Mathematics learning achievement of vocational high school students’ viewed by adversity quotient

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Abstract. Efforts to improve the quality of education have been done by improving the implementation of learning, but the effort has not been enough. This can be seen from the low achievement of students' mathematics learning. One of the factors can influence student’s mathematics learning achievement is the students Adversity Quotient. There are three types of AQ, they are quitters, campers, and climbers. The purpose this study is to find out which one provides better mathematics learning achievement between students with AQ quitters, campers, or climbers type. The type of this research is descriptive quantitative. Data collection techniques of mathematics learning achievement obtained from the value of mathematics test, while the AQ data obtained by the student questionnaire. The subjects of the research are 189 students from three Vocational High Schools in Gunungkidul Regency, Indonesia, with high, medium and low school category. The data analysis technique used is one-way anova with unbalanced cells and post hoc test using Scheffe method. The results show that students with AQ climbers type have better mathematics learning achievement than students AQ type campers and quitters. Students with AQ campers type have better mathematics learning achievement than students AQ quitters type.

1. Introduction
Mathematics is a universal science that underpins the development of modern technology that has an important role in various disciplines and develop the human mind power. Abstract mathematical concepts which correlate each other to form new, more complex concepts [1]. For that in shaping the concept of new mathematical knowledge, students are introduced to things that are abstract. Many assume that mathematics is difficult, because mathematics is identical to a series of numbers, symbols, and formulas that can be solved through mathematical arithmetic operations. Of course this will affect the student's mathematics learning achievement.

One of the goals of learning mathematics for students is that he has a good achievement in learning. The intellectual ability of students can determine the success of students in achievement. The achievement of learning is the result obtained by the students during the learning process takes place in the form of figures or values [2]. In line with this, that academic achievement refers to particular learning in a particular setting which is defined by examination marks, teachers’ given grades and percentiles in
academic subjects [3]. However, one of the greatest crises of educational systems in many countries, especially developing countries is the problem of low academic achievement [4].

Efforts to improve the quality of education have been done by improving the implementation of learning, especially in Indonesia. However, the effort has not been enough to gain satisfactory results. This can be seen from the mathematics learning achievement shown by the students that is still low. The fact was supported by the students' mathematics achievement which is still low. The low achievement of students' mathematics learning can be seen in the report of the National Examination of Vocational High School of 2017 as follows.

| National Exam Score | Indonesian | English | Mathematics | Competence | Total Average |
|---------------------|------------|---------|-------------|------------|--------------|
| Average             | 64.23      | 40.35   | 36.81       | 73.59      | 214.98       |
| Category            | C          | D       | D           | B          | D            |

Based on Table 1, it can be seen that the average of the national exam score of all mathematics subjects of the vocational high school in Indonesia in the academic year of 2017 was 36.81 with the D category. The same problem is also found in Daerah Istimewa Yogyakarta. The mathematics national exam results of Vocational High School lesson in Yogyakarta in year of 2017 are presented in the table 2 below.

| Average Result of UN Mathematics Vocational High School in D.I. Yogyakarta | 2015 | 2016 | 2017 |
|--------------------------------------------------------------------------|------|------|------|
| Average                                                                  | 55.30| 48.53| 49.23|
| Category                                                                 | C     | D    | D    |

Based on Table 2, the national exam results of Vocational High School in Table 2 during the last three years, it can be seen that the results of Mathematics National Exam subjects are still low. In the year 2015 the average of mathematics was 55.30 with C category. Even in the year 2016 the average of mathematics experience decrease to 48.53 with D category. In 2017, the results of mathematics were not much different from the previous year, 49.23 with D category. The same results can also be seen from the achievement of Mathematics National Exam in Gunungkidul Regency as the following.

| National Exam Score | Indonesian | English | Mathematics | Competence | Total Average |
|---------------------|------------|---------|-------------|------------|--------------|
| Average             | 72.98      | 45.81   | 50.43       | 76.94      | 246.16       |
| Category            | B          | D       | D           | B          | D            |

Based on Table 3 above, it can be seen that the acquisition value is still in the low category of 50.43 with D category. The low learning achievement may be due to the use of learning models.

In the learning process in school, each student is expected to obtain satisfactory learning achievement. Achievement was obtained by way of learning, both at school and at home. However, sometimes students are faced with obstacles both within themselves and the surrounding environment. It certainly can make student achievement decreased. To be able to optimize the potential that exists within, a student should have a high fighting power and not easily give up if faced with difficulties. This is what is often referred to as Adversity Quotient (AQ). So, the purpose this study is to find out which one provides better mathematics learning achievement between students with AQ quitters, campers, or climbers type.
2. Literature review

Adversity can be defined in many ways such as difficulties, failures, problems, or even misfortune. Furthermore, adversity quotient is one’s resilience and the ability to survive in facing constant change, stress and difficulty or difficulty is only a measure of how students respond to adversity [5]. Adversity in mathematics is defined as learning difficulties in understanding mathematics that shows how much students struggle to learn, having a passion for self-struggle, in the way of how many students want to improve themselves [6].

