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Optimizing the Creativity of Reflective and Impulsive Students through Writing Articles Based on Information Literacy

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Abstract: Creativity and information literacy are skills necessary for students for task completion in the learning process. One of the tasks assigned to students in learning is to write drafts of scientific articles. Furthermore, teachers must pay attention to cognitive styles in the learning process. This study aimed to describe students' creativity in writing drafts of scientific papers based on information literacy concerning reflective and impulsive cognitive styles. This research was exploratory qualitative research to explain the creativity of reflective and impulsive students in writing scientific article drafts based on information literacy. The research subjects comprised two students for each reflective and impulsive cognitive style. The cognitive style was measured using the Matching Familiar Figure Test instrument. Students' creativity was measured using a test with fluency, flexibility, originality, and elaboration indicators. The results indicated that reflective students were highly creative in writing drafts of scientific articles. Meanwhile, impulsive students were relatively creative in the same activity. In conclusion, students possessing the reflective cognitive style are more creative than students following the impulsive cognitive style in writing drafts of scientific articles based on information literacy. We recommend that writing articles based on information literacy is required to increase HOTs (Higher Order Thinking Skills).

Keywords: *Cognitive style, creativity, impulsive, information literacy, reflective.*

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Introduction

Educational reform requires inculcating 21st-century skills in students to prepare them to face the complexities of an increasingly competitive modern society (Haug & Mork, 2021; Kennedy & Sundberg, 2020). The increasing economic development and technological advancements in the global market determine the skills required at the workplace (Arsad et al., 2011). The 21st-century skill competencies that individuals must master are related to cognitive processes and strategies, knowledge, digital literacy, creativity, and creative thinking (Arsad et al., 2011; Council, 2012). Creativity is a fundamental need and includes all actions and thoughts (Daud et al., 2012). Educational researchers have emphasized the importance of preparing students to acquire the knowledge and creative thinking skills essential for future progress and achievement, which entail solving complex problems (Gregory et al., 2013; Richardson & Mishra, 2018). Individuals who think creatively are more sensitive to problems, deficiencies, and knowledge gaps (Yildiz & Yildiz, 2021). Through creative thinking, a person uses the entire set of cognitive activities based on definite objects, disputes, and conditions. Furthermore, individuals leverage creative thinking to deal with events and problems based on their capacities (Birgili, 2015). Creativity, a 21st-century skill, is the primary goal of education today and must be inculcated in the learning process for all students, i.e., the gifted and average-capable ones (Birgili, 2015; Gregory et al., 2013; Runco, 2014). Learning that is aimed at teaching reading, writing, or arithmetic (Birgili, 2015; Runco, 2014) or oriented toward learning outcomes is insufficient. Therefore, the learning process in this digital era must be able to develop student creativity. Researchers develop student creativity in learning in general through innovative learning models such as the following: 1) Problem-Based Learning integrated with Scaffolding (Ernawati et al., 2022); 2) Instructional Management Model (Itsarangkul-Na-Ayutthaya & Damrongpanit, 2022); 3) Scientific Reading Based Project Model (Suryandari et al., 2021); and 4) Problem-Based Learning and Aptitude Treatment Interaction (Maskur et al., 2020).

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Besides creativity, information literacy is essential in learning in the 21st century. According to Çoklar et al. (2017), information literacy affects searching for information online. Information literacy is crucial because the data is easily accessible through digital technology (Shannon et al., 2019). Students in the 21st century are required to write scientific articles for publication. Therefore, it is essential to develop information literacy in learning (Herring, 2010). Students can use information literacy to recognize, access, evaluate, and use information from various sources. Furthermore, students use this information to write quality scientific articles (Kusunarningsih, 2018; McKeever et al., 2017). Students can find information needed in e-resources such as ProQuest, Science Direct, Advanced Search-Google, and Library Genesis. E-resources have provided easily accessible books, scientific articles, and other information (Kong, 2014). Information literacy helps students find relevant material for writing scientific papers (Dubicki, 2015; Kusunarningsih, 2018). Learning Information literacy benefits students, namely by training students in practical learning, thinking creatively, and producing quality scientific articles (Salleh et al., 2011). In addition, students can use information literacy in everyday life and the workplace (Klebansky & Fraser, 2013).

Educators rarely explore aspects of learning related to students' differences, namely cognitive style. A person's cognitive style will affect his learning style. The cognitive style reflects deep thinking, perceptual accuracy, processing and remembering information and using the information in individual problem-solving processes (Simuth & Sarmany-Schuller, 2014). Seçer et al. (2009) explained that cognitive style is a method used by individuals in searching, collecting, organizing, analyzing, using, evaluating, interpreting, and storing information. McLoughlin (1999) explains that good learning conditions are when the information provided is under various aspects of students. Many researchers in the field of education are interested in studying cognitive styles of creativity, creative thinking, and writing (Cho, 2017; Kozhevnikov et al., 2013; Minchekar, 2017; Nugroho et al., 2020; Nurzulifa & Dwijanto, 2021; Setyana et al., 2019; Yuniasari & Zainuddin, 2019). Kozhevnikov et al. (2013) proved that cognitive style influences student creativity in academic and professional fields. Furthermore, Minchekar (2017) revealed a positive and significant relationship between cognitive style and originality. Similarly, Nugroho et al. (2020) research showed that reflective and impulsive cognitive styles represent each indicator of creative thinking in solving mathematical problems. Likewise, other studies' results show differences in the ability to think creatively in mathematics based on cognitive style (Nurzulifa & Dwijanto, 2021; Setyana et al., 2019). In addition to the above, Yuniasari and Zainuddin (2019) examines the influence of reflective and impulsive cognitive styles in descriptive writing. The results show that there is a difference that impulsive students are better than reflective students in descriptive writing.

Furthermore, many researchers have researched the context of creative thinking and information literacy in learning (Clark, 2018; Harsiati et al., 2019; Marantika, 2019). Wang (2012) has conducted a more specific study of creative thinking about reading and writing. Wang's research (2012) shows a significant relationship between creativity and reading and writing. However, in Wang's study (2012), the relationship between creativity and reading and writing has not been reviewed based on cognitive style. Each individual has a unique cognitive style and is related to learning styles. According to Fatt (2000), teacher teaching must match how students learn. Research on writing creativity is still tiny. Researchers generally study creativity in mathematics related to problem-solving abilities (Nugroho et al., 2020; Nurzulifa & Dwijanto, 2021; Setyana et al., 2019). Indeed, writing skills in the 21st century are essential. Materials for writing scientific articles in biology are now widely available online. To get material and information online need information literacy skills. Therefore, information literacy skills must be integrated into learning to write scientific articles.

