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Mathematics Disposition of Vocational High School Students Viewed by Adversity Quotient

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Abstract. The inclusion of character building education in Indonesia curriculum education that should be strengthened and integrated in students, effect the curriculums at school make adjustments. In the context of such adjustment, students' mathematics learning needs to be instilled in a diligent, persistent, and critical thinking in exploring mathematics problems. In mathematics, it is called mathematics disposition. One of the factors that might influence a student's mathematics disposition is the student's Adversity Quotient (AQ). Adversity Quotient is an ability to change, or process a problem and make it a challenge that must be solved. In mathematics learning, each student has a different AQ. There are three types of AQ, they are quitters, campers, and climbers. The purpose of this study is to find out which one provides better mathematics disposition between students with AQ quitters, campers, or climbers type. The type of this research is quantitative research with survey method. The data were collected through questionnaires. 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 disposition than students with AQ campers and quitters types. Students with AQ campers type have the same mathematics disposition as students of quitters type.

INTRODUCTION

Education plays an important role in preparing qualified human resources which able to compete in the development of science and technology. The concept of education is increasingly important when one enters life in society and workplace, as they must be able to apply what is learned in school to deal with the problems faced in everyday life in this current era of globalization.

Mathematics has a very important role in education system. One of the efforts to achieve a qualified education is to improve the quality of mathematics education. Mathematics education has a very important role in the successful development of education quality in Indonesia because mathematics can build logical and systematic mindset which improve the ability to deal with various problems. One must have a good mathematical literacy in order to interpret data, solve everyday problems, provide explanations in numerical, graphical, and geometrical, and communicate using mathematics [1].

The purpose of mathematics learning is to develop the ability to explore, develop conjectures, organize logical reasons, the ability to complete non-routine, the ability to communicate mathematically and use mathematics as a communication tool, the ability to connect among mathematical ideas [2]. The use of mathematics not only provides the ability in quantitative calculations, but also in structuring the ways of thinking, especially in formating analysing abilities, making synthesis, conducting evaluation until the ability to solve problems. Those abilities can be obtained by familiarizing and characterizing students in math.

The inclusion of character building education in curriculum education in Indonesia that should be strengthened and integrated in students resulted the curriculums adjustments. Mathematics is a subject that builds character value for students. This can be seen from students who are confident, diligent, persistent, interested, and think critically in exploring various mathematics problems. In addition, students must have a curiosity in mathematics and appreciate the use of mathematics. In mathematics, it is called mathematics disposition. Mathematics disposition is a very important concept in the process of mathematics learning. mathematics disposition appears on how often students learning mathematics and how many students enjoy learning mathematics. Mathematics disposition are not just passive experiences, but also the environmental impact and guidance of people around him [3]. Teachers should build a learning process that evokes mathematics disposition because of the different outcomes of student's experience in the classroom that is influenced by how teachers teach. The mathematics disposition of students may increase if students are enthusiastic in teaching and learning [4].

Mathematics disposition is great affects on the success of mathematics learning. Students need to face the problem of mathematical disposition, responsibility in learning, and developing their own potential towards mathematics. This is a very important characteristic of the students. Students will not always use all material they have learned, but it is certain that they need a positive disposition to deal with mathematics problems in their lives by growing a student's mathematics disposition, will have motivation, confidence, confidence in mathematics. While mathematics disposition can not be viewed as dispositions as a whole, they can serve as a basis for fostering other positive attitudes, such as self-confidence, interest in mathematics, the use of mathematics, and the like [5].

