ANALYTICAL DESCRIPTIVE STUDY OF STUDENTS' CRITICAL MATHEMATIC THINKING ABILITY THROUGH GRADED RESPONSE MODELS (GRM)

A THESIS

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ABSTRACT

ZARA ZAHRA ANASHA. "ANALYTICAL DESCRIPTIVE STUDY OF STUDENTS' CRITICAL MATHEMATIC THINKING ABILITY THROUGH GRADED RESPONSE MODELS (GRM)"

Critical mathematic thinking ability is very important to solve daily problems. But in reality, junior high school students' critical mathematic thinking ability is still low. Ability measurement such as measurement of critical mathematic thinking ability cannot be measured through multiple choices test. In that case, an essay test in which graded scoring is used as scoring technique more suitable than multiple choices test. The result of the essay test will be analyzed to describe the already tested ability. There are two approaches in the measurement analysis; classical test theory and item response theory (IRT). The classical test theory has some weaknesses because it only depends on how many the right answers student could achieved. Meanwhile, the IRT technique is more suitable to analyze ability because lies on the pattern of the response and parameter of item test. Graded response models (GRM) is one of the IRT models that analyzed graded response.

The purposes of this research are to know about the result of the item parameter estimation of the test which has been developed by the researcher and to know the result of student's critical mathematic thinking ability parameter estimation through GRM (Graded Response Models).

The research is a descriptive quantitative research. The population of this research are 8th grade students of MTs Al-Ishlah Bobos and of SMP N 1 Dukupuntang in the academic year of 2012/2013. Applying purposive sampling method this research took 140 students as a sample, from whom 70 students from MTs Al-Ishlah Bobos and 70 students from SMP N 1 Dukupuntang. Measurement theory used in this research is Item Response Theory (IRT) with the GRM model and the instrument used to collect data is critical mathematic thinking ability test paper.

The result of the item parameter estimation shows that in terms of the item discrimination all four items tested are less good, meanwhile in the terms of item difficulty the results vary. The first item of the test is considered to be easy, the second and the third item of the test is considered to be very difficult, and the last item of the test is considered just difficult. The result of the critical mathematic thinking ability parameter estimation shows that 4,2% of students have very high critical mathematic thinking ability, 16,4% have high critical mathematic thinking ability, 65,7% have mean critical mathematic thinking ability, 13,5% have low critical mathematic thinking ability and there is no single student with very low critical mathematic thinking ability.

Key words: critical mathematic thinking, item of the test parameter, ability parameter, IRT, GRM

RATIFICATION

The thesis entitled **Analytical Descriptive Study of Students' Critical Mathematic Thinking Ability Through Graded Response Models (GRM)** by Zara Zahra Anasha, Register Number 59451005 has been examined in the viva voce held by the Tarbiyah Faculty of The State Institute for Islamic Studies (IAIN) Syekh Nurjati Cirebon on Tuesday, August 20, 2013. The thesis was submitted to fulfill the Partial of Requirement for Islamic Scholar in Mathematics Education.

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PREFACE

In the name of Allah, Most Gracious and Merciful. All praises and thanks to Allah because of His blessing the writer was able to finish this thesis. May invocation and peace always be with Prophet Muhammad Peace be Upon Him, his family, his colleageus, and his followers up to the end of the world. Making of the thesis entitled is **ANALYTICAL DESCRIPTIVE STUDY OF STUDENTS' CRITICAL MATHEMATIC THINKING ABILITY THROUGH GRADED RESPONSE MODELS (GRM)** was companied by challenges that gave satisfaction for the writer. The writer says thanks to:

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CHAPTER I
INTRODUCTION

A. Problem Background

Education is one of the most important things for the progress of a nation. Many people expect that education can give birth to the new generation with high quality by which they can realize the nation's dreams. Education is a learning process, be it formal or not. Mathematics is a science learnt and studed in every level of education, from the lowest up to the highest level of education.

Mathematics is one of the nature sciences. Mathematics is known as mother of science (Kusumaningrum and Saefudin, 2012). Mathematics has an important role in improving thinking ability. According to Sabandar (2008), learning mathematics has close connection with activity, learning process and thinking, because the basic nature of mathematics is a combination of science and human activity. It means that mathematics is about thinking pattern, organizes logic authentication that uses accurate and clear terminology. Students who learn mathematics are expected to have a mathematical thinking ability.

In term of its depth and complexity there are two types of thinking pattern in mathematics; low order mathematical thinking and high order mathematical thinking (Sumarmo, 2010). Based on Blomm's Taksonomy, knowledge and comprehension are classified as low order thinking, while analysis, synthesis and evaluation are put into the high order thinking (Zohar and Dori, 2003).

Students are in a great need to mathematical thinking ability, especially high order mathematical thinking, because it can help them to solve their daily life problems (Noer, 2009). As such, currently the newest notion in the mathematical learning is armed of developing High Order Thinking Skills (HOTS) for students (Noer, 2009).

High order thinking skills consist of critical, creative, logic and reflective thinking. Some characteristics of the high order thinking skills are tend to be not

algorithmic, more complex, the finding many alternative solutions, and involving many criteria, irregularity and self regulation (Zohar and Dori, 2003).

