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Creative Thinking Patterns In Student's Scientific Works

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ABSTRACT

Purpose: This study aimed to explain creative thinking patterns, including imaginative thinking, divergent thinking, and lateral thinking of students in scientific work. The scientific work studied was in the form of the Student Creativity Program at Malang State University, Indonesia.

Research Methods: This study used a qualitative approach with content analysis method. The data were in the form of sentences, sentence groups, paragraphs, paragraph clusters, and whole text. The data source of this research was the writing of student scientific work. The data were collected through surveys, documentation studies, and interviews. The process of data analysis was grouped into three stages, namely data reduction, data presentation, and conclusion drawing.

Findings: The findings of this study indicated that (1) the pattern of imaginative thinking in student scientific work appeared in the diversity of ideas based on experience and use of metaphorical language. Ideas were born through simple propositions in paragraph form. (2) Divergent thinking patterns in student scientific work could be seen from the diversity of ideas and techniques for problem solving. Criteria for markers of divergent thinking patterns were characterized by originality, flexibility or elaboration. (3) Lateral thinking patterns in student scientific work could be seen from the use of a variety of unique ideas according to the complexity of problem solving.

Implications for Research and Practice: Based on the results of the study, it can be concluded that creative thinking patterns of students in scientific work showed the use of various forms of ideas in accordance with the complexity of problem solving. The findings of this study contribute to our understanding of the importance of using creative thinking patterns in scientific writing. However, for further research it is recommended that we examine creative thinking patterns with different levels of objects so that the findings of this study appear more widely in various levels.

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Introduction

Creative thinking is defined as a mental activity used to build ideas. Creative thinking is a thought process that creates new ideas widely and variedly (Hidayat et al, 2018). Creative thinking is a mental activity that is used by someone to develop new ideas fluently and flexibly. Lee (2005) states that creative thinking skills involve fluency, flexibility, originality, and elaboration while creative personality involves curiosity, independence, risk taking, and task commitment. Creative thinking contains measurable competencies in problem solving (Shabrina & Kuswanto, 2018). In creative problem solving it is necessary to increase the level of confidence (Liu et al, 2017). Problem solving requires creative thinking, including analyzing, clarifying and describing based on information or facts.

Rawlinson (1981, p.6) says that in creative thinking there are three patterns that must be considered, namely imaginative, divergent, and lateral. First pattern is imaginative. Imagination is a cognitive process which is a comlex mental activity in which the elements in mental activity are released from sensory sensations. Djojosuroto (2007, p.259) says that imagination is the power to form images or images (images) of mental concepts in the process of forming a certain picture. Imagination involves a synthesis that combines aspects of memory, memories or experiences into a mental construction that is different from the past, or which becomes a new reality. Second one is divergence. Divergent thinking is oriented towards finding answers or alternatives. Divergent thinking is a type of thinking ability that is often used in creative problem solving. Divergent thinking is the process of generating a number of ideas that allow providing the right solution for a particular problem (Lewis & Lovatt, 2013). Munandar (2004) explains that divergent thinking is a mental operation that demands the use of creative thinking skills, including fluency, flexibility, originality, and elaboration and collaboration. That is, it is said to think divergently if it meets several criteria, smooth thinking, flexibility, originality, and collaborating in finding new ideas. Third pattern is lateral. Lateral thinking is related to generating new ideas. There is a feeling of curiosity that the new idea is related to the discovery of the technique. This is a very small aspect of the problem. The new idea is an element of change and progress in all fields of science ranging from engineering to art, from politics to someone's happiness (de Bono, 1991, p.11).

In a communication, both oral and written, mastery of knowledge of creative thinking patterns is an important aspect. This knowledge includes the process of thinking in solving problems and developing ideas into new ideas. One of the activities implicating creative thinking patterns in written communication is writing student scientific work. Writing scientific papers is a form of writing containing objective ideas. The form of scientific work and the language used to present ideas must be scientific (Kusmana, 2012, p.9). Scientific language in general has systematic, logical, and objective characteristics in presenting scientific ideas.