There are three types of AQ, namely quitters type, campers type, and climbers type. Students with quitter’s type have assumptions that mathematics is complicated, confusing, and dizzy. Their motivation is very poor, so when they find a little difficulty in solving mathematics problems they give up and quit without spending any efforts. Students with camper’s type are those who do not want to take great risks and feel satisfied with the achieved conditions or circumstances. Students of this type tend to give up early, spend less efforts in studying. In mathematics learning, students with camper’s type do not try to the maximum extent possible, they try to be always only in the safe zone, and to be always simple. Students with climber’s type are students who have goals or targets. To achieve those goals, they are able to work persistently. In addition, they also have the courage and high discipline. Like people determined to climb a mountain, this type of students always want to reach the top. Thus, there are three types of adversity quotient as quoted by Stoltz [5].

The three types are grouped into four dimensions of adversity quotient, that are control, origin and ownership, reach, endurance [6]. In mathematics, students with great control of themselves can control themselves from unnecessary stress and thoughts. In the end, students can learn easily, have an open mind over mathematics. The second dimension is origin and ownership. Origin and ownership is defined as something that is done to help a person learn and adapt behaviors that can improve the quality of self. The highest origin and ownership possessed, shows how much responsibility that is owned and the more likely it is that a person perceives that success is always being influenced by external factors and student’s self. The third dimension is reach. Reach measures how far adversity enters the student’s field of life. In Mathematics, the reach can be seen in how many students can overcome difficulties and turn into something positive for themselves. This can be seen when students learn math like coping with panic, despair, sadness, and easily give up or not. The fourth dimension is endurance. Endurance here means how a person sees a problem they have. For example, if students look at mathematics is difficult due to lack of skills then they will improve their skills to make it easier for them to learn mathematics, but if students see mathematics like something that is too difficult to learn then they will stop to learn which can be interpreted that there is no interest in learning. Thus The three types are grouped into four dimensions of adversity quotient by Canivel [6].

Based on several definitions and classifications of AQ type, in this study AQ is an individual ability of students to be able to survive all kinds of difficulties to find a way out, solve various problems, reduce obstacles and obstacles by changing the way of thinking and attitude to the difficulty. The categorization of adversity quotient in this study is based on four components are control, origin and ownership, reach, and endurance. The categorization of adversity quotient according to [5], which the instrument consists of 40 item statements, are as follows: (a) AQ Climber is at the interval 135-200 of the score of the questionnaire because the students can survive and keep trying to solve the problem despite facing severe problems, (b) AQ Camper is at the interval 60-134 because students have been able to take advantage of the potential possessed although it is not maximal. They prefer a safe road, tend to be satisfied quickly, and (c) AQ Quitter is at the interval 0-59 because in that score it is still less students who take advantage of their potential and may have experienced unnecessary problems that can cause great losses and make students less determined to overcome difficulties which they face.
3. Methodology
This type of research is descriptive quantitative. The population of this research is all students of Vocational High School in Gunungkidul Regency Yogyakarta, while the subject of this research is X class students from three schools in Gunungkidul Regency Yogyakarta. Three categories of schools are obtained based on the national examination score in 2017 using stratified cluster random sampling technique. Each school represents three categories, namely high, medium, and low. Based on the results of categorization, obtained SMK Negeri 1 Wonosari as high school category, SMK Negeri 1 Ponjong as a medium school category, and SMK Muhammadiyah 1 Playen as a low school category. The subjects of this study are 189 students divided into high and low category schools each taken 61 students, and school with medium category is taken 67 students. The research was conducted in second semester of academic year 2017/2018.

The instrument used in this research is adversity quotient questionnaire. Adversity quotient questionnaire consists of 40 statement items. Before the questionnaire is given on the subject of the study, each questionnaire is validated and tested first. In this study, the validity test used is the validity test of the content by the validator. Questionnaire has been validated by two experts consisting of one psychology lecturer and one counseling teacher. After obtaining validation from two experts, the questionnaire was tested to 76 students outside the research sample. The data that has been collected and then it is analyzed by using internal consistency test and reliability test with Cronbach Alpha technique.

The data collection techniques in this study is using a questionnaire of adversity quotient and the data of students' mathematics learning achievement is obtained from the final score of odd semester of year 2017 in each school category. The data analysis technique of this research using one-way ANOVA statistical test with unbalanced cells and based on the acquisition of questionnaire scores which then it is categorized by category adversity quotient of students score. In this study, adversity quotient of students is grouped into three the types, they are climbers, campers, and quitters.

