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The influence of emotional intelligence on the self-efficacy of mathematics learning among mathematics majors

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Abstract. Contemporary college students are influenced by Emotional Intelligence (EI) in mathematics learning, and students with high EI also have higher confidence in mathematics learning. In order to alleviate the pressure of mathematics learning for mathematics majors, this study selected 120 mathematics majors from an undergraduate institution in the Central Plains region of China. A questionnaire survey was conducted using the EI Scale and academic self-efficacy scale to collect data. Reliability analysis, gender difference analysis, and regression analysis were used to examine the relationship between the two. The results showed good internal consistency between the two scales. There is a significant difference in EI among mathematics majors of different genders, with female students scoring higher than male students on average, while there is no significant gender difference in academic Self-Efficacy (SE). Regression analysis shows that EI is significantly positively correlated with academic SE, and the dimensions of evaluation and expression, regulation, and utilization are also significantly positively correlated with academic SE. It can be seen that in the cultivation of mathematics professionals, in addition to professional knowledge and learning ability, attention should also be paid to the development of students' EI.

Keywords: emotional intelligence, academic self-efficacy, mathematics major college students

1. Introduction

Contemporary mathematics majors are influenced by various factors during their mathematics learning process. Mathematics learning usually requires strong logical thinking ability and continuous learning engagement. Students may experience anxiety, frustration, and other emotions when facing large learning tasks or complex mathematical problems. Emotional state affects both students' learning process and their judgment of learning ability. Students with high emotional intelligence are usually able to maintain a relatively stable psychological state when facing learning difficulties, have the ability to recognize and regulate their own emotions, and focus on solving difficulties by adjusting their emotions and mentality, thus forming a more positive learning attitude and being more likely to achieve success.

Emotional intelligence affects various aspects of daily life and is also a hot topic in psychological research. EI is not only a person's ability to regulate their own emotions and perceive the emotions of others when facing things, but also a psychological process of self-management of emotions, which plays a crucial role in the learning process [1]. EI also affects students' learning motivation [2]. EI also affects people's satisfaction

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with life [3]. It can be seen that EI has a profound impact on students' learning and daily life. Self-efficacy is defined as the level of one's ability or confidence in oneself when completing a task, and is an important energy in the heart when completing the task [4]. SE can affect students' ability to learn mathematics [5]. SE can also scientifically predict academic performance [6]. SE not only directly affects multiple aspects of students' learning process, but also often serves as an intermediate variable that influences learning. EI and SE both have a certain impact on students' learning. EI reflects a person's ability to manage emotions, and this self-awareness, carried by learning, becomes the core factor affecting SE [2]. EI is positively correlated with SE [7].

Researchers have extensively studied the relationship and impact of EI and SE, but there is still a research gap in mathematics learning for mathematics majors, in order to alleviate the learning pressure of mathematics majors and effectively improve their learning efficiency. This study will focus on mathematics major college students and use the Academic Self Efficacy Scale and EI Scale to investigate the impact of EI on their SE in mathematics learning [8, 9].

2. Methods

2.1. Research design

This study conducted quantitative research using a questionnaire survey. It first selected the EI Scale and Academic Self Efficacy Scale based on the research objectives, and set basic information items and attention testing items in the questionnaire. The beginning of the questionnaire explains the research purpose, filling requirements, and precautions to the participants. The formal survey adopts stratified sampling method, and samples are drawn based on the students' grade level.

130 questionnaires were distributed for the formal survey, and after collection, 120 valid questionnaires were selected based on their completion status and attention test results, with an effective response rate of 92.31%. Invalid samples have been removed. The distribution and collection of questionnaires have been completed within two weeks, after which the data have been screened and entered.

2.2. Research tools

2.2.1. Emotional intelligence scale

This study used the Emotional Intelligence Scale developed by Schutte et al. [9]. This scale contains 33 items, mainly related to the evaluation and expression of emotions, emotion regulation, and emotion utilization. Among them, emotional evaluation and expression include 13 items, emotional regulation includes 10 items, and emotional utilization includes 10 items.