The pattern of creative thinking in student scientific work allows to produce diverse ideas, thus from these ideas one can choose the most appropriate answer in

problem solving. Creative thinking is known to be in the cognitive realm. Anderson and Krathwohl (2001, p. 99) involve three types of knowledge, namely conceptual, procedural, and metacognitive with six cognitive processes in creativity, namely remembering, clarifying, distinguishing, applying, analyzing, and evaluating. Writing is known to be in the psychomotor realm and scientific work is in the affective domain. The integration of the three allows for a shift or development of the theory of creativity into a broader realm, from the cognitive domain to the affective domain or the cognitive and psychomotor domains or encompass cognitive, affective, and psychomotor domains. The cognitive domain focuses on thinking skills and knowledge as the basis for creative work. The cognitive domain emphasizes various aspects of mental abilities related to creativity. In other words, this research can provide theoretical benefits in the form of the birth of the theory of writing new scientific works and forms of creative thinking in writing scientific works, while the practical benefits, students gain practical experience in writing scientific work through creative thinking. The experience is expected to be beneficial for the development of individual intelligence and student social intelligence in writing scientific work. Scientific works that are written are able to produce credible arguments.

Scientific work presents scientific ideas or arguments based on facts. The idea of science must be trusted and accepted by the truth, so that it is necessary to present it correctly (Kusmana, 2012, p.3). Scientific writing is an essay that presents arguments using logical thinking correctly in problem solving. Discussion of the problem in scientific work is usually an important part, so that in this section the author uses the ability to think complex, namely linking between problems, facts, theories, and problem solving.

Creative thinking patterns are expected to reveal problem solving to determine the effectiveness of scientific writing with the reality faced. Creative thinking can contribute to writing, such as helping in building narratives (Lengelle et al, 2013). The complexity of creative writing requires the use of language to explore and express experiences in ways that are unique, imaginative, and appropriate in context (Vass, 2007). In the context of creative writing, productive outcome talks can be defined as expressions of experiences and ideas appearing according to circumstances.

Research on creative thinking has been done by (Lengelle et al, 2013). Lengelle et al examined the effects of creative writing. The research findings obtained are that the idea arises from the situation or information provided and knowledge possessed. Eckhoff and Urbach (2008) conducted research on understanding imaginative thinking (the socio-cultural conception of creativity and imaginative thinking). His research results show that it is based on understanding children's development in an effort to meet the needs of diverse students in each class. Just like early educators who pay attention to the cognitive and social needs of children, it is also important to foster children's creative needs. Lack of attention to developing imaginative thinking, basically not paying attention to the needs of all children. Through careful attention to the imaginative efforts of children, educators will empower children to develop

invaluable tools that can be part of their repertoire's contribution to understanding and contributing to their world.

The difference between this research and the mentioned research can be observed in terms of the focus studied and the subject being targeted for the study. This research seeks to gather information about creative thinking patterns in student scientific work. The difference illustrates that the topic of this research is a new topic that is worthy of research. Based on this context, this research study focused on creative thinking patterns in the writing of student scientific papers.

Method

Research Design

This study used a qualitative approach with the content analysis method. A qualitative approach to the method of content analysis is useful to gain an in-depth understanding of creative thinking patterns. This research approach is used to describe, explain, and explore students' creative thinking patterns in scientific work. Content analysis was used to find the existence of certain sentences, concepts, or paragraphs in texts or a series of texts. The pattern of creative thinking can be seen from the form of developing ideas and the use of cohesion. The activity was carried out to find out the reality of using creative thinking patterns in writing, based on this fact the analysis was carried out so that students' creative thinking patterns in writing could be concluded. The use of a qualitative approach is based on the nature and characteristics, namely having a natural background as a source to get data directly, is descriptive, and meaning is the main concern.

The research data was in the form of interagency relations in the text of the student's scientific work. Interagency relations were exposed in sentences, clusters of sentences, paragraphs and paragraph clusters. The interagency relationship was realized through creative thinking patterns that start from the excavation of ideas, the selection and formation of sentences as a vehicle for developing ideas, and the realization of propositions in a series of sentences in the form of paragraphs. Therefore, sentences, paragraphs, and paragraphs in student writing reflect creative thinking patterns in developing scientific writing ideas.