Researchers have conducted many studies on creativity and information literacy in learning. Therefore, the difference between this research and previous research is that the study of creativity and information literacy is reviewed based on cognitive style. In addition, research on information literacy as a source of student learning in writing scientific articles, as done by Kusunarningsih (2018) and Marantika (2019), is rarely researched. This study focuses on reflective and impulsive cognitive styles. Cognitive styles are differentiated based on the tempo of time in responding to a problem. Therefore, this research is different from previous studies. The findings in this study are information about reflective and impulsive student creativity in writing scientific articles based on information literacy. Based on the description above, the problem formulation is as follows: how is student creativity in writing scientific article drafts based on information literacy reviewed based on reflective and impulsive cognitive styles? The objectives of this research are described as follows:

1. Describe students' creativity who have reflective and impulsive cognitive styles in writing drafts of scientific papers based on information literacy.
2. Describe the differences in students' creativity who have reflective and impulsive cognitive styles in writing drafts of scientific papers based on information literacy.

Methodology

Research Design

This study was descriptive exploratory research, in which the researcher analyzes and describes his understanding of the phenomena being studied or facts in certain activities (Creswell, 2015; Streubert et al., 2011). This study aims to

reveal students' creativity with reflective and impulsive cognitive styles in writing drafts of scientific papers based on information literacy. The research design used quantitative and qualitative data collected and analyzed separately (Othman et al., 2021). The quantitative method functions to retrieve creativity data obtained through creativity tests in writing scientific papers drafts and students' cognitive styles. Furthermore, qualitative methods were used to obtain creativity data based on interview-based tests. This study's qualitative approach deepens and verifies quantitative data (Rahma et al., 2016). Meanwhile, the primary data in this study were student writing (test results) and words from interviews.

Sample and Data Collection

The research subjects were 28 biology education students at the PGRI Ronggolawe Tuban University class of 2017 with reflective and impulsive cognitive styles, all female. Students at the time of the research were in their seventh semester studying conservation and environmental knowledge. The task of this course is to write scientific articles for conferences and be published in international proceedings. Students are given training on scientific writing and information literacy for 3 hours per week for one month. Furthermore, students made environmental observations in the Tuban area, East Java, to get ideas. Researchers as lecturers in conservation and environmental knowledge courses guide students in writing scientific articles to drafts to be submitted at international conferences. Researchers measured students' cognitive styles at the beginning of conservation and environmental knowledge courses. Creativity tests and interviews are conducted at the end of conservation and environmental knowledge courses.

The instrument used for measuring the cognitive style of reflective and impulsive was the Matching Familiar Figure Test (MFFT) (Warli, 2010). MFFT was an instrument for measuring cognitive style consisting of one standard image and eight variation images. Through this instrument, students were asked to choose one of eight variations of the same image as the standard image. The variables observed were the time it took students to answer the first time and the frequency students answered to produce the correct answer. Students with a reflective cognitive style were those with the characteristics of being slow in answering questions but being thorough so that the answers were always accurate. Impulsive cognitive style students were characterized by being quick in answering questions but not being careful, so the answers were often wrong. The reason for using the MFFT was that it was a typical instrument for measuring reflective and impulsive cognitive styles (Rozencwajg & Corroyer, 2005). The research participants in the current study were four out of 28 students whose cognitive style had been measured: two students with the reflective cognitive style (RQ and KW) and two with the impulsive cognitive style (AS and AY). Research participants were determined based on highly reflective and impulsive characteristics.

The research instruments were: (a) a test to measure creativity; (b) interview guidelines for test-based interviews; and (c) MFFT for determining research subjects. The creativity test was administered as questions the students had to answer after looking at the picture about environmental damage. The questions for the creativity test are based on Fluency, Flexibility, Originality, and Elaboration indicators (Ma et al., 2018). The quality of student creativity in writing drafts of scientific papers based on information literacy was determined based on the creativity rubric that refers to (Warli, 2010) (Table 1). In the following step, researchers conducted test-based interviews. Interviews were conducted with students by giving five questions equivalent to test questions to measure creativity. Furthermore, researchers compared the results of creativity tests and interviews to obtain valid research data (internal validity). Internal validity testing was carried out for verification through method triangulation, namely, creativity tests and interview.

Table 1. Rubric for Determining the Quality of Students' Creativity in Writing Drafts of Scientific Papers Based on Information Literacy

Score	Creativity Indicator	Category
	Fluency	
3	Students demonstrated many ideas in writing drafts of scientific papers, more than three of which were correct.	Very fluent
2	Students demonstrated two or three ideas in writing drafts of scientific papers, which were all correct, or students showed more than three ideas, but some were wrong.	Fluent
1	Students demonstrated one or two of their ideas in writing drafts of scientific papers, but only some were correct.	Less fluent
0	Students do not show ideas in writing drafts of scientific papers or offer one or two ideas in writing drafts of scientific papers; all of these ideas are wrong.	Poor fluent

Table 1. Continued

Score	Creativity Indicator	Category
	Fluency	
Flexibility		
3	Students can change one idea to another in writing drafts of scientific papers, more than two of which were correct.	Very flexible
2	Students can change one idea to another that was dissimilar in writing drafts of scientific papers (two) of which were correct. Alternatively, students can change one idea to another that was dissimilar in writing drafts of scientific articles more than two, but some of the ideas were incorrect.	Flexible
1	Students can change one idea to another that was dissimilar in writing drafts of scientific papers (two), but only some of the ideas were correct.	Less flexible
0	Students cannot change one idea to another that was different in writing drafts of scientific papers. Alternatively, students can change one idea to another that is dissimilar in writing the draft of scientific papers, but it was incorrect.	Poor flexible
Originality		
3	Students showed different ideas in writing the drafts of scientific papers, more than two of which were correct. Alternatively, students offered unusual ideas in writing drafts of more than two scientific papers based on their knowledge level, which was correct.	Very original
2	Students showed two ideas in writing the drafts of scientific papers that were all correct. Alternatively, students offered unusual ideas in writing drafts of scientific papers (more than two), but some were incorrect.	Original
1	Students showed two different ideas in writing the drafts of scientific papers, but some were correct. Alternatively, students conduct an unusual notion in writing the drafts of scientific papers based on their level of knowledge correctly.	Less original
0	Students do not show ideas in writing different drafts of scientific papers. Alternatively, students do not indicate unusual ideas in writing drafts of scientific papers based on their level of knowledge. Alternatively, students showed different ideas in writing drafts of scientific papers, but all were incorrect.	Poor original
Elaboration		
3	Students can develop and enrich more than two ideas in writing drafts of scientific papers into attractive presentation forms, all relevant to writing scientific papers.	Very elaborate
2	Students can develop and enrich two ideas in writing drafts of scientific papers into attractive presentation forms, all relevant to writing scientific papers. Alternatively, students can develop and increase more than two ideas in writing drafts of scientific papers into an attractive presentation form that is only partially relevant to writing scientific papers.	Elaborate
1	Students can develop and enrich two ideas in writing drafts of scientific papers into attractive presentation forms that are only partially relevant to writing scientific papers.	Less elaborate
0	Students can develop and enrich one or two ideas in writing drafts of scientific papers into an attractive presentation form that is not relevant to writing scientific papers.	Poor elaborate

