

Mathematics prospective teachers' grit respect to adversity quotient

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Abstract. Duckworth defines grit as a driver that combines passion and perseverance toward achieving long-term goals. Grit is important in the teacher professional development, included mathematics prospective teachers. Developing grit in the teacher professional development means modelling them as an influencer on the students' achievement. The experience of succeeding how to responds to adversity in solving math problems was designed to help them become more "gritty". This paper describes the mathematics prospective teachers' grit in solving math problems respect to adversity quotient. The uses of math problems were intended to enhance students' understanding about the topics.

1. Introduction

The fourth industrial revolution, called Industry 4.0, brings a fast-growing process that triggers society to go to technology-driven changes. The emerging of ride-sharing system and room-sharing system to online educational services mark a shift in the way of life. This shift triggers the emergence of various uncertainties. Thus, students need to be equipped with a variety of adaptive skills so that they can survive the changes that occur quickly and uncertainly.

It is also needed by mathematics prospective teachers as students. Practically it will be used in dealing with any difficulties both in and outside the classroom. As mathematicians they are problem solvers, while as prospective teachers they have to deal with various learning problems that have to be solved. Success in solving these problems will be a leap for their success in facing various other difficulties.

Difficulties are one source of strength [1]. The experience of succeeding in dealing with adversity will provide learning experiences about turning adversity into a chance for success in achieving goals [2]. This ability named Adversity Quotient (AQ). AQ describes a person's ability to endure difficulties. Correspondingly, Duckworth holds that what a person needs in order to succeed is grit [3].

Grit shows one's endurance in surviving challenges. Duckworth believes that this character not only survives in the face of failure, but also has a strong commitment for years. This is in line with the role of Mathematics Education Study Program students as prospective mathematics teachers who are expected to be able to withstand the challenges of change so that they are worthy of being called warrior teachers. To develop passion and perseverance, students need to be faced with challenges that create various difficulties, but allow it to be faced rather than avoided. Therefore, this study aims to describe the grit of prospective mathematics teacher respect to adversity quotient through math test.

1.1 Grit: passions and persistence for long-term goals

Based on her teaching experience as a mathematics teacher at a high school in New York, Angela Lee Duckworth discovered the fact that a person's high IQ does not guarantee success in the classroom. This underlies Duckworth's curiosity to know something that causes a person to survive to achieve his long-term goals. Therefore, Duckworth returned to college to research by starting to see education from the perspective of psychology and motivation as one of the benchmarks, not IQ as in general [3]. A character that Duckworth refers to as grit appears as one of the determinants of success.

Duckworth defines grit as a person's ability to withstand challenges [3]. Grit can be developed as long as someone has a growth mindset. A person is said to have a growth mindset when he is able to appreciate his work, assuming that his ability can change depending on his work [4]. Duckworth in their research revealed that it is important for a higher education institution to teach growth mindset and grit to its students [5]. This effort can facilitate the long-term goals of students in carrying out their role in society in the future.

In grit there are two aspects, namely passion (consistency of interest) and perseverance. Consistency of interest shows the extent to which a person is consistent in achieving a goal. This can be seen from the interests and goals of someone who is not easily changed or distracted. Perseverance shows the strength of someone in trying and maintaining his business to achieve goals. This can be seen from his diligent behaviour and hard work, and withstanding his choices despite facing various challenges and failures.

1.2 Adversity quotient

Stoltz expresses adversity quotient (AQ) as a person's ability to face difficulties by turning them into challenges that must be solved [2]. In other words, someone who has a high AQ is assumed to have more ability in solving problems, so that it can finally be said to be successful. Through AQ it can be estimated that someone's obstinacy in dealing with problems, so it can be known who is successful and does not overcome the problem and who is desperate and survive.

AQ is divided into four dimensions, namely control, origin and ownership, reach, and endurance [2]. Control is related to one's ability to control difficulties and feel the role of control in the emerging of difficulties. Origin and ownership are related to one's ability to understand who and what causes difficulties and their influence as a cause of difficulties. Reach relates to one's ability to assess the range of difficulties. Endurance is related to a person's perception of their resilience in the face of adversity.

