

The Research on the Status of Autonomous Learning Ability of Graduate Students Majoring in Mathematics in China

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Abstract

With the rapid development of graduate education, the quality of graduate training has become the most important part of the development of higher education. One of the standards to measure the quality of graduate training is whether graduate students have learning ability, especially the ability of autonomous learning. Autonomous learning is the premise and foundation of scientific research for graduate students. Therefore, mastering the present situation of graduate students' autonomous learning ability can not only provide better suggestions for improving graduate students' autonomous learning ability but also help to further improve the quality of education in colleges. To grasp the present situation about the autonomous learning ability of graduate students majoring in mathematics in China, this paper carries on the related research to the mathematics graduate student through the method of the questionnaire survey. The research draws the following conclusions: Most of the graduate students majoring in mathematics in China have autonomous learning ability and the autonomous learning ability is high, especially in the three aspects of preparing the relevant learning materials before class autonomously, taking class notes autonomously, and finishing the homework autonomously. However, students' autonomous learning ability still needs to be improved in the following aspects: making classroom learning goals autonomously, taking extracurricular exercises autonomously, testing learning content autonomously in classroom learning, and testing learning effects in non-classroom learning autonomously.

Keywords

Graduate Students, Autonomous Learning, Ability, Current Situation

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1. Introduction

The graduate educational objectives in China pointed out that one of the standards to measure the quality of graduate training is whether the graduate students have learning ability, especially the ability of autonomous learning [1-2]. Moreover, graduate students have gradually changed from the simple knowledge receivers to the creators of knowledge. With the improvement of knowledge structure, they need to have the ability to study autonomously [3]. Therefore, it is necessary to study the current situation of the autonomous learning ability of the graduate students, to further provide relevant suggestions

for autonomous learning of graduate students. Through a questionnaire survey, this study investigated the autonomous learning ability of graduate students majoring in mathematics. This study can not only clarify the current situation of the autonomous learning ability of mathematics graduate students in China but also provide a reference for further research on autonomous learning ability. At the same time, it can also provide corresponding guidance for the improvement of the autonomous learning ability of mathematics graduate students. The research question of this paper is "how about the autonomous learning ability of graduate students majoring in mathematics in China".

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2. Literature Review

With the increase of the researches of the students' autonomous learning ability, more and more scholars start with study of the definition of autonomous learning and carry out relevant theoretical analysis, which provide the corresponding theoretical support for the investigation. Zou points out that the key to autonomous learning lies in autonomy instead of depending on others [4]. He points out that autonomous learning emphasizes learners' subjectivity, and students need to analyze, explore, practice, and create autonomously. In essence, autonomous learning is the process of students arranging and executing their own learning plans based on certain learning tasks [5]. In addition, some scholars analyze the students' autonomous learning performance from the definition, which also provides the relevant classification basis for the questionnaire design. Pang points out that if a student can determine his learning goals autonomously, make a learning plan autonomously, prepare for specific learning activities autonomously and so on, his learning is autonomous [6-7]. Wang points out that, autonomous learning ability can draw on Chen's exposition of "autonomous learning": learners can design autonomously, manage autonomously, regulate autonomously, test autonomously, evaluate autonomously and transform autonomously [8].

For the study of graduate students' autonomous learning ability, most scholars mainly start with theoretical analysis, analyze the training mode of graduate students' autonomous learning, and put forward relevant training opinions. Lu and Fu point out that the autonomous learning ability of graduate students refers to set their own learning goals, select learning materials and learning methods, monitor the learning process objectively and evaluate the learning effect scientifically [9]. Li, He, and Liu believe that the cultivation of graduate students is different from the undergraduate students. It not only focus on the study of professional knowledge but also the ability to explore, study, and solve problems independently. It is necessary to have clear professional learning goals, choose learning methods correctly and evaluate the effectiveness of learning for graduate students [10]. Zhang and Luo believe that graduate education should focus on developing students' ability to analyze and solve problems, so the autonomous learning ability is very important [11]. Wu and Wang believe that the cultivation mode of constructing graduate students' autonomous learning ability should start from the following aspects: Breaking the thinking pattern and constructing the idea support; Improving the teaching method and constructing the mechanism support; Regulating the behavior actively and constructing the main body support [12].

It can be seen that the current research on the autonomous learning ability of graduate students is mainly based on

theoretical analysis. Scholars analyze the training mode of graduate students' autonomous learning and put forward relevant training suggestions. However, there is a lack of empirical research and related data support, and there is still a blank in the research about the autonomous learning ability of mathematics graduate students. Therefore, this paper investigates the autonomous learning ability of graduate students majoring in mathematics in order to grasp the present situation of the autonomous learning ability of graduate students majoring in mathematics in China. In addition, this paper also can provide the corresponding data support for further study and provide corresponding suggestions for graduate students to improve their autonomous learning ability.

