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Investigation and research on mathematics learning emotion of junior middle school students in Zaozhuang city

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Abstract: *This paper takes middle school students in a middle school in Zaozhuang City as the research object, and investigates the four dimensions of mathematics learning emotion of middle school students in a middle school in Zaozhuang City by using mathematics learning emotion questionnaire, and finds that: students' attitude towards mathematics learning is good, teacher-student relationship is average, mathematics learning interest and mathematics learning beliefs need to be improved, and there is no significant difference between different grades, and the difference between genders is large. To this end, this paper develops teaching strategies that can mobilize students' emotions toward mathematics learning in four dimensions: mathematical beliefs, and evaluation, and also expands the scope of the theoretical basis for developing students' emotions toward mathematics learning.*

Keywords: *Mathematics learning; Learning emotions; Development strategies*

1. Introduction

Emotion is a function of the human brain and a psychological state, which is an external manifestation and an internal change that arises from the different attitudes that people hold toward objective things [1]. That is, emotions are the experiences and feelings that people have about whether objective things satisfy their own needs; if things can satisfy their inner needs, they produce positive and beautiful experiences, and if they cannot, they produce negative feelings[2]. Emotional learning in mathematics refers to the attitudes and psychological experiences that students exhibit in the mathematics classroom. Specifically, it refers to students' emotions, attitudes, and self-confidence in learning mathematics, showing their active involvement in mathematical activities and reflecting their approach and attitude in solving difficult problems in the process of learning mathematics. The author teaches in a township middle school. Most of the students come from the central primary school and the surrounding villages. Due to the remote location of this region, the cultural atmosphere is not strong, the parents' educational level is not high, the teachers' teaching method is outdated and boring, resulting in more and more junior high school students' math performance is very unsatisfactory, they resist math, don't like to attend math classes, seriously affect the students' emotion of learning math. Junior high school students are not mature mentally, and their enthusiasm for mathematics mainly comes from the guidance and cultivation of teachers. Therefore, it is particularly important for teachers to make use of emotional factors to improve the deficiencies in previous teaching.

2. Domestic and international development background of emotion in mathematics learning

2.1 Status of foreign research on emotions in mathematics learning

From the perspective of psychology, scholar Mcleod.D put forward three elements of emotion: emotion, attitude and belief, and believed that the emotional component of the three elements gradually decreased, while the cognitive component gradually increased, and the stability gradually increased.

Goldlin G.A., an American mathematician, studied Mcleod.D's findings in depth and proposed a tetrahedral model of emotion, including four aspects: emotions, beliefs, attitudes and values. He believes that emotion is the more active emotional factor in mathematical activities and does not have

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stability; beliefs and attitudes are relatively stable, and it is a smooth state achieved by the coordinated action of cognition and emotion; and values are the most stable emotional state, which has a high emotional factor and cognitive component[3]. Goldlin proposed the "Emotional Pathway Model of Mathematical Problem Solving", which locates mathematical emotions in an emotional state.

Scholar Reyes believes that students' confidence in math learning is highly positively correlated with their math scores [4]. In terms of gender, American scholars Fennema and Sherman analyzed middle school students' math learning emotion by using the scale and obtained the norms of male and female students in each dimension of math emotion [5]. According to the research of scholars Newman and Wick, there is no significant gender difference in students' self-confidence in primary school, while boys' self-confidence is higher than girls' in middle school. This kind of self-awareness and self-efficacy of junior high school students is one of the important factors affecting the achievement [6]. Scholar Pekrun's research report showed that the higher the math anxiety of students, the less ideal math performance.

2.2 Status of domestic research on emotions in mathematics learning

In his paper "Thirty years of research on students' mathematical beliefs: a review and prospect", Professor Sheng Zhang pointed out that mathematical beliefs have a profound influence on a person's thinking and calculation as well as on his behavior [7]. According to Zhang Dingqiang, mathematics classroom teaching is the process of awakening knowledge, and the teaching design should face students to awaken the four bases and four abilities, and integrate mathematical literacy in emotion and context. Mathematical emotion is a crucial factor in determining whether students can develop core mathematical literacy and the quality of their thinking [8]. Binyan Xu systematically analyzed the curriculum standards and syllabus of secondary school mathematics since the 20th century and obtained the following conclusion: in the development of mathematics curriculum reform, the dynamic changes in the composition of the elements of affective goals, on the one hand, adapt to the needs of social development, and on the other hand, are comparable to the physical, mental and cognitive development of students [9]. To sum up, affective teaching has a positive influence on students' learning mathematics, and teachers should carefully design the teaching process to integrate affect with the four fundamentals and four abilities, so that students can both master knowledge and develop well physically and mentally.

