

Case Study on Improving High School Students with Learning Difficulties in Mathematics

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This case study focused on investigating factors of leading learning difficulties in mathematics, and developing strategies for improving mathematics learning for students with learning difficulties. Two types of learning difficulties were identified: learned helplessness and defensive attribution. The students enhanced their learning in mathematics with the use of appropriate strategies in the interventions.

Key words: mathematical learning difficulties, learning attribution, learning method.

Introduction

Nowadays, much research has been carried out in “learning difficulties” (Qian, 1996). However, most of the research focused on discussion of psychology of learning, which lacks a connection to concrete content in mathematics. Although some scholars mentioned that learning difficulty is a significant topic in the research field (Du, 2003; Tao, 2004), it is still rare in research that focuses on high school students’ learning difficulties in mathematics. In particular, there lack effective strategies to improve struggling students in their mathematics learning processes.

Conceptual Framework

In daily teaching practice, various factors contribute to good performance

in the learning mathematics process, including students being working hard, applying effective learning skills, and being good at mathematical thinking. However, many reasons could cause students to have learning difficulties in mathematics. For example, students with poor performance may fail in mathematical learning from not making sense of mathematics learning. There are different types of learning difficulties in mathematics in high schools in China. Therefore, it is necessary to apply proper strategies to improve their learning

Learned Helplessness

According to Slavin (2003), learned helplessness is the expectation, based on experience, that one's actions will ultimately lead to failure. It is an internal factor and relates to student confidence. Sometimes, learned helplessness is also related to external factors. For example, some students lack help for learning mathematics. They failed in mathematics because of rarely getting help in their learning process. If they achieved academic success on certain mathematics exams, they thought that there were instability factors, such as luck. Otherwise, failures are based on some uncontrollable factors, such as knowledge of mathematics foundations and loss of interest in the subject, or low ability in mathematics learning and lack of ability. Their self-confidence can be enhanced thru guiding them to improve learning skills and correct negative attribution.

Defensive Attribution

Some students are with “defensive attribution,” with mathematical learning difficulties; they usually do not study hard, not taking the initiative, losing interest, and always complaining. For example, they complain that mathematics is boring, mathematics curriculum materials are not good enough, and teachers do not teach well. Never do they try to find problems within themselves. Martin, Marsh, and Debus (2001) believe that students with repeated failures may develop a defensive attribution to protect themselves from negative feedback.

Methods of Helping Students with Learning Difficulties

Slavin (2003) addresses four helpful general principles for supporting

students with a tendency to accept failure: (1) Accentuate the positive. Understand the student's strengths and use these to develop their confidence; (2) Eliminate the negative. Deal with the student's weaknesses tactfully. Talk to the student and develop a plan to improve learning; (3) Go from the familiar to the new, using advanced organizers or guided discovery; and (4) Create challenges in which students actively create problems and solve them using their own knowledge and skills.

The National Research Council (2001) points out the principles for helping students with learning difficulties: (1) Learning with understanding involves connecting and organizing knowledge; (2) Learning builds on what children already know; and (3) Formal school instruction should take advantage of children's informal everyday knowledge of mathematics.

This case study focused on investigating two types of students' learning styles, discussing some aspects of the transforming process, and developing some strategies that can be used in helping struggling students. The following research questions were asked in this study:

- 1) What are the factors that caused learned helplessness in the student learning mathematics?
- 2) What are the factors that caused defensive attribution in the student learning mathematics?
- 3) What strategies can be used to help these two types of students with learning difficulties in mathematics?

Method

This study chose two high school students who suffered difficulties learning mathematics as key cases. One student had learned helplessness and another student had defensive attribution in learning mathematics.

Case Study Method

Case study is an appropriate choice of research method for studying the changing process (Gay, Mills, & Airasian, 2009). The descriptive narrative method is used to answer research questions. Triangulation is applied through the use of multiple data sources: Interview the student, analyze the student's exams, and talk with parents and teachers.

Case 1: Learned Helplessness

The student having difficulties learning mathematics results from the lack of help from others.

Background of Case 1

Research subject: .Xiao, female, a high school student in a city of north China.

Research period: Between February and August 2006.