The process of collecting data in the present study used a triangulation method. According to Moleong (2008), the triangulation method consists of two strategies, namely, (a) checking the degree of confidence of research findings with several data collection techniques and (b) checking the degree of confidence of several data sources with the same method. In the current study, several data collection techniques, including checking data from written answers and data from interviews, were used to measure the degree of confidence in the findings of research results. The data is valid if the writing test and interview data results are the same. Furthermore, accurate data were analyzed to obtain conclusions from the study's results.

The next step, i.e., data validation, includes writing drafts of scientific articles based on creativity indicators and then scoring. The scoring is performed twice, i.e., to obtain the achievement and weighted scores. Achievement score is a score to measure students' ability to write drafts of scientific articles. The score weight is multiplied by the achievement score (Table 1) for each creativity indicator. Furthermore, the weight score is determined based on the quality of each creativity indicator. Originality is weighted 3, flexibility is weighted 2, and fluency and elaboration are weighted 1. The creativity score of students in writing drafts of scientific papers is determined based on the number of weighted scores of each indicator, as presented in Table 2.

Table 2. Creativity Quality

Creativity quality	Weighted score
High creativity	Ws ≥ 20
Moderate creativity	13 ≤ Ws ≤ 19
Low creativity	6 ≤ Ws ≤ 12
Very low creativity	0 ≤ Ws ≤ 5

Analyzing of Data

The last step was assessing the drafts of scientific papers based on information literacy reviewed by students on environmental problems. The supporting instrument is a scientific article assessment sheet based on information literacy. The assessment components refer to the assessments commonly used to review articles published in a journal. These components comprise (a) the title, which reflects the content and purpose of the research; (b) the abstract, which is a summary of the contents of the paper; (c) the introduction, which clearly explains the state of the art of research; (d) the novelty, which is clearly defined; (e) the purpose and objective of the work, which is clearly stated; (f) a clearly stated methodology; (g) well-presented data; (h) well-discussed results based on references; (i) conclusion, which answers the problem in the research; (j) relevant references based on recent journals; (k) meaningful, valid suggestions based on the findings; (l) adequate references; (m) cohesion, which is achieved throughout the article; (n) ensuring that the work contributes to the field; and (o) clear and understandable language. The data analysis technique used is qualitative analysis, which has four stages: data collection, data reduction, data presentation, and drawing conclusions and verification, which is the last step (de Casterlé et al., 2012). To determine the validity of the research data: (a) credibility test (internal validity), showing the degree of confidence in the findings with evidence through triangulation methods (two different methods); (b) transferability test (external validity), looking for and collecting empirical events about creativity in writing articles with similar contexts then providing descriptive data; (c) dependability test (reliability auditing), audit tracking of all records/documents, starting from the process to the research results; and (d) confirmability test, ensuring that the findings are genuinely based on data, conclusions are arranged logically.

Findings/Results

This study entails data on the following aspects: (a) the creativity of students who have reflective cognitive styles in writing drafts of scientific papers based on information literacy with indicators of fluency, flexibility, originality, and elaboration; (b) the creativity of students who have impulsive cognitive styles in writing drafts of scientific papers based on information literacy with indicators of fluency, flexibility, originality, and elaboration; (c) drafts of scientific papers based on information literacy written by students who have reflective cognitive styles, and (d) drafts of scientific papers based on information literacy written by students who have impulsive cognitive styles.

The Creativity of Students Who Have Reflective Cognitive Styles

Students' creativity in writing drafts of scientific papers was based on the component's title, introduction, problems, methods, and discussion, whereas the indicators of creativity are fluency, flexibility, originality, and elaboration. Furthermore, the components of scientific papers made by reflective students based on valid creativity indicators were scored (coding). Determination of the quality of students' creativity (all the components of scientific papers) by weighing the scores obtained from all the indicators are shown in Table 3.

Table 3. Reflective Students' Creativity Score and Weight in Writing Drafts of Scientific Papers

Scientific paper components	Creativity indicator score × Weight (RQ)				Total score × Weight	Creativity indicator score × Weight (KW)				Total score × Weight
	Flu (1)	Fle (2)	Ori (3)	Elan (1)		Flu (1)	Fle (2)	Ori (3)	Elan (1)	
Title	3	6	9	3	21 HC	3	6	9	3	21 HC
Introduction	3	6	9	3	21 HC	3	6	9	2	20 HC
Problem	3	6	6	3	18 MC	3	6	6	3	18 MC
Method	2	4	6	2	14 MC	2	4	6	2	14 MC
Discussion	3	4	6	2	18 MC	3	6	6	2	17 MC

Description: HC, High Creativity; MC, Moderate Creativity; LC, Low Creativity; VLC, Very Low Creativity; RQ, Reflective Student 1; KW, Reflective Student 2

Based on Table 3, students with reflective cognitive styles (RQ and KW) in the title and introduction components for fluency, flexibility, originality, and elaboration tended to have high scores on creativity. Thus, reflective students' creativity in writing titles and introductions to scientific papers is associated with their high creativity levels. In terms of the components of the problem, method, and discussion for indicators of fluency, flexibility, originality, and elaboration,

the scores tend to be moderate. Thus, students with reflective cognitive styles for problems, methods, and discussion of scientific articles are moderately creative.

