THE PROFILE OF STUDENTS' MATHEMATICAL PROBLEM POSING BASED ON THEIR COGNITIVE STYLES

Abdul Rahman
FMIPA Universitas Negeri Makassar, Jln. Dg. Tata Raya,
Kampus Parangtambung Makassar

ABSTRACT.

This study aims at revealing the profile of students' mathematical problem posing based on their cognitive styles. The research subjects were 8 grade XI IPA students consisting of 4 students for each of the *field dependent* (GK-FD) and the *field independent* (GK-FI) cognitive styles. The research results show that students GK-FI pose 79 mathematical questions of which 4 are solvable. Whilst students GK-FD pose 80 mathematical questions and 33 of them are unsolvable. From semantic and syntaxes viewpoints, it is seen that the response quality of students GK-FI and GK-FD are respectively in the high and average middle categories.

KEYWORDS:

Profile; Problem Posing; Cognitive Style.

INTRODUCTION:

Implementation of Indonesian Competency-Based-Curriculum is a forward step to improve the quality of the national education. The curriculum emphasizes on developing students' ability to pose tasks with certain performance standards in order to perceive the learning outcome.

Romberg & Carpenter (1996) states that many studies related to teaching explicitly assume about students learning, but they are inconsistent with the current cognitive learning theories. Therefore, it is suggested to do an integrated research and incorporate required teaching and learning. Romagnano (Jaeng, 2004) reveals that there are three main dilemmamas in mathematics teaching and learning activities during his research, they are: (1) "Ask Them or Tell Them" Dilemma, (2) "Good Problems" Dilemma, and (3) "Grading" Dilemma. Dilemma (1) regarding the concept delivery, dilemma (2) concerning the difficulty to pose problems during the instructional process, and dilemma (3) concerning the evaluation, how to use measuring tool well. One of the three dilemmas is posing mathematical problem as the focus of this study.

One of abilities necessarily students have in terms of mathematical problem solving is the ability of posing mathematical problems. The research conducted by Hashimoto (Silver & Cai, 1996) indicates that learning through problem posing approach elicits a positive influence on students' ability in problem solving.

Among the research results reporting on problem posing approach to learning are Leung, Silver, and English (Christou et al., 2005). They propose that problem posing has a positive influence on students' ability to solve word problems, and provided a chance to gain insight into students' understanding of mathematical concepts and processes (p. 150). Besides that, Kilpatrick (Christou et al., 2005) argues a thesis that the quality of problems that students pose

functions as an independent variable to predict how well students can solve problems. In addition, Mestre (2002) states that problem posing can be used to delve transferring of concept accross context, and identifying knowledge, reasoning, and concept development that students have.

Mathematical problem posing plays an important role in mathematics curriculum, since it encompasses the core of mathematics activities, among other things, students' activities to construct their own problems, as the preliminary step prior to coming into problem solving steps. Performing problem posing in mathematics learning was strongly recommended by NCTM, because problem posing is worth as well for children's knowledge development and understanding to the important concept of school mathematics (English, 1998).

Mayer et al. (Silver & Cai, 1996) find that students are in difficulty to solving mathematical problems, because they are in difficulty to understand problems languange. Further, they reveal that questions containing relation and subjunctive propositions are more difficult for students to solve than those containing assignment proposition. Thus, language structure in constructing questions is greatly important to be noticed to avoid the unsolvable questions. In the preliminary research that the researcher administers to grade XII IPA-1 students of SMA Negeri 11 Makassar, it is found that students with the cognitive style of field-independent are all the more in posing solvable mathematics questions (53,21%) than those of field-dependent (only 19,23%) (Rahman, 2006). This is because not all students have the same way in receiving dan processing data existing in given information.

Based on the survey results that the researcher took to grade XI IPA students of SMA Negeri 3 Makassar in the early academic year 2007–2008, it was given that from 240 students, 87 or around 30% of them scored under 7.0– The Minimum Mastery Criteria of mathematics subject that the school established. The low mathematics scores of such students were not merely resulted from the mathematics content itself and the teacher ability in managing learning in the classroom, but it was necessary to consider some of those students characteristics in learning mathematics in the classroom, among other things were students cognitive style and their ability to pose mathematical problems. The outline above indicates the significance of conducting a research concerning mathematical problem posing on the basis of students cognitive style.

There are several definitions of problem solving. Problem solving is a problem receiving process as a challenge to be able to solve. Besides, Cooney (Tambunan, 1987) states that problem solving is a process of receiving problem and there exist endeavor to solve it. In addition, Polya (1973) defines problem solving as an attempt to find way out of a difficulty to attain a goal which is not presently could be solved. Problem solving is a psychological process engaging not just as application of theorems having been learnt. Further, Bullock & Stallybrass (Checkland, 1985) state that problem solving is that form of activity in which the organism is faced with a goal to be reached, a gap in the route to the goal and a set of alternative means, none of which are immediately and obviously suitable. Furthermore, McGivney & DeFranco (1995) argue that problem solving comprised two aspects, that is: problem to find and problem to prove. Henceforth, Santrock (2007) state that problem solving means seeking an appropriate way to achieve a goal. Problem solving can also be defined as finding steps to overcome the existing gap, while Dahar (1989) reveals that problem solving acitivity itself is human activity in practicing concepts and rules having been acquired before.