Student demographic background: The student's mother is an employee in a foreign company and her father is doing private business. After her parents divorced, Xiao has lived with her mother and grandparents. In Xiao's learning processes, she seldom can pass mathematics exams in high school. Therefore, Xiao was identified as a struggling student in mathematics.

Learning Characteristics

Xiao is an introverted character; she seems depressed all the time. When the author met her, she always smiled, a form of greeting. When Xiao's mother talked about Xiao in front of her, she would escape to her room. Xiao's mother believed that Xiao was a nice girl, listened to her parent, and studied hard. She used to study until midnight from the time she went to high school. She did well in some subjects except mathematics. She has failed mathematics exams many times. Due to her learning character, parents did not give her pressure and only hoped the author would be able to help Xiao and teach her effective learning skills in order to make her more relaxed in learning. Actually Xiao did well in middle school. However, Xiao did not catch up with her classmates in high school. Xiao's mother felt responsible for her family to improve Xiao's scores. Therefore, she was looking forward to the author to be able to understand this particular situation and continue to be patient with Xiao.

Diagnostic Assessment

The author chatted to Xiao and asked: "Do you like mathematics?"

Xiao said: "I don't know, I only learn mathematics because of teacher's requirements."

The author: "What has happened so far in learning mathematics?"

Xiao was surprised and reluctant to answer this question and kept silence a while, then said: “Because I have to take mathematics exams.”

The author: “Anything else?”

Xiao told the author that she learns mathematics in order to comfort her mother; she knew that it was not an easy life for her mother, and also she felt guilty for her poor performance in mathematics.

After the author contacted Xiao a few times, the author discovered that Xiao is indeed a sensible girl but feeling stressed. For example, Xiao was asked the reasons why she could not do well in mathematics. She kept saying that she has low ability in mathematics and could not remember the methods for solving problems with flexibility, and her brain cannot match this challenge. In addition, she felt she was not as clever as her classmates. The author attempted to guide her, and asked: “What do you think about your teacher’s teaching? Did the teacher care about you?”

Xiao said: “My mathematics teacher is excellent, although I am not good at mathematics; the majority of students in the class do well. It can be proved that I was not good at mathematics. I suppose my teacher doesn’t know my name. It is understandable because he/she is usually busy and I am not good at mathematics.”

The author: “It can be sure that teachers care about every student. Your teacher believes that you can behave yourself and don’t need to be controlled by her.”

Xiao: “Maybe.”

When talking about her parents, Xiao believed that there is no direct relationship between her mathematics results and her parents’ divorce. Xiao emphasized that her exam results were ok except for mathematics. Therefore, her parents always argued because of her poor performance. She felt really guilty about this. The author told her it was wrong that she always blamed herself; she should not have to burden herself, because adults should have their own life. Xiao felt very stressful in daily learning; she told the author that she felt nervous when she saw a new topic in mathematics; she thought she could not do it, and stupid, and lost confidence completely.

Analysis of Reasons for Xiao’s Poor Performance

During the period of contact with Xiao, the author believed that Xiao’s experience in learning mathematics led to an apparently negative trend in learning based on her personal character circumstances. A possibly reason for

her unsatisfactory results in learning mathematics is her learning skills not being suitable for learning mathematics. In addition, Xiao always depended on remembering some results and concrete methods to solve problems, and ignoring comprehension of mathematics concepts in high school, and being less focused on the summary of the method for solving problems. Therefore, she would like to practice some topics using a series of fixed and connected steps. When changing topics, she would not be able to deal with it, even she did a problem right, and she always doubted it. Xiao personally believed that her weak foundation in mathematics led to her failure.

Based on this particular learner's character and lack of help, the author attempted to develop some strategies to change her learning.

Intervention

Praise at proper time and enhance the student's confidence

When analyzing topics of mathematics, the author often asked Xiao whether she could find a good idea, and if her thoughts were reason base. the author would agree with her responses and praised Xiao, built her confidence, and had her see the hope in improving her learning. In addition, the author often showed the process of thinking and told her how to "think" when the author and Xiao studied the topic. Sometimes, the author failed to identify her thinking. Sometime, it took several trials.

Later on, Xiao was not afraid to solve mathematics problems. She has recognized that even mathematics teachers did not know the best way to solve problem sometimes. So, Xiao did not give up any more like she used to.

