Exploring the elementary students learning difficulties risks on mathematics based on students mathematic anxiety, mathematics self-efficacy and value beliefs using rasch measurement

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Abstract. The learning process sets up the individual differences during material transfer. In mathematics subjects, these changes point to student struggles in following the movement of the material and raise the learning obstacles. However, the identification of the mathematics learning difficulties condition is done after the final test, instead through the study of students who have learning difficulties risks. This study examines the compromise of learning difficulties in mathematics in terms of several aspects that can trigger it, which are mathematical anxiety, self-efficacy mathematics, and value beliefs. This preliminary study consisted of 127 elementary school students from 3rd to 6th grades. The result of this study shows that students are more dominant to experience cognitive anxiety towards mathematics, especially when working on issues with high difficulty levels. In addition, students are at compromise of learning disabilities if they have low self-efficacy levels, especially if it concerns to the circumstantial use of mathematics. The risk of learning difficulties is also dominant experienced by students who do not spend time effectively in learning mathematics. The attention of the learning difficulties risks on mathematics is essential to ward off the failure of students to optimize their potential in the learning process.

1. Introduction
The learning process is a complex activity that involves many variables [1–5]. Masteries of the learning material and individual differences of students are the main focus in looking at the indicators of success [6] and the basis in determining students experience barriers and difficulties in learning [7]. One of the subjects that became the most difficulty in student learning was mathematics. It is common to students, especially in elementary schools. Mathematics is an important subject in the education of students in the future; which actually experiencing many obstacles in terms of mastery. The condition of mathematics difficulty becomes an indicator of low learning achievement [1]. The results from the PISA survey in 2015 on 15-year-old students on mathematics performance show that Indonesia ranked 64 out of 72 countries in the assessment, with an average score of 386.

Student learning difficulties are influenced by various factors, both from internal and from external factors [3]. Psychological condition of the student is one important factor that sometimes has less
attention on the process of learning difficulty’s analysis. These factors include students' mathematics anxiety, mathematics self-efficacy, and value beliefs.

Mathematics anxiety is a condition of tension experienced by students who related to subjects that contain mathematical calculations, both in school and in daily life [8]. This condition leads to rejection [8], avoidance, psychosomatic reactions, inability to optimize memory [9], loss of motivation and other risky conditions [2]. Handling the student’s anxiety is one of the mental health rehabilitation efforts that can overcome various obstacles in learning. In addition, the conditions of self-efficacy and value beliefs also determine the difficulty in learning. Individual's belief about their ability and self-esteem related to the learning process of mathematics influences subjective wellbeing condition of the student so that it will affect the achievement in learning.

Diagnosis and analysis of the learning difficulties condition is important, especially with regard to the basic concepts of mathematics [4,5,10]. However, a popular treatment by Indonesian elementary school’s teacher is to analyze learning outcomes to locate learning difficulties by putting other factors on less-substantial proportions. So it needs an adequate and comprehensive research effort to see other factors that affect student learning difficulties [1]. Furthermore, there is a need for research that concern in risks that might be the cause of student learning difficulties in the future. Then, it can be known where the tendency of students at risk for experiencing difficulty in learning. This study aims to explore the learning difficulties risk based on the mathematics anxiety, mathematics self-efficacy and value beliefs of students on math subject.

2. Method

2.1. Participants
The sample in this study consisted of 127 elementary school students in Indonesia. Research subjects are from 3rd to 6th grade and have been through the process of licensing data collection.

2.2. Measuring
Mathematic anxiety was measured by using the inventory of Mathematic Anxiety Rating Scale - Elementary Form (MARS-E) [2] which has been translated and adapted to the Indonesian language from German version. This inventory is a shortened version adjusted to the needs of the pilot project and the condition of the data source, most of item properties refer to MARS-E German version. The MARS-E inventory consists of the cognitive and affective scale [11] and has been through data testing process with reliability value (Cronbach Alpha-KR20) of 0.96. The mathematics self-efficacy condition was measured by using inventory with reliability value equal to 0.95 and condition of student value beliefs to mathematics [2] measured by inventory that consist of intrinsic and extrinsic domain; with reliability value 0.97.

2.3. Data Analysis
The data findings were analyzed by using Rasch Models [12]. Data analysis involves the use of Winstep Version 3.72 applications [13] and data sets of research results could be accessed through the Open Science Framework [14].

