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An Analysis of Mathematical Problem Solving Ability in Terms of Students' Cognitive Style in Learning PBL Includes Ethnomatematics

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Abstract

This study aims to (1) analyze the students' mathematics problem solving ability with cognitive style in learning PBL which contains Ethnomathematics; (2) analyze the students' mathematics problem solving ability with cognitive style viewed from gender defferentiation. Type of the research is descriptive qualitative research. The data was taken from Group Embedded Figure Test (GEFT). The subjects of this research were given introduction of Polya problem solving steps and Problem Solving Test (TPM). The students' answers in TPM were analyzed and the research subjects were interviewed as triangulation. The result of this research showed that (1) Field Dependent man (FDLk) subjects could write detected and questioned matters, not clear enough in making problem sketch, could not finish the problems in all Polya steps. Field Dependent woman (FDPr) subjects could write detected and questioned matters, could arrange the completion planning, could not implement the completion planning and recheck the result of completion; (2) Field Intermediate man (FDILk) and Field Intermediate woman (FDIPr) subjects could not be carefully and only could finish three of four steps in Polya problem solving; (3) Field Independence man (FILk) and Field Independence woman (FIPr) could finish all Polya steps. Teachers should be able to create learning activities that are adjusted to the students' cognitive styles, correct preriquisite knowledge, give counting skill, and give open-ended questions so the students have good problem solving abilities.

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INTRODUCTION

Education is one of crucial things in human life. It can improve noble character of the nation. Education is the process of ability improvement and human behaviour. Education is also conscious and planned effort to create a learning atmosphere. In this case, the students will active to improve their self-potency to get religious spiritual power, self-control, personality, intelligence, social attitude, and skill which is needed for their self, society, nation, and country. Bloom *et al* (1981) stated that Education is a process to change students. It means that, there is a process in education which students must go through. This process can be influenced by the selection of learning models, curriculum, and materials that will be given by the teacher.

Education and culture are two interrelated things, because culture is an intact unity in whole society and education is a basic need for every individual in society. Education and culture have an important role in growing and improving noble values of the nation. A thing which can be a bridge between culture and education is ethnomatematics (Wahyuni *et al*, 2013). Ethnomatematics is a kind of mathematics which is affected or culture based. D'Ambrosio (1985) pointed out that purpose of ethnomatematics existence is to admit that many different ways in doing mathematics. It considers with academic mathematics knowledge which is improved by society sector. Moreover, it also considers different modus where different culture determined their mathematics practice (the way in grouping, counting, measuring, designing buildings or tools, playing, and so on).

Based on theory which is showed by Gagne, high level of intellectual skills can be improved through problem solving (Orton 2004: 25). NCTM (2000 : 44) decribed that mathematics skill must be owned by students are yaitu problem solving skill, reasoning and proof skill, communication skill, connection skill, dan representation skill. Teaching about problem solving is teach strategies or heuristics to solve the problems.

Polya (Orton, 2004 : 86) improved four steps in solving the problems such as understanding the problem; devising a plan; carrying out the plan; looking back. Students' activity in processing information have typical step namely cognitive style. Based on Witkin *et al* (1977) cognitive style can be divided into two kinds 2 such as Field Dependent (FD) dan Field Independent (FI). Field Intermediate (FDI) is students' cognitive skill which is between FD and FI. The differentiation of students' ability with cognitive style field dependent and students' ability with field independent are affected by oleh gender differences.

In a research which is conducted by Zhu (2007) concluded that female and male have different preferences in using problem solving strategy. Abdullah (2015), in his research, mentioned that students' problem solving ability with PBL learning model nuanced ethnomatematics reach Minimum Completeness Criteria. Saeroni (2017), in his research also pointed out that there is an enhancement in character of student curiosity, skill in creative thinking process students mathematical, and students' character in caring local culture that is used ethnomatematics learning. Nugraheni (2016) metioned that there is an enhancement in students' skill, students' character in caring local culture, and students' problem solving ability which are getting ethnomatematics modul in learning. The statement above same with Kaselin (2013), she stated that there is an enhancement of students' independence and students' mathematics communication skill which is used ethnomatematics in learning.