There are several criteria for a student can be categorized into a good problem solver in mathematics learning. Suydam (1980) proposes 10 (ten) criteria, that is students should: (1) understand concept and terminology, (2) review

intertwinment, difference and analogy, (3) select appropriate procedures and variables, (4) understand conceptual inconsistency, (5) make estimation and analysis, (6) visualize and interpret data, (7) make a generalization, (8) use a variety of strategies, (9) attain high score and have a good relationship to other students, and (10) have a low score in anxiousness test.

From some definitions regarding problem solving aforementioned, it in this research prefers to the second thesis of Branca (1980), that is problem solving as a process. This is because problem solving process is closely related to problem posing. This instance is strengthened by Silver & Cai (Christou, 2005) that problem solving performance has a high correlation to problem posing performance, and furthermore asserts that problem posing can improve thinking, problem solving skill, attitude, and students' self-esteem to mathematics and mathematical problem solving, along with contribute to a more extensive understanding on mathematics concept.

Duncer (Stoyanova & Ellerton, 1996) proposes a definition for mathematical problem posing as an attempt in constructing or formulating problem of a given information. On the contrary to those, Dillon (1982) defines mathematical problem posing as problem finding, that is a thought process producing mathematical question of a certain information given to solve. Silver (1993) proposes a definition for mathematical problem posing as well. To him, it is an endeavor to pose a new problem of information or experience that students have. Further, Stoyanova & Ellerton (1996: 518) add to the definitions by stating that:

> "Problem posing is defined as the process by which, on the basis of mathematical experience, students construct personal interpretation of concrete situation and formulate them as meaningful mathematical problems".

The problem situation of the study is:

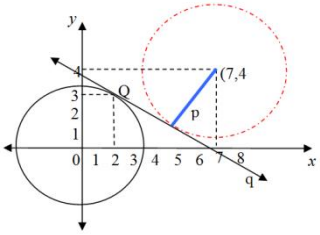
Tangent line of circle $L_1 \equiv x^2 + y^2 = 13$ at Q(2,3) is tangent to circle

$L_2 \equiv (x-7)^2 + (y-4)^2 = p^2$. Find *p!*

Problem posing:

(1) Draw the position of both Circles L_1 and L_2 in one Cartesian coordinate system?

Solution:



(2) What is the relationship between *p* and radius L_2?

Solution: $p = r_2$ or $r_2 = p$, $r_2 > 0$

(3) How to find r_2?

Solution: r_2 = the distance from center point L_2 to the tangent line L_1 at Q(2,3)

(4) What is the tangent line equation L_1 at Q(2,3)?

Solution: The tangent line equation L_1 at Q is $x_1x + y_1y = 13$ or $q \equiv 2x + 3y = 13$

(5) What is the value of r_2?

Solution: r_2 = the distance from the point (7, 4) to the line $2x + 3y = 13$ is

$$r_2 = \left|\frac{2 \times 7 + 3 \times 4 - 13}{\sqrt{2^2 + 3^2}}\right| = \left|\frac{14 + 12 - 13}{\sqrt{4 + 9}}\right| = \left|\frac{13}{\sqrt{13}}\right| = \sqrt{13}$$

(6) What is the value of p?

Solution: Value $p = r_2 = \sqrt{13}$

Thus, the solution is $p = \sqrt{13}$

In the light of the solutions above, there are 6 questions leading the problem solution until obtained the result. This is in accordance with the third point of problem posing definitions that Sutiarso proposed as: 1) is a question posed before solving problem, while 2), 3), 4), 5), and 6) are questions posed when problem solving takes place. And then, from the result, it can be more posed a problem as the advance of the existing problem solving, that is:

(1) Find the tangent point of circle L_2 to the line $q \equiv 2x + 3y = 13$!

(2) Find the distance from the tangent point of circle L_1 the tangent point of circle L_2 by the line $q \equiv 2x + 3y = 13$!

The examples indicate that problem posing is not merely to pose problem/question from a given information, but also it will give a clue to solve the problem/question properly. Besides that, if students are accustomed to posing mathematical problem appropriately, it is expected that they are capable of developing their own mathematical thinking pattern. The definition of problem posing followed within this study is the third definition that Sutiarso (2000) states, and all at once as a foundation that the researcher administers to reveal students' steps in posing mathematical problem.

Some definitions, concerning cognitive style which are stated by Witkin (Nasution, 2003), state that cognitive style as characteristic modes of functioning that we reveal throughout our perceptual and intellectual activities in highly consistent and pervasive way. Further, Messick defines that cognitive style as a person's typical modes of perceiving, remembering, thinking and problem solving. Furthermore, Vernon defines cognitive style to be a "superordinate construct which is involved in many cognitive operations, and which accounts for individual differences in a variety of cognitive, perceptual, and personality variables". This means that cognitive style constitutes typical characteristics of functioning perceptual and intellectual acitivities. The characteristics is consistent and can "penetrate" to entirely behavior, either in cognitive aspect or affective aspect.

Several experts, such as Messik, Zelniker & Waber (Rahman, 2003), restricted the meaning of similar cognitive styles as preference of someone which is relatively persistent in receiving, thinking, and solving problem, along with keeping information in mind. Further, Soedjadi (1986) proposes that:

Cognitive style may be described by the following characteristics: (1) They are concerned with the forms rather than the content of cognitive activities, (2) They refer to individual differences concerning how people perceive, think, solve problems, learn and relate to others, (3) They are features of personality, the patterns of collective characters which include behavioral, temperamental, emotional and mental traits of an individual, (4) They are stable over time, and (5) They are distinguishable from intelligence and other ability dimensions.