The creativity of students with the impulsive cognitive style

The results of scoring and weighing the components of impulsive student scientific papers based on indicators of fluency, flexibility, originality, and elaboration are delineated in Table 4.

Table 4. Impulsive Students' Creativity Score and Weight in Writing Drafts of Scientific Papers

Scientific paper components	Creativity indicator score × Weight (AS)				Total score × Weight	Creativity indicator score × Weight (AF)				Total score × Weight
	Flu (1)	Fle (2)	Ori (3)	Ela (1)		Flu (1)	Fle (2)	Ori (3)	Ela (1)	
Title	2	4	6	2	14 MC	2	4	6	2	14 MC
Introduction	1	2	3	2	8 LC	1	2	3	1	7 LC
Problem	1	4	3	2	10 LC	2	4	3	2	11 LC
Method	2	4	3	1	10 LC	2	4	3	1	10 LC
Discussion	1	4	3	2	10 LC	1	4	3	2	10 LC

Description: HC, High Creativity; MC, Moderate Creativity; LC, Low Creativity; VLC, Very Low Creativity; AS, Impulsive Student 1; AF, Impulsive Student 2

Based on Table 4, students with impulsive cognitive styles (AS and AF) in the title components for fluency, flexibility, originality, and elaboration tended to have moderate creativity scores. Thus, impulsive students are moderately creative in writing titles for scientific articles. In terms of the components, introduction, problem, method, and discussion for indicators of fluency, flexibility, originality, and elaboration, the creativity scores tend to be low. Thus, students with impulsive cognitive styles for problems, methods, and discussion of scientific articles score low in creativity.

The Results of The Review of The Draft Scientific Articles

Students' draft scientific articles are reviewed using review guidelines for articles in international journals. Paper Title (RQ): "Analysis of Environmental Conditions and Diversity of Fishermen Catches in the Beach of the Village of Karangmangu". Meanwhile, Paper Title (KW): "Diversity of Bivalves on the Sowan Coast as a Tourism Object in Tuban Regency". The results of a review of draft scientific articles prepared by students who have reflective cognitive styles (RQ and KW) include the following aspects: (a) the title, which reflects the content and purpose of the research; (b) the abstract, which summarizes the paper content; (c) the introduction, which clearly explains the state of the art of research; (d) clearly stated purpose and objectives of the work; (e) a clearly described methodology; (f) well-presented data; (g) well-discussed results based on references; (h) a conclusion, which answers the problem presented in the research; (i) relevant references based on recent journals; (j) adequate references, and (k) cohesion achieved throughout the article. The 11 aspects were declared clearly (71%) of all reviewed aspects, whereas for other elements of scientific articles, (a) the novelty is clearly defined; (b) the suggestions are meaningful, valid, and based on the findings; (c) the work is contributing to the field; and (d) the language is clear and understandable. The four aspects were declared partially obvious (29%).

Paper Title (AS): **"**Gastropod Diversity in The Tundung Musuh Mangrove Forest Conservation Area, Tasikmadu Village, Palang District, Tuban Regency". Meanwhile, Paper Title (AY): "Identification of the Diversity of Marine Algae on the Coast of the Cumpleng Hamlet in Brengkok Village, Lamongan District". The results of a review of draft scientific articles prepared by students who have impulsive cognitive styles (AS and AY) include the following aspects: (a) the title, which reflects the content and purpose of the research; (b) the abstract, which summarizes the paper content; (c) clearly stated purpose and objectives; (d) clearly described methodology; (e) well–presented data; (f) relevant references based on recent journals; and (g) adequate references. These seven aspects were declared clearly (47%) of all reviewed aspects. The Six factors are stated as self-explanatory (40%) are as follows: (a) the introduction clearly explains the state of the art of research; (b) the conclusion answers the problem in the research; (c) the references are relevant and based on recent journals; (d) cohesion has been achieved throughout the article; (e) the work contributes to the field; and (f) the language is clear and understandable. Two other aspects declared unclear (13%) are as follows: (a) the novelty is clearly defined and (b) the suggestions are meaningful, valid, and based on the findings.

The results of the review of the drafts of scientific articles of students with reflective cognitive styles are better than those with impulsive cognitive styles. Aspects of scientific papers, more than 70% of the drafts of scientific articles (Student Reflective) are clear. Parts of scientific articles that are less than 50% of the drafts of scientific papers (impulsive students) are clear.

Profile of Reflective and Impulsive Students' Creativity in Writing Scientific Articles

Here is an example of how the creativity of reflective students makes scientific article titles based on fluency indicators. First, the students looked at the picture of the limestone diggers in the artificial cave (Figure 1). The results show that reflective students can make various scientific article titles, more than four, which are correct. The validity of this data was strengthened by the results of interviews that showed the same results. Students with reflective cognitive styles (RQ and KW) are fluent in making various scientific article titles. Examples of student answers in the creativity test for writing drafts of scientific articles are shown in Figure 2 (student answers in Indonesian).