The data source of this research was the writing of student scientific work. Scientific writing has the characteristics of a model of persuasion in logical reasoning that is in accordance with the logic of thinking of scientific truth to be convincing. This paper contained many ideas, so that patterns of creative thinking in language activities or pouring ideas would appear. Scientific writings chosen as data sources were scientific writings written based on themes that were not determined and met the adequacy for analysis. The selection of scientific writing needs to be done with the intention that the scientific writing can be analyzed according to the focus of the problem under study.

Research Sample

The participants in this study were 15 students with various fields in Malang State University, Indonesia. This study examined the patterns of creative thinking of students in writing scientific papers. The scientific work studied was in the form of the Student Creativity Program in 2017 on a topic not determined by the subject of the study. This was based on the idea that the Student Creativity Program is one form of scientific work compiled using scientific procedures. Because the Student Creativity Program was the result of scientific thinking, and the theoretical foundation used as an analytical tool was a theory about the characteristics of scientific thinking.

Research Instruments and Procedures

The instrument of this study consisted of data collection instruments and data analysis guides. The data collection instrument was used to obtain data that was in accordance with the focus of the research, while the data analysis guide was used to analyze the data according to the problems in this study. This research, when viewed from the focus of the problem under study, actually only examined documents in the form of student scientific papers. To confirm the data that has been obtained from the student's writing, the researcher conducted an interview with the supervisor. In conducting interviews with lecturers interview guides containing questions related to the focus of the research problem were used.

Based on this explanation, the instruments developed as a tool for collecting data for researchers were of two types, namely surveys and data collection guidelines. Both types of instruments were used gradually in the process of conducting research. The data collection guide was used to collect data about creative thinking in writing student scientific papers. The guide was based on the focus of the research under study.

Collecting data about creative thinking in the development of paragraphs and paragraph groups in student scientific work directs observations in paragraph form. The form of the paragraph in question included (1) the pattern of developing ideas in paragraphs, and (2) the technique of exposing ideas in paragraphs. By using a few steps of the guide, the data needed can be captured more thoroughly and focused. When reading data sheets, researchers can mark the data found by coding the data. After reading the data sheet, the researcher moved the data on the data formatting sheet to be analyzed further.

Data Analysis

This research, when viewed from the focus of research, primarily aimed at reviewing documents in the form of student scientific papers. To confirm the data that has been obtained from the student's writing. The process of data analysis was grouped into three stages, namely data reduction, data presentation, and conclusion (Miles & Huberman, 2014, p. 16). (1) Data reduction in research is a form of analysis that sharpens, classifies, directs, and organizes data in such a way that final

conclusions can be taken accurately. (2) Presentation of data is an activity when a set of information is compiled, thus giving the possibility of drawing conclusions and taking action. The form of qualitative data presentation (a) narrative text, in the form of notes and (b) matrices, graphs, networks, and charts. These forms combine structured information in a form that is coherent and easily achieved, making it easier to see what is happening, whether the conclusions are correct or otherwise do the analysis again. (3) Efforts to draw conclusions are conducted continuously by researchers as long as they have not found new things from the study of creative thinking in the writing of student scientific papers.

Results

This section presents the results of research on creative thinking patterns in scientific work. Writing scientific papers is an activity that requires writers to produce writings with scientific conventions. The scientific conventions in question included the logic of thinking, systematics, and the style of language used. In this study, creative thinking patterns in student scientific works were presented based on three aspects, namely imaginative thinking, divergent thinking, and lateral thinking.

Based on the results of the research data analysis, there were 36 creative thinking patterns with data sources of 15 student scientific works. The results of grouping data on creative thinking patterns can be seen in the table 1.