Several cognitive style types that Siegel & Coop (Thomas, 1990) identify are: (a) to pay special attention to global versus detail (partly); (b) to distinguish a stimulus into larger categories versus numerous smaller ones; (c) to

incline to classifying ítems on the basis of apparent characteristics such as similarity of function, time, or space versus selecting similarity of some abstract attribute; (d) quick, impulsive versus slow, seriously problem solving behavior; (e) intuitive, inductive versus logical cognitive, deductive cognitive.

There are two cognitive styles that are particularly important in education, they are: "field-independent versus field-dependent and impulsive versus reflexive." Each of these both is based on psychological and conceptual tempo differences". The implication of cognitive styles of field independent and dependent that students have in learning is as follows.

1) Students with the cognitive style of field-independent learn mathematics individually, enable to provide better responses, and are more independent. Those with this cognitive style are to more allow for attaining the goal of learning mathematics by intrinsic motivation and incline to work for satisfying their own ambition.
2) Students with the cognitive style of field-dependent learn mathematics in group and frequently interact with teacher, require extrinsic reinforcement. For those with this cognitive style, a teacher requires to design what should be undertaken and how to undertake it. They will work, if there is guidance from teacher and their high motivation is such reward and encouragement.

Henceforth, Witkin (1977) proposes that: "someone having the cognitive style of field-independent inclines to separate parts of a number of patterns and analyses them on the basis of their components. Whereas, he or she having the cognitive style of field-dependent tended to view a pattern as a whole, not separating into parts."

Based on the thesis mentioned above, a student with the cognitive style of field-independent inclines to pose mathematical problem as.

(1) Using his own perception. This means that a student, in posing mathematical problem, sees clearly given information and is poorly influenced by environment.
(2) Analyzing patterns in the light of their components. This means that a student, in posing problem, can involve numerous semantic and syntaxis elements.
(3) Analytic. This means that a problem that a student poses on the basis of given information is systematic and is intertwined among its elements.

Again, a student with the cognitive style of field-dependent tends to pose mathematical problem as.

(1) Responding a stimulus using environment as the basis for his or her perception. This means that posing mathematical problem that a student administers in the light of given information is only able to undertake until the apparent boundary of information raising from the environment. Or, in other words, a response that a student poses is highly influenced by invironement.
(2) Viewing a pattern as a whole, not separating it into parts. This means that a student is, in posing mathematical problem, merely able to see wholly, in difficulty to pose mathematical problem involving elements existing in given information, so that the problem posed poorly engages semantic and syntaxis elements.

The following is an example in the matter of inclination of both cognitive styles which may occur in mathematics learning.

A student is given geometric objects as follows.

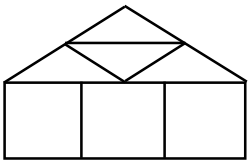


Figure 1

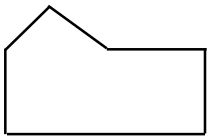


Figure 2

If a student is asked to find Figure b inside Figure a, then he or she with the cognitive style of field-independent is more quick finding it than another with the cognitive style of field-dependent. This is because he or she is not influenced by the figure existing around Figure b within Figure a, so that student FI easily finds Figure b form inside Figure a. Conversely, one with the cognitive style of FD is in difficulty to find Figure b inside Figure a. It is due to he or she is influenced by figures that exist around Figure b environment within Figure a.

Besides, in algebraic class, students are given a quadratic equation: $x^2 + 2\sqrt{2}x + 2 = 0$.

If they are asked to find its roots, then students FD may carry out it by performing the "formula abc" only. But, students FI in spite of the "formula abc", they also can find other ways such as factoring to arrive at finding that the quadratic equation $x^2 + 2\sqrt{2}x + 2 = 0$ can be changed to be $\left(x + \sqrt{2}\right)^2 = 0$. This can be undertaken by the students FI, since they are not influenced by the coefficient of x, $2\sqrt{2}$, and by the existing completion pattern. Whereas students FD are influenced by the coefficient of x, which is not an integer $2\sqrt{2}$. Therefore, they cannot carry out the equation using factorization and they are influenced as well by the existing completion pattern, so that they can do only by utilizing the formula abc as the only completion pattern for the quadratic equation. On the contrary for the quadratic equation $x^2 + 2x + 4 = 0$, students FD tend to directly factorize in determining its roots. Whereas for students FI, they firstly come to probe into discriminant of the quadratic equation. Since the value is less than zero, the students then sooner arrive at conclusion that the quadratic equation does not have a real root.

Meanwhile, Silver & Cai (1996) within their research found 6 informations of semantic relationship in posing mathematical problem, that is: (1) there is no semantic relationships; (2) there is only one semantic relationship, that is restating; (3) there are 2 semantic relationships, they are: restating and changing; (4) there are 3 semantic relationships, that is: restating, changing, and grouping; (5) there are 4 semantic relationships, they are: restating, changing, grouping, and comparing; and (6) there are 5 semantic relationships, they are: restating, changing, grouping, comparing, and varying.

