Analysis of senior high school students’ ability to understand concept and adversity quotient on elasticity

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Abstract. This study aims to determine the ability to understand the concept and adversity quotient of tenth-grade students on elasticity. This research is a single case study where the purpose of the study is to examine the conditions and situations that are happening, thus providing a picture based on facts found in the field. The design of this study is the post-only group design. Data analysis techniques using the Rasch model with a research sample of 30 students consisting of 11 male students and 19 female students. The instrument used in this study was a test of concept comprehension ability with multiple choice questions of 15 questions ($r = 0.62$) and an adversity quotient questionnaire with an Adversity Response Profile (ARP) questionnaire of 20 statements ($r = 0.77$). The results showed that in general the ability to understand concepts in each concept was low and the adversity quotient also showed that the majority of students had moderate fighting power (camper). The conclusion of this study is that there must be a treatment that makes students able to understand physical concepts such as models or learning methods and makes students able to face and overcome difficulties in learning physics.

1. Introduction
Most of the concepts of physics are still abstract concepts for students and even they do not recognize the key concepts or relationships between concepts needed to understand the concept. As a result, students do not build an understanding of fundamental physics concepts in their early learning of physics. Understanding a concept is a thought process carried out by individual humans by truly understanding an object or event [1,2]. Understanding is generally accepted as an active process in which meaning is constructed, with new information, be interpreted concerning current knowledge [3]. In constructivism’s view of learning, students develop understanding as they integrate with new knowledge for their current understanding [4,5]. In learning activities, a concept is a generalization of thoughts about something so that facts and perceptions are needed to build a concept. Understanding concepts is the most important part of learning physics. Concepts in physics include the principles, laws, and theories of physics along with their applications in life [2]. Indicators of cognitive understanding processes include: interpreting, exemplify, classifying, summarizing, drawing conclusions, comparing, and explaining [6].

Another problem in learning physics is the ineffectiveness of traditional teaching methods and explains the lack of understanding of science content and processes when students become subject to conventional teaching and demonstration [7]. Using laboratories is one of the main efficient ways to make understanding difficult theories simpler and clearer [7]. Meaningful learning can be achieved
when laboratory activities become an integral part of the science curriculum [8]. But not only that, another problem is the scarcity of teachers to conduct laboratories or simple laboratories to strengthen students' knowledge of abstract material due to inadequate laboratory equipment. Students only expect knowledge provided by the teacher without intending to find other sources of reference other than science. Stoltz [9] argues that Adversity quotient as a form of individual response to difficulties and control of consistent responses, can not be separated from how individuals respond to pressing situations in their lives. Attitude to situations related to beliefs about good things happening now or in the future [10]. Adversity quotient helps individuals strengthen their abilities and perseverance in facing the challenges of daily life, still holding fast to the principles and dreams regardless of what is happening. Stoltz also offers four basic dimensions that will result in high adversity intelligence capabilities, namely, Control (the feeling of control that belongs to), Origin and ownership (origin and recognition), Reach (reach), and Endurance (individual resilience).

On the other hand, to create a smooth teaching and learning process, teachers as human resources in learning are required to be competent in utilizing learning technology and able to develop themselves independently and sustainably. The use of technology in learning is where the teacher and students together use technology as a learning resource, aids and learning communication infrastructure. In addition to being required to be competent in utilizing technology, teachers are also required to have the skills to know various characteristics of students [11]. So, the ability to understand the concept of science especially physics and adversity quotient is one of the important abilities and must be possessed by students, by understanding the concept, students can develop their abilities in learning physics, students can apply the concepts they have acquired to solve simple problems to the complex, students can relate one concept to another, students can interpret and predict where the problem will be solved. Likewise, with the adversity quotient, students can face a challenge and have confidence and have struggled to overcome various problems that exist, especially in terms of physics. This analysis is carried out on elasticity which includes the relationship between force on length, stress and strain, spring constant, parallel and series in spring, material elasticity, and modulus of elasticity with the aim of research to analyze the understanding of concepts and adversity quotient in tenth-grade high school students.

2. Methods
The method used in this study is a single case study. Researchers used a post-test only group design with a sample of class X high school students in one school in Bandung. The research sample was obtained through a random sampling technique in class X in one of the schools in Bandung with a total of 32 students. The instrument used in this study was a test of concept comprehension ability on the material Elasticity with 15 multiple choice questions and an adversity quotient questionnaire with an Adversity Response Profile (ARP) questionnaire. This test takes two hours of class time, where one hour of study is 45 minutes. The test is given to students who have previously studied the concepts tested on this test. The students’ concept understanding tests were analyzed using the Rasch model [12]. In this study using ministep software to process data obtained from the results of test instruments and student questionnaires.