The scale adopts a 5-point scoring method, ranging from 1 point of "strongly disagree" to 5 points of "strongly agree". Schutte et al. conducted reliability and validity tests on the scale, and based on this, this study used the scale to measure the EI of mathematics major college students.

2.2.2. Academic Self Efficacy Scale

This study used the College Student Academic Self Efficacy Scale developed by Liang Yusong [8]. This scale contains 22 items, including two dimensions of SE in learning ability and SE in learning behavior, each dimension containing 11 items.

The scale adopts a 5-point scoring method, ranging from 1 point of "completely disagree" to 5 points "completely agree", with higher scores indicating higher academic SE of students. The original research

reported the reliability and validity of the scale, and this study used the scale to measure the academic SE of mathematics major college students.

2.3. Sample description

This study conducted stratified sampling by grade from mathematics majors in a certain undergraduate institution in the Central Plains region of China. A total of 120 valid questionnaires were collected, including 66 for male students and 54 for female students. The proportions of questionnaires for freshmen, sophomores, juniors, and seniors are 25.9%, 25%, 24.1%, and 25%, respectively.

3. Results

3.1. Scale reliability test

This study first conducted an internal consistency test on the EI Scale and the Academic Self Efficacy Scale.

Table 1. Reliability analysis of the emotional intelligence scale and academic self-efficacy scale

Scale name	Cronbach's alpha	Number of items
Emotional Intelligence Scale	0.913	33
Academic Self Efficacy Scale	0.865	22

According to Table 1, the Cronbach's alpha coefficient of the Emotional Intelligence Scale is 0.913, and the Cronbach's alpha coefficient of the Academic Self Efficacy Scale is 0.865. This indicates that the two scales have good internal consistency in the sample of this study and can be used for subsequent analysis.

3.2. Analysis of gender differences

In order to investigate whether there are differences in EI and academic SE among mathematics majors of different genders, this study conducted gender difference analysis on two variables.

Table 2. Differences in emotional intelligence and academic self-efficacy among mathematics majors of different genders

	Male average	Female average	Average	Male standard deviation	Female standard deviation	Significance of different genders
Emotional intelligence	111.5152	116.9444	113.9583	20.62280	5.25722	0.004
Academic self-efficacy	72.0909	75.6852	73.7083	13.43214	3.96125	0.772

According to Table 2, the average scores of EI are 111.5152 (male students) and 116.9444 (female students). The significance level of gender difference is 0.004, which is less than 0.05, indicating significant differences in EI between mathematics majors of different genders.

In terms of academic SE, the average score is 72.0909 (male students), and 75.6852 (female students). The significance level of gender difference is 0.772, which indicates that there is no significant difference in academic SE among mathematics majors of different genders. Although the average score of girls is slightly higher than that of boys, this difference has not reached a statistically significant level.

In addition, the standard deviations of EI and academic SE in male students were higher than those in female students, indicating a relatively large degree of individual score dispersion among male students in this study sample. However, this description only reflects the distribution within the sample and cannot be used to further infer the psychological characteristics of students of different genders.

3.3. Regression analysis of emotional intelligence and academic self-efficacy

Table 3. Regression analysis of emotional intelligence and its three dimensions with academic self-efficacy

	B	standard error	standardized coefficient Beta	*t*	significance
Evaluation and expression of emotional categories	1.233	0.082	0.812	15.099	< 0.01
Regulation of emotional categories	1.554	0.102	0.815	15.253	< 0.01
The utilization of emotional categories	1.709	0.115	0.808	14.878	< 0.01
Total emotional intelligence	0.580	0.028	0.882	20.369	< 0.01

According to Table 3, the standardized regression coefficient β of total EI is 0.882, and a significance level of is less than 0.01. The results show a significant positive relationship between EI and academic SE.

The regression coefficients of emotional evaluation and expression, emotional regulation, and emotional utilization have all reached a significant level, with significance levels less than 0.01, indicating a significant positive relationship between all three dimensions and academic SE. Among them, the standardized regression coefficients for emotional evaluation and expression, emotional regulation, and emotional utilization are 0.812, 0.815, and 0.808, respectively. The coefficients for all three dimensions are relatively high, but it cannot be simply assumed that one dimension has the greatest impact on academic SE.