Table 1 Grouping of Mathematical Problem Posing in the Light of Students' Cognitive Style

Cognitive Style Types	Mathematical Problem Posing		
	Responses	**Syntaxis Analysis**	**Semantic Analysis**
FI	- Such question and, in general, it can be carried out. - The posed question is frequently difficult to be carried out. - The posed question contains new thing.	- The posed question contains proposition - Relationship, or - Subjunctive	There have been the posed questions containing 3 until 4 semantic relationships, namely: - changing - comparing - grouping - varying
FD	- The posed question, in general, does not contain new thing - The posed question is usually not difficult to carry out - The posed question frequently does not have solution	The posed question is still dominated by semantic relationship, namely: assignment	The posed question, in general, has only 1 or 2 semantic relationship, such as: - restating, and - changing

METHODS

This study was conducted in SMA Negeri 3 Makassar, Indonesia. Subject of study were 8 grade XI science students. The choosing of SMA Negeri 3 Makassar as the research site was based on several considerations, namely: (1) SMA Negeri 3 Makassar was frequently chosen as the site for scientific activity by researchers, (2) students of SMA Negeri 3 Makassar are not dominated by certain social stratum or certain achievement (heterogen), (3) the researcher himself has a good emotional relationships with the staff in that school.

The research subjects were grade XI science students. The establishment of research subjects was based on several considerations, that is: (1) the time allocation of mathematics lesson in the grade XI science was greater than that in the grade XI non-IPA, (2) they had adequately learning experiences, so that it was expected that they could pose questions in the light of given information, (3) they would be easier to be interviewed to obtain the needed accurate data in this study.

The establishment of subjects in this study was conducted by referring to the test result of cognitive style. Building on the test result of cognitive style, students were grouped into two, that is, the group of students with the cognitive style of field-independent (FI) and that with the cognitive style of field-dependent (FD).

1) The group of students with the cognitive style of field-independent (FI) was represented by 4 (four) students consisting of 2 (two) students as the representative of top-end and 2 (two) students as the representative of bottom-end from the interval boundary of grouping the cognitive style of field-independent.
2) The group of students with the cognitive style of field-dependent (FI) was represented by 4 (four) students consisting of 2 (two) students as the representative of top-end and 2 (two) students as the representative of bottom-end from the interval boundary of grouping the cognitive style of field-dependent.

The data collection within this research used main instrument, that is: the researcher himself, and supporting instruments, that is:

Instrument for Group Embedded Figures Test (GEFT)

Group Embedded Figures Test (GEFT) is a test that is adapted from the result of development by Witkin et al. (1977). This test was utilized to investigate one's cognitive style psychologically, namely: the cognitive styles of field-independent and field-dependent. Material of this GEFT was such geometrical figures. This test consisted of 3 (three) parts, that is: (1) it consisted of 7 items, (2) it consisted of 9 items, and (3) it consisted of 9 items. The first part of this test was prepared for participants as the exercises, whereas the second and the third parts were the core parts of this test.

The data obtained from this GEFT test was then utilized to group students on the basis of their cognitive styles, that is: (1) the cognitive style of field-independent (FI), and (2) the cognitive style of field-dependent (FD). The grouping used requirements as: students acquiring scores greater than 9 (50% of the maximum score) are grouped into the cognitive style of field-independent (FI), whereas those acquiring scores less than or equal to 9 (50% of the maximum score) are grouped into the cognitive style of field-dependent (FD) (Ratumanan, 2003).

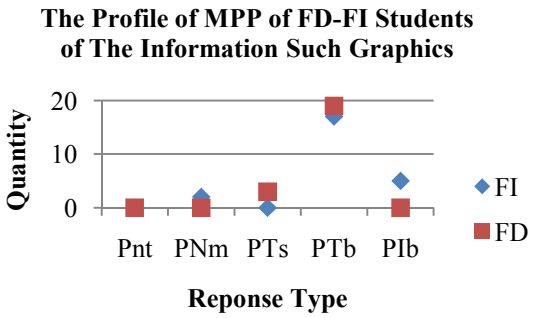
Instrument for Mathematical Problem Posing

This mathematical problem posing test was constructed from several information associated with mathematical materials. The material for the test was taken from the materials that students had learned and not taken from the material that teacher was being teaching. This was conducted to keep students away from constructing or making question by imitating their teacher's way of making or constructing questions. The test for mathematical problem posing utilized in this research displayed 4 (four) different information, that is such graphics, verbal sentence, mathematical sentence, and figures. This test was expected to be able to reveal the profile of mathematical problem posing on the basis of students cognitive style. The test was constructed by the researcher himself by studying instrumental examples of mathematical problem posing that Silver & Cai (1996), Gonzales (1994), Siswono (1999) and Hamzah (2003) had developed. 4 (four) items of this test displayed 4 (four) distinctively information context, that is such graphics, verbal sentence, mathematical sentence, and figures.

FINDINGS AND DISCUSSIONS

The Profile of Mathematical Problem Posing (MPP) of GK-FI and GK-FD Students on Information such Graphics

The subjects involved in this study were 8 students that was divided into two groups, namely: each consists of 4 students as the representative for group GK-FI, and 4 students as the representative for group GK-FD. It was seen that the profile of students mathematical problem posing in the light of the cognitive style (GK-FI and GK-FD) on the information such a graphics was as follows.