3. Design and description of the questionnaire

In order to understand the current situation of mathematics learning emotion of middle school students in a middle school in Zaozhuang City and analyze the main factors affecting students' learning emotion in mathematics, this paper took two classes from each of the three grades to issue questionnaires. A total of 350 questionnaires were distributed, 312 valid questionnaires and 38 invalid questionnaires, 148 girls, accounting for 47.4%. There were 164 male students, accounting for 52.6%. The questionnaire was designed with five questions on four dimensions: attitude toward learning mathematics, interest in learning mathematics, teacher-student relationship in mathematics, and belief in learning mathematics. 20 questions were designed in total, and the Likert five-point scale was used. Each declarative question had five different attitudinal ratings, namely: "fully conform", "somewhat conform", "generally conform", " Since 8, 15, 17, 18, and 19 are reverse questions, the actual scores need to be subtracted from 6 to convert them into positive scores before counting these 5 questions，as shown in Table 1.

Table 1: Questionnaire design breakdown

First level dimension	Second level dimension	Question number
Attitude towards learning mathematics	Understanding of mathematics Understanding of how closely math is related to life	1,2,3,4,5
Interest in learning mathematics	Concentration of attention Motivation to participate in mathematical activities	6,7,8,9,10
Math Teacher-Student Relationship	The influence of teachers on students' learning of mathematics The importance of teachers	11,12,13,14,15
Mathematics Learning Beliefs	Willpower to learn mathematics Math test anxiety	16,17,18,19,20

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4. Research results and analysis

The valid raw data obtained from the collection and collation were all input into the computer, and the SPSS software was used for reliability and validity analysis, and the test Cronbach'a coefficient was 0.903, KMO=0.881>0.8, indicating that there is a certain correlation between the four dimensions under the emotion of mathematics learning, while the sphericity test yielded a companion probability Sig=0.000<0.05, which is below the significant level and has good structural validity.

4.1 Descriptive statistics

Table 2: Descriptive statistics for each dimension of the questionnaire

	Learning Attitude	Interest in Learning	Student-Faculty Relations	Learning Beliefs	Total Scale Score
Mean value	22.1056	17.9577	19.2156	16.8648	76.1437
Standard deviation	3.49536	4.55365	4.24455	5.51823	17.81179
Variance	11.415	19.125	17.554	26.981	174.342
Minimal value	5.00	5.00	5.00	5.00	36.00
Very large value	25.00	25.00	25.00	25.00	100.00

It is concluded from Table 2 that middle school students' affective learning of mathematics is at an average level, indicating that further motivation is needed. The maximum and minimum values of each dimension of the questionnaire do not differ significantly, while the mean values vary widely. Among them, the mean score of attitude toward learning mathematics was the highest, interest in learning mathematics and mathematics teacher-student relationship were average, and the level of belief in learning mathematics was the lowest. This indicates that students have good attitudes toward learning and know the importance and necessity of learning mathematics, but have average teacher-student relationships and lack interest and confidence in learning mathematics.

4.2 Analysis of the emotions of learning mathematics by gender

In order to explore whether there are differences between male and female students in mathematics learning emotion, this paper analyzed the mean differences of each dimension of mathematics learning emotion between male and female students in a middle school in Zaozhuang City using SPSS22.0 and conducted independent samples t-test, and the results obtained are shown in Table 3.

Table 3: Independent sample t-test for different genders

	Sex	N	Mean value	Standard deviation	T Value	Sig.(Bilateral)
Learning Attitude	women	148	21.3562	3.21542	-3.652	0.000
	men	164	20.4851	3.35468		
Interest in Learning	women	148	16.1545	4.43652	-4.365	0.009
	men	164	18.7654	3.87416		
Student-Faculty Relations	women	148	16.9412	4.16841	-4.231	0.000
	men	164	18.8679	4.02871		
Learning Beliefs	women	148	15.5624	4.62114	-2.432	0.015
	men	164	16.8979	5.55482		

As can be seen from Table 3, the values of the two-tailed test for the probability of companionship Sig. (two-sided) for all four dimensions are less than 0.05, indicating that middle school students' mathematics learning emotions differ more in terms of gender. In the mathematics learning attitude dimension, girls had a more serious and correct attitude toward learning mathematics and were more able to complete the tasks assigned by the teacher on time. In the dimension of interest in learning mathematics, boys enjoyed learning mathematics more and were happy to investigate geometric figures and algebraic problems, thus experiencing a sense of achievement in learning mathematics. In the dimension of teacher-student relationship in mathematics, the mean score of boys was 18.8679 and the mean score of girls was 16.9412. The reason is that adolescent girls are more introverted and not good at communicating with their teachers; they are more willing to follow the teacher's questions and answer them together. In the mathematics learning belief dimension, girls lack confidence in learning mathematics well, and are more prone to anxiety and to doubt their ability and intelligence. By comparing the means, the differences between male and female students were somewhat greater in

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terms of their interest in mathematics and their relationship with their teachers.

4.3 Emotional analysis of mathematics learning in different grades

To explore whether there are grade differences in the emotions of learning mathematics among rural junior high school students, this paper used SPSS22.0 to compare the means and nonparametric tests for each dimension across grades, and the results are shown in Tables 4 and 5.

Table 4: Comparison of mean values of different grades

grade	Learning Attitude	Interest in Learning	Student-Faculty Relations	Learning Beliefs
Grade 7	20.4812	17.6456	18.2210	15.5554
Grade 8	21.2325	17.8871	17.9584	17.0214
Grade 9	21.2990	17.9927	18.0254	16.1021

From Table 4, it can be seen that 7th grade students get along with their teachers the best, but their learning attitudes, learning interests and learning beliefs need to be improved; 8th grade students are more confident in learning mathematics, but do not like to communicate with their teachers; 9th grade students have good learning attitudes, learning interests and learning beliefs, and can get along with their teachers better.