Based on AQ, Stoltz classifies humans into three categories, namely quitters, campers, climbers [2]. Quitters are portrayed as someone who tends to avoid, back off, or stop when faced with difficulties. Bids for success that are accompanied by challenges and obstacles will be rejected and stop at the fulfilment of basic needs. Campers is described as someone who has stepped in and responded to a challenge, but stopped at a certain point even though there is still a chance to develop. While climbers are described as visionary, optimistic, and able to change the slightest difficulty as an opportunity for success. Climbers cannot be controlled by the environment, but try to control the environment.

2. Method

This research is a qualitative research. Since this research will describe the grit of prospective mathematics teacher in solving math problems respect to adversity quotient (AQ), then this research used descriptive data in the form of written or oral words from participant and observable behaviour. Three participants, namely students with high, medium, and low AQ were included as participants in this study. The setting of this study uses normal lecture classes so that any observations or interviews with participants are assumed to be natural.

In general, this research consists of two stages: preparation and implementation. Activities in preparation include reviewing literature related to grit and AQ, compiling research instruments, and validating instruments involving colleague lecturers as validators. The AQ test used is the result of adaptation of several commonly used tests, while the Toughness Test items taken from school books.

Naturally, all 2019 Mathematics Education Study Program students are involved in the AQ test. This test is carried out to measure the extent of the resistance of each student in surviving to face difficulties. Based on the results of these tests, students are grouped into three categories: high, medium, and low. Based on these categories, taking into account their communication skills, students are randomly selected as many as 1 student for each category.

The next stage is the conducting of Toughness Tests which is designed so that all students are motivated to take the test as many times as work to get a perfect score (100). This treatment is designed to measure the extent to which participants' grits succeed in getting a score of 100. Based on the results of this test interviews are conducted unstructured using open questions based on participant work results and Duckworth grit aspects [5]. Simultaneously, participants will be asked questions related to the activities carried out in particular the participant's response to the design of the trying as many times to get a perfect score.

Qualitatively, all data will be analysed to answer the research questions. The analysis process is ongoing, meaning that the process has taken place since the preparation, implementation, and analysis of the data itself. To get a logical and strong argument about the answers to the research questions, the data in the form of field notes, recordings, documents of participants' work, and photographs and videos (if any) will be presented in the form of qualitative data until coding is performed. Search for less convincing data is done using the triangulation method.

3. Results and discussion

3.1. Result

Two aspect of grit as identified before relate to passion and perseverance. This provides the theoretical framework in data analysis. There are two kinds of test conducted: online test using Schoology (app.schoology.com) and offline written-oral test.

The result of the first grit test shows that each participant has different grit performed. The two aspects of grit are apparent with three participants. The low level of AQ participant, P1, shows that he has attempted the first test in 7 times then had perfect score. This attempts has conducted at the same time in the second day of test published online. The medium level of AQ participant, P2, has attempted in 17 times in the different time with no perfect score but as soon as the test published (the first two days of test published). While P3, the high level of AQ participant, has done to get the perfect score in the different time in less number of trying.

Not only in the first test, but also in the second test the participants show their own grit. After having the offline written test, the participants had to be involved in the written-based oral test. As previously, P1 succeeded in getting a perfect score in the third day of test published. He has tried 3 times at the same time. P3 also needed 3 attempts in getting the perfect score at the different time in the different day. While P2 only needed 2 attempts but at the different time in the first two days. The point of this second test is the success of P2 in getting the perfect score.

3.2. *Passion: consistency of interest*

As identified above, P1 shows his passion in finishing what he started up to getting perfect score at the same time in the second day. He was consistent in trying to get best on both test. P2 always be the first of doing test as soon as the test published. His passion also appeared when he never distracted by others. He also be influencer of the others in doing the test in time. This influence seemed working to P3. By the end of the time publishing, he did the both test in a perfect score.