Description:
PNt = Statement
PNm = Non-mathematical statement
PTs = Unsolvable mathematical statement
PTb = Solvable mathematical

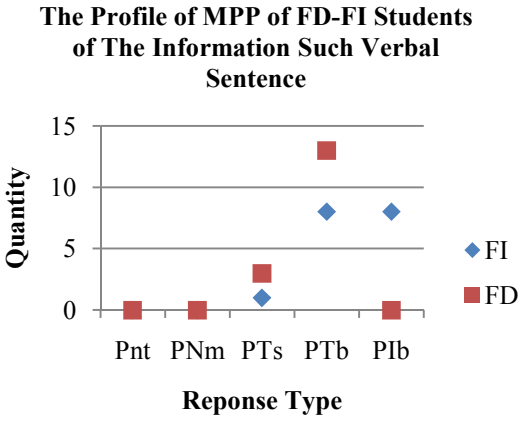
Figure 3 The Profile of Mathematical Problem Posing on the Basis of the Cognitive Style on the Information Such Graphics

Figure 3 above showed that the ability to pose mathematical problem of students of group GK-FD and GK-FI on the information such graphics was not quite different in posing solvable mathematical problem, but mathematical problems containing new data were posed only by the students of group GK-FI.

There had been the quality of mathematical problems that students of group GK-FI posed on the information such this graphics accomplishing to the high category, whereas those of group GK-FD accomplish only to the moderate category.

The Profile of Mathematical Problem Posing of GK-FI and GK-FD Students on the Information such Verbal Sentence

The subjects involved in this study were 8 students consisting of 4 students as the representative for group GK-FI, and 4 students as the representative for group GK-FD. Based on the results of response analysis that each subject posed on the information such this verbal sentence, it was obtained the profile of mathematical problem posing of students GK-FI and GK-FD on the information such verbal sentence as follows.



Description:
PNt = Statement
PNm = Non-mathematical statement
PTs = Unsolvable mathematical statement
PTb = Solvable mathematical

Figure 4 The Profile of Mathematical Problem Posing of Students GK-FI and GK-FD on the Information such Verbal Sentence

Figure 4 above described that mathematical problem that students GK-FI posed on the information such this verbal sentence, not all of them were solvable mathematical problems. From 17 mathematical problems that students GK-FI posed, there existed 1 unsolvable problem, and 16 other mathematical problems were solvable and among them were 8 problems containing new data. And then, the number of mathematical problems that students GK-FD posed on the information such this verbal sentence was 16 problems, and among them, there were 3 unsolvable problems and 13 others were solvable and none among them containing new information.

There had been among the mathematical problems that students in the group GK-FI posed on the information such this verbal sentence attaining the high category, whereas students in the group GK-FD only attain the moderate category.

The Profile of Mathematical Problem Posing of Students GK-FI and GK-FD on the Information such Mathematical Sentence

The subjects involved in this study were 8 students comprising of 4 students as the representative of group GK-FI, and 4 students as the representative of group GK-FD. Based on the results of data analysis of responses that each subject posed on the information such mathematical sentence, it was obtained the profile of students' mathematical problem in the groups of Students GK-FI and GK-FD on the information such mathematical sentence as follows.

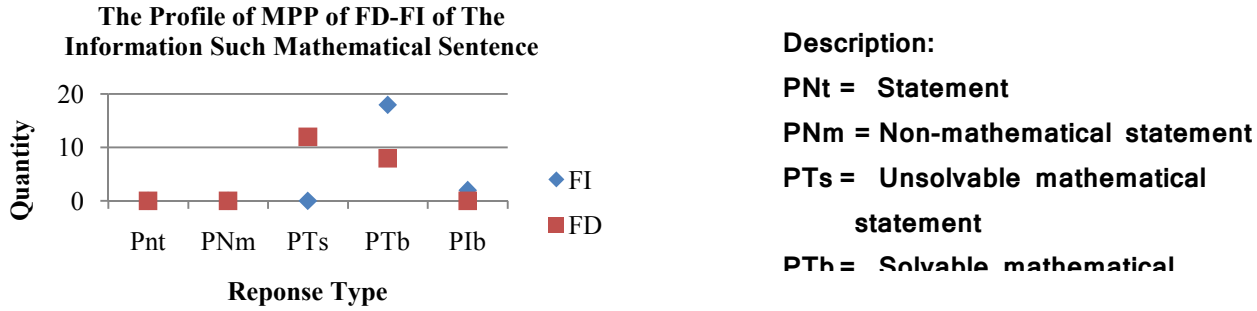


Figure 5 The Profile of Mathematical Problem Posing of Students GK-FI and GK-FD on the Information such Mathematical Sentence

Figure 5 above described that the number of students' mathematical problem posing of group GK-FI on the information such mathematical sentence was 20 problems. All the problems were solvable mathematical problems and among them, there were 2 mathematical problems containing new data, whereas students in the group GK-FD posed 20 problems, but only 8 of them were solvable and 12 others were unsolvable. Among the solvable mathematical problems, none containing new data.

There had been the quality of mathematical problems that students of group GK-FI pose on the information such this mathematical sentences accomplishing to the high category, whereas those of group GK-FD accomplish only to the moderate category.

The Profile of Mathematical Problem Posing of Students GK-FI and GK-FD on the Information such Figures

The subjects involved in this study were as many as 8 students consisting of 4 students as the representative of group GK-FI, and 4 students as the representative of group GK-FD. Based on the results of data analysis on the responses that each subject posed of each cognitive style, it was obtained the profile of mathematical problem posing of students FI and FD on the information such figure as the following.

