

**ENHANCING THE STUDENTS' ABILITY OF REASONING ON ASPECTS TO  
FORMULATE THE COUNTER EXAMPLE THROUGH PROBLEM SOLVING  
STRATEGIES MAKE AN ORGANIZED LIST**

**Kadir and Muhamad Faozan Afandi**

*Department of Mathematics Education*

*Faculty of Tarbiya and Teaching Sciences*

*Universitas Islam Negeri Syarif Hidayatullah Jakarta*

**Abstract**

The objective of the investigation was to find out the implementation of problem solving strategies make an organized list to enhance the students' ability of reasoning on aspects to formulate the counter example through problem solving strategies Make an Organized List. This research was conducted at SMP Muhammadiyah 22 Pamulang in academic year 2012/2013. The method of the research used quasi-experimental method with control group post test only design. The Subject for this research were 64 students which selected through cluster random sampling technique from the population at the seventh grade students class. Data of the students' ability to formulate counter example were collected thorough test. The result of the research revealed that the ability of formulating counter examples of students who are taught with a strategy the make an organized list higher than students taught with conventional strategy. Reasoning abilities in aspects formulating counter examples of students who are taught with a strategy make an organized list gives about 61,33% true or false statement, to make their own statements are true examples and counter example 70.94%, found errors on particular sentence or statement 62.5%. Conclusion of the research, problem solving strategy make an organized list affect the students' reasoning ability on aspects formulating counter examples; in which the make an organized list strategy is more effective in improving the students' reasoning ability on aspects formulating counter examples than the conventional strategies.

Keywords: *Problem solving strategies, make an organized list, ability to formulate counter example*

**INTRODUCTION**

**A. Background**

Education plays a central role for preparation of human resources and developing students potential either intellectual, physical, emotional, mental, social, moral or ethics. Mathematics as one of the main lessons on the educational unit plays a very important in development the students potency and character, because mathematics is a method of logical thinking, critical, creative, order, art, and language. In this case then, the math becomes one of the main subject that must be learned by those students at every level of education. Mathematics is formed as a result of human work-related ideas, processes, reasoning, and art. Moreover, mathematics has the values to develop the children' intelligent.

According to Keraf in (Fajar Sadiq, 2004: 2), reasoning as a thinking process which effort to correlate the evidences which understood that leads to the conclusion. The reasoning needs logical foundation. The reasoning in logic is not a process of memorizing or imaging but as a set of to search previous reasonings. In process of seraching these reasonings, students have a discussing, sharing, interaction with other sides to draw a conclusion on a problem. This case could be useful for solving any problems are faced. One of the strategy that could stimulate

---

students reasoning is problem solving strategy *make an organized list* which make the students compose an alternative solution. Applying this strategy the students have much opportunity to create new ideas, express ideas to solve the problem, elucidate anything as detail as possible, observe the problem from any point of views, etcetera.

One of the indicators of mathematical reasoning that can be solved through *make an organized list* strategy is to formulate counter example, where the students be asked to comprehend not only true example but also incorrect one. As Sergiy Klymchuk (2008: 1) states that Counter-example is an example which shows that statement which being given (assumption, hypothesis proposition, and formulation) is incorrect.

### **B. Formulation of the problem**

To clarify and give proper direction in the formulation of the problem in this study, the researchers provides restrictions in accordance strategy used strategy of problem solving t *make an organized list*. That is study strategy claiming student to list various solution alternative which possible used so that alternative which not possible (to) be used can be disregarded by student. Reasoning ability in mathematics is formulate the counter examples, and items limited at triangle and parallelogram.

Based on the restrictions above, the researchers formulate the problems as follows:

1. Was there any different ability of mathematical reasoning on aspect of formulating the couter example between the students taught with problem solving strategy *make an organized list* and conventional strategy?
2. How were the students' mathematical reasoning on aspect of formulating the couter example of the students taught with problem solving strategy *make an organized list*?

### **C. The objectives of the research**

Based on the formulation of the problems, the study aims at:

1. Analyzing students mathematical reasoning ability to formulate counter example between the students taught with problem solving strategy *make an organized list* and conventional strategy.
2. Analyzing students mathematical reasoning ability to formulate counter example of the students with problem solving strategy *make an organized list*.