Fajari *et al* (2012) conducted a research about students' critical thinking process in solving the contextual mathematical problem in terms of cognitive style FD – FI and gender showed that male and female students with cognitive style FI is better than male and female students with cognitive style FD. A research is conducted by Hidayat (2013) in class X of SMA Negeri 7 Surakarta expressed about errors and causes of errors that happened to students in learning three dimensional space material in terms of students' cognitive style. Moreover, a research is conducted by Lestari (2012) in class X of SMA Negeri 6 Mataram discussed about students ability who has cognitive style field dependent and field independent. The result of this research are showed that students with cognitive style field dependent: can determine what is known and what is asked in understanding the problem; cannot determine the relation between what is known and what is asked,

cannot use the available information in planning a problem solving; cannot use steps and answer in true way in completing a problem solving; cannot use information which they got to arrange a new plan in checking the answer again. While students with cognitive style field independent: can determine what is known and what is asked in understanding the problem; can determine the relation between what is known and what is asked, can determine other information which are not known in question to plan the problem solving in planning a problem solving; can use steps in true way and competent in answering questions to complete the problem solving. In addition, a research which is conducted by Ulya (2014) in class VIII of SMP 2 Kudus discussed about field independent subject who has good ability in solving the problem. While field dependent subject is not able to meet almost indicators of problem solving in geometry material yet. There is an enhancement in the students' problem solving ability who have been given scaffolding.

Based on the description above, the objectives to be achieved in this study are: (1) analyze the students' mathematics problem solving ability with cognitive style Field Dependent (FD), Field Intermediate (FDI) and Field Independence (FI) in learning PBL which contains Ethnomathematics in SMA Negeri 1 Boja; (2) analyze the students' mathematics problem solving ability with cognitive style Field Dependent (FD), Field Intermediate (FDI) dan Field Independence (FI) viewed from gender defferentiation learning PBL which contains Ethnomathematics in SMA Negeri 1 Boja.

METHOD

This research is a qualitative research with a qualitative descriptive approach. The qualitative research has a purpose for understanding the phenomenon about what is experienced by the subject in holistic. It is a description using words and language in a natural specific context with utilize various natural methods (Moleong, 2005: 6). This research describe students' mathematics problem solving ability with cognitive style FD, FDI dan FI in completing question of problem solving. The steps to finish is based on the cycle or syntax from Polya. This research is divided into two main stages namely pre-field stage and stage of field work. The flow of this research can be seen in the following figure:

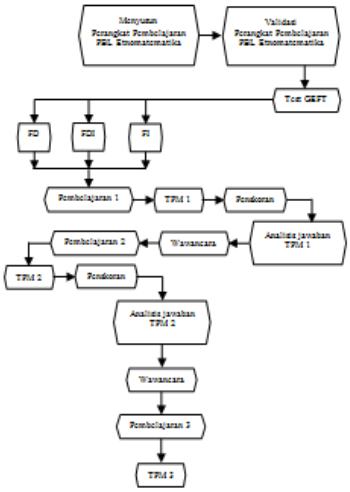


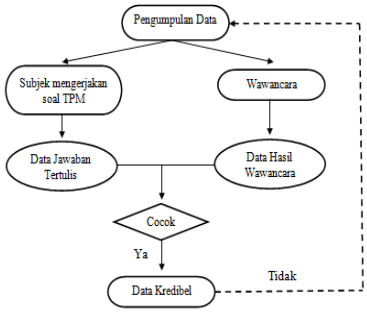
Figure 1. the flow of research

This research was carried out in students class X SMA Negeri 1 Boja Kendal district, Jawa Tengah province. The learning material is Linear Equation Systems of Two Variable, Three Variable, and Linear Inequality System of Two Variable with learning model of PBL contains Ethnomathematics. The subject of this research is female and male students in class X in SMA Negeri 1 Boja who has cognitive style FD, FDI, and FI. The research subject is determined based on the test result of students' cognitive style using GEFT. It seen from score of GEFT test result. The research subject is two male and two female from each cognitive style.