3. Result and Discussion

3.1. Students’ Mathematics Anxiety
The measurement of students' anxiety condition on mathematics subject is summarized in Table 1. The result of measurement shows that the average logit score of student anxiety is 0.18, and the transformation/rescaling logit value (with range 0-100 value) is 52.99. This means that in general the respondent has an anxiety level over the 50 point on the scale, with variation of logit value equal to 1.12. The high condition of anxiety is also indicated by the achievement of maximal value of respondents with 2.56 logit and rescaling 72.58 logit. Despite the diversity of data (Standard Deviation of 1.12 logit) indicates that respondents’ data are quite diverse, but the student's anxiety level can be said to be at a level that requires special attention.
The condition of elementary school students' anxiety towards mathematics is also evidenced by the test of information function in Figure 1. The test of information function shows the high level of information obtained from the measuring instrument used to see the condition of anxiety of elementary school students. The right-moving curve between logit 1 and 2 indicates the student's anxiety condition is strong in the high direction, as also shown in Table 1. The high anxiety of elementary school students on mathematics subjects becomes an indication of students' psychological discomfort in the learning process [2,10]. Psychological conditions that are not conducive in the learning process would be led to adverse reactions.

Table 1. Summary of Students’ Mathematics Anxiety (MA), Mathematics Self-Efficacy (MS) and Value Beliefs (VB).

| Estimation                | Logit Value | Rescaling Logit Value (0-100) |
|---------------------------|-------------|--------------------------------|
|                           | MA          | MS                             | VB         | MA      | MS      | VB      |
| Mean Person               | .18         | .13                            | .67        | 52.99   | 50.32   | 55.57   |
| SD Person                 | 1.12        | .89                            | 1.76       | 9.18    | 8.90    | 14.51   |
| Max Measure               | 2.56        | 2.39                           | 6.06       | 72.58   | 72.98   | 99.96   |
| Min Measure               | -5.00       | -2.81                          | -3.27      | 10.39   | 20.81   | 23.15   |
| Separation Index Person   | 2.79        | .86                            | 2.04       | -       | -       | -       |
| Person Reliability        | .91         | .65                            | .86        | -       | -       | -       |
| (Cronbach Alpha-KR20)     |             |                                |            |         |         |         |

3.2. Students’ Mathematics Self-Efficacy
The summaries of the mathematics self-efficacy analysis are presented in Table 2. The condition of self-efficacy mathematics of elementary school students is on logit 0.13. The diversity of responses of respondents is not in varied condition, which is at logit 0.89. It can be interpreted; statistically, the condition of self-efficacy of elementary school students is not too varied. Based on the data analysis, it is also known that self-efficacy which contain students' beliefs to solve math problems especially related to the application to daily life is low [14]. The condition of self-efficacy does not show in low results, although there is a tendency of self-efficacy that tends to be weak. This is evidenced by the curve of the test information function in Figure 2 that leads to the left that passing the logit 0 to -1.

3.3. Student’s Value Beliefs on Mathematics
Based on rasch analysis, the respondent had value beliefs on mathematics at logit 0.67 (with rescaling value of 55.57). Conditions that need attention in the exposure of this data relate to the maximum value of logit obtained respondents, which is on a scale of 99.96 (in the form of rescaling value) or logit 6.06. This condition indicates that there are respondents with extreme logit value for value beliefs. In addition, there is a considerable diversity of respondents' answers on value beliefs with a logical value of 1.76.

The test of information function in Figure 3 shows that the strength of measurement and information at the level of grade beliefs of elementary school students is almost equitable, which means that there are students who are at a high level of beliefs, as well as low. So the distribution of data becomes more evenly than the two previous variables.

3.4. Identification of learning difficulties risk on mathematics
The symptoms of student learning difficulties are complex psychological phenomena and involve many variables, especially with regard to mathematics subject. Anxiety, self-efficacy and value belief’s mathematics are some dominant factors that affect the student learning process. Analysis of these three factors needs to be done to see the potential of learning difficulties that can be caused [15]. The interaction analyzes of mathematics anxiety, self-efficacy and value beliefs are presented in Figure 4. The values shown in Figure 4 are transformation and rescaling logit values ranging from 0-100 points for better interpretation.
Figure 1. Test Information Function of Students’ Mathematics Anxiety