Figure 1. Limestone Diggers in an Artificial Cave

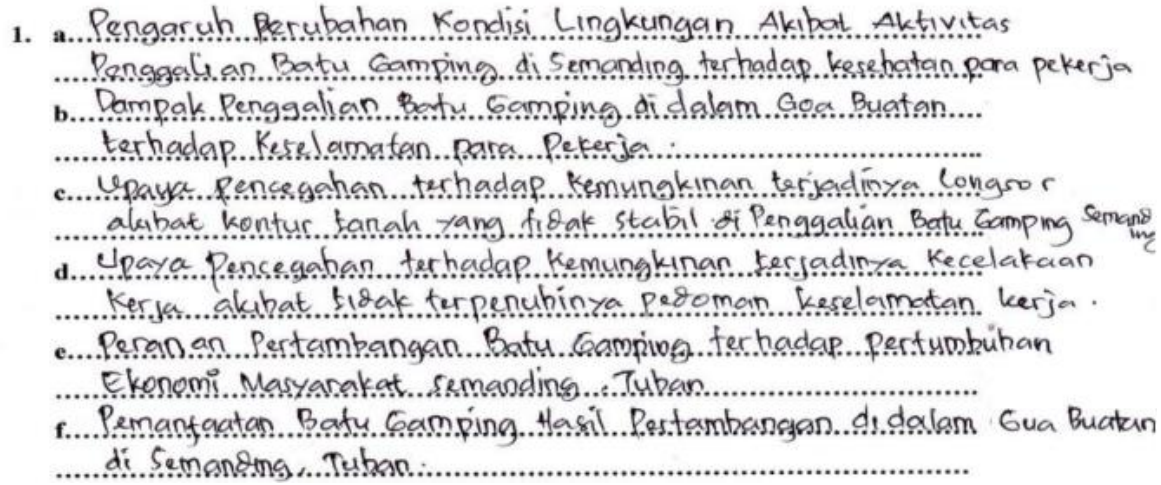
1. a. Pengaruh Perubahan Kondisi Lingkungan Akibat Aktivitas Penggalian Batu Gamping di Semanding terhadap kesehatan para pekerja
b. Dampak Penggalian Batu Gamping di dalam Goa Buatan terhadap Keselamatan para Pekerja
c. Upaya Pencegahan terhadap Kemungkinan terjadinya Longsor akibat kontur tanah yang tidak stabil di Penggalian Batu Gamping Semanding
d. Upaya Pencegahan terhadap Kemungkinan terjadinya Kecelakaan Kerja akibat tidak terpenuhinya pedoman keselamatan kerja.
e. Peranan Pertambangan Batu Gamping terhadap Pertumbuhan Ekonomi Masyarakat Semanding, Tuban
f. Pemanfaatan Batu Gamping Hasil Pertambangan di dalam Gua Buatan di Semanding, Tuban

Figure 2. Answers by Students Who Have Reflective Cognitive Style; These Results Depict their Fluency in Drafting Various Scientific Article Titles (student answers in Indonesian)

English translation:

a. The effect of changes in environmental conditions due to limestone quarrying activities in Semanding on the health of workers.
b. Impact of excavation of limestone in artificial caves on the health of workers.
c. Efforts to prevent the possibility of landslides due to unstable soil contours in limestone quarrying.
d. Efforts to prevent the possibility of work accidents due to non-fulfillment of work safety guidelines.
e. The role of limestone mining on the economic growth of the Semanding community, Tuban.
f. Utilization of limestone from mining in an artificial cave in Semanding, Tuban

Examples of impulsive student creativity in making scientific article titles based on fluency indicators are shown. The steps are as follows. First, the students look at the picture of the limestone/kumbung diggers in the artificial cave (Figure 1). Next, students are instructed to make many scientific article titles. The results showed that impulsive students could make three kinds of scientific article titles, all of which were correct. The validity of the data (various titles of scientific articles) is supported by the results of interviews that showed the same results. This result implies that students with impulsive cognitive styles (AS and AF) are fluent in making various titles of scientific articles. Examples of student answers are shown in Figure 3 (student answers in Indonesian).

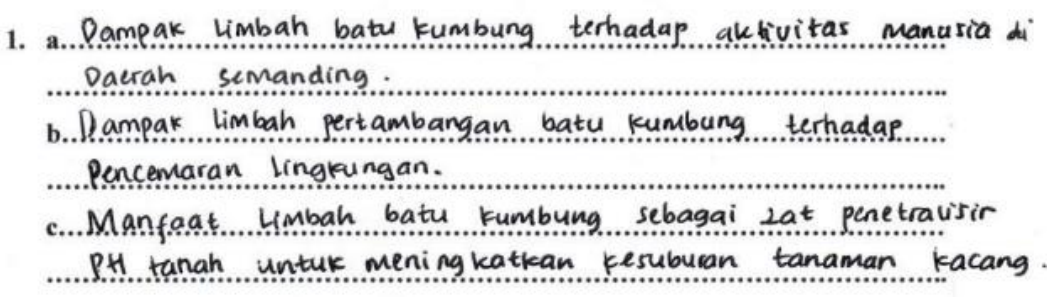

Figure 3. Student's Answers Who Have Impulsive Cognitive Style Showing Fluency in Making Various Scientific Paper Titles (student answers in Indonesian)

English translation:

1. Impact of limestone waste on human activities in the Semanding area.
2. Impact of limestone mining waste on environmental pollution.
3. Benefits of limestone waste as a soil pH neutralizing agent to increase the fertility of peanut plants.

A comparison of creativity profiles between reflective and impulsive students in writing drafts of scientific articles based on indicators of fluency, flexibility, originality, and elaboration is shown in Figures 4 – 8. Writing scientific articles includes the title, background, problems, method, and discussion.

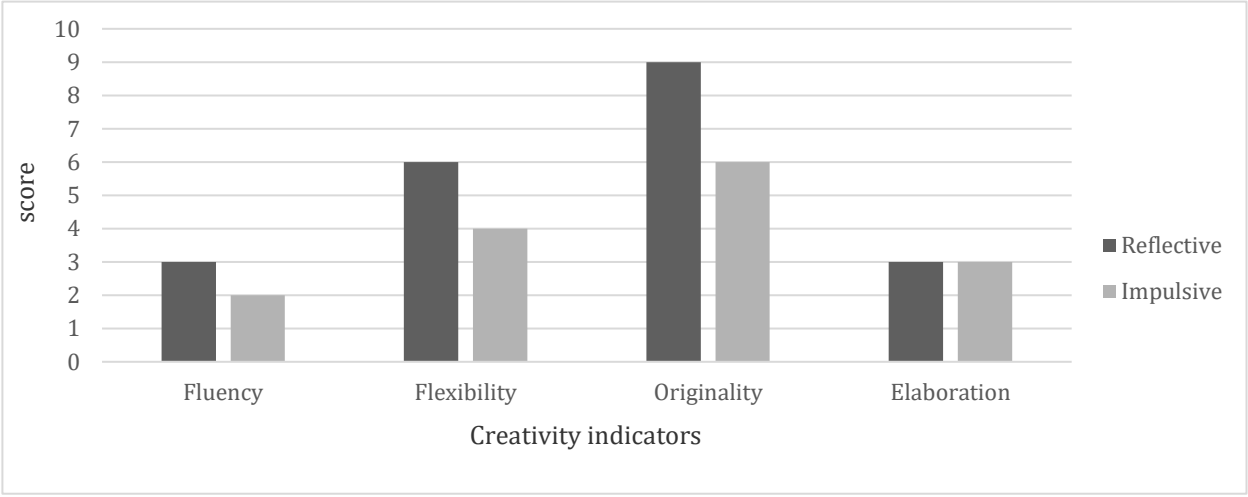

Figure 4. Profile of Reflective and Impulsive Students' Creativity in Writing Scientific Article Titles

Based on Figure 4, fluency indicators suggest that the creativity of reflective students is better than that of impulsive students in drafting scientific article titles. Reflective students get three points, and impulsive students get two points. Referring to Table 1, reflective students can show many ideas (showing many titles) in writing drafts of scientific articles, more than three of which are all correct. Meanwhile, impulsive students can show three titles in writing drafts of scientific papers, all of which are correct. Similarly, for indicators of flexibility and originality, reflective students were found to be better than impulsive students. However, for the elaboration indicator, the creativity of reflective and impulsive students is the same.