Table 1

The Results of Grouping Data on Creative Thinking Patterns

Number of data sources	*Creative thinking patterns*	*Indicator*	*Number of sentences*
15 Scientific work	Imaginative	Ideas Based on Experience	2
		Use of Metaphorical Language	1
	Divergent	Development of Ideas	11
		Various Interpretations	10
	Lateral	Assumption	6
		Bringing Up a New Idea	6
Amount of data			36

Based on the table it can be seen that (a) imaginative thinking patterns had a total of 3 data consisting of ideas based on experience (2) and the use of metaphorical language (1), (b) divergent thinking patterns had a total of 21 data consisting of development of ideas (11) and various interpretations (10), and (c) lateral thinking patterns had a total of 12 data consisting of assumptions (6) and new ideas (6).

Based on the results of data analysis it can be seen that the creative thinking patterns that were dominantly used in student creativity programs were divergent and lateral thinking. However, all creative thinking patterns in writing student scientific papers complemented each other. Therefore, the creative thinking patterns will be described in more detail as follows.

First, imaginative thinking is able to generate new ideas, and help to look at things differently so that they can be explored and understood better. In scientific works, imaginative thinking can be seen in ideas that are poured out based on experience. This can be seen in the following example.

(1) There are still many teachers who do science learning in junior high school using conventional methods or teacher centered learning so that the majority of junior high school students feel that science subjects they learn include subjects whose concepts are too difficult to understand and are not fun to learn, so they are lazy to learn Science. Learning media that exist today also has not really attracted students to study science as a fun subject. (I (G.B.P) PKM Indah Aulia R.D)

(2) The problems that occur at this time, the local government is too dependent on the DAU allocation to finance capital expenditure and development without optimizing the potential of the region. This fact has led to asymmetrical behavior in the regional government. To see whether there is an indication of inefficiency in the transfer fund, it can be seen from the response of government expenditure known as Flypaper Effect. (I (G.B.P) PKM Wahyu Kurniana)

The paragraph in the data citation (1) above is a short paragraph that only consists of two sentences. The paragraph uses illustration techniques in explaining the ideas contained in paragraphs. In the paragraph, students intend to explain the idea that *Current teachers still use conventional teaching methods* to explain the idea, students explain with illustrations (a) *teacher-centered learning*, (b) *the concept is too difficult*, and (c) *learning media that are not interesting*.

Starting from the example of data (1), it can be stated that students have a distinctive use of illustration techniques in imaginative thinking. Illustration techniques in imaginative thinking patterns are ways to explain effective ideas. According to students, through illustrations, the ideas conveyed will be easily understood by others who read them. Moreover, the data was raised from the Student Creativity Program funded by the Directorate of Higher Education. Therefore, students must be able to really convince the reviewers. In example (1), it has been proven to be able to convince reviewers, because the scientific writing is funded by the Directorate of Higher Education.

Furthermore, in the sample data (1) the delivery of ideas is revealed based on experience, as in sentence (a) "*There are still many teachers who do science learning in junior high school in a conventional way ...*", (b) "*Learning media that exist today are not yet really attract students to learn science as a fun subject*". The idea is the author's experience in uncovering a problem.

Based on the description, it can be stated that the ideas in scientific works are developed by students based on experience. In the paragraph it appears to have one main idea. The main idea of a paragraph is a general statement which is the subject matter discussed in the paragraph based on experience. The statement manifested in the paragraph can occupy the preliminary position, literature review, and closing.

In data (2) the connection between the ideas of sentences a-c is evident through cohesion devices. Complaints in a text are very important so that readers can be sure

or can follow the author's ideas well so that what the author expects is the same as what is captured by the reader. In the student creativity program this is very important to convince reviewers. In addition, in data (2) the paragraph begins with revealing the problem, namely "*The problem that is currently occurring, the local government is too dependent on DAU allocation to finance capital expenditure and development without optimizing the potential of the regions*". This sentence is a form of the student's initial experience in raising a problem in writing a proposal.

Second, divergent thinking is a type of thinking ability that is often used in creative problem solving. That is, it is said to think divergently if it meets several criteria, smooth thinking, flexibility, originality, and collaborating in finding new ideas. This can be seen in the following example.

