A tentative study on the causes of math underachievers in junior high schools and the conversion strategies

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Abstract: Underachievers are an objective dissimilated group in the learning process. Math underachievers are a practical problem which should be addressed by present math educators. Through field survey and upon analysis of individual characteristics of underachievers from multiple perspectives of teachers, family education and students, a targeted conversion strategy is formulated. With focuses on teaching and learning method, the strategies for conversion of math underachievers in junior high schools are explored and summarized, followed by practical discussion on individual cases.

1 Introduction

The mathematics curriculum should be geared toward the objective of the compulsory education, the needs of all students and individual personality development, so that all students can receive good mathematics education and make respective achievement in mathematics. [1] This objective means that as the teaching content in compulsory education, the mathematics curriculum must meet the needs of students' future. Regardless of where it starts and ends, mathematics must be closely connected to the real world of students. Although mathematics education at junior high school is a part of basic education, it is not only a transition stage from primary school to senior high school, but also a stage from concrete thinking to abstract thinking. Therefore, there will be more math underachievers with advances of grade, and it's an important topic to study the conversion from "elite" education to "mass" education under the new curriculum standard.

2 Definition of relevant concepts and theoretical basis

2.1 Definition of relevant concepts

"Underachievers" refers to students who suffer learning disability which is also known as learning disorder, low achievement or learning incompetence. [2] These students are not mentally retarded, nor are they suffering from brain trauma or diseases. However, they leg behind their peers or even their potentials considerably due to other subjective and

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objective reasons, and cognitive abnormalities. The former Soviet educator Sukhomlinsky believed that "in our creative educational work, the work on 'underachievers' is the most challenging." Sukhomlinsky divides “underachievers” into three categories from the perspectives of psychology and philosophy: the underachievers with “unawakened” thinking; the underachievers with “unveiled” talent; and the underachievers with “poor understanding and slow wit”. [3] In a broad sense, there are no more than these three categories of underachievers. It of greater significance for front-line educators to understand the manifestations and causes of learning disabilities than to carry out theoretical classification of underachievers.

In this paper, the concept of math underachievers is defined under the general evaluation criteria. In other words, they suffer no obvious sensory and emotional disorder, but have normal intelligence with an international standard intelligence test score of over 80. Although they receive normal education under normal conditions, their scores rank below 25% in standard mathematics achievement test. In short, underachievers are students with poor mathematics achievement excluding the factor of congenital intellectual deficiency. [4]

2.2 Theoretical basis

2.2.1 Theory of multiple intelligences

Proposed by Gardner in 1983, the theory of multiple intelligences has undergone several modifications and improvements. According to this theory, intelligence is the ability to solve a problem or create a product which is considered valuable in a specific culture or environment. Upon observation of its basic structure, it can be found that there are multiple intelligences which at least include language intelligence, mathematical logic intelligence, spatial intelligence, physical movement intelligence, music intelligence, interpersonal intelligence, and self-knowledge intelligence on each person. With the in-depth research, scientists have identified more categories of intelligence. For instance, in 1996, Gardner proposed the eighth intelligence—the naturalist intelligence. [5] According to the theory of multiple intelligences, the educational goals should be pluralistic and geared toward the overall development of the eight intelligences. Mr. Tao Xingzhi remarked that: "Whenever you punish, snub or satirize a student, remember that he or she may be the next Watt, Newton or Edison.” The proportion of each intelligence varies among different underachievers. Therefore, teachers should respect students' unique personality, coordinate with their unique pattern of intelligence, give fully play to their respective superior intelligence and promote their weak intelligence. Only in this way will successful teaching be achieved.

2.2.2 The zone of proximal development

The zone of proximal development is a concept proposed by Soviet educator Lev Vygotsky on children's educational development. He believed that there were two levels of student development: the current level, which refers to the level of problem-solving that can be achieved in independent activities; and the possible level, which means the potential obtained through teaching. The difference between the two levels is referred to as the zone of proximal development. [6] According to the zone of proximal development theory, teachers should first analyze and determine the current development level of math underachievers before helping them identify respective learning potentials. After development of their current development level, their self-esteem and self-confidence will

be satisfied accordingly, which fully mobilizes and gives full play to their spirit. The improvement of development level can promote students to develop faster.