### **D. Significances of the Research**

The results of the research are epected to give some significances not only theoretically but also pratically as follows:

1. For teachers, the results of the research could give both theoretically and pratically in improving their professionalism and as an alternative of mathematical learning model, especially in the mathematical reasoning domain.
2. For students, problem solving strategi *make an organized list* can be used as a learning model at home in order to enhance learning outcomes and positive attitudes on mathematics.
3. For schools, this results can be useful for designing and evaluating the effectiveness of mathematical instructioan model to improve the mathematical reasoning domain.
4. For other researchers, the results of this study can evoke inspiration to develop and strengthen reasoning ability in mathematics.

## **RESEARCH METHODOLOGY**

### **A. Method and Research Design**

Research method used of this research was quasi-exsperiment. Meanwhile, research design applied for this research was *Randomized Control Group Design*. The

complete research design can be drawn as follows.

**Table 2. Research Design**

| Groups           | Treatment      | Observation |
|------------------|----------------|-------------|
| (R) <sub>E</sub> | X <sub>E</sub> | Y           |
| (R) <sub>C</sub> | X <sub>C</sub> | Y           |

Note:

R: Class-randomly selected

E: Experimental Group taught with problem solving strategy *make an organized list*.

C: Control Group taught with conventional strategy.

X<sub>E</sub>: Treatment for Experimental Group.

X<sub>C</sub>: Treatment for Control Group.

Y: Test of ability for mathematical reasoning on aspect of counter example.

### **B. Research Population and Sample**

Research population of this Research was those seventh grade students of Muhammadiyah 22 Pamulang in academic year 2012/2013. While, the research sample was the seventh grade (VII-1 and VII-2) as the experimental and control class were 32 each. The choosing of the research sample *used ClusterRandom Sampling technique*.

### **C. Research Procedures**

The treatment on both eksperimental and control class conducted with following some steps as follows: (1) to determine the instructional material, namely to identify the properties of triangle, retangle, square, and trapecium, (2) to design lesson plan and students activity in exsperimental group with problem solving strategy on aspect *make an organized list* and control group taught with conventional strategy, (3) to conduct instruction based on design has made., (4) to monitor the instruction 6 sessions, and (5) to conduct a test for measuring the level of the students mathematical reasoning on aspect counter example on both groups.

### **D. Research Instruments**

The instruments used in collecting data of the study consisted both test and non-test. The test instrument that used in this research was test mathematical reasoning on aspect conter-examples. Content validity the test conducted through *expert judgment* with using *Content Validity Ratio* (CVR) method from Lawshe (1975). Result of analysis CVR obtained 11 valid items with average of CVR about 0,836. Meanwhile, empirical item validity conducted through try out in the school, obtained 8 valid item with range (0,36 – 0,61) and reliability coefisient 0,70. Ability of students mathematical reasoning on aspect counter example measured with holistic rubrics.

Observation of activity sheets were used to determine students' mathematics learning activities. Observation sheet is also used to analyze on each sessions to improve learning in the next session.

### **E. Data Analysis Techniques**

Data analysis techniques used in this research covering both descriptive and inferensial technique. Descriptive technique used to gain information of tendency central and variabiliy data (mean, median, mode, range, standar deviation, variance, and skewness). Meanwhile, inferensial technique that used in this research was t-test with significance level  $\alpha = 0,05$ .

## RESULTS AND DISCUSSION

### A. Research Results

The data ability of students mathematical reasoning on aspect formulating counter example both experimental and control group after treatment have conducted were drawn as follows.

#### Mathematical reasoning ability on aspect formulating counter-example

Result of descriptive analysis students' ability mathematical reasoning on aspect formulating counter-exampel both problem solving *make an organized list* and konvensional strategy group can be drawn as follows.