Several studies have identified a mathematical disposition among students, mathematics is full of rules and formulas to be remembered [6],mathematics is dry, it does not leave room to feelings [7], mathematics does not make sense, the aim of learning certain things is not clear, and in mathematics, there is no room to express one's own ideas [8]. One of the factors that might influence student's mathematical disposition is student's Adversity Quotient (AQ). Adversity Quotient is an ability to change, or process a problem and make it a challenge that must be solved [9]. Each student has a different AQ. Of course with different AQs, student's mathematics disposition will have many variations. So, the purpose of this study is to find out which one provides better mathematics disposition between students with AQ quitters, campers, or climbers type

Mathematics Disposition

Disposition is a customs to behave consciously, frequently, and voluntarily to achieve certain goals. This behavior includes self-confidence, persistence, curiosity and flexible thinking. In the mathematics context, mathematical disposition relate to how students solve mathematics problems: whether confident, diligent, interested, and flexible thinking to explore alternative resolutions. In the context of learning, mathematics dispositions relate to how students ask questions, answer questions, communicate mathematical ideas, work in groups, and solve problems [10]. Mathematics disposition is a customs to think and act positively. This trend reflected students' interest and belief in mathematics and the willingness of learning to reflect on their own thoughts [11]. Mathematics dispositions are the desire, awareness, and strong dedication of students to learn mathematics and apply various mathematical activities [12].

Attitudes and beliefs that help to shape student's reactions to mathematics and therefore they are the element key in the students mathematics disposition development. A student's disposition to mathematics can be defined as multidimensional which can improve learning as well as inhibit the mathematics learning, depending on the affective perspective which is taken by the student [13].

Mathematics disposition is productive or positive attitudes and positif habits to view mathematics as logical, useful, and valuable. Student mathematics disposition is a major factor in determining their educational success reviews [14]. Mathematics disposition is included the willingness to take risks and seek solutions from diverse problems, persistence to solve challenging problems, be responsible for reflection on work, appreciate the power of math language communication, willingness to ask and suggest other math ideas, the willingness to try different ways to explore mathematical concepts, have confidence in his abilities, and see problems as challenges.

Disposition is closely linked to attitude. In research to determine mathematics teachers' influences on students' attitudes toward mathematics, In the results of the study [15], that teachers influenced students' understanding and mathematics disposition, that are: (a) through the way they taught mathematics, (b) by making certain that their students understood mathematics, and (c) through their personalities. Students claimed they understood and liked mathematics when their teachers: (a) had fun and interesting lessons, (b) had the students actively engaged in the

classroom, (c) showed the students how the mathematics they were learning was related to their lives, (d) taught at a relatively slow pace, (e) helped students outside of the classroom, (f) cared about their students, and (g) teachers were enthusiastic about mathematics and teaching mathematics.

Mathematics disposition relates to how students solve mathematical problems, whether confident, diligent, interested, and flexible thinking to explore any kinds of alternative solutions. In the context of learning, mathematics disposition is concerned with students asking, answering questions, communicating mathematical ideas, working in groups, and solving problems.

The mathematics disposition contains seven components, that are: convinced in the use of mathematics, flexible in mathematics, persistent and tenacious, possessing curiosity in mathematics, reflective in the way of thinking, appreciating mathematics applications and appreciating mathematical roles [16]. There are six indicators of mathematics disposition, which are: demonstrating a passion in learning mathematics, showing a serious interest in learning mathematics, showing resilience in the face of mathematical problems, showing confidence in learning and solving mathematical problems, showing high curiosity, and having a desire to share with others [14].

Based on the description, in this research, mathematics disposition is how a student behaves towards mathematics. The attitude can be demonstrated by the passion of learning, attention, persistence, confidence, curiosity and sharing in mathematics. The mathematics disposition in this study is measured by making a scale that contains statements from each indicators. The aspects of mathematics disposition used in this study are: (a) confidence in the use of mathematics; (b) flexible in mathematics; (c) persistent and tenacious in doing math tasks; (d) having a curiosity in mathematics; (e) reflecting on the way of thinking; (f) appreciating the mathematical applications; and (g) appreciating the role of mathematics.

From each aspect, it will be divided into several indicators that will be arranged in several statements and five response answers using likert scale. Furthermore, the grouping of mathematical disposition of students using the norm reference that is with the calculation of the average class and standard deviation into three levels of mathematics disposition that is high, medium, and low.