3 Analysis of causes of math underachievers in junior high schools

In the process of learning, students must have very strong logical thinking and abstract thinking abilities. At the same time, with the continuous improvement of the requirements on students, the part to be memorized will also increase. Students should have more time to summarize knowledge points. So the poor mathematical foundation of learning difficulties are formed. [7]

3.1 Subjective factors

The author selected 500 students with math learning difficulties in four ordinary junior middle schools in a certain place as the investigation object, among which 228 boys and 272 girls were born. The students include 123 in Grade seven, 267 in Grade eight and 110 in Grade nine. Students are aged between 13 and 15. The last 10 students in each class were selected based on the comprehensive score of the midterm exam, final exam and regular scores. The information distribution of students is shown in Table 1.

Table 1. The information distribution of students.

Grade	Grade seven	Grade eight	Grade nine
Age	13 years old	14 years old	15 years old
Boy	71	122	61
Girl	52	145	49
Total	123	267	110

3.1.1 Lack of interests in math

Interest is the best teacher. Interest in learning will directly affect students' enthusiasm in learning mathematics. As shown in Table 2, 28.8% math underachievers are with general interest in mathematics; 57.6% math underachievers have no interest and are pressurized to learn or are weary of learning, etc.; 55.8% math underachievers said that they always made mistakes or even weren’t able to learn. We found that nearly half the students were not interested in math at all. They don't like math, and some students even hate math. Under the guidance of such negative emotions, it is difficult to expect students to learn mathematics well. Fortunately, we also found that nearly a quarter of the students like to read math books, which pointed out a feasible way for us to choose the direction and methods of guidance in the future.

Table 2. The influence of interest on Mathematics learning.

Your interest in math ( )	**Why do you dislike math ( )**	**What are you most interested in math ( )**
A. Neither like or dislike 28.8%	A. Abstract and boring 39.2%	A. None 50.5%
B. Dislike 57.6%	B. Dislike the math teacher 5%	B. Take math classes 20.5%
C. Like 13.6%	C. Always make mistakes and unable to learn 55.8%	C. Extra-curricular reading materials 29%

3.1.2 Lack of self-confidence and poor self-control

For the junior high school students who have just entered the middle school, the failure of several math exams and the criticism from parents and teachers may affect their confidence in learning math and produce a fear of difficulty. As shown in Table 3, 62.4% math underachievers lack self-confidence; 68.5% math underachievers have poor ability and weak will to withstand setbacks. Self-confidence is the psychological characteristic of individuals who believe that they have the ability to successfully complete an activity, and is the conscious characteristic and psychological state of actively and effectively expressing self-worth, self-esteem and self-knowledge. A person lost self-confidence, will lose the power to move forward, and once there is sufficient self-confidence, may produce a strong drive, in the face of difficulties and setbacks will be courageously forward, never retreat.

Table 3. The influence of self-confidence on mathematics learning.

Your ability to withstand setbacks ( )	**Your confidence ( )**
A. Strong 5.6%	A. Strong 2%
B. Ordinary 25.9%	B. Ordinary 35.6%
C. Poor 68.5%	C. Inadequate 62.4%

As shown in Table 4, 59% math underachiever have poor self-control, which is reflected in poor concentration at classes and indulgence in games and network. The rapid development of mobile communication network has brought a lot of convenience to our life. However, the stimulation and temptation of the Internet also deeply attract a group of children with poor self-control ability. But they are addicted all day long and unable to extricate themselves, some students have even reached the point of Internet addiction, which is a very terrible phenomenon, but also a serious concern and attention of the whole society.

Table 4. The influence of self-control on mathematics learning.

Your self-control ( )	**Which of the following is your circumstance? ( )**
A. Strong 3%	A. Indulgence in mobile phones 45.5%
B. Ordinary 38	B. Learning while playing 52.5%
C. Poor 59%	C. Give priority to learning despite of temptation 2%

3.1.3 Lack of good learning habits.

Thoughts become actions. Actions become habits and habits become values. As shown in Table 5, 70.8% underachievers said that they did not know how to learn mathematics, and most of them lacked analytical thinking and innovation ability; 75.9% underachievers never discuss math problems with teachers or students; 69.3% underachievers often failed to complete their homework.