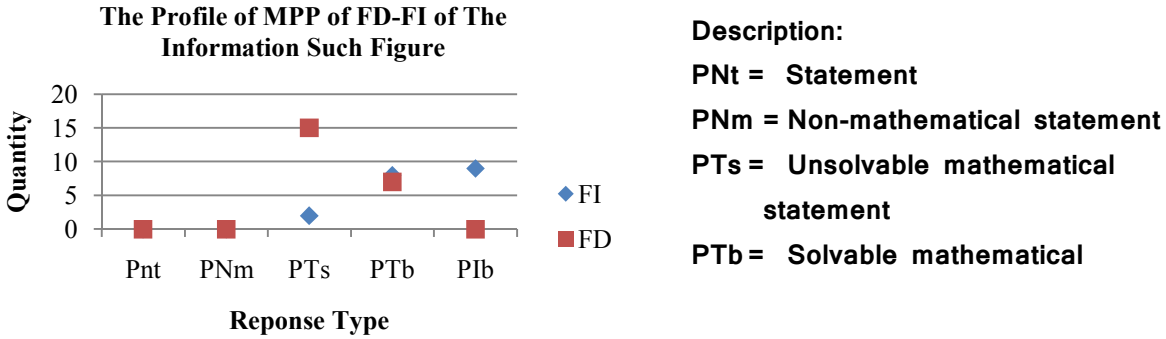


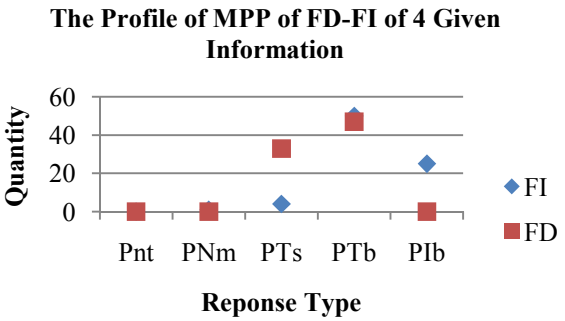
Figure 6 The Profile Mathematical Problem Posing of Students GK-FI and GK-FD on the Information such Figure

Figure 6 above described that not all of mathematical problems that students GK-FI posed on the information such this figure constituting solvable mathematical problems. From 19 mathematical problems that students GK-FI posed, there were 2 unsolvable problems, 17 solvable problems and among them there were 8 problems containing new data. Henceforth, mathematical problems that students of group GK-FD posed on the information such this figure, there were as many as 22 mathematical problems and among them, there were 15 unsolvable problems and only 7 solvable problems and among them, none containing new data.

There had been the quality of mathematical problems that students of group GK-FI pose on the information such this figure accomplishing to the high category, whereas those of group GK-FD accomplish only to the moderate category.

The Profile of Students' Mathematical Problem Posing on the Basis of Cognitive Style

The research subjects as the representative of students in group GK-FI were as many as 4 students consisting of 2 students as the representative of upper bound value of interval GK-FI and 2 students as the representative of lower bound value of interval GK-FI. Based on the test results of mathematical problem posing, it was obtained information that of 4 information that was given in this test, the students as the representative of group GK-FI posed 80 responses. It was obtained the profile of mathematical problem posing of 4 given information as follow.



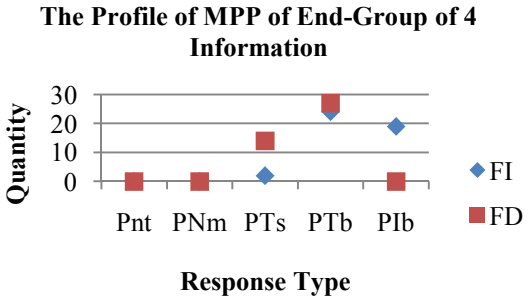
Description:
PNt = Statement
PNm = Non-mathematical statement
PTs = Unsolvable mathematical statement
PTb = Solvable mathematical statement

Figure 7 The Profile of Students' Mathematical Problem Posing of Group GK-FI and GK-FD

Figure 7 described that in posing mathematical problems of 4 given information, students of GK-FI posed more mathematical problems containing new data than those of GK-FD. And then, students of GK-FD posed more unsolvable mathematical problem than those of GK-FI. Henceforth, students of GK-FI were able to pose mathematical problems containing new data, whereas students of GK-FD were not able to pose mathematical problems containing new data of 4 given information.

Within this study, it was discussed cognitive styles of FI and FD. In establishing students in a certain group of cognitive style, it was used criteria that is: "if students can only find a simple figure of a complex figures from figures 0 to 9, then they are grouped into the cognitive style of FD, whereas those who can find simple figure exceeding 9 figures, then they are grouped into the cognitive style of FI. In this section, the researcher analysed the profile of students' mathematical problem posing in the extreme point of each of cognitive style groups, so that making a new group, namely end-group (GK-FI-Ba and GK-FD-Bb) and middle group (GK-FI-Bb and GK-FD-Ba).

The research subjects as the representative of GK-FI-Ba were as many as 2 students, namely ANR and INT. Based on the data of mathematical problem posing of 4 given information, it was obtained the profile of students' mathematical problem posing of the end-group (GK-FI-Ba and GK-FD-Bb) as shown in the following graphics.



Description:
PNt = Statement
PNm = Non-mathematical statement
PTs = Unsolvable mathematical statement
PTb = Solvable mathematical statement and not

Figure 8 The Profile of Students' Mathematical Problem Posing of The End-Group of 4 Information

Figure 8 described problem/question that students posed of four given information. It indicated that students in the group GK-FI-Ba posed more solvable mathematical problem/question and containing new data,

whereas the solvable mathematical problems and not containing new data were posed more by students in the group GK-FD-Bb, but the difference was not significant.

In the light of the data of mathematical problem posing that both groups posed above, it was gained the profile of students' mathematical problem posing of middle group (GK-FI-Bb and GK-FD-Ba) as displayed in the following graphics.