In summary, the regression analysis results support the judgment that there is a positive relationship between EI and academic SE. It should be pointed out that this study used cross-sectional questionnaire data, so the regression results reflect the statistical relationship between variables and cannot directly determine the causal effect of EI on academic SE.

4. Discussion

This study focuses on mathematics major college students and investigates the relationship between EI and academic SE through a questionnaire survey. The results showed that both scales had good internal consistency in the sample of this study; Regression analysis further indicates a significant positive relationship between EI and academic SE. The total score of EI, as well as the dimensions of evaluation and expression, regulation, and utilization, are all significantly correlated with academic SE. Based on this result, the following discussion will focus on three aspects: the reasons for the positive relationship between the two, the implications for the learning and cultivation of mathematics majors, and the limitations of this study.

4.1. The reasons for the significant positive relationship between emotional intelligence and academic self-efficacy

The regression analysis results showed that the standardized regression coefficient of total EI was 0.882, and the three dimensions of evaluation and expression, regulation, and utilization also reached a significant level, indicating that mathematics majors with higher EI often have higher academic SE, which is consistent with the

positive correlation between EI and SE in previous studies [7]. At the same time, gender analysis shows that the average EI score of girls is higher than that of boys, while the gender difference in academic SE has not reached a significant level. This indicates that the positive relationship between EI and academic SE holds true for both boys and girls, and gender differences have not changed this overall trend [10]. The reasons for the formation of this relationship can be understood from several aspects where EI plays a role.

Emotional regulation is a major clue to understanding this relationship. Mathematics learning is often accompanied by frequent trial and error and setbacks, making it easy for students to experience anxiety, frustration, and other emotions in the face of difficult problems. Self efficacy to some extent depends on an individual's judgment of their own emotional state, and persistent negative emotions can lead to underestimation of their ability to cope with learning tasks. Students with high EI are able to promptly detect changes in their emotions and refocus their attention on problem-solving by adjusting their mindset. Their negative emotions generally do not accumulate over a long period of time, and their learning state is relatively stable. State stability means that when faced with tasks of the same difficulty, they are more likely to experience success, which is an important foundation for forming and consolidating SE.

Emotional evaluation and expression are also significantly correlated with academic SE, indicating that the influence of EI on SE is not only reflected in emotional regulation. Students who can accurately identify and express their emotions have a clearer objective understanding of the problems and difficulties encountered in learning. This clear self-awareness helps them attribute failure to modifiable factors such as methods and investment, rather than broadly attributing it to their own lack of ability, thus reducing the risk of denying their learning ability due to a single setback. Students who are able to utilize emotional resources will convert moderate tension and engagement into motivation for continuous learning, and are more willing to persevere when faced with difficulties. The sense of achievement brought by actual learning progress will in turn enhance their confidence in their own abilities. It can be said that EI is positively correlated with academic SE through interconnected pathways such as stabilizing emotional states, forming clear self-awareness, and mobilizing emotional resources.

The learning content of mathematics majors is highly logical and abstract, with direct feedback on right and wrong. Students are more likely to accumulate frustration in frequent failures, and emotional fluctuations have a more significant impact on learning confidence. Therefore, the buffering effect of EI in such situations is particularly prominent. Meanwhile, EI and academic SE may also mutually promote each other. Students with stable emotions are more likely to accumulate successful experiences, which in turn consolidate their emotional state. The two may form a virtuous cycle in the long-term learning process. The cross-sectional data is difficult to distinguish this sequential relationship, and its direction of action and specific mechanism still need further research and verification.

4.2. Inspiration for the learning and teaching cultivation of mathematics majors

The research results suggest that enhancing the EI of mathematics majors may be a practical path to enhance their academic SE, and the enhancement of academic SE is beneficial for improving learning performance [11, 12]. In the cultivation of mathematics professionals, the development of emotional abilities can be combined with the learning of professional knowledge without being seen as an additional burden.