Table 5. The influence of learning methods on Mathematics learning.

Your math learning method ( )	**What do you lack in math learning ( )**
A. Appropriate 2.6%	A. Calculation ability 26.4%
B. Ordinary 26.6%	B. Analysis ability52.6%
C. No ideas 70.8%	C. Innovation ability 21%

It can be clearly found from Table 6 that 75.9% of students with learning difficulties never discuss problems with teachers and classmates. Nearly 70 percent of students often do not complete their homework. That's a pretty high percentage. The study of mathematics needs a step-by-step, in-depth understanding process. Especially for some students with learning difficulties, they need the help of teachers and classmates. They can't achieve their learning goals by their own efforts alone. However, these students with learning difficulties are often unwilling to communicate with their teachers and classmates for various reasons, which leads to a vicious circle of learning and worse and worse grades.

Table 6. The influence of learning habits on Mathematics learning.

Your completion of math homework ( )	**Do you discuss with students ( )**
A. Completion on time 9.6%	A. Sometimes 21.6%
B. Occasional failure 21.1%	B. Often 2.5%
C. Frequent failure 69.3%	C. Never 75.9%

3.2 Other objective causes from families and schools

3.2.1 Improper parents' means of education

Mathematics learning difficulty is not caused by a single factor, but the result of the interaction of many factors. Attempts can be made to adjust learning methods, enhance students' awareness of transforming declarative knowledge into procedural knowledge, and strengthen learning motivation, which requires the joint efforts of parents and teachers. [8]

Table 7. The influence of parents' attitudes on mathematics learning.

Parents' tutoring with homework ( )	**Parents' attitude toward your poor match result ( )**	**Parents' means of education ( )**
A. Often 2.8%	A. Severe criticism 61%	A. Simple and rough 62%
B. Sometimes 26.7%	B. Ignorance without commence 28.5%	B. Ordinary 30.1%
C. Never 70.5%	C. Encouragement 10.5%	C. Communication 7.9%

As shown in Table 7, there are 70.5% parents of math underachievers never give tutoring to their children. There are 62% parents simply criticize children for their poor math result. There are 28.5% parents ignore children's math result without any comment and only 7.9% parents would have a communication with children.

3.2.2 Backward educational concept of teachers and lack of after-class tutoring

As shown in Table 8, there are 65% math teachers adopt old-fashioned and boring teaching method and 39.7% math teachers never provide after-class tutoring. As a result, students' curiosity in math is gradually wiped out, which becomes an objective factor that causes math underachievers. Since factors of families, schools, and students will all lead to students' learning disability, the schools, families, and the society must joint hands to take targeted measures to change this situation.

Table 8. The influence of teacher factors on mathematics learning.

Math teachers' means of education ( )	**Math teachers' tutoring to students ( )**
A. Old-fashioned and boring 65%	A. Often 26.1%
B. Ordinary 28.1%	B. Sometimes 34.2%
C. Novel and easily-understood 6.9%	C. Never 39.7%

4 Strategies for conversion of math underachievers in junior high schools

4.1 Arousing underachievers' learning interest and boosting their confidence through emotional education

Firstly, the mathematics teaching in classrooms should be a process which allows full emotional communications between teachers and students under specific scenarios. Secondly, it is a process of learning of knowledge, exploration of methods, and enlightenment of thinking. In this process, if students' desire to communicate is not satisfied, they will lack enthusiasm in learning, resulting in learning disabilities. An old saying goes that: "There is no fire in the stones, but it comes when strikes". The positive emotional communication between teachers and students in classrooms can often stimulate students' high enthusiasm in learning and ignite the spark of their minds. During teaching, teachers should try to use vivid language, so that students will feel the sense of kindness and trust and develop the desire to express themselves. Teachers' positive emotions have impact on students, allowing students to learn mathematics in a positive learning environment.

In emotional communication with math underachievers, teachers should be good at guiding them to discover and utilize their advantages. Furthermore, teachers should timely praise and recognize student's progress, and in particularly, give them as much successful experience as possible in terms of classroom questioning, exercise, assignments and inspection, etc., so that students will enjoy more in learning. This is a process that involves patient and meticulous long-term help. Teachers should follow the principle of "giving more encouragement and exploring diverse potentials" in daily teaching.