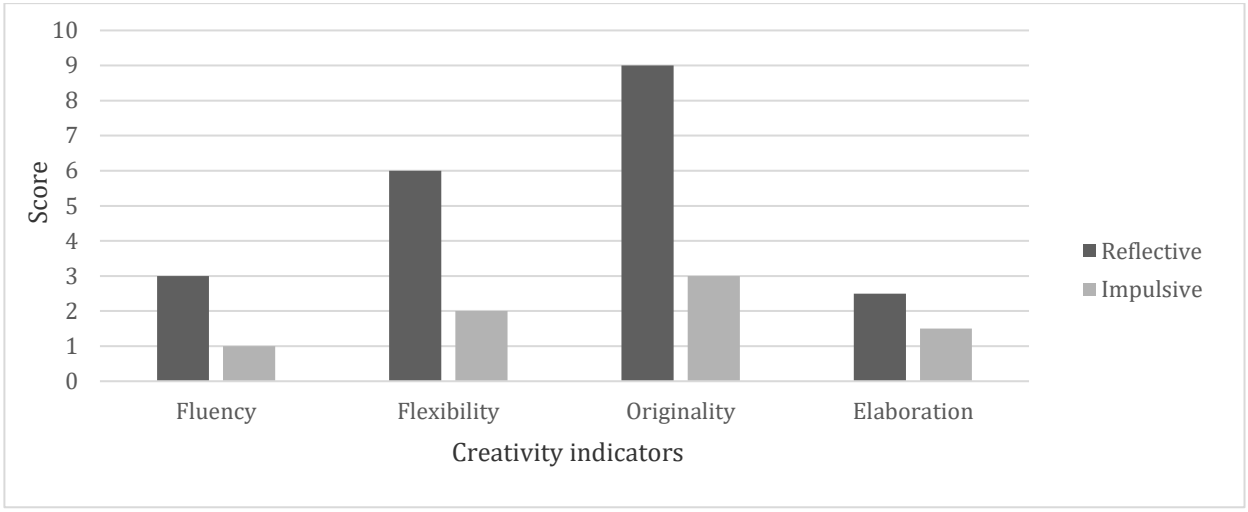

Figure 5. Profile of Reflective and Impulsive Students' Creativity in Making Scientific Article Backgrounds

Based on Figure 5, the creativity of reflective students is better than that of impulsive students in drafting the background of scientific articles based on fluency indicators. Reflective students get a weight of three, and impulsive students get one. The findings of this study indicate that reflective students can show many ideas (using many theories) when compiling the background of scientific articles, more than three of which are correct. Meanwhile, impulsive students can demonstrate two concepts while drafting the background of scientific papers that are only partially correct. Similarly, reflective students are better than impulsive students for flexibility, originality, and elaboration indicators.

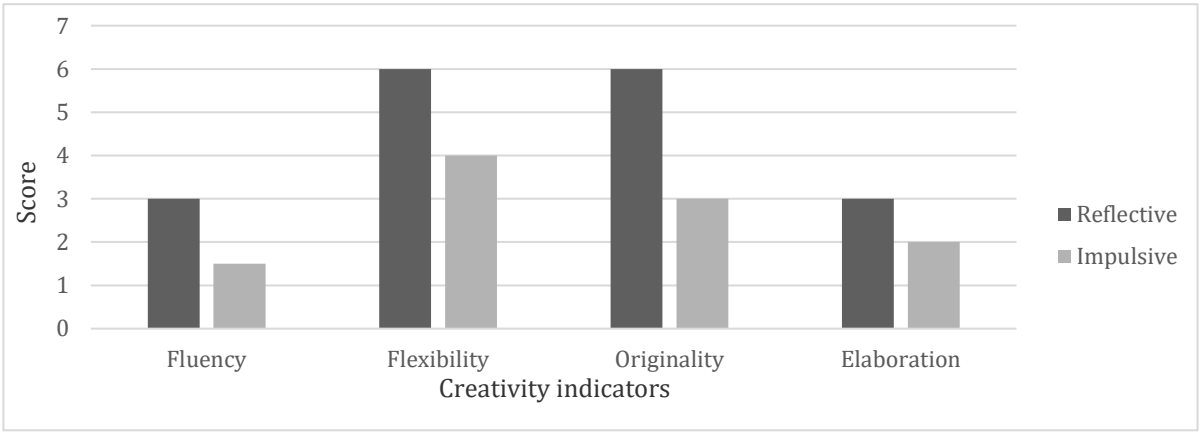

Figure 6. Profile of Reflective and Impulsive Students' Creativity in Making Scientific Article Problems

Based on Figure 6, the creativity of reflective students is better than that of impulsive students in making scientific article problems based on fluency indicators. Reflective students get a weight of three, and impulsive students get one. Referring to Table 1, reflective students can show many ideas (show many theories) in making scientific article problems, more than three of which are all correct. Meanwhile, impulsive students can show two theories in making the background of scientific articles that are only partially correct. Similarly, reflective students are better than impulsive students for flexibility, originality, and elaboration indicators.

