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The Post-Failure Thoughts' in Mathematics Problems Solving Amongst Gifted and Normal Pupils

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Abstract: This study aims at investigating the post-failure thoughts' in mathematics' problems solving amongst gifted and normal pupils in the Middle School in Ouargla- Algeria. The study adopted the data collection on the mathematics teacher's appointments, and the Raven intelligence test to identify the gifted and the normal pupils, Also use the mathematical problems, and open questionnaire to determine the post-failure thoughts' in problem solving in mathematics. The sample consisted of (79) pupils in middle school. The outcomes showed: 1 - The post-failure thoughts' are: the thoughts of challenging, and thoughts of stopping. 2. There are significant differences at 0.05 in the thoughts of challenging between gifted and normal pupils favor the gifted pupils.

Keywords: Post-failure thoughts', Mathematical problems, Gifted

Introduction

The interest in caring for the gifted and their needs is an inevitable result of the stage of development that the society is going through. We cannot take one step towards progress without training the talented of our children by knowing their needs and providing sufficient opportunities to develop their abilities so that their abilities and energies can be invested to the maximum extent. It is an educational right for every gifted and normal pupils. Among the rights of the students is the right to error while solving problems or engaging in any thought process directed through dealing with a situation. Learning from error is rooted in the theory of learning by the attempt and error of Thorndike, and by the contributions of the philosopher Bachlard who said: "The truth is a rectified error" and to Popper's work which he said: “I tried to show that our knowledge grows through trial and error-elimination, and that the main difference between its prescientific and its scientific growth is that on the scientific level we consciously search for our errors: the conscious adoption of the critical method becomes the main instrument of growth” (Popper, 2002, p. 131) . It should be noted that most of the educational theories are concerned this concept, Including: Behavioral, Gestalt, and Structural Theory.

The role of failure in learning and problem solving is no doubt intuitively compelling. Research on impasse-driven learning in coached problem-solving situations provides strong evidence for the role of failure in learning, in general, and in problem solving. As the goal of most instructional methods is to maximize students’ performance on the long term (retention) and outside the instructional context (transfer), a solution to reach this goal is called for. An instructional method called productive failure could be a fruitful solution. Productive failure starts from the assumption that people can learn from their own mistakes, and that instruction should be delayed until after experimenting (Kupur, 2008). VanLehn, Siler, Murray, Yamauchi and Baggett (2003) reported that learning of a new physic concept is related with failure, which means that it would be better to delay the instruction until after the students reach an impasse and are not able to go on with the task. Mathan and Koedinger (2003) conducted an experiment using two different feedback conditions. In one condition, the tutor offered immediate feedback on errors. In the other, the tutor waited to see whether learners detected their own errors, and attempted to guide them

through detecting and correcting their mistakes only if they attempted to move on to a new problem. Findings from this study indicated that while the learners in the two groups performed similarly on the first problem, those in the delayed feedback condition learned at a faster rate on all subsequent problems (Wise & O'Neill, 2009). The most of the studies were conducted in a high school context in which productive failure turned out to be effective (Kapur, 2008, 2009, 2013). Finally, the experience of failure could lead to negative emotion, lowered self-esteem, reduced intrinsic motivation, and lower expectancies of future success (Chase, 2011;Rausch,Seifried, and Harteis, 2017).

Bandura pointed out that the a talented person has judgments and expectations about his performance in ambiguous situations which harms the selection of appropriate strategies to resolve ambiguity and face difficulties (Bandura, 1997).

Through the above we note the following:
Literature emphasized the importance of the strategy of productive failure and the role of failure in learning and psychological situations that may accompany the failure, but did not describe what happens after the failure. Also the educational theories did not clearly indicate what thoughts come to our mind after failure.
There are few studies that have addressed the issue of failure.
Hence, this study comes to investigate the post-failure thoughts' in solving the mathematical problems amongst gifted and normal pupils by asking the following questions:
Study questions.

- What are the post-failure thoughts' in solving mathematical problems among middle school pupils?
- Do post-failure thoughts' differ in solving mathematical problems among pupils (gifted, normal)?

Hypotheses.

- post-failure thoughts in mathematical problem solving are to challenge and/ or to stop((reluctance) thoughts among sample (gifted, normal).
- there are no significant differences between gifted and normal pupils in post-failure thougts'.

Method

The descriptive approach is the most appropriate approach to this study

Participants

The sample of study was 79 pupils(45 gifted, 34 normal) from 5 middle schools in Ouargla, Algeria,

Instruments and Procedures

The data of this study were collected through the following:

Teachers' observations

The researcher asked mathematics teachers to identify their gifted pupils in mathematics (ask puzzling questions, think deeply about mathematical problems, solve mathematical problems in different ways, and does not require to be high-achieving pupils)

Raven's Progressive Matrices

The Raven Standard Progressive Matrices (SPM; Raven, 1938) is a test of nonverbal reasoning ability and general intelligence (the so-called g factor; Spearman, 1927) that minimizes cultural bias. The Raven SPM contains 60 items that are arranged in five sets of 12 items each (Sets A, B, C, D, and E). Each item requires the examinee to infer a

rule relating to a collection of elements and then use this rule to verify that a presented element is a legitimate relative to the rule. (Van der Elst et al., 2013)

Mathematical Problems

I designed three mathematical problems, one problem for each level (second, third, and fourth grade). The duration of each problem was 20 minutes. Four math teachers at the middle school level agreed that the difficulty of these problems was appropriate, unusual and relevent to the curriculum.

Open Questionnaire

It is a paper with an open question asking the participants to identify their thoughts after engaging in solving the mathematical problem.