| Table of STANDARDIZED RESIDUAL variance in Eigenvalue units = Item information units |
|---------------------------------|-----------------------------|-----------------------------|
| Eigenvalue Observed Expected    |
| Total raw variance in observations | 5.3919         | 100.0% | 100.0% |
| Raw variance explained by measures | 2.3010         | 44.4%  | 43.2%  |
| Raw variance explained by persons | 1.0223         | 19.0%  | 18.5%  |
| Raw Variance explained by Items  | 1.3696         | 25.4%  | 24.7%  |
| Raw unexplained variance (total) | 3.0000         | 55.6%  | 56.0%  |
| Unexplained variance in 1st contrast | 2.0854         | 38.2%  | 38.6%  |
| Unexplained variance in 2nd contrast | 0.9004         | 17.4%  | 33.3%  |
| Unexplained variance in 3rd contrast | 0.0013         | 0.0%   | 0.0%   |
| Unexplained variance in 4th contrast | 0.0001         | 0.0%   | 0.0%   |

Figure 1. Validity result of multiple-choice test instrument
Multiple choice test instrument has 44% validity where the test items can be categorized as valid in the condition some test items should be replaced or revised. Besides testing the validity, the multiple choice test and the person reliability was also tested by using Rash Model. The person reliability gained was 0.33 and the test item reliability was 0.44. Based on the data, the consistency of the students’ answers can be categorized as weak. The test item reliability was also categorized as weak. It can be said that the instrument cannot be reliably recognized.

![Figure 2. The reliability result of the test items and the students’ Adversity Quotient](image)

The questionnaire of Adversity Response Profile (ARP) has 76% validity. Therefore, the questionnaire can be categorized as valid. Moreover, the researcher also tested the reliability of the questionnaire by using Rash Model. She found that the person reliability was 0.72 and the test item reliability was 0.86. Based on the data shown, the students’ answer consistency was categorized medium. The test item reliability can be categorized as good. It can be concluded that the instrument can be used.

3. Results and Discussion

This research was held to find out the tenth-year students’ understanding level on concept and adversity quotient at senior high school. Before conducting this research, the researcher previously conducted preliminary research by using instruments developed before. The maximum score for the students who answer all the items correctly was 100. According to the test result of students’ understanding, the mean score of the students was 45.6 with the highest score was 86.7 and the lowest score was 26.7. From the data presented, it can be said that there were only two students who gained the score higher than the standard score. This indicated that the students' understanding of the concept was still low on elasticity in the tenth grade of senior high school.

![Figure 3. Percentage of students answering each indicator correctly](image)
Based on the data gained as shown in figure 3, the percentage of the students answering each aspect correctly in relation to the concept understanding consist of: inference (48%), classifying (43%), interpreting (55%), comparing (38%), summarizing (44%), and explaining (45%). The highest percentage was concept understanding of interpreting which was 55%. In the aspect of interpreting, students can transform information. The example is test item number 10 as shown in figure 4.

**Figure 4. Sample of test item in aspect of interpreting**

The questions on interpreting aspects are aimed at making students able to interpret the results of the experiment in graphical form. In this problem, there are also many students who are unable to answer or just leave blank answers. This is in line with Sa’diyah’s research [13] which states that students find it difficult to analyze concepts for material elasticity and modulus. Of the various sub-materials, students only graduate in a number of sub-materials, including material on the application of springs. The second aspect is inference or drawing conclusions with the acquisition of a percentage of 48%. In this aspect, students are expected to abstract a concept or principle that occurs from a series of examples or events by drawing connections between the characteristics of a series of examples or events. One of the questions from this aspect is that students are able to draw conclusions about the flexibility of material through tables. Based on students’ answers, many did not understand the material. This is the same as Sa’diyah’s research [9] which said that 57% of students did not pass the material modulus of elasticity of the material. The aspect with the third highest result is to explain with a percentage gain of 45%. In this aspect, students have expected In this aspect students are able to explain the causes of increasing spring length in everyday events. Based on the answers from students, only some students are able to explain the purpose of the question. Some students or even more than half percent of students are unable to even answer the question incorrectly. The fourth highest aspect aspect is summarizing with a percentage gain of 44%. In this aspect, students are expected to be able to express one sentence that presents information received or abstract a theme. One of the questions from this aspect is students are able to summarize information or meaning from an everyday event. Based on the answers from students, students only leave their answers blank. This is also in accordance with Sa’diyah’s research [13] and statements on aspects of inference that students lack understanding for material modulus of elasticity. The aspect with the lowest two results is the classification with a percentage gain of 43%. In this aspect, students are expected to be able to know that something (a particular example or event) belongs to a certain category (concept or principle). Questions from this aspect are aimed at making students able to classify springs that have large constants. But apparently most students are not able to answer this. This is in accordance with previous research which says that students are very difficult to solve questions on aspects of classifying for physics learning [14]. The aspect with the lowest yield is comparing with the percentage gain of only 38%. In this aspect, students are expected to be able to detect similarities and
differences between two or more objects, events, ideas, problems, or situations. In this aspect, most students do not answer the questions in the questions.