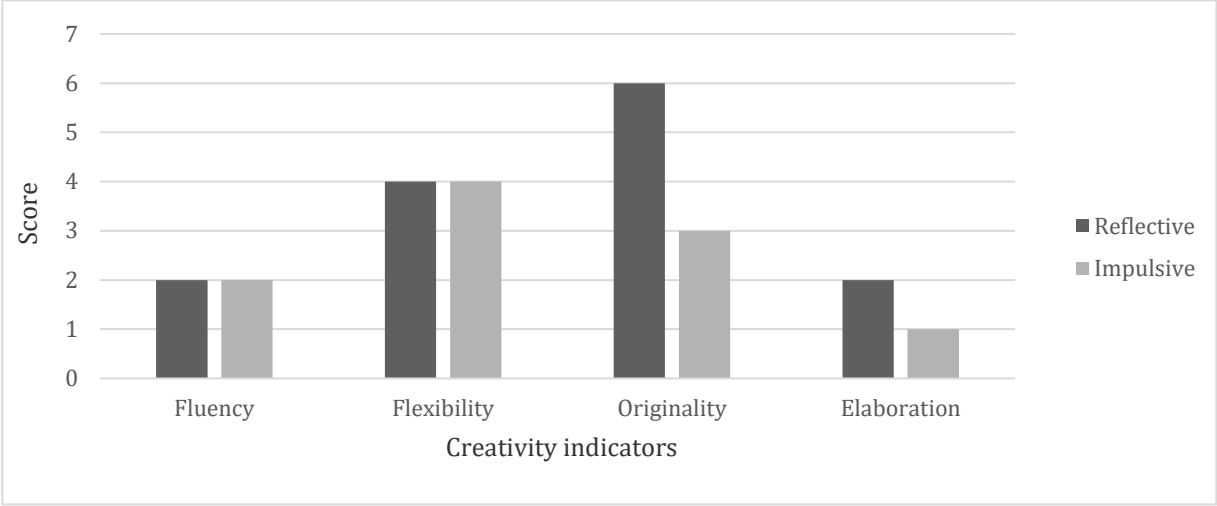

Figure 7. Profile of Reflective and Impulsive Students' Creativity in Making Scientific Article Methods

Based on Figure 7, the creativity of reflective students is better than that of impulsive students in making scientific article methods based on originality indicators. Reflective students get a weight of six, and impulsive students get a weight of three. Referring to Table 1, reflective students can show ideas not usually used in making scientific articles, more than two, but some are correct. Meanwhile, impulsive students can show an unusual idea in making scientific article methods based on their level of knowledge correctly. Similarly, reflective students are better than impulsive students for the elaboration indicator. However, for indicators of fluency and flexibility, the creativity of reflective and impulsive students in making scientific articles method is the same.

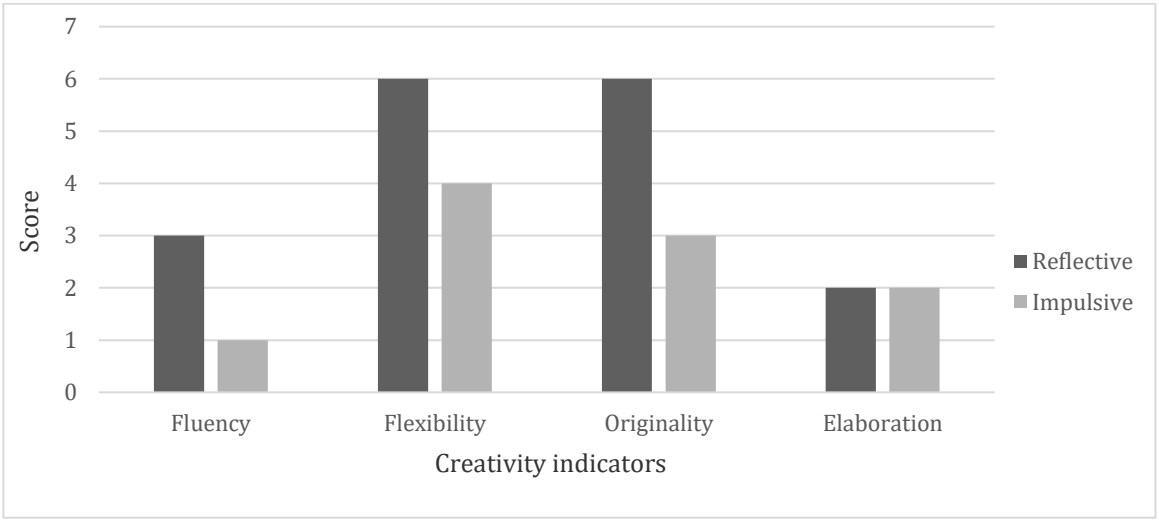

Figure 8. Profile of Reflective and Impulsive Student's Creativity in Making Scientific Article Discussions

Based on Figure 8, the creativity of reflective students is better than that of impulsive students in making discussions of scientific articles based on flexibility indicators. Reflective students get a weight of six, and impulsive students get a weight of four. Referring to Table 1, reflective students can change one idea to another in making scientific article discussions, more than two of which are all correct. Meanwhile, impulsive students can change one idea to another that is different in making the discussion of scientific articles (two) right. Similarly, reflective students are better than impulsive students for indicators of fluency and originality. However, for indicators of elaboration, the creativity of reflective and impulsive students in making discussions of scientific articles is the same.

Discussion

Reflective students show high creativity in titles and introductions based on fluency, flexibility, originality, and elaboration indicators. Meanwhile, reflective student creativity in making questions, methods, and discussions is included in the moderate category. However, the creativity of students who are impulsive in making titles is classified as moderate, for introductions, questions, methods, and discussions are classified as low. Reflective student creativity is better than impulsive students writing scientific articles based on fluency, flexibility, originality, and elaboration indicators. Thus, there is a difference between reflective and impulsive students in the creativity of drafting scientific papers based on fluency, flexibility, originality, and elaboration indicators.

In contrast to Morovat's research, reflective and impulsive characteristics are not determining characteristics in the success of getting a language test score (Morovat, 2014). In this study, students' reflective and impulsive characteristics determine creativity in writing scientific articles. The characteristics of reflective students who are always conscientious, considerate, not in a hurry, and take longer to complete assignments (Morovat, 2014) support creativity in writing scientific articles. In addition, reflective students have a high capacity for perceptual analysis and synthesis. Another fact is that reflective students take a long time to respond, make a few mistakes, and are meticulous in making a statement, but all these produce the best solution (Michalska & Zając-Lamparska, 2015). Therefore, reflective students can do well in writing scientific articles based on the criteria for making titles, introductions, problems, methods, and discussions.

On the other hand, this study has similarities with research conducted by Rahayu et al. (2022) that reflective and impulsive characteristics affect the ability to problem-solving. Reflective students have advantages in reading and understanding problems, presenting problems, developing problem-solving strategies, problem-solving, and confirming answers (Rahayu et al., 2022). These characteristics affect the ability of reflective students to be better than impulsive students in the creativity of writing scientific articles. The characteristics possessed by reflective students help in terms of (a) choosing words for titles; (b) determining the points for compiling the background; (c) determining and selecting the information in preparing the preliminary anatomy; (d) The ability to determine statistical analysis; and (e) selecting and determining information and other research findings for discussion.