(3) Dictionary is a medium to facilitate the search for meaning / translation of a word. Conventional book-shaped dictionaries tend to be fixed, cannot be added, or changed, and require considerable time to do word searches. With Subsequent developments dictionary programs appear to have advantages faster in the search for word meanings, and can be updated so that the contents of the dictionary will always develop. On the contents of an Android-based dictionary besides being faster in search, it can also be accessed anywhere. This Indonesian Language dictionary application is based on Android which is intended for blind people so that an explanation on the dictionary is voiced and designed as minimal as possible so that it does not consume too much storage capacity. (D (P.G) PKM Imam Shafi'i)

(4) Distribution is a process of transferring goods from the place of origin to several destinations (Vandiko et al. 2013: 1), especially in the process of distribution from one area to another. This transfer is the reason why distribution is an important component in the sustainability of a business. Optimizing distribution costs will be able to increase profits from a business that has been done. To achieve the ideal use of transportation facilities, a model is needed, which can illustrate various problems in the field of distribution. In addition, a method or algorithm is needed to solve the problem model. By modeling the problem, it is hoped that it will facilitate the search for solutions. (D (M.P) PKM Rully Atus Soimah)

The paragraph in the sample data (3) consists of five sentences. Of the five sentences there are three sentences that contain elements of ideas. Every idea contains a novelty meaning. The sentence in question is (a) "*Conventional book-shaped dictionaries tend to be fixed, cannot be added, or changed, and require considerable time to do a word search*", (b) "*Further development comes with a dictionary program that has more advantages in word search meanings, and can be updated so that the contents of the dictionary will always develop*", and (c)" *This Indonesian Language dictionary application is based on Android which is intended for blind people so that an explanation in the dictionary is voiced and designed to a minimum so that it does not consume too much storage capacity*". The diversity of ideas appears several times in one paragraph so that creativity in expressing ideas is more visible.

Then, based on the sample data (3), it can be seen that the presentation of ideas in paragraphs is carried out chronologically, tiered, and generally into more detailed ones. Then the paragraph meets the criteria for divergent thinking. The details of the

interagency relationship in the sentences in data (3) show the development of ideas that have one main idea. Example (3) consists of five sentences, namely (a) the first sentence is a sentence that has a simple structure, and (b) the second, third, fourth, and fifth sentences are sentences that have a complex structure. In all these sentences, there is the word "*Dictionary*" which is an emphasis on developing important ideas. Judging from the repetition of the word "*Dictionary*" of each sentence, the sentences have a solid relationship in expressing ideas.

In data (3) the presentation of ideas looks tiered, that is, from more general things to more specific ones. Beginning with the meaning of the word "*Dictionary*" in the first sentence, and followed by the explanatory sentence in the second, third and fourth sentence, and the fifth sentence is more related to the application. The paragraph fulfills the completeness and completeness criteria of the paragraph because the information presented in the paragraph is complete. The paragraph can be categorized into paragraphs developed by explanatory techniques. Sentences explain each other.

Judging from the language exposure, in data (4) the sentence a-f contains explanatory sentences. The paragraph does not contain statement sentences. Each sentence in the paragraph has the same position. Among these sentences, there is no sentence that takes precedence over its position. In this case the students compose paragraphs prioritizing solutions or kinds of interpretations of the problem. However, overall the sentences in the paragraph are related to one another. In addition, in the example data (4) there appears a problem-solving technique such as in sentence (a) "*By optimizing distribution costs it will be able to increase profits from a business that has been done*" (b) "*In addition, methods or algorithms are needed to complete the model of the problem*". The ideas used in problem solving are quite common. The idea contains two arguments to support the main idea so that the elaboration aspects and aspects of originality appear.

Based on these explanations, it can be stated that the divergent thinking patterns of students in developing paragraphs appear in students' thinking abilities in using tiered ideas or from more general things to specific things. Thus, it can be stated that the divergent thinking patterns of students will appear from the development of ideas that have interalimic similarities in paragraphs.

Third, lateral thinking is related to generating new ideas. In this case it has a feeling of wanting to know that new ideas relate to the discovery of techniques. This can be seen in the following example.