Encourage developing problem-solving skills

The author not only developed Xiao's diligence but also pointed out her weaknesses in learning skills and required her to exchange ideas with classmates via communications. Xiao found many of her classmates always resolved mathematics problems that they could not solve the first time, and recorded the strategies of problem solving in their notebooks so that they would be able to review before exams. The author also told her to write down the reasons why she could not solve problems, and the key factors in solving these problems via doing various practices to master them. Later on, Xiao realized that there are differences between high school and middle school mathematics. In high school, there should be more focus on thinking and not only simply imitate examples. More focus should be on trial-and-explore

solving methods. She started to explore methods in solving problems and learned how to think mathematically, not only remember results while doing mathematics.

Provide guidance to identify reasons beyond personal factors

The author trained Xiao to objectively organize positive aspects and to realize that successful learning depends on various factors. It does not only include personal work, ability, learning strategies, but also relates to the level of tasks, teachers, teaching methods, and family background, etc. Finally, the author helped her to develop some methods to deal with these factors.

Results

Xiao made great progress during the term the study was done. She got 80 % on her final mathematics exam. The author asked her to talk about her experience of improvement. She was able to relate clearly, why and how she thought. She likes mathematics now and has learned how to enhance her mathematics learning. The author continued to encourage her to apply effective learning skills. For example, her effective learning skills include outlining the structure of the topic, re-doing problems with mistakes in her homework, exchanging ideas with classmates, regularly reviewing the content, and focusing on the connection between mathematics concepts.

Case 2: Defensive attribution

The student having difficulties learning mathematics results in “defensive attribution.”

Research Background of Case 2

Research subject: Wang, male, a high school student in a city of north China.

Research period: Between February and August 2008.

Student demographic background: Wang’s parents are managers of a bank. Both of them are very busy and do not have time to help with Wang’s learning. The family’s financial situation is good. Wang is an only child in the family. The parents have high expectations for him. Wang used to study in a key middle school in Tianjin. Due to Wang not doing well on the final exams, he

had to attend a common high school. After that, his achievements seemed not good enough. Five out of eight times he failed on the final exams. He got 38 out of 100 points on the mathematics exam. He was classified as a difficult learner in this study.

Diagnostic Assessment

When the second term started, the author interviewed Wang and asked how he felt about his mathematics learning.

Wang said: "Very bad, I cannot understand all of it."

The author: "Would you like to carry on learning?"

Wang: "Ok, but I got good results in middle school."

The author: "But why are you not good at mathematics now?"

Wang: "Well, the mathematics teacher bored me, her lessons were not attractive, and she often lost her temper, only focusing on exam results. I didn't like to see her."

The author was surprised that he had such prejudice toward his mathematics teacher, and asked him: "Anything else?"

Wang thought a while, said: "Yes, for example, there are many students who cheated on the exams, but the teacher didn't find out. After the exams, the teacher criticized students who failed, including me most of the time. Furthermore, there was no connection between the early and later contents in the current mathematics curriculum. The teacher re-arranged the order of the lessons, and I was not able to catch up with these."

The author: "What and how do you think you could learn mathematics?"

"If I put more effort and practice more, I will be outstanding. But I don't want to." Wang seems to be confident, but has a negative attitude.

The author: "You are clever; try to study hard. Can you achieve a good score on the next exam?"

"No problem," Wang said.

Analysis of Reasons for Wang's Poor Performance

After a trigonometry unit test, the author chatted with Wang during lunchtime in the office. The author showed him the exam paper and asked: "This exam result is not ideal, what problem do you think there is?"

Wang answered: "I haven't finished it yet; also I misunderstood a question. Next time, I will not." He tried to be relaxed.

“Why can’t you finish it on time?”

“There was a classmate who felt sick; the teacher asked for a student to accompany the classmate to the hospital. I cared about him and wasted time on thinking about it.”

“There were a few questions which you did before. Why did you still make mistakes?”

“I can do these problems, but on the exam, I was nervous.”

“Why were you absent in mathematics lessons a couple of days before the exam?”

“I fought with some classmates and I was not allowed to go to the classroom. I have to be educated by the school for fighting.”

“Promise me, you will try to avoid this issue happening again.”

“I will try my best.”

After term final exams, the author talked to Wang.

