitive style take a short time and answer the problem more carelessly, so that the answers tend to be incorrect.

Acknowledgements

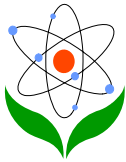
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References

- Acharya, Ms. Chandrama (2002) Students' Learning Style and Their Implication for Teachers. *Centre for Development of Teaching and Learning*. September 2002 Vol. 5 No. 6.
- Aliyari, S. (2015). The relationship between critical thinking and impulsive and reflective learning styles among Iranian female EFL learners. *International Journal of Language Learning and Applied Linguistics World*, 10, 21-31. Retrieved from <http://www.ijllalw.org/finalversion1032.pdf>
- Arniwati & Cintamulya, I. (2017). Analisis Kemampuan Berfikir Kritis Siswa yang Bergaya Kognitif Reflektif dan Impulsif pada Pembelajaran Biologi melalui Model SQ3R (Survey, Question, Read, Review, Recite) dengan Media Kartu Bergambar. *Bio-Pedagogi*. 6(2), 13-18.
- Cintamulya, I. (2014). Kemampuan berpikir kritis mahasiswa yang bergaya kognitif impulsif dan mahasiswa bergaya kognitif reflektif dalam genetika dasar. *Prosiding Seminar Nasional Biologi/IPA dan Pembelajarannya*, pp. 289-297. Malang: State University of Malang. Retrieved from <http://fmipa.um.ac.id/index.php/component/attachments/download/275.html>
- Cintamulya, I. (2016). Analysis of learning outcomes of biology based reflective and impulsive cognitive style. *Proceeding of 3rd International Conference Research, Implementation and Education of Mathematics and Science*, pp. 13-18. Yogyakarta: State University of Yogyakarta. Retrieved from <http://seminar.uny.ac.id/icriems/sites/seminar.uny.ac.id/icriems/files/prosiding/B-E-03.pdf>
- Ellis, R. (1990). *Instructed second language acquisition: Learning in classroom*. Oxford: Blackwell.
- Ennis, R. H. (1985). A logical basic for measuring critical thinking skills. *Educational Leadership*, 43, 44-48. Retrieved from http://www.ascd.org/ASCD/pdf/journals/ed_lead/el_198510_ennis.pdf
- Ennis, R. H. (1996). *Critical thinking*. New Jersey: Printice-Hall Inc.
-



- Fadiana, M. (2016). Perbedaan kemampuan menyelesaikan soal cerita antara siswa yang bergaya kognitif reflektif dan impulsif. *Journal of Research and Advances in Mathematics Education*, 1, 79-89. Retrieved from <http://journals.ums.ac.id/index.php/jramathedu/article/view/1775>
- Fisher, A. (2008). *Berpikir kritis sebuah pengantar*. Jakarta: Erlangga.
- Forood, S. M., & Farahani, A. A. K. (2013). A comparative study between the performance of Iranian high and low critical thinkers on different types of reading comprehension questions. *Theory & Practice in Language Studies*, 3, 1710-1716. DOI: 10.4304/tpls.3.9.1710-1716.
- Fridanianti, A., Purwati, H., dan Murtiyanto, Y.H. 2018. Analisis Kemampuan Berpikir Kritis Dalam Menyelesaikan Soal Aljabar Kelas VII SMP Negeri 2 Pangkah Ditinjau dari Gaya Kognitif Reflektif dan Kognitif Impulsif. *Aksioma.*, 9 (1), 11-20.
- Galbreath, J. (1999). Preparing the 21st century worker: the link between computer-based technology and future skill sets. *Educational Technology*, 39, 14-22. Retrieved from <https://www.researchgate.net/publication/234748419> Preparing the 21st Century Worker The Link between Computer-based Technology and Future Skills Sets
- Griggs, S. A. (1991). *Learning styles counseling*. Ann Arbor: ERIC Counseling and Personnel Services Clearinghouse.
- Heidari, F., & Bahrami, Z. (2012). The relationship between thinking styles and metacognitive awareness among Iranian EFL learners. *International Journal of Linguistics*, 4, 721-733. DOI: 10.5296/ijil.v4i3.2061.
- Johnson, E. (2009). *Contextual Teaching & Learning*. Bandung: Mizan Media Utama.
- Kagan, J., & Kogan, N. (1970). Individual variation in cognitive process. In P. Mussen (Ed.), *Carmichael's Manual of Child Psychology*, 3rd Ed., 1, 235-240. New York: Wiley.
- Liu, Y., & Ginther, D. (1999). Cognitive style and distance education. *Journal of Distance Learning Administration*, 2. Retrieved from <https://www.westga.edu/~distance/liu23.html>
- Lucas-Stannard, P. (2003). Cognitive style: A review of the major theories and their application to information seeking in virtual environments. 1-18. Retrieved from <http://www.personal.kent.edu/~plucasst/Cognitive%20Styles.pdf>
- Mahdavinia, M., & Molavizadeh, M. (2013). On the relationship between impulsivity/reflectivity cognitive style and the use of idioms in composition writing among Iranian advanced EFL learners. *International Electronic Journal for the Teachers of English*, 3, 49-61. Retrieved from http://eltvoices.in/Volume3/EVI_31_6.pdf
- Marzano, R. J. (1992). *A different kind of classroom: teaching with dimensions of learning*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Muryani, U. & Cintamulya, I. (2018). Analisis Berpikir Kritis Siswa Yang Bergaya Kognitif Reflektif Dan Impulsif Pada Pembelajaran Biologi Melalui Model Pembelajaran Problem Based Learning Dengan Media Gambar. *Jurnal Biogenesis*, 14 (2), 67-72.
- Paul, R., & Elder, L. (2007). *The miniature guide to critical thinking concepts and tools*. Berkeley: The Foundation for Critical Thinking.
-