(5) Genetic algorithms as one branch of the evolution algorithm are adaptive methods commonly used to solve a value search in an optimization problem. The mechanism in genetic algorithms is very simple, which only involves copying strings and exchanging string parts. The breeding cycle begins with making random sets of solutions called populations, wherein there are individuals called chromosomes. These chromosomes gradually undergo electoral iterations in a generation. During a generation, these chromosomes are evaluated, using formulas in the fitness function. (L (A.A) PKM Novinda Cahya Diyanti)

(6) To create the next generation with a new chromosome (called offspring) can be done by combining the two chromosomes that have been obtained previously by using a crossover operator or by modifying a chromosome using the mutation operator. A new generation before being evaluated again, then he goes through a selection process based on his fitness function. From this selection, the best chromosomes have a high probability of being selected. After several generations, the algorithm will experience convergence on a number of the best chromosomes, which have the optimum value of the problem being solved. (L (M.G.B) PKM Novinda Cahya Diyanti)

Data (5) written by these students can be grouped into paragraphs which are presented with techniques which give rise to assumptions. The main idea discussed in the paragraph is "*Genetic Algorithms*". To explain the "*Genetic Algorithm*", the idea in example (5) conveys several ideas, namely (a) "*Genetic algorithm mechanism*", (b) "*Breeding cycle*", and (c) "*evaluating method*". The three ideas presented in the paragraph provide an explanation that explains the ideas related to "*genetic algorithms*". Every idea expressed in a paragraph has the same position, there is no main idea.

Example (6) consists of four sentences, namely (a) "*To create the next generation with a new chromosome (called offspring) it can be done by combining the two chromosomes that have been obtained previously by using a crossover or with modify a chromosome by using a mutation operator*", (b) "*A new generation before being evaluated again, then he goes through a selection process based on his fitness function*", (c) "*From this selection, the best chromosomes have a high probability of being selected*", and (d) "*After several generations, the algorithm will converge on the best number of chromosomes, which have the optimum value of the problem being solved*". The sentence a - c functions as a cause related to the topic. The relationship between the arguments is so close that the flow of ideas becomes smooth. The smoothness of the idea appears in the existence of a link between statements, both function as causes (problems) and as a result (new solutions or ideas). New ideas arise because of problems. In data (6) it appears that the emergence of new ideas is based on causal techniques.

The complexity of problem solving in data (6) is carried out in an abstract manner, such as "*To create the next generation with a new chromosome (called offspring) it can be done by combining two chromosomes that have been obtained previously by using crossover operators or by modifying a chromosome using the mutation operator ...* ". The research data shows that students use more complex and abstract ways in developing their ideas about problems. With the use of this method students' thinking becomes more complex because students must consider the preparation of ideas carefully so that a paragraph that has coherence or combination is presented.

Based on this example, it can be seen that the new idea relates to the discovery of techniques to problems and raises new kinds of ideas about problems. The development of mindset in bringing up this idea shows that students present their creative ideas with their competencies.

Discussion, Conclusion and Recommendations

Creative thinking is a psychological phenomenon that is getting attention from various aspects of life, including education. Education that is currently developing is all based on creative thinking. Through creative thinking, all self-potential is valuable so ideas can be born. In teaching language, the element of creative thinking plays an important role, especially in regard to pouring ideas imaginatively, divergingly, and laterally. These three things are patterns of creative thinking. Rawlinson (1981, p.6) says that in creative thinking there are three patterns that must be considered, namely imaginative, divergent, and lateral.

First, imaginative thinking is a fundamental ability to connect experiences and build new knowledge (Chan, 2016). As an example (1) stated in the results section of the study, ideas in scientific works were developed by students based on experience. In the paragraph it appeared to have one main idea. The main idea of a paragraph is a general statement which is the subject matter discussed in the paragraph based on experience. The statement manifested in the paragraph can occupy the preliminary position, literature review, and closing.