Figure 2. Test Information Function of Students’ Mathematics Self-Efficacy

Figure 3. Test Information Function of Students’ Value Beliefs on Mathematics

The condition of mathematics anxiety experienced by elementary school students is inversely proportional to self-efficacy and value beliefs. High levels of anxiety are accompanied by low self-efficacy and value beliefs, especially in extreme conditions. It is proved by the position of respondent with code 089P4 with anxiety value of 2.56 logit or rescaling value 72.58, otherwise mathematics self-efficacy logit value is at -0.21 logit and value beliefs at -1.28 logit, so it can be interpreted that height of anxiety followed by low self-efficacy and student beliefs values [14]. The condition of student learning difficulties should be predictable and known about the form of risk of learning difficulties [16,17] prior to the examination, either at mid or final test. So the teacher does not only do diagnostic activities when difficulties have occurred, but the need for anticipation before the difficulty happens in learning.

In Figure 4, the most at-risk condition is learning difficulties with high anxiety and low self-efficacy and value beliefs. Students with high levels of anxiety feel powerless and unsure of being able to solve problems or tasks related to math, and then have low value beliefs to be able to generate desire and motivation from within. Some aspects that can be an indicator in the identification of student learning hardship risk can be known through analysis of fit and measure items [14]; which are some examples shown in Table 2. The exposures in the table show the conditions that teachers need to be aware of in identifying students at risk of learning disabilities. In the anxiety aspect, students generally experience anxiety when asked to do multiplication with multiples above ten (with the highest logit value is 1.0). Another condition that needs to be considered is the students feel worried if when they have grown will get work related to mathematics. Tension due to anxious feelings will lead to reactions to withdrawal, avoidance, procrastination, physical disturbance resulting in student achievement in school [18].
Figure 4. Students’ Mathematics Anxiety, Mathematics Self-Efficacy and Value Beliefs Interaction based on Rescaling Logit Value (0-100)

This condition is also supported by the low aspects of self-efficacy and value beliefs of students who trigger learning difficulties, as described in data sets [14]. Summary in Table 2 there are two aspects of triggers derived from mathematics self-efficacy and value beliefs, which is students find it difficult to estimate returns while shopping and study hard to make parents proud. This has become an important indicator of low confidence in solving problems related to mathematics in daily life. In addition, the low grade of value beliefs is an indicator of the lack of the parent’s role in student learning. Based on the research findings, the dynamics of these three factors are predicted to be an important indicator in the risk analysis of students' learning difficulties in elementary schools.

Table 2. Example of Identifier Items for Students Learning Difficulties Risks based on Rasch Measurement.

| Items                                             | Logit Value | Rescaling Logit Value (0-100) | Outfit MNSQ | Outfit ZTSD | Var. |
|---------------------------------------------------|-------------|--------------------------------|-------------|-------------|------|
| I am worried if asked by the teacher to do the task more than ten multiples | 1.00        | 59.75                          | 1.08        | .60         | MA   |
| I was worried when the teacher gave me a task about mathematical drawing | .53         | 55.89                          | .76         | -1.9        | MA   |
| I'm worried if I grow up, I'll meet a job that contains calculations | .36         | 54.48                          | .83         | -1.4        | MA   |
| I can estimate the number of change after shopping | -1.17       | 37.27                          | .91         | - .7        | MS   |
| I try hard to learn math to make parents proud    | -1.29       | 39.48                          | .79         | -1.5        | VB   |

4. Conclusion
Mathematics anxiety is a complex psychological phenomenon and involves many factors. Furthermore, anxiety that arises in the form of tension and fear of dealing with mathematics will affect the academic achievement in school. In addition, the active involvement of students in learning mathematics is also the impact of cognitive, affective motivation and the role of parents and teachers. So it can be judged that the complexity of psychological symptoms of anxiety to mathematics plays a significant role in the smooth process of student learning in school. On the other hand, mathematics self-efficacy and value beliefs play an important role in students' subjective well-being in school and optimal emotional development. Various related researches prove that the success of academic performance is also closely
related to self-efficacy and value beliefs, which in this case relates to subject mathematics. The study has also presented findings that improvements in self-efficacy and value beliefs can positively decrease the anxiety. The three variables in this study generally have the potential to identify the risk of learning difficulties experienced by students. Full attention to the risk of learning difficulties need to be done by the teacher in order to optimize the learning process in school while still paying attention to the rhythm, and individual differences in learning.

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