The male subject in group cognitive style Field Dependent is called Field Dependent *Laki-laki* (FDLk). The female subject in group cognitive style Field Dependent is called Field Dependent *Perempuan* (FDPr). The same condition is also applied in subject with cognitive style Field Intermediate and Field Independent such as FDILk, FDIPr, FILk and FIPr. In determining the research subject, the researcher also considers about subject ability in saying their opinion in oral or written to support the research implementation.

The data collection technique in this research is test techniques and non-test techniques. Test techniques is used to get students work result in finishing the problem solving. While, non-test

techniques is an interview method that is used to get data credibility. This interview is used to get validity of results from students work in TPM 1 and TPM 2. The stages of data collection are shown in the following figure:



Figue 2. the stages of data collection

In this qualitative research validity of data is obtained through checking credibility, dependence, and certainty (Sugiyono, 2010:366). Credibility of data validity in this research can be fulfilled with data triangulation techniques. This data triangulation techniques is done by comparing and checking again degree of trust in information which is obtained through different techniques namely TPM 1, TPM 2 and interview. Data passability in this research is obtained with describing students' mathematics problem solving ability in detail and systematically. Data dependence can be reached by taking two subject in every cognitive style. Certainty of data in this research is obtained by avoiding subjectivity in collecting data. It can be reached by making interview guideline, test assessment, and present the data based on reality.

In this research, data analysis is began from pre-field stage until stage of field work. Data analysis in pre-field stage is began from doing validation toward the support tools such as device and research instrument. The analysis of data interview in this qualitative research is using Miles and Huberman model data analysis technique (Sugiono, 2010: 337-345). The data analysis is covering: (1) data reduction; (2) data display; and (3) conclusion drawing or verification.

RESULT AND DISCUSSION

Cognitive style of students in class X IPA 1 is divided into three such as FD, FDI and FI. The research subject in class X IPA 1 determined through a psychiatric test GEFT which is developed by Witkin *et al* (1997). The data of students' ability in solving the problem is the data students' ability in finishing mathematics problem solving questions in the first problem solving test by following the steps Polya. The questions used are non-routine questions or questions contains story about a society culture in Daerah Istimewa Yogyakarta (DIY). Problems must be resolved with Polya stages consist of four aspects such as (1) understanding problem, (2) arranging the planning of problem solving, (3) applying the problem solving plan, and (4) checking the result of problem solving again. Subject FDLk and FDPr are male and female subject who have the lowest GEFT score in FD category that is score 0-9. Subject FDILk and FDIPr are subject who have the lowest GEFT score in FDI category. Subject FILk and FIPr are subject who have the lowest GEFT score in FI category.

In stage of understanding problem of both subject FDLk dan FDPr can write what is asked in the question but cannot mention the meaning of question clearly. Subject FDLk can't draw the sketches about the problem in true way. While subject FDPr can write what is known of problem clearly and completely. Subject FDLk and FDPr can write what is known of problem clearly and completely. Both subject are same. They can write what is known and what is asked in the question, but subject FDLk is not clearly in write the problem sketches. While subject FDPr can write the problem sketches enough clearly.

In stage of arranging the planning of problem solving both subject are FDLk are FDPr have differentiation. Subject FDLk cannot arrange the planning of problem solving correctly. While subject FDPr can arrange the planning of problem solving correctly.

In stage of applying the planning of problem solving both subject between FDLk and FDPr cannot answer the problem correctly because cannot arrange the planning of problem solving correctly. Because the problem is not resolved, so the subject cannot make a last conclusion.