3.3. *Perseverance: persistence in working*

This aspect was identified by looking at the pattern of the participants' working. P1 always be consistent in doing test, he finished his test in the same time in getting perfect score but in the second day. P2 has different experience in both test. He was the highest scorer of the number of attempting in the first test. He showed his persistency of getting perfect score. The figure 1 below shows that he had good persistency; doing the test in many times even get worse. This persistency emerged during the test published. It was convinced by the P2 opinion about the task designed, "*pada saat berusaha untuk menjawab 10 pertanyaan dengan waktu yang singkat dan diberi kesempatan untuk memperbaikinya, greget jika sudah banyak percobaan tapi nilai tetap sama.* (When trying to answer 10 problems in a short time and given the opportunities to retry, it was interested in trying a lot but haven't been better)". This comment indicates that P2 succeeded in pushing himself to do his best in getting the perfect score. In other word, the number of P2's attempt indicated his persistence of achieving success. This was answered in the second test which P3 succeeded getting perfect in two attempts.

9/23/19 8:32am	9/23/19 9:01am	28 min 57 sec	6/10
10/15/19 10:20am	10/15/19 10:50am	29 min 34 sec	8/10
10/15/19 11:05am	10/15/19 11:06am	1 min 19 sec	9/10
10/15/19 11:07am	10/15/19 11:08am	1 min 31 sec	8/10
10/15/19 11:09am	10/15/19 11:12am	3 min 12 sec	8/10
10/15/19 11:12am	10/15/19 11:16am	3 min 33 sec	9/10
10/15/19 12:33pm	10/15/19 12:36pm	2 min 52 sec	8/10
10/15/19 12:38pm	10/15/19 12:42pm	4 min 18 sec	8/10
10/16/19 10:58am	10/16/19 10:59am	56 sec	8/10
10/16/19 10:59am	10/16/19 11:00am	39 sec	8/10
10/16/19 11:00am	10/16/19 11:01am	51 sec	8/10
10/16/19 11:01am	10/16/19 11:02am	40 sec	8/10
10/16/19 11:02am	10/16/19 11:03am	44 sec	8/10
10/16/19 11:04am	10/16/19 11:05am	54 sec	9/10
10/16/19 11:08am	10/16/19 11:09am	49 sec	7/10
10/16/19 11:10am	10/16/19 11:11am	55 sec	6/10
10/16/19 11:11am	10/16/19 11:12am	1 min 3 sec	8/10

Figure 1. The persistency of the participant in getting perfect score in the same time even get worse

P3 as the high level of AQ participant succeeded in getting the perfect score on both test. Less trying but having higher score than the others indicates that P3 was passionate and persistence during this program.

3.4. Discussion

This study aims to describe the participants' grit during the program designed. This program is one of teacher professional development that designed for mathematics prospective teacher. Teacher professional development will be effective when the students learning show improvement [1]. This improvement was felt by the participants as teacher students when they were faced several questions. In several attempts, every participant succeeded in getting perfect score. This achievement was reached in a purpose. This program designed indirectly implied that being prospective mathematics teacher means being passionate. It is well known by the participants.

The three participants with the various level of AQ has performed their own grit level. The level of participants AQ does not guarantee their level of grit. It is convinced by P2's performance. Even he has medium level of AQ, he does show his passion and perseverance. He achieved the highest number of attempts in the first test but didn't achieve the perfect score as others did. Contrary, he achieved the perfect score in the second test in the least attempts.

Based on the data collection, the participants were satisfied with the program designed. The opportunities of doing test in unlimited attempts was challenging all of the participant. Their response on the program implied that as mathematics prospective teachers they need to be passionate. On both online or offline test were meaningful from the participants' view. During this program they were be aware of the important of understanding the teaching subject.

4. Conclusion

The result of this research shows those three participant with different level of AQ has performed their own level of grit. Based on two grit aspects, passion and perseverance, three of them have shown their grit in their own ways. The medium AQ participant has high determined his passion in facing the series of test and persistence harder than the others, even though he has to fail before succeed. In other word, the grit emerged and developed by the design of the program. The result of this program offer further research. How such a program would work with a larger group of prospective teachers is yet to be seen. Further research also include participant who are at various characteristics. It is also interested in conducting teacher professional development based technology. It is challenging for two reason, the availability of technology driven people to be native and prospective teachers are expected to technology in encouraging students to develop their ability to work with technology.

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