Adversity Quotient

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 difficultiy or difficulty is only a measure of how students respond to adversity [9]. Adversity in mathematics is defined as learning difficulties and understanding of mathematics that will show how much students struggle to learn, having a passion for self-struggle, in the way of how many students want to improve themselves [17].

There are three types of AQ, namely: quitters type, campers type, and climbers type. Students with quitters type have characteristic assumes that mathematics is complicated, confusing, and dizzy. Their motivation is very poor, so when they find a little difficulty in solving math problems they give up and quit without accompanied any effort. Students with campers type are students who do not want to take risks which are too big and feel satisfied with the conditions or circumstances that have been achieved at this time. Students of this type tend to feel quite in the middle position, less effort to study harder. In learning mathematics, students with campers type do not trying to the maximum extent possible, they are only in the safe zone, and they are just trying to be simple. Students with climbers type are students who have goals or targets. To achieve that goal, they are able to work with persistent and persistent. It is not only that, they also have the courage and high discipline. Like people determined to climb a mountain, then this type of students always want to reach the top. Thus The three types of adversity quotient by [9].

The three types are grouped into four dimensions of adversity quotient, that are control, origin and ownership, reach, endurance [17]. 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 higher 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 learning 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 is then interpreted there is no interest in learning. Thus The three types are grouped into four dimensions of adversity quotient by [17].

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 [9], 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.

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 high, medium, and low of schools are obtained based on the national examination score in 2017 using stratified cluster random sampling technique. The results of the categorization shows there are 9 schools with high category, 15 schools in the medium category, and 17 schools with low category. From each of these categories, is selected a school to serve as a study sample based on school accreditation and the average grade of the school. 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 a questionnaire of mathematics disposition and an adversity quotient questionnaire. Each questionnaire of mathematics disposition and adversity quotent 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. Each 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. In the test questionnaire mathematics disposition and adversity quotient each 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 0,9518 for questionnaire of mathematics disposition and 0,9291 for adversity quotient questionnaire. Based on the results of the questionnaire analysis it is obtained 40 items statement on each questionnaire that is ready to be used as research instrument.

The data collection techniques in this study is using a questionnaire of mathematics disposition and questionnaire adversity quotient. The data analysis technique of this research using one-way ANOVA statistical test with unbalanced cells and based on the score of questionnaire which then it is categorized by category of mathematics disposition and adversity quotient of students score. In this study, the student's mathematics disposition is grouped into three categories, namely high, medium, and low. Adversity quotient of students are grouped into three the types, they are climbers, campers, and quitters.

RESULTS AND DISCUSSION

The research begins by giving 40 item statements an adversity quotient questionnaire instrument that have been validated and ready to be tested to students in three categories of schools, to get the data categories of students in each school to find out the number of students who are climbers, campers, and quitters in each school. The following is a result of adversity quotient questionnaire analysis.

TABLE 1. 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 1, students with adversity quotient climbers type are 63 students, campers type are 71 students, and quitters type are 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 trend in this type is students rarely want to take too big a risk either when solving a problem or a bigger target. Furthermore, the following is the result of questionnaire analysis of student's mathematics disposition.

TABLE 2. Student Mathematics Disposition Distribution

Mathematical Disposition Category	School Category			Number of Students
	High	Medium	Low	
High	31	22	17	70
Medium	17	23	21	61
Low	13	22	23	58
Number of Students	61	67	61	189

Based on the TABLE 2, it is obtained that students with high mathematics disposition category are 70 students, medium category are 60 students, and low category are 59 students. The results of this analysis shows that students with high category mathematics disposition is more than the other two categories. It is similar to the results of the questionnaire adversity quotient analysis, the number of students from each category does not have a significant difference. Although it is not dominant compared with the number of students with a high disposition category, students with medium and low categories, if it is examined more deeply it has a majority number than students with high category disposition. It means that most students lack a positive attitude towards mathematics such as confident, diligent, persistent, interested, and critical thinking in exploring various math problems at lower middle level. Likewise the curiosity of students in mathematics and appreciating the use of mathematics. Furthermore, the following is the result of the questionnaire quote and student's mathematics disposition analysis.