The author: “How were your exam results?”

Wang was upset: “I paid attention to the mathematics lessons, but the exam results disappointed me.”

The author encouraged him and said: “You did few questions correctly, which means you have grasped the concept of sequences.

“Yes, I did. Arithmetic sequences were all right. But geometric sequences, I was not sure.”

The author: “When you practiced geometric sequences, did you find these to be a problem?”

Wang: “Honestly, I often copied geometric sequences homework from other students. No revision after lessons. I will do it in my home.”

The author added: “Hopefully you can continue to study hard.”

Based on a series of test results and Wang’s performance, it could be seen that Wang did not study hard, not taking the initiative, lost interest, and also complained that mathematics was boring, the mathematics teacher was no good, but never sought reasons from himself. Therefore, Wang was identified as difficult learner because of external factors. The author combined his choleric character and strong performance desire, so the following strategies were designed for improving Wang’s poor mathematics performance.

Intervention

Objective analysis of the reasons for poor performance in mathematics

The author suggested to Wang’s mother after a mathematics exam that she

should attempt to praise Wang's concrete behavior, and not say he is clever. Otherwise, Wang would not understand why he always failed in mathematics. Wang has disadvantages in his character. He should not blame himself; however, he needs more patience in treating him and guiding him to know his merits and shortcomings. Wang's mother promised to do so.

Encourage student to find the reasons for lacking effort in the subject

Wang was interested in the PE program; also he read the PE News every day. The author commended Wang's attitude of persistence and asked him questions relating to PE knowledge. The author hinted to Wang that if he wants to gain good results in mathematics exams, he would have to put his effort into it, like the effort he put into watching the PE program every day. The author told Wang why he used to not be able to learn mathematics better. The possible reasons included the mathematics teacher not being good enough, and curriculum problems. However, it is necessary to think about why other students could do well with the same teacher and curriculum. Therefore, Wang should find the reasons for himself.

Offering opportunities for students to present their ability in the classroom; supervising and fostering learning habits

Based on Wang's character, the author intended to encourage Wang's answering questions and presenting his thinking in front of his classmates. Also the author led Wang to feel the teacher has cared about his improvement, in order to raise his expectation in learning mathematics. In addition, the teacher specifically treated Wang face to face when marking his homework. When the teacher found an error in Wang's homework, the teacher let him analyze the reason why he made a mistake. After that the teacher taught him the correct way. Finally, Wang corrected it by himself. Moreover, the teacher often contacted Wang's parents in order to address his truancy.

Focusing on analysis of attribution of success and failure after every exam

The author also communicated with Wang once a month, helping Wang evaluate his learning and find personal shortcomings in learning, during the study. The author suggested that Wang should cooperate with classmates in order to make a new plan to achieve success in their learning.

Results

Three months later, Wang has changed in a few aspects; for example, he was able to pass his mathematics exams, is full of passion in learning mathematics, and his learning aim is much clear. His character has been changed somewhat.

Conclusion

This study focused on two cases, both high school students with learning difficulties in mathematics. The author employed different strategies to improve their performance in mathematics learning. The author has attempted to draw the picture of “lack of help” and “defensive” attribution, and has found some strategies to address changing poor performance in mathematics learning. The more effective strategies for case one is that personal confidence was enhanced, guiding the student to find effective learning skills and correct her negative attitude. After letting the student focus on understanding and practice with various methods to achieve willingness to think mathematically, learning habits were improved. The more effective strategies for case two are that more communication with the teacher and helping the student analyze mathematics topic face to face. The author also supervised his learning process, pushed him to learn hard, compared early and later exam results, and help him find more personal reasons in his learning, not only relating to outside factors such as the mathematics teacher. It is necessary to have parents’ participant and help the student to use some strategies to address poor performance in mathematics. For example, not only emphasize attitude in learning step by step mathematics basic knowledge and skills, but also master these skills. However, this study is only a starting point. The cases only focused on two students with learning difficulties. It is difficult to give a general picture about changing performance in mathematics with all students with learning difficulties. In addition, different students have different situations and different thinking styles. The attribution process is a kind of meta-cognitive process. Therefore, further studies should be undertaken whether there is a relationship between meta-cognitive and attribution tendencies, whether new curriculum offers support or not, and how.

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