Table 5: Non-parametric tests

	Learning Attitude	Interest in Learning	Student-Faculty Relations	Learning Beliefs
chi-square	2.076	.351	.611	3.569
df	2	2	2	2
Asymptotic significance	.360	.839	.734	.159

The author conducted Kruskal-Wallis H-test for each dimension of students' emotions towards mathematics learning using grade level as the grouping variable. From Table 5, it can be seen that the values of the asymptotic significance of the four dimensions of mathematics learning attitude, mathematics learning interest, mathematics teacher-student relationship, and mathematics learning beliefs are all greater than 0.05; therefore, there is no significant difference between the levels of different dimensions of mathematics learning emotions in different grades.

4.4 Correlation analysis of achievement and mathematics learning emotion

In order to investigate whether there is a correlation between junior high school students' mathematical learning emotional level and their mathematical scores, the author numbered the subjects and entered the corresponding midterm test scores, worked out the total average of each student's emotional scores, and conducted Pearson correlation analysis with the test scores, finally obtained the processing results of different grades, as shown in Table 6, Table 7 and Table 8 below.

Table 6: Correlation Analysis of Grade 7

		achievement	Total score of the scale
achievement	Pearson correlation	1	.542**
	Significance (bilateral)		.000
	N	100	100
Total score of the scale	Pearson correlation	.542**	1
	Significance (bilateral)	.000	
	N	100	100

Table 7: Correlation Analysis of Grade 8

		achievement	Total score of the scale
achievement	Pearson correlation	1	.459**
	Significance (bilateral)		.000
	N	106	106
Total score of the scale	Pearson correlation	.459**	1
	Significance (bilateral)	.000	
	N	106	106

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Table 8: Correlation Analysis of Grade 9

		achievement	Total score of the scale
achievement	Pearson correlation	1	.393**
	Significance (bilateral)		.000
	N	106	106
Total score of the scale	Pearson correlation	.393**	1
	Significance (bilateral)	.000	
	N	106	106

According to Pearson correlation analysis, the results in Table 6, Table 7 and Table 8 show that the correlation coefficients between the mathematics learning emotion level of the three grades of township junior middle school students and their mid-term exam scores are r (grade 7)=0.542, r (grade 8)=0.459, r (grade 9)=0.393, and the concomitant probability of the two tailed test Sig (2-tailed)=0.000 ＜ 0.05, indicating that there is a significant correlation between junior high school students' mathematics learning emotional level and test scores.

5. Strategies for cultivating junior middle school students' emotion in mathematics learning

5.1 Set math problems skillfully

The learning style of middle school students can be divided into receptive learning and inquiry learning. Mathematical inquiry can effectively promote the development of students' curiosity, understanding and self-belief. However, the survey shows that most students are only satisfied with completing tasks and lack a certain degree of reflective spirit in math learning. In addition, nearly one third of students give up easily when they fail to explore independently [10]. Therefore, in teaching, teachers should not only support students' learning to meet their needs of understanding and knowledge, but also cooperate with the infiltration of mathematical beauty, mathematical history and mathematical application, so that students can feel the charm of mathematics lies in exploration, and cultivate students' mathematical spirit. Creating an atmosphere of inquiry also requires the support of parents and classmates, and it is easier to obtain positive emotional experience under the action of common cohesion.

5.2 Cultivate mathematical belief and relieve anxiety

Success in learning satisfies students' need for self-improvement, provides a great sense of accomplishment, enhances self-confidence, and gives motivation to learning. Teachers should make every student's experience of success as continuous as possible, so that everyone can experience different levels of satisfaction and achievement. On the one hand, help students set long-term and immediate goals that are appropriate to their actual level, motivate students to learn, and encourage them to take the initiative to learn and achieve in mathematics. On the other hand, teachers should extend the scope of "success" to include meeting the learning objectives of each lesson, completing today's homework correctly, correcting one's mistakes, and completing homework more carefully [11], with immediate evaluation and motivation, so that students have hope and goals for success at every moment. In addition, it is possible to "help individuals or groups improve their performance in mathematics through positive interventions such as socialization, caring, and motivational engines."

5.3 Make reasonable evaluation and obtain emotional support

Evaluation itself is an important learning activity, and the results of its evaluation can not only diagnose teachers' teaching, but also support students' learning emotions. The traditional mathematics classroom generally uses the classroom standard as a means of evaluation, focusing on the high or low score, but rarely focuses on evaluating students' learning process and emotional experience, which is not conducive to the development of students' positive mathematics learning emotions in the long run. In fact, each student is a unique individual, high or low grades are not the standard for evaluating whether students are good or not. Teachers and parents can look for shining points in students from multiple perspectives, such as the degree of effort and progress, the students' willpower, concentration, and character, instead of just pressuring learning, so as to mobilize positive factors in students' mathematics learning and thus improve their mathematics learning emotions.

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