TABLE 3. Grouping between Adversity Quotient and Student Mathematics Disposition

Mathematical Disposition Category	Adversity Quotient Category			Number of Students
	Climbers	Campers	Quitters	
High	49	10	11	70
Medium	8	37	16	61
Low	5	25	28	58
Number of Students	62	72	55	189

Based on the TABLE 3 the classification between mathematics dispositions of students and adversity quotient of students obtained by the high mathematics disposition categories which dominantly owned by a students with

adversity quotient of climbers type. Students with adversity quotient of climbers type have a characteristic to like challenge, always want to achieve goals or targets, able to cultivate with perseverance and persistence, so the motivation, enthusiasm and attitude of the students to mathematics with adversity quotient of climbers type is very high. The category of medium mathematics dispositions dominantly owned by students with adversity quotient of campers type who have a character of satisfied with the conditions or circumstances that they have been achieved, either successfully satisfactory or just to meet the targets they achieve. The tendency in this type is students rarely want to take too big risk either when they are solving a problem or a bigger target, so that the motivation, enthusiasm and attitude of students to mathematics with adversity quotient of campers type in the medium category. The category of low mathematics disposition dominantly owned by students with adversity quotient of quitters type. Students with adversity quotient of quitters type have the characteristic of assuming that mathematics is complicated, confusing, and dizzy. Their motivation is so poor that when they find a little difficulty in solving mathematics problems they give up and stop without any effort, so that the motivation, enthusiasm and attitude of students to mathematics with adversity quotient of quitters type is in the low category.

In this study, because the size of each sample in each school is not the same, to know which gives better mathematics disposition 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 as follows.

TABLE 4. Data of Students' Adversity Quotient

Adversity Quotient Category	n	Mean	Standar Deviasi	Minimum Score	Maximum Score
Climbers	63	133,17	14,639	80	155
Campers	71	111,94	13,917	70	155
Quitters	55	106,82	20,653	58	143
Number of Students	189	117,53	19,816		

Based on TABLE 4, we obtain the data to be used for statistical tests. The Average mathematics disposition score of students on each of AQ types was obtained climbers AQ of 133,17, campers 111,94 AQ, and quitters AQ 106,82. Student categorization data with these three types of adversity quotient, will then be grouped by their respective types of mathematics disposition scores. After the data of the students' mathematics disposition 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 to see the effect of the independent variables of students adversity quotient to the dependent variable of mathematics disposition by comparing the mean of some populations. Whether the three types of adversity quotient have the same effect on the students' mathematics disposition (as H_0), or at least two types do not have the same effect on the students' mathematics disposition (as H_1). The statistical test results can be seen in the following table.

TABLE 5. Anova Summaries

	Sum of Squares	Df	Mean Square	F_{obs}	F_{α}	Sig	p
Between Groups	23946,054	2	11973,027	44,648	3,0445	0,000	$<$ 0,05
Within Groups	49879,036	186	268,167	-		-	-
Total	73835,090	188	-	-		-	-

Based on TABLE 5 was obtained if Critical Area = $\{F|F > F_{\alpha;\,k-1\,;\,N-k}\}$ with $F_{0,05;\,2\,;\,186} = 3{,}044$, and $F_{obs} = 44{,}648 \in$ 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 disposition. Furthermore, in this study,

post hoc tests with the scheffe method is performed to find out which one provides better mathematics disposition between students with adversity quotient type of quitters, campers, or climbers. The results of post hoc test analysis with Scheffe method as follows.