**Table 1**  
**Students' mathematical reasoning ability on aspect formulating counter-example both experimental and control group**

| Statistic               | Groups       |         |
|-------------------------|--------------|---------|
|                         | Experimental | Control |
| Sample (n)              | 32           | 32      |
| Maximum (Xmax)          | 91           | 84      |
| Minimum (Xmin)          | 31           | 22      |
| Mean ( $\bar{X}$ )      | 67,97        | 56,91   |
| Median (Me)             | 67,50        | 57,80   |
| Mode (Mo)               | 65,94        | 58,63   |
| Variance ( $s^2$ )      | 213,58       | 251,64  |
| Standard deviation(s)   | 14,61        | 15,86   |
| Skewness ( $\alpha_3$ ) | 0,096        | -0,169  |
| Kurtosis ( $\alpha_4$ ) | 0,254        | 0,232   |

Base on analysis result at Table 1, show that 32 students both experimental and control group, obtained mean skor experimental group higher than control group with discrepancy about 11,06 ( $67,97 - 56,91$ ) also median and mode at experimental group higher than control group. Thus, students' mathematical reasoning on aspect counter-example experimental group better than control group.

Visually data distribution both conduct instructional with problem solving strategy *make an organized list* as follows.

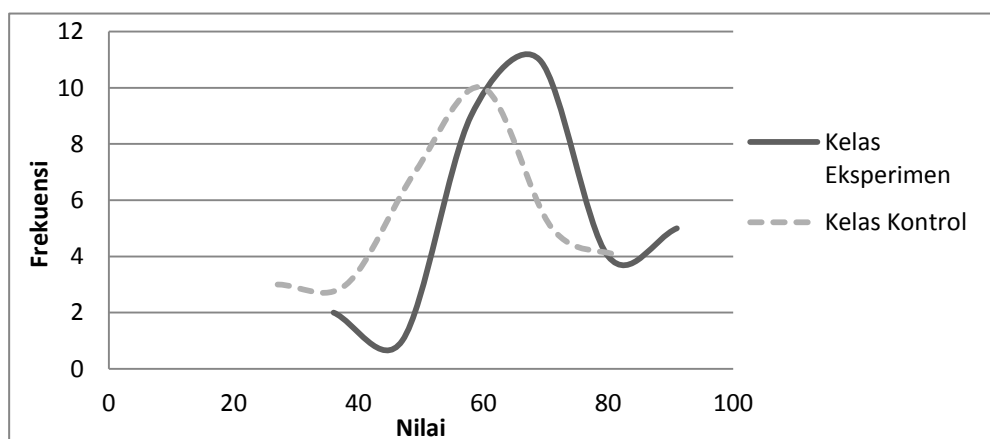


Figure 1

Curve skor students' ability of mathematical reasoning on aspect counter-example both experimental dan control group

### 1. Percentage ability of matematisal reasoning base on indicators formulating counter-example

Mathematical reasoning ability on aspect counter-example in this research covering: formulating true and false statement, making statement by self in real correct example and counter-example one, and finding a mistake mathematical statement. Base on the mathematical reasoning ability on aspect formulate conter-example indicators, percentage both experimental and control group can be drawn as follows.

Table 2  
Persentase students' mathematical reasoning ability base on indikator formulating counter-example both experimental and control group

| No | Mathematical reasoning on aspect formulating counter-example indicators                  | Ideal Skor | Experimental Group |       | Control Control |       |
|----|--|------------|--------------------|-------|-----------------|-------|
|    |  |            | $\bar{x}$          | %     | $\bar{x}$       | %     |
| 1  | Formulating true and false statement   | 8          | 4,91               | 61,33 | 2,94            | 36,72 |
| 2  | Making statement by the students selves in real correct example and counter-example one. | 20         | 14,19              | 70,94 | 12,66           | 63,28 |
| 3  | Finding a mistake mathematical statement   | 4          | 2,5                | 62,5  | 2,53            | 63,28 |

Base on analysis result in table 2, show that the biggest percentage on experimental group were making statement by the students selves in real correct example and counter-example one indikator as much 70,94%. Meanwhile the smallest percentage on formulating in real correct and wrong indikator 61,33%. While at control group, biggest percentage in finding a mistake mathematical statement indikator about 63,28 %.

### 2. Normalitas and homogeneity testing

Result of data normalitas and homogeneity testing both experimental and control group can be drawn as follows.