4. Result and discussion
The research first begins by determining the subject of research. The population of this research is all students of Vocational High School in Gunungkidul Regency Yogyakarta. The subject of this research is taking sample of class X students from three schools in Gunungkidul Regency Yogyakarta. Three categories of schools are obtained based on the analysis of national exam scores in 2017. The results of the categorization show there are 9 schools with high category, 15 schools in the medium category, and 17 schools with low category. From each of these categories, each selected a school to serve as a study sample based on school accreditation and the average grade of the school. The result of the categorization school analysis is as follows.

| School Category | School Name                  |
|-----------------|------------------------------|
| High            | SMK Negeri 1 Wonosari        |
| Medium          | SMK Negeri 1 Ponjong         |
| Low             | SMK Muhammadiyah 1 Playen    |

Based on the Table 4, there are three schools which are categorized into high, medium, and low category. High school category is SMK Negeri 1 Wonosari, medium category school is SMK Negeri 1 Ponjong, and school with low category is SMK Muhammadiyah 1 Playen. The subjects in this study is taking sample of 189 students, including 61 students from high and low schools, and 67 students from low category school.

After determining three schools and research subject, then a questionnaire test which has been validated by two experts is adversity quotient questionnaire to 76 students outside the research subject. In the test adversity quotient questionnaire amounted to 60 items of statement. The result of
questionnaire test which is done by internal consistency test of each item, and ended with Alpha Cronbach reliability test equal to 0.9291 for adversity quotient questionnaire. Based on the results of the questionnaire analysis it is obtained 40 items statement on questionnaire that is ready to be used as research instrument.

The prepared questionnaire instrument then is given to the research subjects in three schools. Questionnaire adversity quotient is used to find out the number of students who are climbers, campers, and quitters in each school. The following is an adversity quotient questionnaire analysis:

**Table 5. Students adversity quotient distribution.**

| Adversity Quotient Category | School Category | Number of Students |
|-----------------------------|-----------------|--------------------|
|                             | High | Medium | Low |
| Climbers                    | 31   | 19     | 13  | 63  |
| Campers                     | 18   | 32     | 21  | 71  |
| Quitters                    | 12   | 16     | 27  | 55  |
| Number of Students          | 61   | 67     | 61  | 189 |

Based on the Table 5, students with adversity quotient type climbers are 63 students, campers type 71 students, and quitters type 55 students. From the results of this analysis it is seen that students with adversity quotient of type campers is more than the other two types although in the terms of numbers, the difference is not very significant. This means that many students who have a character at the middle level which is feeling satisfied with the conditions or circumstances that they have been achieved, either successful with satisfactory or simply to meet the targets they achieve. The tendency in this type is students rarely want to take too big a risk either when solving a problem or a bigger target.

In this study because the size of each sample in each school is not the same, to know which gives better mathematics learning achievement between students with adversity quotient of quitters, campers, or climbers type, then in this study using statistical test one-way analysis of variance with unbalanced cells. The data analysis results will be used in the one-way anova statistical test with unbalanced cells.

**Table 6. Data of students’ adversity quotient.**

| Adversity Quotient Category | n  | Mean    | Standar Deviasi | Minimum Score | Maximum Score |
|-----------------------------|----|---------|-----------------|---------------|---------------|
| Climbers                    | 63 | 57.90   | 12.339          | 20            | 80            |
| Campers                     | 71 | 49.75   | 14.941          | 20            | 80            |
| Quitters                    | 55 | 30.91   | 12.877          | 10            | 75            |
| Number of Students          | 189| 117.53  | 46.98           |               |               |

Based on Table 6, we obtain the data to be used for statistical tests. Student categorization data with these three types of adversity quotient, will then be grouped by their respective types of mathematics learning achievement scores. After the data of the students’ mathematics learning achievement scores on the students with adversity quotient types of climbers, campers, and quitters grouped, will be tested hypothesis using one-way anova with unbalanced cells. Whether the three types of adversity quotient have the same effect on the students’ mathematics learning achievement (as H₀), or at least two types do not have the same effect on the students’ mathematics learning achievement (as H₁). The statistical test results can be seen in the following table Anova Summaries.
Based on Table 7, if Critical Area = \{F|F > F_{\alpha; k-1; N-k}\}$ with $F_{0.05; 2; 186} = 3.0445$ and $F_{\text{obs}} = 60,847 \leq$ critical area, then $H_0$ is rejected. In conclusion, it is not true that the three adversity quotient types of climbers, campers, and quitters give the same effect to a student's mathematics learning achievement. Furthermore, in this study, post hoc tests with the scheffe method is performed to find out which one provides better mathematics learning achievement between students with adversity quotient type of quitters, campers, or climbers. The results of post hoc test analysis with Scheffe method.