Procedures

After taking the authorization from the Directorate of Education in the Ouargla province to conduct this study, the researcher randomly selected 5 middle schools . I asked The mathematics teachers in these schools to identify the gifted and normal pupils in mathematics. They nominated 195 pupils (102 gifted, 93 normal). Then i applied the Raven test and converting scores to percentiles. According to Raven, the gifted is the higher than or equal to the percentile 95(corresponding to score 47) and the normal pupil is between 75 and 95 percentile(greater than 40 and less than the score 47 (Bensaci, 2014). after two weeks we provided for each level a mathematical problem for 20 minutes. then, pupils were given an open questionnaire sheet to describe their thoughts precisely after solve the problem.

Results

H1: post-failure thoughts' in mathematical problem solving are challenge and stop(reluctance) thoughts among sample (gifted, normal).

Table 1. Challenge thoughts, classification of pupils, frequencies and percent

01	MY thoughts were confused but after the focus and insistence, i solved it	GIFTED	17	21,52%
		Normal	7	8,86%
02	I got a bit confused at first, but I can solve problems more difficult than this problem	Gifted	6	7,59%
03	This problem needs a longer focus and time, but I am going later solve it to myself . I must take it as a lesson to make more effort in learning mathematics	Gifted	3	3,80%
		Normal	3	3,80%
04	Although the problem was difficult but I was telling myself I must find some way to solve it.	Gifted	2	2,53%
		Normal	2	2,53%

Challenge thoughts' focused on four main ideas . The most common thought is the first one" My thoughts were confused but after the focus and insistence, I solved it", which was the answer of 17 gifted (i.e.21,52% of the sample).The less common idea is the "fourth idea", which is equal in the answer gifted and normal pupils(2 for each classification2.53%), While not was answered the second thoughtonly gifted(6 i.e. 7.59%). The third thought, the gifted and the ordinary were equal in answered (3i.e. 3.80% for each classification). As a result, the total number of gifted whose thoughts after failure were challenge (28, i.e.35.44%), However were(17, i.e. 21.52%.).

Table 2. Thoughts of stop(reluctance), classification of pupils and percent

01	I found it difficult to understand the problem and decided to stop thinking about solving it	GIFTED	5	6,33%
		Normal	11	13,92%
02	I lost confidence in my abilities	Gifted	6	7,59%
		Normal	3	3,80%
03	I feel like i did not learn mathematics.	Gifted	2	2,53%
		Normal	3	3,80%
04	I am desperate to solve this problem.	Gifted	2	2,53%
		Normal	3	3,80%
05	I feel my mind stop	Gifted	2	2,53%
		Normal	2	2,53%

The thoughts of stop (reluctance) centered on five main ideas. The most common idea was the first one" I found it difficult to understand the problem and decided to stop thinking about solving it", which was the answer of 11 normal pupils, which represented 13.92% of the sample, and 5 gifted by 6.33%. Followed by the second idea "I lost confidence in my abilities" it was the opposite of all other thoughts of stop, where it was the answer of 6 gifted(i.e. 7,59%), and 3 normal pupils(i.e. 3,80%).While the third and the forth thoughts were equal in frequency of gifted (2) and normal pupils (3).The fifth thought "I feel my mind stop" the number of gifted (2) and normal (2) whose answered it. In total, the number of gifted pupils whose thoughts of stop(reluctance) were 12(i.e. 15.19%), was lower than the percent of normal pupils(22,i.e. 27.85%). Therefore, the thoughts of challenge were more prevalent among the gifted. While the thoughts of stop (reluctance) were more prevalent among the normal pupils.
H2: There are no significant differences between gifted and normal pupils in post failure thoughts'.

Table 3. Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5,618	1	0,018
Continuity Correctionb	4,593	1	0,032
Likelihood Ratio	5,689	1	0,017

Table 3 shows X^2(5.618, 0.018), Therefore I reject the null hypothesis and accept the alternative hypothesis that There are significant differences at 0.05 in the thoughts of challenging between gifted and normal pupils favor the gifted pupils.

Discussion and Conclusions

This study aimed at revealing post-failure thoughts' in solving mathematical problems. It reached two kinds of thoughts: thoughts of challenge, and thoughts of stop(reluctance), and showed that gifted pupils had more challenging thoughts than simply giving up. Outcome of second hypothesis emphasized the result of the first one, "There are significant differences at 0.05 in the thoughts of challenging between gifted and normal pupils favor the gifted pupils". It means the gifted pupils face their problems (Bandura, 1997). This can be explained that gifted pupils are more patient and challenging than normal pupils. They are involved in solving problems that are so difficult and they trust their abilities. This is what we found in one of the answers: "I got a bit confused at first, but I can solve problems more difficult than this problem" These results may explain that gifted have more experience than others in failure. They have already tried difficult problems and failed, which led to accumulate new experiences of challenging. Failure can also lead to instability. Continuing to try again until the solution is achieved is an expression of the demand for adaptation to the new situation, as expressed by Piaget (Woolfolk, 2010). The

gifted are also more self-organized than the normal (Sabatin, 2006), and maintain their enthusiasm until they solve the problem they face. However, through Table 2, we noticed that some gifted had thoughts of stop. This can be explained that other factors intervened in guiding the behavior of this classification, such as motivation, emotion and anxiety (Chase, 2011), negative reactions of the teacher and the classmates, individual beliefs, and contextual factors (Tulis, Steuet, and Dresel, 2015). As we observed that some normal pupils have challenge thoughts'. We can explain that they either have previous experiences in failures learned from dealing with failures through support from their teachers, classmates, and parents. Or that the measuring instruments could not detect that they were gifted. Therefore, the design of more sensitive measurement tools should be planned to detect the gifted in mathematics.

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