- Rahayu, Y.A & Winarso, W. (2018). Berpikir Kritis Siswa dalam Penyelesaian Matematika Ditinjau dari Perbedaan Tipe Gaya Kognitif Reflektif dan Impulsif. *Jurnal Ilmiah Pendidikan dan Pembelajaran*, 2 (1), 1-11.
- Rahman, A. (2008). Analisis Hasil Belajar Matematika Berdasarkan Perbedaan Gaya Kognitif Secara Psikologis dan Konseptual Tempo pada Siswa Kelas X SMAN 3 Makasar. *Jurnal Pendidikan dan Kebudayaan*, 14(072), 452-473.
- Rezaei, A., Boroghani, T., & Rahimi, M. (2013). Reflectivity/impulsivity as an important individual factor and effectiveness of awareness raising activities. *Sino-US English Teaching*, 4, 281-286. Retrieved from <http://www.cqvip.com/QK/88585X/201304/46073036.html>
- Rofi'ah, K. & Masriyah. 2018. Identifikasi Kemampuan Berpikir Kritis Siswa Dalam Pemecahan Masalah Matematika Open-Ended Ditinjau Dari Gaya Kognitif Reflektif dan Impulsif. *Mathedunesa*, 7(3), 550-556.
- Rozencwajg, P., & Corroyer, D. (2005). Cognitive processes in the reflective-impulsive cognitive style. *The Journal of Genetic Psychology*, 166, 451-463. DOI: 10.3200/GNTP.166.4.451-466.
- Slavin, R. E. (2008). *Cooperative learning (teori, riset, dan praktik)*. Bandung: Penerbit Nusa Media.
- Sugiono. (2008). *Metode penelitian kuantitatif kualitatif dan R&D*. Bandung: Alfabeta.
- Teng, F., & James, P. (2000). Understanding the Learning Styles of Students: Implications for Educators. *The International Journal of Sociology and Social Policy* 20, 11(12), 31-45. <http://dx.doi.org/10.1108/01443330010789269>
- Trilling, B., & Hood, H. (1999). Learning, technology, and education reform in the knowledge age or "we're wired, webbed, and windowed, now what?" *Educational Technology*, 1-25. Retrieved from https://www.wested.org/online_pubs/learning_technology.pdf
- Warli. (2010). *Profil kreativitas siswa yang bergaya kognitif reflektif dan siswa yang bergaya kognitif impulsif dan reflektif dalam memecahkan masalah geometri*. Dissertation thesis. Surabaya: Graduate Program of State University of Surabaya.