**Table 3**  
**Normalitas testing result**

| Group        | n  | $\chi^2_{\text{observ}}$ | $\chi^2_{\text{tabel}}$ | Decision            |
|--------------|----|--------------------------|-------------------------|---------------------|
| Experimental | 32 | 6,25                     | 7,81                    | Normal distribution |
| Control      | 32 | 2,95                     | 7,81                    |                     |

While the data homogeneity testing of mathematical reasoning ability of aspek formulating conter-example between example and control group can be drawn as follows.

**Table 4**  
**Homogeneity testing result**

| Group        | n  | Variance ( $s^2$ ) | $F_{\text{observ}}$ | $F_{\text{tabel}}$ | Decision             |
|--------------|----|--------------------|---------------------|--------------------|----------------------|
| Experimental | 32 | 213,58             | 1,18                | 1,82               | Homogeneous variance |
| Control      | 32 | 251,64             |                     |                    |                      |

Base on analysis result as presented in table 3 and 4, mathematical reasoning on aspect formulating conter-example both experiment and control group have normal and homogeneous variance distribution.

### 3. Hypothesis testing result

Difference analysis of mathematical reasoning ability on aspect formulating counter-example between the experimental and control group, conducted testing of hypothesis with t-test. Testing result can be drawn as follows.

**Table 4**  
**t-test result**

| $t_{\text{observ}}$ | $t_{\text{tabel}}$ | Decision     |
|---------------------|--------------------|--------------|
| 2,90                | 2,00               | Reject $H_0$ |

Base on analysis result on table 4 show that  $t_{\text{observ}} > t_{\text{tabel}}$  ( $2,90 > 2,00$ ) hence can be concluded to reject  $H_0$ . Therefore, mean skor mathematical reasoning on aspect formulating conter-example students taught with problem solving strategy *make an organized list* higher than conventional strategy.

## B. Discussion

Generally, the research findings indicate that the average of students' mathematical reasoning on aspect to formulate counter example of experimental group is higher than control group with the difference 11.06 (67.97 to 56.91). this finding shows the similarity with Yanto Permana and Utari Sumarmo (2007) revealed that students' mathematical reasoning and connections ability of Students acquire problem-based learning is better than students mathematical reasoning through the conventional instruction.

The percentage for the ability to formulate counter example for the indicator who gave the true or false statement which were being taught by problem solving strategy *make an organized list* and *conventional strategy* was 36.72%. Meanwhile the average skor for whom the restate a concept experimental group students are 4.91 and 2.94 of the control group. So it can be said that the indicators provide a true or false statement that students are taught by problem solving strategies on aspect to formulate counter example is higher than they are taught by conventional strategy. Description of the ability to formulate the statement is true or false,

students are taught by problem-solving strategy *make an organized list* shown can answered completely and precise. Students also use all elements of the triangle are known, and gives the conclusion of the statement is true or false.

Meanwhile for the group that are taught through conventional strategy is less complete, not complete to determine of the triangle, and the using of time inefficiency in solving the problem. The activity of students to formulate the true or false statement who are taught by problem solving strategy *make an organized list*, among others: students express their own ideas based on language, making the statement true or false based on the understanding that they receive. These findings are similar to findings Fahinu (2007: 18) who reported that the use of a counter-example to effectively improve critical thinking skills of students of mathematics and students can broaden their horizons about the statement is true and false as well as being a strategy of evidence to prove the statement calculus

The next finding is the ability to make true example and its counter example shows that the students are taught by problem-solving strategy *make an organized list* is higher than students are taught through by conventional strategy shows that they used to understand the problem, restate the problem based on their prior knowledge that they have, choose the concise procedure to solve the problem. Differ from the group that are taught through conventional strategy, the students understand of what the teachers has been taught, find the matter with different problem, using inappropriate procedure to solve the problem.

These findings are similar to research conducted by Sergiy Klymchuk Nobert Gruenwald (2003: 33-41) reported that the use of a counter example to help students reduce and minimize the misconceptions experienced, provide a deep understanding of the concept, prevent mistakes in the future, develop logical thinking skills and critical thinking of students and make students more active in the learning.