To fill in the ideas related to the information to be conveyed and the means of ideas relating to the language tools were used in accordance with the problem. In this case language is seen as truth, without language there is no truth (Djojosuroto, 2007, p.261). Language is used for idea activities that give an understanding of the symptoms that explain the problem. The problems described in the scientific work are clear and complete to help the reader understand the starting point of the overall problem of a problem raised in scientific writing (Kusmana, 2012, p.37). The problems revealed in data (2) have been clearly described. The main problem becomes the basis for the birth of an argument in scientific writing.

Presentation of the problem by describing it through the disclosure of comparative sentences will further clarify a problem for the reader. The questions asked will help if there are questions raised in the scientific writing. As in the data (2) of this study, the authors uncovered the problem with comparative and correlational sentences so as to convince the difficulties for the reviewer on the student creativity program. Then, the objectivity of the problem in scientific work is very necessary to avoid the wrong interpretation. In describing its revolution, writers are sometimes dragged into the presentation colored by the author who is not subjective (Suyitno, 2012, p. 4). Therefore, the author needs to discuss the matter of writing before revealing the opposition. Responding or revealing to a problem in scientific work can be done by evaluating conclusions, reconsidering the evidence provided by the author, evaluating the argument, and proposing alternative ideas (Sultan et al, 2017a).

In data (1 and 2) ideas were born through propositions in the form of simple paragraphs. In pouring ideas, students equip themselves with ethical knowledge or rules about scientific writing. Knowledge of the rules of writing will be part of the competence in writing scientific in general and more specifically in writing student creativity programs. To be able to strengthen its competence students need to

prepare several previous studies to continue to develop these competencies. Previous research was needed to obtain information and ideas that were revealed as a process of building competencies. Learning activities train students in the process of building competencies by directing them to be able to investigate the meaning and message behind language choices, information, and arguments found in previous research texts (Sultan et al, 2017b).

The research findings on imaginative thinking patterns in student scientific writing are represented in the form of diversity of ideas based on experience and use of metaphorical language. In the data (1 and 2) the meanings of ideas were not using the real meanings of words, but rather as figures of speech based on equality and comparison. Based on these findings, it can be concluded that the diversity of ideas based on experience and use of metaphorical language in student scientific work shows creative thinking with imaginative patterns.

Second, in divergent thinking the presentation of ideas in paragraphs was carried out chronologically, tiered, and generally into more detailed ones as shown in the sample data (3 and 4). Rawlinson (1989, p. 7) says divergent creative thinking patterns start from a description of the problem then spread to be able to produce various kinds of ideas for problem solving. The ideas poured are original, not similar to previous ideas. Although the idea has already been there, in creative thinking one tries to renew it into a new idea. Divergent thought patterns often lead to originality, and originality is the center of the feature of creativity (Runco & Acar, 2012).

In creating the originality of scientific work, the method that can be taken is to conduct a study which is a recommendation from a similar study, or study that has been carried out by another party (Kusmana, 2012, p. 84). Therefore, the authors of scientific works must be able to find the gaps of scientific arguments that are still neglected. That is, various limitations of the previous studies can be used as a point of departure in compiling scientific arguments. The scientific work needs to reveal fundamental differences. The difference is essential scientific ideas, so that the originality of scientific work can be maintained.

The ability of divergent thinking involves the capacity to generate ideas (fluency), the capacity to produce unusual associations (originality) and fluency, and the capacity to change the category of flexibility (Runco, 1986). The ideas outlined in data (3) fall into the criteria of fluency in thinking. The measure of fluency does not limit ideas for originality, flexibility or elaboration. Divergent thinking groups have the highest scores on measures of fluency and originality compared to groups that do not involve divergent thinking (Yi et al, 2015). One reason why divergent thinking can improve quality is because it detaches itself from the established mindset (Lewis & Lovatt, 2013). Therefore, the tendency of open individuals to provide ideas from a broader frame of reference (Batey et al., 2009). In divergent thinking, previous ideas have less influence, because the next idea has greater weight (Yagolkovskiy & Kharkhurin, 2016).