For teachers, classroom teaching can focus more on students' emotional reactions when facing difficult problems. The sense of frustration in mathematics classrooms is often amplified by comparison and competition. If teachers can create a classroom atmosphere that allows for mistakes and values the thinking process, reducing high-intensity comparisons of students' problem-solving results, students' anxiety will be alleviated, and they will be more willing to continue trying when faced with difficult problems. Timely and

specific feedback is equally important, shifting students' attention from doubts about their own abilities to improvements in methods and investment, which helps to protect and gradually enhance their judgment of their own learning abilities.

In terms of course and homework arrangements, progressively difficult practice tasks can be set up to enable students of different levels to have accessible successful experiences, gradually accumulating learning confidence through continuous small successes. Demonstrations and encouragement among peers also play a role. Organizing study groups or providing assistance to senior students allows them to gain alternative experiences through observing and imitating peers' problem-solving processes, which is also an important source of SE.

For students themselves, the process of learning mathematics can also become a process of training emotional abilities. Students can practice recognizing their own emotions when they are anxious and depressed, and try to regulate their state through reasonable attribution, adjusting goals, and confiding in others, without seeing emotional fluctuations as obstacles to learning. At the school level, EI related content can be incorporated into mental health education and extracurricular activities, through lectures, group counseling, themed workshops, and other forms, to help students systematically understand and practice methods for emotion recognition, regulation, and utilization. Of course, these suggestions are based on inferences from research results, and their actual effects still need to be tested through targeted intervention studies in real teaching contexts.

4.3. Limitations and future prospects of this study

This study has some limitations. Firstly, the sample comes from an undergraduate institution in the Central Plains region of China, with a total of 120 mathematics majors. The sample size and source range are relatively limited. Whether the research results can be extended to mathematics majors in other regions and types of universities requires larger sample sizes and multi school sampling studies to verify. The gender differences found in this study may be particularly affected by the characteristics of the sample.

Secondly, this study used a cross-sectional questionnaire survey, and regression analysis can only reflect the statistical correlation between variables, making it difficult to confirm the causal effect of EI on academic SE. It is also difficult to rule out the interference caused by variables that were not included, such as academic performance, learning engagement, and learning pressure. Again, this study measured EI through a scale, but did not directly observe the emotional regulation process of students, so the explanation of the mechanism of action still remains at the inferential level.

Future research can continue to deepen in several directions. It can expand the sample size and use cross regional and multi university sampling to test the stability and universality of the research results; Longitudinal tracking or experimental design can be introduced to investigate the direction and process of changes in the relationship between EI and academic SE; Variables such as learning pressure, learning engagement, and social support can also be included in the analysis to further clarify the specific mechanisms by which EI affects academic SE.

5. Conclusion

The research results indicate that, in terms of gender differences, there are significant differences in EI among mathematics majors between different genders, with female students scoring higher on average than male students in EI; There is no significant difference in academic SE among students of different genders. The regression analysis results indicate a significant positive relationship between EI and academic SE, and the

three dimensions of emotional evaluation and expression, emotional regulation, and emotional utilization are also significantly positively correlated with academic SE.

Therefore, in the sample of this study, there is a close relationship between EI level and academic SE of mathematics majors. In the process of cultivating students majoring in mathematics, while emphasizing the cultivation of professional knowledge and mathematical abilities, appropriate attention can be paid to students' emotional recognition, emotional regulation, and emotional utilization abilities.

This study still has certain limitations. Firstly, the research sample comes from the same undergraduate institution, with a sample size of 120 people, and the representativeness and generalizability of the research results are limited. Secondly, this study used a cross-sectional questionnaire survey, and regression analysis can reflect the statistical relationship between variables, but cannot determine causal relationships. Finally, this study mainly examined EI, academic SE, and gender, but did not include other potentially related variables such as academic performance, learning engagement, and learning pressure. In the future, the research sample size can be expanded and longitudinal or experimental studies can be used to further investigate the relationship and possible mechanisms between emotional intelligence and academic self-efficacy.

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