In stage of checking the result of problem solving again both subject FD cannot check again towards work result and cannot contains another alternative answer.

According to Guisande (2007), characteristics of subject FD is cannot describe complex information into separate part. Research subject which belongs to the inside cognitive style FD cannot understanding the problem well. The information in the question are not understandable and utilized by the other subjects. After reading repeatedly, subject FD can mention things which is known from the question but does not understand the meaning. Individual FD not selective in information absorption and tend to be influenced by external cues. Mulyono (2012) also mentioned that subject FD tend to be difficult to determine simple parts from the original context or easily affected by deceptive elements in the context because they look at it globally.

Subject FDILk and FDIPr do problem solving using Polya stages pretty well. Subject FDILk and FDIPr are able to understand the problem well. Subject FDIL and FDIK can write things which are known in the problem complete and correct. Both subject can write what is asked and write the sketch correctly. In stage of arranging the planning of problem solving, both subject namely FDILk and FDIPr can use information to arrange problem solving correctly. It shows that person of FDILk and FDIPr better in arranging the planning of problem solving when compared with subject FDLk and FDPr. Moreover, there a little error which is conducted by subject FDILk and FDIPr. Both subject write an arranging problem solving less completly. The less complete of planning of problem solving caused the subject cannot finish the problem well.

In stage of applying the planning of problem solving, both subject namely FDILk and FDIPr are same. Subject FDILk and FDIPr can answer the problem with good steps because can make the planning of problem solving correctly. Subject FDILk and FDIPr cannot check the result and determine the other alternatives to solve the problem.

Both category of subject FI can understand the problem well. Subject FILk and FIPr can write what is known from the problem complete and correctly. Subject FILk and FIPr also can write what is asked and can write the sketch complete and correct. Subject FILk and FIPr have an ability to arrange the problem solving in very good way. It caused subject FILk and FIPr answer the problem correctly. Subject FILk and FIPr also can communicate the last conclusion. This result strengthen the result of research which is conducted by Muhtarom (2012), it showed that in applying the arranging of problem solving, subject can answer the problem correctly based on the stages of problem solving that has been compiled.

Subject FILk and FIPr have ability to check the result again towards the results obtained or stages very well done. Subject FILk and FIPr can check the result and determine the other alternative to finish the problem. This result is different with a research conducted by Susanto (2012) and Sutrisno (2013), they stated that subject FI can check the results or stages again, both of the subject FI cannot make the other alternative answers to existing problems.

CONCLUSION

Based on the result of the research about the ability of problem solving students' FD, FDI and FI can conclude that: (1) problem solving ability of students FDLk classified as not good enough. This is shown by students which cannot able to build new mathematics knowledge through problem solving well, cannot use prerequisite knowledge to complete the problem, cannot arrange complete strategy and systematic, not able to reflect the process of problem solving yet using Polya's stages. (2) problem solving ability of students' FDPr is classified as not good. This is shown by students which is able to build new mathematics knowledge through problem solving but the students cannot able to use prerequisite knowledge to use the problem in finishing the problem, able to arrange complete strategy but cannot finish the problem, not able to reflect the process of problem solving using Polya correctly. (3) problem solving ability of students' FDILk and FDIPr is classified good enough, the students can build new mathematics knowledge through problem solving, able to solve problem in many context which is related to mathematics, able to arrange complete and systematic strategy so the subject can finish the problem. But the subject cannot arrange the problem solving using different steps. (4) problem solving

ability of students' FILk is classified well. The students can understand the problem well, able to arrange and apply the planning of problem solving, and able to check the result of problem solving again in very good way but cannot make the other alternative answer in several problem. (5) problem solving ability of students' FIPr is classified good. They can understand the problem well, can arrange and apply the planning of problem solving, and able to check the result of problem solving again in very good way. The students also can make alternative problem solving using the other stages in several problem completely.

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