The findings of divergent thinking patterns in accordance with idea Rawlinson (1981, p. 7) suggests is that divergent thinking patterns are initiated from a

description of the problem then spread to be able to produce various kinds of ideas for solving problems or providing various possible answers to the problem. In divergent thinking, one can produce ideas in large numbers. From these ideas one can choose the answer that is most appropriate in accordance with the indicators of the problem under study. The findings in the study of divergent thinking are ideas in this pattern which can be seen from the number of ideas set forth in scientific work. The idea is inseparable from the combination of ideas, and there shouk-ld be a single main idea in a paragraph. Based on these findings, it can be concluded that the diversity of ideas and techniques for developing sentences in paragraphs is a marker of creative thinking in student scientific work.

Third is lateral thinking. Idea alternatives appeared as if they do not have a contribution to the problem and have nothing to do with the problem at hand, as shown in the sample data (5 and 6). In the data (5 and 6) the problems faced require new innovations that are creative in nature. Needs that continue to change over time (requires lateral thinking to be fulfilled), rather than pre-existing patterns and rules (Waks, 1997). Markers of lateral thinking patterns are raising new kinds of ideas on new problems and ideas related to the discovery of techniques to problems. Student achievement in problem solving depends on lateral thinking (Arsad et al, 2012). That is, lateral thinking plays an important role in producing quality student resources. More competitive, more creative and innovative thinking is very important in getting the best results from the ideas that are poured.

Lateral thinking patterns have contributed to the development of the ability to write scientific works ranging from the development of language elements to the development of the ability to carry out the stages of the creative process. The creative process is able to decipher alternative problem solving with various delivery styles. Achieving various solutions to problems is presented in an abstract manner, so that it is easily understood by the reader or reviewer.

Decomposition of problem solving alternatives in data fragments (5) is carried out in an abstract manner, with previously expressing the solution in principle. The description of the solution is expressed in an abstract about optimization problems. Abstract problem solving requires the reader to think abstractively or use abstract frameworks in understanding problems, but it does not mean that the problems expressed are irrational because abstracts do not mean they are irrational (Kusmana, 2012, p. 35). Clarity of a solution to the problem will be very helpful if the author reveals the position of alternative problem solving or the main problem solving presented in the writing he made in a few paragraphs. Even so, in presenting problem solving in scientific works can also be done by using a combination of ways of deduction by induction so that the clarification of the problem description is easier to understand.

Findings about creative thinking patterns in line with opinions (de Bono, 1991) suggest that lateral thinking is more a way of generating ideas in new ways to present a new idea. The findings of this study concerning lateral thinking, namely the selection of ideas based on creative thinking that considers the authenticity of

ideas poured out on problems. Then, the idea is in accordance with the topic and the suitability of the sentence and the interalimat. Based on these findings, it was concluded that the lateral thinking patterns of students in scientific papers were represented in the use of various ideas that were in accordance with the complexity of problem solving.

In general, the findings of this study about creative thinking patterns in student scientific work, showed that creative thinking patterns lie in the form of ideas used. Writing scientific papers is a creative thinking process that prioritizes the ability of students to develop and organize ideas, and pour them into written language. Therefore, the form of ideas in scientific work is a representation of student creativity in developing ideas in writing. The form of ideas is able to combine them into diverse, detailed, and unique forms. However, for further research it is recommended that we examine creative thinking patterns with different levels of objects so that the findings of this study appear more widely in various levels.

The implication of creative thinking patterns in student scientific works raises several things, namely (1) through understanding creative thinking patterns, various ideas become more directed and structured. In writing scientific papers organizing a text is an activity of representing ideas into a text. In terms of structure, scientific work has a complex structure. The intended structure includes the opening part, the contents section, and the closing section. Each part has its own peculiarities which can be obtained from understanding creative thinking patterns (imaginative patterns, divergent patterns, and lateral patterns), (2) disclosure of ideas are able to convince readers or reviewers and the use of language more effectively and easily understood. Creativity in expressing ideas appears in the type of development of ideas involving inductive and deductive techniques, the use of experience to enter new information, and the presentation of various problem-solving techniques supported by a foundation of thinking.

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