4.2 Helping underachievers cultivate good learning habits and scientific learning methods

Students with difficulty in learning mathematics in junior middle schools can solve problems with the help of flipped classroom. The flipped classroom teaching mode realizes the teaching tasks that are difficult to be completed by traditional teaching. This teaching mode reconstructs the learning process of students and fits several key opportunities of learning transformation for students with mathematical learning difficulties. [9] In teaching activities, teachers should require students to make preview and cultivate self-learning ability, and introduce an evaluation mechanism. In classrooms, teachers should create more scenarios for questions to improve students' self-selection ability, and give them more opportunities to speak. If a student fails to answer a question, the teacher should be good at inspiring. After class, underachievers should be required to complete learning tasks independently to deepen their understanding of new knowledge and skills, and then make a summary. The development of these good habits requires endeavor from both teachers and students. The strengthening of tutoring on learning methods should start with the contradiction between the weakness in students' learning and the required methods for learning mathematics, so as to provide targeted guidance in an all-round way step-by-step in a planner manner.

4.3 Setting up second classroom teaching and competition groups

Teachers should carry out second classroom teaching for math underachievers by setting up interest groups, help groups, competition groups, etc. This is another form of curriculum teaching and an indispensable part of mathematics teaching. Classroom teaching orientates

at all students, where the teaching process is carried out in accordance with the unified teaching objectives and requirements. However, due to poorer capability of underachievers, there is a large gap between the demand for math learning and their competence. In order to fill up the gap, underachievers may choose to joint an activity group that suits their competence. Adolescents are motivated by competition. Their enthusiasm in learning can be improved through optimization of grant of awards and timely recognition of progress.

4.4 Strengthening individual tutoring for underachievers through close cooperation between teachers and parents

Teachers should utilize provide targeted individual tutoring in spare time. Due to the poor foundation of underachievers, the tutoring must be started from a lower level and be advanced step by step. Furthermore, heuristic teaching should be adopted to enable them to think independently and improve the ability to analyze and solve problems. Teachers should work with parents closely based on students' situation, thus helping them develop a correct outlook on learning, values and life. Research suggests that a harmonious family is conducive to the good morals and healthy psychology of children. The more adequate communications with children, the better the parents can comprehend children's development in a timely manner, and the easier it is to overcome their learning disabilities.

4.5 Case study of practice in conversion of math underachievers in junior high schools

4.5.1 Background of the underachiever

Student Z was a typical math underachiever. The main problems confronting the student were lack of fundamental mathematical knowledge and basic learning method, poor mathematical thinking ability and inadequate confidence. In mass classes, he easily fell asleep or looked dull. He was also introverted and feel shy to ask for help from teachers or classmates when he couldn't solve a problem. Therefore, he was always one of the last few students to hand in homework. In examination, he would leave many blanks on the paper. His parents were out of town working and lacked the ability in child's education. Except intellectual factors, the greater problem with this math underachiever was lack of learning motivation. Nonetheless, he was kind, honest, and active in labor, with the desire for progress. In providing tutoring, I focused on the fundamental mathematical knowledge and basic learning method, intensified his learning motivation and provided guidance on his learning habits and methods.

4.5.2 Strengthening emotional communication

In the first week, I had heart-to-heart communications with student Z at relaxing places such as a leisure room or playground. During conversation, I would recognize his unique advantages and gave him a sense of being appreciated. This greatly enhances psychological communication and creates a harmonious psychological atmosphere, whereby he developed friendliness with me and become willing to open up his mind. Then, I learned about the specific difficulties in his learning and life, and shared the stories of some celebrities or other learners of mathematics around him, helping him improve learning interest and confidence and gradually eliminate the fear of learning mathematics. Next, I arranged him a desk mate who was good at math and willing to help others. When I am absent, he can seek help from the desk mate. If necessary, the desk mate would remind him of the discipline

and completion of homework. At math classes, I would ask him some questions with low or medium difficulty and praise him, so that he can enjoy the joy of success. I also encouraged him to participate more in class activities and develop the awareness of team spirit and competition with classmates. Furthermore, I prepared a feasible plan based on his characteristics, classroom performance, and examination results. I supervised him to strictly stick to the plan and give timely and appropriate evaluation after each practice. After one semester, the most obvious change was that he became more outgoing and was willing to communicate with students. Furthermore, his learning efficiency was also improved a lot. In the last monthly examination, his ranking in the classroom was improved by 10 places, suggesting significant progress in math learning.