But, in the reality, some mathematic teachers of Junior High School declared that many students do not have good critical mathematic thinking ability. They say that students just use one of information that given by the teacher without do some confirmation whether it can be believe or not. Students also just produce one solution of the problem, they cannot wider their though about the problem and just follow the example that given by the teacher.

Measure one's critical thinking is often to use a special test on a particular subject. The model of the test is usually multiple choice that provides two probably answers for students; true or false. Students cannot freely express their thought. As a matter of fact to measure thinking ability, we need to consider students' reasoning as well their references in answering the question. Thus, an essay test can be used to measure how students take such conclusions (Quelmalz, 1985).

The characteristics of the essay test are different from the multiple choice test in term of scoring technique, time allocation and a number of questions. In the scoring technique the multiple choice test uses a dichotomy score, 1 for the right answer and 0 for the wrong answer. Meanwhile essay test uses polytomous score in which scores must be graded into more than two categories considered to be appropriate with some categories (Budiharti, 2011).

To see the result of the test, we must apply a score test analysis. In the classical test theory, the total score achieved by students is based on how many right answers students set. This technique is very important thing to analyze item test as well as to evaluate students' achievements which usually refers to a sample analysis. Nowadays, a new method of evaluation is Item Response Theory (IRT) particularly for latent variable model. Lord and Novick are the pioneers of the IRT to evaluate student ability and test item, including item discrimination and the differences of student ability (Matteucci and Stacqualursi, 2006).

Unlike the classical test theory, in which the test scores of the same students may vary from test to test, depending upon the test difficulty, in IRT item parameter calibration is sample-free while student proficiency estimation is item-independent. Test in the IRT, students with same scores cannot be assumed to have the same level in the ability. Instead, the IRT will firstly consider the pattern of the answer given by students before coming to take a conclusion based on the difficulty level of the answered item. So, this test does not depend on the right or wrong model of answering (Chong Ho Yu, 2012).

The Graded Response Models (GRM) is one of the IRT models for the graded scoring. GRM is the first model for graded polytomus data. This model is believed to be the best model and the newest model to the error compared to the other approaches. This model has been used globally in psychology research to measure respondents' ability based on interval scale quisioner (Sukirno and Siengthai, 2010).

From the above mentioned background, this research take the title is "Analytical Descriptive Study of Students' Critical Mathematic Thinking Ability Through Graded Response Models (GRM).

B. Formulation of Problems

1. Area Study

The area study of the research is the development of the general thinking ability since critical thinking ability is a part of the general thinking ability. The researcher will analyze critical mathematic thinking ability using GRM (Graded Response Models).

2. Identifications of problems

Mathematics is a science that teaches us the rule of thinking. Thinking is a process where information and facts are processed to take a conclusion. Everyone in this world absolutely has a thinking experience. There are two types of thinking in mathematic; low mathematic thinking and high mathematic thinking. Based on Blomm's Taksonomy, knowledge and

comprehension are classified as low order thinking, while analysis, synthesis and evaluation are put into the high order thinking Some of scientist said that is high order thinking consist of critical thinking.

How to measure a critical thinking ability? To measure low order thinking is enough by a cognitive test. The test can be in the terms of multiple choice or essay test. But to measure thinking ability it's better to use an essay test rather than a multiple choice, because multiple choice only gives two answer options, right or wrong. That's why an essay test is viewed to be more suitable to measure high order thinking ability. Because scoring in the essay test can be graded in accordance with student ability, not just right or wrong answer.

How to analyze thinking ability test? In this era there are many analysis models to measure test result. But, most of them still use the classical test theory that in many ways does not match to analyze thinking ability using an essay test. The right analysis model for this kind of test is GRM (Graded Response Models) that is based on polytomus data providing more than two score categories.

3. Limitations of problems

There are many problems revealed above and impossible to cover all of them in a research since the researcher has some restructives, such as limitation of time, of ability, and of cost. So, the researcher decides to limit the research problem into:

1) High order thinking ability in this research is critical thinking ability in mathematics context.
2) Critical thinking ability as the focus of this research is the level of someone's critical thinking ability in the cognitive area taken from the cognitive test of the critical thinking ability that refers to critical thinking indicators. The test should be mathematics test.

3) The researcher will analyze critical mathematic thinking ability using GRM (Graded Response Models).
4) The researcher will estimate item parameter and parameter of the student ability from critical mathematic thinking ability test using GRM (Graded Response Models).

4. Research questions

Based on the identifications and limitations of the problems, the research questions are:

1) How the results of critical mathematic thinking tests' items parameter estimation through GRM (Graded Response Models)?
2) How the results of students' critical mathematic thinking ability parameter estimation through GRM (Graded Response Models)?

C. Research Objectives and Significance of Research

1. Research objectives

Based on the research questions, the objectives of this research are:

1) To know the results of critical mathematic thinking tests' items parameter estimation through GRM (Graded Response Models).
2) To know the results of students' critical mathematic thinking ability parameter estimation through GRM (Graded Response Models).

2. Significance of research

The significances of this research are:

1) This research is expected can be one of the references for other researches in using Item Response Theory (IRT) in their analysis of research.
2) This researcher is expected to be a good example to measure thinking ability, estimate the thinking ability using GRM and estimate the parameter of critical mathematic thinking ability of the students through GRM (Graded Response Models).

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