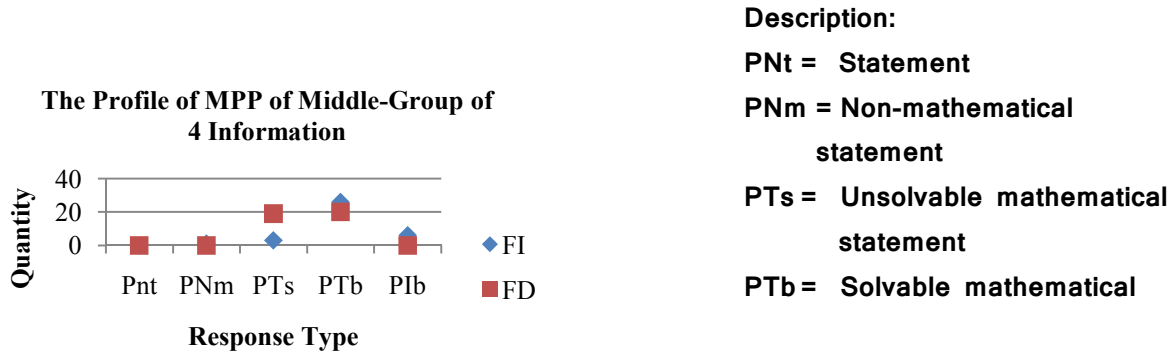


Figure 9 The Profile of Students' Mathematical Problem Posing of Middle Group of 4 Information

Figure 9 above described problem/question that students of both groups posed of four given information that students in the group GK-FI-Bb posed more solvable mathematical problem/question either containing new data or not, than those in the group GK-FD-Bb.

Figure 8 and 9 showed that students in the middle group of cognitive style had the profile of mathematical problem posing at the end-group of cognitive style. This difference was seen in the mathematical problem that had solution, but not containing new data.

CONCLUSION

1. The profile of students' mathematical problem posing from information such graphics.

The response type that students of GK-FI pose on the information of such graphics is still dominated with 22 solvable mathematical problems/questions, and among them, there are 5 problems containing new data and 2 other responses constitute unsolvable mathematical problem. Whereas, students of group GK-FD pose 22 responses on this information of such graphics. The response type that students of group GK-FD pose is also dominated with 19 solvable problem, yet among them, none containing new information. And 3 other responses constitute unsolvable mathematical problem. This shows that students GK-FD are still focused on available data on the information of such graphics when posing problem, so that on the information of graphics, none problems that students pose containing new data.

The quality of problems that students of group GK-FI pose on the basis of the result of semantic and syntaxis analysis, in general, included in the moderate category, and there are 3 problems that students of group GK-FI pose included in high category. Whereas, the quality of mathematical problem that students of group GK-FD pose can merely attain the moderate category.

2. The profile of students' mathematical problem posing from the information such verbal sentence.

The response type that students pose of group GK-FI in this information, in general, is 16 solvable mathematical problems, and among them, there are 8 problems containing new data. Whereas, the response type that students of group GK-FD pose, in general, is also 13 solvable mathematical problems, but among them, none containing new data.

The quality of mathematical problems that students of group GK-FI pose on the information of the verbal sentence based on the result of semantic and syntaxis analysis, it is obtained that the sentence structure of the problem that students pose, in general, included in the moderate category, and there have been 6 problems that students of group GK-FI pose in this information included in the high category, whereas the quality of mathematical problems that students of group GK-FD pose, overall included in the moderate category.

3. The profile of students' mathematical problem posing from information such mathematical sentence.

The response type that students of group GK-FI pose in the information of the mathematical sentence overall constitutes 20 solvable mathematical problem, and among them, there are 2 problems containing new data. Whereas, the response type that students of group GK-FD pose are 20 responses. But in general, it constitutes 12 unsolvable mathematical problems, and there are only 8 solvable mathematical problems, yet among them, none containing new data.

The quality of mathematical problems that students of group GK-FI pose on the information of mathematical sentences in the light of the results of semantic and syntaxis analysis, in general, included in the moderate category, that is there are as many as 18 problems and only 1 problem that students of group GK-FI on this information including in the high category, whereas the quality of problem that students of group GK-FD pose overall included in the moderate category. This is because mathematical problems that students of group GK-FD pose on this information contain at most 1 semantic relationship and in general they use assignment proposition.

4. The profile of students' mathematical problem posing from the information such figure.

The response type that students of group GK-FI pose on this informasi is, in general, 17 solvable mathematical problems, and among them, there are 9 problems containing new data, whereas the response type that students of group GK-FD pose, in general, is 15 unsolvable mathematical problem, and there are only 7 solvable mathematical problems, but none among them containing new data.

The quality of mathematical problems that students of group GK-FI pose on the information of such figure on the basis of the result of semantic and syntaxis analysis, in general, included in the moderate category, and there are 2 mathematical problems that students of group GK-FI pose on this information including in the high category, whereas mathematical problems that students of group GK-FD pose on this information are at most in the moderate category.

REFERENCES

Branca, N. A. 1980. Problem Solving as a Goal, Process and Basic Skills. In S. Krulik and R.E. Reys (Eds.). *Problem Solving in School Mathematics.* Washington: NCTM.

Checkland, P. B. 1985. Formulating Problems for Systems Analysis. In H.J. Miser & E.S. Quade (Ed.) *Handbook of Systems Analysis: Overview of Uses, Procedures, Applications, and Practice,* 151-170. New York: Elsevier Publishing Co. Inc.