Understanding of student concepts for all aspects can be said to be low. Students experience difficulties in almost all aspects. The high failure rate in Physics is due to the inability to understand the basic concepts of these materials and the principles of physics in formulas which cause a lack of remembering equations based on problems in physics [15]. Then another reason is that most teachers do not familiarize students with understanding up to the classification and comparison stages, usually the teacher is only trained for the extrapolation stage. In fact, classroom learning activities are based on observing and interviewing high-level students, when they learn physics simply by following the instructions of the teacher. In addition, students rarely use other ways to solve problems. Ideally, teachers should provide opportunities for students to discuss, conduct laboratory experiments, work together as a group, either collaboratively or cooperatively, or occasionally carry out such learning activities as practicums outside the classroom in an open environment to help students understand concepts [16].

In addition to understanding students' concepts, this case study also revealed students' adversity quotient or fighting abilities of four dimensions namely the control dimension (Control), the dimensions of origin and recognition (Origin-Owner Relations), the dimensions of reach (Reach), dimensions of endurance (Endurance).

![Figure 5. Questionnaire distribution of adversity quotient](image)

Based on Figure 5, Adversity quotient shows that only 4 students are climber type (high fighting power), 25 students are camper type (moderate fighting power), 3 students are quitter type (low fighting power). If seen from the results of filling in the student adversity quotient questionnaire or student's fighting abilities, it was revealed that in physics subjects' students had moderate fighting ability. Minorities have a high fighting spirit. This is evident from the students' concept understanding test scores, students who have a high fighting power usually also have good grades, because if we succeed in achieving the target, it is because of the effort or the struggle that we do. This is in line with a report [16] which says that the results of this study indicate that students who have below-average adversity quotient will produce low conceptual knowledge while students who have difficulty quoting above average will produce conceptual knowledge that is high. This condition is seen in the classroom investigations using Macromedia flash where the learning model is applied appropriately for students who have above-average difficulties.

4. Conclusion

Based on the findings and discussion that have been presented previously, the conclusion obtained in this study is the low ability to understand student concepts in every aspect of understanding students' concept. From the percentage, it can be seen that the lowest students' understanding ability of concepts is in the comparing aspect and the highest in inference. The percentage on each of these indicators is
still relatively low because it is below 50%. Adversity quotient shows that the majority of students only have a moderate struggle (camper). So to overcome this we need a variety of solutions that can improve students’ understanding of concepts and student struggles such as methods, strategies or methods.

5. References
[1] Arends R I 2012 Learning to teach (7th Eds.)(New York: McGraw Hill Company Inc.)
[2] Arista F S &Kuswanto H 2018 International Journal of Instruction 111 1-16
[3] Mashadi A and Woolnough B 1996 Cognitive Mapping of Advanced Level Physics Students’ Conceptions of Quantum Physics In Meeting of the Singapore Educational Research Association (Singapore) p 3
[4] Fosnot C T 2005 Constructivism: Theory, Perspectives, and Practice (New York: Teachers College)
[5] Aktan DC 2012 European Journal of Physics 34 1 33
[6] Anderson L W and Krathwohl D R 2013 A taxonomy for learning, teaching, and assessing: A revision of Bloom’s taxonomy of educational objectives (New York : Longman)
[7] McDermott LC 2001 Oersted medal lecture 2001: “Physics Education Research—the key to student learning”. American Journal of Physics 691 1127-37.
[8] National Science Teachers Association 2010 NSTA position statement: The integral role of laboratory investigations in science instruction 11 201-204
[9] Stoltz PG 2000 Adversity Quotient: Turning Obstacles into Opportunities (Mengubah Hambatan menjadi Peluang) (Jakarta: Grasindo)
[10] Abele AE and Gendolla GHE 2007 Personality and Individual Difference 43 1125-1135
[11] Sutopo and Waldrip 2013 International Journal of Science and Mathematics Education 12 741-765
[12] Sumintono B 2017 Rasch model measurements as tools in assessment for learning, advances in social science Education and humanities research 173
[13] Sa’diyah H, Sarwanto S and Sukarmin S 2017 International Journal of Science and Applied Science: Conference Series 21 139-155
[14] Avargil S, Lavi R and Dori Y J 2018 Cognition, Metacognition, and Culture in STEM Education 33-64
[15] Reddy M and Pancharoensawad B 2017 Journal of Education and Practice 8 14 59-62
[16] Reis P 2014 Activist Science and Technology Education pp.547-574.