4.5.3 Targeted guidance on learning method based on different causes

In view of the characteristics of mathematics, the key point of math learning is cultivation of fundamental mathematical knowledge and basic learning method. After class, I would play a video about some important knowledge in primary school, and help him comprehend the transition from calculation and basic graphics at primary school to algebra and geometry at junior high schools, as well as their inner connection. Taking “Cube Root" as an example, student Z had poor cognition of this concept. The primary reason is that he lacked full understanding, as a result of which he could only calculate the square root of simple numbers. Second, he was not concentrated. As often as not, his attentions would be distracted, resulting in poor learning effect. Therefore, we analyzed the causes of distraction and find the solutions. First, I acquaint him with the concept of square root. Then, I inspired him to speak out the concept of square root through analogy and introduction of practical problems, and helped him understand the inverse operation between extraction of cubic root and cubing, thus effectively helping him improve learning.

4.5.4 The practical difficulties in conversion

However, there are still many practical difficulties in the conversion. For example, he was not good at combing the key knowledge points after learning the basic knowledge of a unit. He would simply copy down the concepts and formulas from the book, without any extension to detailed knowledge. When doing problems, he often referred to his note. In view of this, I taught him to ask himself more questions when sorting the chart of knowledge, underline the frequently used formulas or concepts with a highlighter and sort out typical types of questions below. He was required to review these them on a daily basis but not on occasions of doing problems. In this way, he could check how much knowledge he’d mastered, find out the problems, achieve better note review effect, and make more effective application. For instance, when reviewing linear function, I ask him the concept, nature and graph of a linear function, and then told him to organize them together to form a knowledge network. As a result, he achieved a better understanding. Second, I found that he had difficulties in comprehending complex math problems. In fact, the strategies for solving such problems had been taught at primary schools, such as the approaches from conditions or questions, drawing, enumeration, conversion, and assumption. In view of situation of student Z, I taught him to find out the known conditions in a question and analyze whether there is a quantitative relationship among them at first. Then, he should review the question and determine whether the result can be reached from the known conditions directly or through conversion, thus finding the right approach to solving the problem.

As the saying goes: "it takes more than one cold day to freeze three feet of ice." The conversion of math underachievers at junior high schools cannot be done overnight but

must undergo the four stages of awakening, changes, repetition, and stability. This requires enthusiasm and perseverance from educators. It should be born in mind that underachievers are not born. Instead, each of them is a malleable talent with multiple intelligences, and should not be given up and denied. As long as teachers support them with reasons, patience, appropriate approaches and love and be good at identifying their advantages, there will be less underachievers and a step forward in math teaching.

References

1. Ministry of Education of the People's Republic of China. *Mathematics Curriculum Standards of Full-time Compulsory Education (Experimental Draft)*. Beijing: Beijing Normal University Publishing Group (2012)
2. Bai Yongxiao, Gao Qiping. *Case Study on Conversion of Math Underachievers in Junior High Schools*. Journal of Beijing Institute of Education (2013)
3. Guo Chunyan. *Study Method of Educational Science.People's Education Press, (2003)*
4. *Math Leaning Difficulties and Working Memory* [J]. Advances in Psychological Science, 39—47 Jan (2005)
5. (American) Howard Gardner. *Multiple Intelligences*.Beijing: Xinhua Publishing House, Oct (1999)
6. Zhang Chunxing. Journal of Educational Psychology.Zhejiang Education Publishing Group, May (1998)
7. He Xiangyu. *The causes and transformation countermeasures of middle school mathematics learning difficulties*. 2020 "Classroom Teaching Reform Based on Core Literacy" Symposium proceedings. Beijing (2020)
8. Lin Qiushi, Qiu Mang. *A case Study of junior middle school mathematics learning difficulties*. Journal of Heilongjiang Institute of Teacher Development, Jan (2021)
9. Lin Shengjuan, Liu Junshan. *The transformation strategy of Middle school mathematics students with learning difficulties based on flipped classroom mode*. Modern Education, Jun (2016)