Another thing that supports reflective students in the creativity of writing scientific articles is the dimension of creativity. Referring to the opinion of Hu and Adey (2002), one dimension of creativity is a process that includes thinking and imagining. Analytical and synthetic thinking processes as reflective student characteristics support fluency, flexibility, originality, and elaboration in making titles, introductions, problems, methods, and discussions. Fluency is the ability to come up with many ideas. The good ideas obtained are related to the many opportunities (Suryandari et al., 2021). Flexibility is based on (a) using many alternatives or different points of view in looking at a problem; (b) giving lots of ideas; (c) providing answers or questions from different perspectives; and (d) providing many alternative answers (Almeida et al., 2008; Moore et al., 2009; Murphy et al., 2013). Originality is the ability to generate different ideas that are not common. The ability to think elaboratively is the ability to develop and enrich ideas in detail (Parikh et al., 2020).

In contrast to the holistic thinking process as a characteristic of impulsive students (Rozencwajg & Corroyer, 2005), it does not support fluency, flexibility, originality, and elaboration in making titles, introductions, problems, methods, and discussions. Besides that, the creativity of impulsive students is also influenced by the habit of doing tasks that tend to be fast and gambling in deciding things (Morovat, 2014). Impulsive students, through holistic thinking, can be seen from the lack of variety in making titles, ideas for making introductions, problems, methods, and discussions that are not enriched and developed in detail. Experts make criteria for titles containing keywords, a label, not a sentence, must be concise and specific (Ecarnot et al., 2015; Grant, 2013; Torres-Valladares et al., 2022; Vitse & Poland, 2017) According to Meo (2018), information at the beginning of the introduction must present broad aspects, narrow to more specific ones, and present the problems and objectives at the end. Next is the method aspect, the most crucial part of scientific work, which provides information on the strength of the statistical analysis (J. C. Wang et al., 2017). Other important information that must be included in the method is to make it easier for the reader to understand what to do, where to do it, and how to do it (Meo, 2018). Finally, a discussion contains answers to the problems tested using existing knowledge or other people's findings to support the interpretation of research results (Vitse & Poland, 2017). In addition, impulsive students do not reveal much about information and other research findings used to make the introduction, method, and discussion. The lack of creativity of reflective students is supported by Warli and Nofitasari (2021) results that students with an impulsive cognitive style are less able to draw connections between one concept and another in solving problems.

The theories used for introductions, problems, and discussions in writing scientific article drafts are scientific knowledge possessed by students who are reflective and impulsive. According to Hu and Adey (2002), scientific knowledge is produced as a dimension of scientific creativity. Reflective students who use scientific expertise in introductions, problems, and discussions are better than impulsive students. Reflective students are characterized by many considerations and are careful in presenting scientific theories/knowledge to make introductions, problems, and discussions. According to Aktamis and Ergin (2008), there is a relationship between creativity and analytical intelligence because these two aspects originate from mental abilities. Theory/scientific knowledge to make introductions, problems, and discussion is a new idea from analytical thinking skills. This process has an impact on the creativity of reflective students.

Based on the research and discussion, the findings of this study are (a) the characteristics of reflective and impulsive students influence creativity in writing scientific articles and (b) the creativity of writing scientific articles for reflective students is better than for impulsive students. Information about reflective and impulsive student creativity in writing scientific articles as an important finding in this study is helpful for educators in carrying out learning innovations. Ideally, reflective and impulsive student creativity in learning should be the same. Therefore, educators must be able to design learning methods or strategies to accommodate these two cognitive styles in developing creativity students.

Conclusion

This study has described the differences in students' creativity who have reflective and impulsive cognitive styles in writing scientific articles. Creativity, reflective students write scientific articles better than impulsive students based on fluency, flexibility, originality, and elaboration indicators. Differences in student creativity based on the cognitive style in writing scientific papers, the researcher summarizes four significant findings, namely: (a) the creativity of reflective student in making titles and introductions are categorized as high creativity; (b) the creativity of reflective student in making problems, methods, and discussions categorized as moderate creativity; (c) the creativity of impulsive students in making titles are classified as moderate creativity; and (d) the creativity of impulsive students in making introductions, problems, methods, and discussions are classified as low creativity.

This research only focuses on student creativity in writing articles based on information literacy. Therefore, it is necessary to do other research to develop 21st-century skills such as critical thinking, collaboration, and communication in writing scientific articles. Topics for writing scientific articles can be developed from other branches of biology, such as Plant Anatomy, Plant Morphology, Plant Physiology, and Plant Development. Unique local wisdom from various regions in Indonesia can be used as a source of material for writing scientific articles in developing 21st-century skills. We believe the results of this research contribute to learning, especially in developing 21st-century skills to prepare students for the future.

Recommendations

Based on the research results, several recommendations exist for lecturers who develop student creativity in writing scientific articles and other research. When developing student creativity in writing scientific papers, lecturers must pay attention to differences in student cognitive styles. For example, (a) reflective and impulsive students form a group during discussions to fill each other's weaknesses and (b) reflective students have better creativity, so when learning impulsive students, they must receive special attention to increase their creativity. For other researchers, developing creativity in writing scientific articles can be implemented in other branches of biology and literacy, including different cognitive styles, such as dependent and independent fields.

Limitations

The research conducted has several limitations. First, the selected subjects did not meet the researchers' expectations. For example, students who are reflective or impulsive can only be selected from the cognitive style measurement of 28 students, so we cannot choose subjects who are high and low reflective as well as those who are impulsive. In addition, when conducting triangulation for tests for drafting scientific articles and interviews, the time allotted was not the same. These conditions can impact the characteristics of impulsive students, who tend to respond quickly dan many make mistakes, while reflective students, who tend to be slow to react but are correct. Second, this research is limited to conservation materials and environmental knowledge and does not represent other biological materials, such as plants and animals.

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Authorship Contribution Statement

Cintamulya: Concept, design, data collection, data analysis/interpretation, manuscript preparation, editing/reviewing, and critical revision of manuscripts. Mawartiningsih: Data collection, administration, technical support, observer, and editing/reviewing. Warli: Design, data collection, statistical analysis, data analysis/interpretation, securing funding, material support, and editing/reviewing.

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