TABLE 6. Post-ANOVA Multiple Comparisons with Scheffe Method

	[I] AQ	[J] AQ	Mean Difference (I-J)	F_{obs}	F_{α}	Sig	p
Scheffe	Climbers	Campers	21,231	56,058	6,089	0,000	$<$ 0,05
		Quitters	26,356	76,003	6,089	0,000	$<$ 0,05
	Campers	Climbers	-21,231			0,000	$<$ 0,05
		Quitters	5,125	3,044	6,089	0,222	$>$ 0,05
	Quitters	Climbers	-26,356			0,000	$<$ 0,05
		Campers	-5,125			0,222	$>$ 0,05

Based on TABLE 6, the mean comparison between students with adversity quotient types of climbers and campers has $F_{obs} = 56{,}058$. If critical area = $\{F|F > (k-1)F_{\alpha;\,k-1\,;\,N-k}\}$ with $2F_{0{,}05;\,2\,;\,186} = 6{,}089$ then $F_{obs} \in$ critical area, then H_0 is rejected. This means that students with adversity quotient type of climbers type give different effects with students of campers type. Since the mean of students with adversity quotient of climbers type had higher mean of students with adversity of campers type in mathematics disposition of students, it was concluded that students with climbers type had better mathematics disposition compared with students with campers type. Likewise, the average comparison between students with adversity quotient of climbers and quitters types has $F_{obs} = 76{,}003$, $F_{obs} \in$ critical area, then H_0 is rejected. This means that students with adversity quotient of climbers type give different effects with quitters. Since the average of students with adversity quotient of climbers type has higher mean of students with adversity quotient of quitters type on the mathematics disposition of students, it can be concluded that students with climbers type have better mathematics dispositions than students with quiters type. These result was relevant that students with AQ climbers type have better mathematics disposition than students with AQ campers and quitters types [18]. Furthermore, the mean comparison between students with adversity quotient campers and quitters types has $F_{obs} = 3{,}044$ $F_{obs} \notin$ critical area, then H_0 not rejected. This means that students with adversity quotient campers type give the same effect with quitters type students against mathematics disposition of students.

Based on the statistical analysis of the test it can be concluded that, students with adversity quotient of climbers type have better mathematics dispositions than students with adversity quotient of campers and quitters types. Students with adversity quotient of campers type have the same mathematics disposition with students of quitters type. It is relevant that adversity quotient influences to the disposition in solving problem. That students with adversity quotient of climbers type having high learning motivation, creative thinking and being able to understand math problems well [19]. It means students have a good mathematics disposition on the students with adversity quotient of climbers type. Other studies have shown that, in the United States, students typically attend school with a positive attitude towards mathematics, but many students failed to maintain this attitude [20]. It is encountered when students find too 'difficult' lesson, they give up and express their anger feelings, dissatisfaction, and doubt about their own abilities [21]. Repeated failures cause some students to develop their mathematical anxiety and avoidance habits[22]. These feelings inhibit the development of mathematics, and students become locked in the cycle of failure. In contrast, students with positive thinking or disposition see mathematics as useful, helpful, and achievable so they have more motivation to engage in mathematics [23]. Therefore, the mathematics disposition of students becomes an important benchmark for the involvement of teachers in the learning process of mathematics by observing adversity quotient of students to measure teacher awareness of students mathematics disposition [24].

CONCLUSION

Based on the statistical analysis of the test it can be concluded that students with adversity quotient of climbers type had higher mean of students with adversity of campers type in mathematics disposition of students, it was concluded that students with climbers type had better mathematics disposition compared with students with campers type. students with adversity quotient of climbers type give different effects with quitters. Since the average of students with adversity quotient of climbers type has higher mean of students with adversity quotient of quitters type on the

mathematics disposition of students, it can be concluded that students with climbers type have better mathematics dispositions than students with quiters type. students with adversity quotient campers type give the same effect with quitters type students against mathematics disposition of students

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