Another finding is the ability to find mistake in the statement, ie, the percentage of students who are taught by the problem solving strategy *make an organized list* of 62.5% and 63.28% for the conventional strategy, while the average value restate a concept class students experiment were 2.5 and 2.53 grade control. This means to find fault indicator statement, students are taught with conventional strategies higher than students who are taught by the make problem-solving strategies *make an organized list*.

These findings are supported by the students activities who are taught by conventional strategy where the teachers' role more dominate in giving description about properties flat rectangular of the students detailly, so the students used to follow the steps to find the true statement from the teacher. Difference from the exspremental group, where the instructional process focus on students when they have a role in a group.

Based on the above findings, in general reasoning ability in formulating aspects counter- examples of students who are taught by the problem solving strategy *make an organized list* on the subject of triangles and rectangles, which is applied to the learning process in this study had a positive impact on students ability to formulate a counter examples.

## **CONCLUSION AND SUGGESTIONS**

### **A. Conclusion**

Based on the research results and disussion, it can be concluded that:

1. The ability of mathematical reasoning on aspect to formulate counter example to the students are taught by problem solving strategy *make an organized list* is higher than the students who are taught by conventional one. Apparently, the average of outcomes on the ability of mathematical reasoning on aspect to formulate with being taught by using problem solving strategy for 56, 97 and the average of outcomes of mathematical reasoning

on aspect to formulate counter example with conventional strategy is 56,91. It can be conclude that the using of problem solving strategy *make an organized list* is more effective than conventional strategy.

2. The ability of mathematical reasoning based on indicator to formulate counter example for the students are taught by problem solving strategy *make an organized list* is higher than the students who are taught by conventional strategy. This case can be seen from the indicator average percentage to formulate counter example, on the students are taught with by problem solving strategy *make an organized list* obtained the ability to give true or false statement is 61,33%, make correct example and counter example is 70,94%, founded incorrect statement is 62,5%. While for the students who are taught by conventional strategy obtained, the ability to formulate true or false statements is 36,72%, to compose their own statement correctly and counter example is 63,28%, founded incorrect statement is 63,28%. Activity formulate counter examples with problem-solving strategies of *make an organized list*, among others: students can express their own ideas based on language, choosing appropriate procedures, making the statement is true or false based on the understanding that they receive.

## B. Suggestions

Based on research conclusion, it can be delivered some suggestions as follows:

1. Based on the research results that learning mathematics with problem solving *make an organized list* can enhance the ability of mathematical reasoning on aspect to formulate counter example, so that it can be an alternative for students' learning mathematics at home.
2. To improve the ability of reasoning on aspect to formulate counter example, it needs a good problem-solving. Therefore, students need to be trained and socialized to learn to solve problems during the learning process with a variety of problem solving strategies.
3. Student activity sheets and instruments used in this study can be used to further improvements to measure the development of the students' mathematical reasoning.
4. For completing this results, It needs to be conducted further investigation to what extent does the influence of each problem-solving strategy *make an organized list* on other aspects of mathematical reasoning abilities.

## REFERENCES

- Fahinu. (2007). Efektifitas Penggunaan Metode Bukti Counter-Example Dalam Meningkatkan Kemampuan Berpikir Kritis Mahasiswa Matematika. *Jurnal WAKAPENDIK* Vol. 3 No. 2.
- Gruenwald, Norbert dan Sergiy Klymchuk. (2003). *Using Counter-Example in Teaching Calculus: Students' attitudes*. The New Zealand Mathematics Magazine. ISSN: 0549-0510. Vol 40, No 2.
- Klymchuk, Sergiy. (2008). *Using Counter-Examples to Enhance Learnings' Understanding of Undergraduate Mathematics*. GPPG AKO AOTEAROA. AUT University.
- Lawshe, CH. (1975) *A quantitative approach to content validity*. By Personnel Psychology, INC.
- Permana, Yanto., dan Utari Sumarmo. (2007). Mengembangkan Penalaran dan Koneksi Matematika siswa SMA Melalui Pembelajaran Berbasis Masalah. *Educationist*. Vol. 1 No. 2.
- Shadiq, Fajdar (2004). *Pemecahan Masalah dan Komunikasi*. Yogyakarta: Diklat Instruktur/Pengembangan Matematika SMA di PPPG Matematika.