A Rasch model measurement analysis on students’ concept mastery in food additives topic

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Abstract. The students’ concept mastery is low in food additives topic in junior high school level. This study aims to analyze students’ concept mastery by using Rasch Model Measurement. The participants involved 70 students of grade VIII and IX grades consist of 30 boys and 40 girls. The result was shown from students have already studied food additives topic. Item is comprised of 30 multiple-choice questions. Data analyzed on person-reliability, item-reliability, and wright map. The findings showed Cronbach α was 0.69 (sufficient), item-reliability was 0.92 (excellent), and person-reliability was 0.65 (weak). It shows interaction between students and items were sufficient, so items can be used for students. Thus, most students could answer food additives questions. For better result, the researcher should make difficult item.

1. Introduction
The main characteristic of education is aimed at improving ability and behaviour to present knowledge that is used as a subject for living in the world [1]. The education requires to be modified that they can facilitate the students to learn and reach knowledge [13]. One of the systems of knowledge has a function for improving quality of education, especially in science [2]. Science is one of nature study in the kind of concepts, information, and principles. The example of a natural science subject is food additives. Food additives is a topic that has been taught in junior high school. This research aims to analyze student’s understanding in food additives. Students’ performance is still low rate, especially in understanding concept of science [3]. Student’s thinking was not ideally developed.

Based on the TIMSS (Trends in International Mathematics and Science Study) and PISA (Programme for International Student Assessment) shows that Indonesian students’ achievement is low rank. The rank is 36 of 49 countries in 2015 [4]. It concludes that Indonesia students have low content. The students are only good at mastering simple questions and memorization without deep learning. So, in this case, education quality requires to be improved for a better future [4].

Many Indonesian students have low of interest in their lesson during learning activity and it effects to their concept mastery [15]. The causes of low students’ achievement are teaching-learning process facilitated by the teacher. Student’s participation influences learning method in improving students’ thinking skills. If the students are not participating well during learning, it will be less effective for the sharing of knowledge, concept, and discussion. In addition, teaching material is also a factor for student learning results. Teacher’s ability has to master materials in teaching that can be captured by student’s concept mastery [14]. So, the teacher should be smart to fix instructional tools such as using multimedia elements, games, and learning activities to trigger students’ active in work collaboratively, discussing,
and develop their thinking skills. So, low students’ concept mastery is caused by a lack of an appropriate teaching-learning process and proper student activity in the classroom. 87.16% of learning process is teacher has consistently used learning methods, such as discussion and exercise [4].

Based on the problems, the goal of this research is to analyze students’ concept mastery of VIII and IX grades in food additive topic. We look forward that the data analysis will assess students’ performance and reach their learning goals. For the teacher, we expect to inspire teachers to select appropriate learning models for facilitating students to become more high enthusiasm in the learning process and obtain them a learning experience variety. Also, one of main thing of achievement is from student’s concept as their ability [16].

2. Methods
The Method aims to report students’ concept mastery in food additives topic. Participants of this research were 70 students of VIII and IX grades in one of the private schools in Bogor. The students consisted of 30 boys and 40 girls. All students had studied food additives topic.

Instrument consists of 30 multiple choices questions and the topic of instrument is food additives. The concepts are food additives types, the effects of food additives and human effort to reduce food additives. Cognitive domain based on assessment of revised Bloom's taxonomy. Cognitive domain consists of six levels such as remember, understand, apply, analyze, synthesis and evaluation. Bloom's taxonomy is useful model in assessment of teaching and learning process. [10]. The data analyzes by using the Rasch Model Measurement in 4.4.5. version [9].

3. Result and Discussion

3.1 person-reliability and item-reliability
The result of reliability in instrument to investigate student's concept mastery that has been shown in figure 1 it shows that it is fair level. This research finds reliability of Cronbach-α was 0.69 which is sufficient. The person-reliability is 0.65 it indicates weak and in figure 2 shows item-reliability is 0.92 (excellent).
The result of figure 2 shows that the item-reliability is (0.92) it indicates high. Because of items have excellent potential variable. It explains that instrument can be used for students. The result of Cronbach-α is 0.69. It is sufficient for interaction between students and items [11]. The person's reliability is 0.65, it indicates bad because the students mostly can answer the question.

Figure 1 shows person-separation is 1.37, it shows that students are not well in cognitive abilities they only dominated in one ability or it can be another factor such as the number of students is too small. If person-separation is high, it must be student's cognitive skill categorized in high, medium and low. The good quality of separation item is larger than 2.0, it means question-separation is divided into easy, medium and difficult [11].

The separation values can be identified as the differences in level of person and items. Separation is more than 2.0, it is a good value. The attributes are mean square value (0.5 <Outfit MNSQ<1.5), a Z-standard Outfit value (-2.0<ZSTD<+2.0) [11]. Based on figures 2 the values (0.5 <1<1.5), a Z-standard Outfit value (-2.0<0.01<+2.0) shows that attributes are appropriate for students to conduct this item. The findings that initial assessment is efficient for analysis student's concept mastery because Cronbach-α is 0.69 and good ranges of Mean Square Outfit (MNSQ) and Z-standardized values (ZSTD) outfit.

3.2 wright map
The figure 3 shows distribution of 70 students and distribution of difficulty item are same scale. From the figure 4 shows highest ability. The code is 30P with the logit value is 2. The lowest ability students are 11P and 25P codes with logit value is -1. The logit value is 1 shows the students are high ability.

![Wright maps (high ability students)](image-url)
Figure 4. Wright maps (low ability students)

The Figure 4 shows highest item is p21 which is above 2SD or T. p21 item is high cognitive item, it is C3 (Executing) because ability to use concepts that are received in real new situations. While, the easiest items are p25 and p7 because items are cognitive skill level C1 (remembering) which is ability to capture information and restate information without understanding it. The difficulty items are p19, p23, and p10 which items have a logit value is 1 logit. Hard items are p19, p23, p10, p16, p2, p22, p24, p6, p12, p4, p8. Easy items are p17, p18, p20, p29, p30, p11, p15, p27, p1, p28, p3, p14, p13, p9, p26, p5. Figure 4 also shows average of student high ability is above 0 logit. It shows that average of student achievement is above with difficulty item [12].

4. Conclusion
This research concludes that the reliability based on Cronbach-α was 0.69 indicates sufficient interaction between students and items. Item-reliability was 0.92, it is excellent in potential variables and item can be used. Person-reliability is bad (0.65) because most of students can answer questions. In terms of attributes value (0.5 < 1 (Outfit MNSQ) <1.5) and (-2.0 < 0.05 (ZSTD) <+2.0) have good values and appropriate for students to conduct item test. It can conclude that items are efficient for students’ concept mastery.

The questions have levels, such as hardest and easiest levels. Hardest item is p21. Easiest items are p25 and p7. This item is dominated by easy items, hard items total is 12, and easy item total is 18. In better future, the researcher should construct easy item into difficult item. Thus, students’ concept mastery is good in food additives topic because they have studied food additives before.

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