Christou, Constantinos, Nicholas Mousoulides, Marios Pittalis, Demetra Pitta-Pantazi, Bharath Sriraman., 2005. *An Empirical Taxonomy of Problem Posing Processes*. In ZDM 2005, 37 (3), 149-158.

Dahar, R. W. 1989. *Teori-teori Belajar*. Jakarta: Erlangga.

Dillon, J. T. 1982. Problem Finding and Solving. *Journal of Creative Behavior*. 16, 97-111.

English, L. D. 1998. Children's Problem Posing within Formal and Informal Contexts. *Journal for Research in Mathematics Education*, 29(1), 83-106.

Gonzales, N. A. 1994. Problem Posing: A Neglected Component in Mathematics Courses for Perspective Elementary and Middle School Teachers. *School Science and Mathematics Journal*. 94(2), 78-84.

Hamzah. 2003. *Meningkatkan Kemampuan Memecahkan Masalah Matematika Siswa Sekolah Lanjutan Tingkat Pertama Negeri Di Bandung Melalui Pendekatan Pengajuan Masalah*. Bandung: Disertasi PPs UPI Bandung.

Jaeng, M. 2004. *Pengembangan Model Pembelajaran Matematika Sekolah dengan Cara Perseorangan Dan Kelompok Kecil*. Surabaya: Disertasi PPs UNESA Surabaya.

McGivney, J. M. & DeFranco, T. C. 1995. Geometry Proof Writing: A Problem Solving Approach ala Polya. *The Mathematics Teacher Journal*. 88(7), 552-555.

Mestre, P. J. 2002. Probing Adults' Conceptual Understanding and Transfer of Learning via Problem Posing. In: *Applied Developmental Psychology*. 23, 9-50.

Nasution, S. 2003. *Kurikulum dan Pengajaran.* Jakarta: Bina Aksara.

Polya, 1973. *How to Solve It (A New Aspect of Mathematical Method),* Second Edition. Pricenton, New Jersey: Pricenton University Press.

Rahman, A. 2003. *Analisis Hasil Belajar Matematika Berdasarkan Gaya Kognitif Guru dan Gaya Kognitif Siswa pada Kelas II SMU Negeri 3 Makassar.* Makassar: Lembaga Penelitian UNM Makassar.

Rahman, A. 2006. *Deskripsi Pengajuan Masalah Matematika Berdasarkan Gaya Kognitif Siswa Kelas XII(IA)-1 SMA Negeri 11 Makassar*. Surabaya: Makalah Seminar, PPs UNESA Surabaya.

Ratumanan, T. G. 2003. Pengaruh Model Pembelajaran dan Gaya Kognitif Terhadap Hasil Belajar Matematika Siswa SLTP Negeri 1 dan SLTP Negeri 4 Ambon. Surabaya: Disertasi PPs Unesa.

Romberg, T. A. & Carpenter, T. P. 1996. Research on Teaching and Learning Mathematics; Two Disciplines in Scientific Inquiry. *Handbook of Research on Teaching (Third Edition)* editor Merlin C. Wittrock. New York: McMillan Publishing Company.

Santrock, J. W. 2007. *Psikologi Pendidikan*. (Translated by Tri Wibowo). Jakarta: Kencana Prenada Media Group.

Silver, E. A. & Cai, J. 1996. An Analysis of Aritmetic Problem Posing by Middle School Students. *Journal for Research in Mathematics Education*, 27 (5), 521-539.

Silver, E.A. 1993. On mathematical problem posing. In I. Hirabayashi and N. Nohda, K. Shigematsu and F.L. Lin (Eds.). *Proceeding of the Seventeen International Conference for The Psychology of Mathematics Education.* 3, 66-85. Tsukuba, Japan: International Group for the Psychology in Mathematics Education.

Siswono, T. Y. E. 1999. Metode Pemberian Tugas Pengajuan Soal (*Problem Posing*) dalam Pembelajaran Matematika Pokok Bahasan Perbandingan di MTs Negeri Rungkut Surabaya. Tesis PPs IKIP Surabaya.

Soedjadi, R. 1986. *Student Difficulties in Learning Mathematics (Indonesia). Outlines of the Research*. Surabaya. Program Pascasarjana IKIP Surabaya.

Stoyanova, E. & Ellerton, N. F. 1996. A Framework for Research into Students Problem Posing in School Mathematics. In P.C. Clarkson (Eds.). *Technology in Mathematics Education*. Melbourne: Mathematics Education Research Group of Australasia.

Sutiarso, S. 2000. Problem Posing: Strategi Efektif Meningkatkan Aktivitas Siswa dalam Pembelajaran Matematika. *Prosiding Konferensi Nasional X Matematika*. Bandung: ITB Bandung.

Suydam, M. N. 1980. Untangling Clues from Research on Problem Solving. In S. Krulik and R. E. Reys (Eds.) 1980 Yearbook. *Problem-solving in School Mathematics*. Virginia: NCTM.

Tambunan, G. 1987. *Materi Pokok Pengajaran Matematika*. Jakarta: Penerbit Kurnia.

Thomas. 1990. *Educational Psychology: A Realistic Approach*. London: Longman.

Witkin, et. al. 1977. Field-Dependent and field-Independent Cognitive Styles and Their Educational Implications. *Review of Education Research*. Winter 1977. 47 (1). 1-64.