**Table 8. Post-anova multiple comparisons with scheffe method.**

| [I] AQ | [J] AQ | Mean Difference (I-J) | $F_{\text{obs}}$ | $F_{\alpha}$ | Sig | p |
|--------|--------|----------------------|----------------|-------------|-----|---|
| Scheff | Climbers | 8,143                | 7,696 | 6,089       | 0.003 | < 0.05 |
|        | Quitters | 26,988               | 41,127| 6,089       | 0.000 | < 0.05 |
| Campers| Climbers | -8,143               | 121,468| 6,089       | 0.000 | < 0.05 |
|        | Quitters | 18,844               | 121,468| 6,089       | 0.000 | < 0.05 |
| Quitters| Climbers | -26,988              | 121,468| 6,089       | 0.000 | < 0.05 |
|        | Campers | -18,844              | 121,468| 6,089       | 0.000 | < 0.05 |

Based on Table 8, the mean comparison between students with adversity quotient types of climbers and campers has $F_{\text{obs}} = 7,696$. If critical area = \{F|F > (k-1)F_{\alpha; k-1; N-k}\}$ dengen $2F_{0.05; 2; 186} = 6,089$ then $F_{\text{obs}} \leq$ critical area, then $H_0$ is rejected. This means that students with adversity quotient type of climbers give different effects with students of camper’s type. Since the mean of students with adversity quotient type climbers had higher mean of students with adversity campers type in mathematics learning achievement of students, it was concluded that students with climber’s type had better mathematics learning achievement compared with students with camper’s type. Likewise, the average comparison between students with adversity quotient of climbers and quitters types has $F_{\text{obs}} = 41,127$, $F_{\text{obs}} \leq$ critical area, then $H_0$ is rejected. This means that students with adversity quotient climbers type give different effects with quitters. Since the average of students with adversity quotient climbers type has higher mean of students with adversity quitters type on the mathematics learning achievement of students, it can be concluded that students with climber’s type have better mathematics learning achievement than students with type quitters type. Furthermore, the mean comparison between students with adversity quotient campers and quitters types has $F_{\text{obs}} = 121,468$, $F_{\text{obs}} \leq$ critical area, then $H_0$ is rejected. This means that students with adversity quotient campers type give the different effects with quitter’s type students against mathematics learning achievement of students, it can be concluded that students with camper’s type have better mathematics learning achievement than students with quitter’s type.

It is relevant that adversity students with adversity quotient type climbers having high learning motivation, creative thinking and being able to understand math problems well [7]. It means students have a good mathematics learning achievement on the students with adversity quotient type climbers.
is encountered when students find too ‘difficult’ lesson, they give up and express their anger feelings, dissatisfaction, and doubt about their own abilities [8]. Other studies have shown that students face many situations or obstacles in their daily life, and to overcome or solve this problem, adversity quotient is needed [9]. Further they said that students who have good AQ will be able to endure in facing various difficulty in mathematics learning. When you see the AQ indicators, a student who has ability to control the response in studying is more resilient and not easily discouraged. It is associated with aspects of process control in student’s own thinking. This supports Stoltz [10] previous findings that the contrarian dimension has the greatest influence on student achievement. In other words, students need to get used to control thinking process called metacognition. This is in accord with opinion of Schoenfeld [11] and Gartmann and Freiberg [12] that metacognition is a habit in controlling the process of cognitive behavior, control or self-monitoring of one’s thought processes.

Furthermore, the findings of this study indicate that the higher the adversity quotient, the better their academic achievement in mathematics. These findings support Bandura's social cognitive theory (SCT) that the person's ability to succeed in a particular situation or complete the task and can contribute to a better performance [13]. The results of this study also support three other studies conducted by Amalia, Wiswayana, Fadhila [14-16] that AQ climbers type give better mathematics learning achievement than AQ campers and quitters type. In other studies, provide solutions that when students are exposed to high thinking mathematics content, the learning is increased [17].

5. Conclusion
Based on the statistical analysis of the test it can be concluded that, students with AQ of climber’s type have better mathematics learning achievement than students with AQ of campers and quitter’s types. Students with AQ campers type have better mathematics learning achievement than students AQ quitters type. The dominant high mathematics learning achievement is possessed by a student with adversity quotient climbers type. Students with adversity quotient climbers type have the characteristic of a challenge, want to always reach the goal or target, he is able to cultivate with tenacious and persistent. Mathematics achievement of middle aged students, dominantly owned by students with adversity quotient campers type who have a character feel satisfied with the conditions or circumstances that have been achieved, the trend in this type of students rarely want to take risks that are too large. The students' mathematics learning achievement is low, dominantly owned by students with adversity quotient quitters type. Students with adversity quotient quitters type have the characteristic of assuming that mathematics is complicated, and confusing.

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