3. Theoretical Basis

3.1. The Concept of Autonomous Learning

This paper uses the literature analysis method to define the keywords. For the word "autonomy", most scholars believe that autonomy means that one's own decision is not controlled by others [13]. Therefore, we can define the concept of "autonomous learning" as a way of study in which students can make their own decisions, instead of being controlled by others [14]. Autonomous learning means that students can dominate their own learning completely. For the word "ability", most scholars believe that ability is a kind of personality characteristic, which must be possessed by a person to complete a certain activity smoothly [15]. Therefore, we can define the concept of "autonomous learning ability" as the personality characteristics of students in autonomous learning [16].

3.2. The Investigation of Autonomous Learning

The objective of this study is to investigate whether Chinese mathematics graduate students have high autonomous learning ability. Therefore, From these concepts, the student has the following performance If he has high autonomous learning ability: (1) Students can make their own decisions and make study plans autonomously. (2) Students can set their own learning goals autonomously. (3) Students can plan the learning time autonomously. (4) Students can choose their own learning materials to study autonomously. (5) Students can choose their own learning methods autonomously. (6) Students are able to prepare for class autonomously. (7) Students can think autonomously, instead of relying on others. (8) Students can take notes in class according to their own understanding. (9) Students can participate in class discussions autonomously. (10) Students can finish their homework autonomously. (11) Except for the homework assigned by the teacher, students can do their own exercises

autonomously. (12) Students can check the implementation of the plan autonomously. (13) Students can test the learning effect autonomously. (14) Students can summarize their learning content autonomously. (15) Students can make an objective evaluation autonomously. (16) Students are able to regulate their learning status autonomously. (17) Students can autonomously take measures to make up for deficiencies in their studies.

Therefore, the above performance can be divided into two aspects: classroom learning, non-classical learning.

3.2.1. Classroom Learning

In the course of classroom learning, the performance of students can be divided into three aspects: the performance of students before class, the performance of students in the class, and the performance of students after class.

Before class, the student has the following performance if he has high autonomous learning ability: (1) Students can preview autonomously before class. (2) Students can set their own learning goals autonomously. (3) Students can choose their own learning materials to study autonomously.

In class, the student has the following performance if he has high autonomous learning ability: (1) Students can think autonomously, instead of relying on others. (2) Students can participate in class discussions autonomously. (3) Students can take notes in class according to their own understanding.

After class, the student has the following performance if he has high autonomous learning ability: (1) Students can finish their homework autonomously. (2) Except for the homework assigned by the teacher, students can do their own exercises autonomously. (3) Students can autonomously test the learning effect. (4) Students can summarize their learning content autonomously. (5) Students can autonomously take measures to make up for deficiencies in their studies.

3.2.2. Non-classroom Learning

In the process of non-classroom learning, the performance of students can be divided into three aspects: the plan of learning, the process of learning, and the reflection of learning.

In the process of making a non-classroom plan, if the student has high autonomous learning ability, he will have the following performance: (1) Students can make their own decisions and make study plans autonomously. (2) Students can finish the learning content autonomously according to the study plan. (3) Students can check the implementation of the study plan and find out the existing problems and solutions.

In the process of non-classroom learning, if the student has high autonomous learning ability, he will have the following performance: (1) Students can set their own learning goals autonomously. (2) Students can plan the learning time

autonomously. (3) Students can choose their own learning materials to study autonomously. (4) Students can choose their own learning methods autonomously.

In the process of self-reflection, if students have high autonomous learning ability, they will have the following performance: (1) Students can test the learning effect autonomously. (2) Students can summarize their learning content autonomously. (3) Students can make an objective evaluation autonomously. (4) Students are able to regulate their learning status autonomously. (5) Students can autonomously take measures to make up for deficiencies in their studies.

4. Methods

4.1. Sample

In order to reflect the present situation of autonomous learning ability of master degree students majoring in mathematics in China, I choose the graduate students of the School of Mathematics and Statistics, Shandong Normal University

4.2. Instrument

In this survey, 48 questionnaires were distributed in the classroom. In order to ensure the reliability of the research, and the recovery rate of the questionnaire, students filled in the questionnaire in the classroom. Finally, 12 questionnaires were deleted, and 36 valid questionnaires were adopted.

The questionnaire is mainly compiled from two aspects: the performance of classroom learning, and the performance of non-classroom learning. The performance of classroom learning is investigated from three aspects: the performance before class, the performance in class, and the performance after class. The performance of non-class learning is investigated from three aspects: the performance of the learning plan, the performance of the learning process, and the performance of reflection. Therefore, this questionnaire is divided into two major research aspects and six detailed research aspects.

4.3. Data Processing

For each question, we count the number of times that appear in 36 questionnaires and calculate the percentage of this option. We quantify the evaluation indicators by marks: A: 5 points; B: 4 points; C: 3 points; D: 2 points; E: 1 point. The average score is 3. And then we calculate the weighted average of each problem.

5. Results

Using the above methods for data processing, we can discuss the results of the six aspects and the present situation of students' autonomous learning ability in each aspect.

5.1. Before Class

In the investigation of autonomous learning ability before class, we set up three investigation questions: Question 1 investigates the students' ability to preview autonomously before class. Question 2 investigates the students' ability to determine their learning goals autonomously. Question 3 investigates the students' ability to prepare relevant learning materials autonomously. And then we count the number of times each option appeared in 36 questionnaires, and calculate the percentage of the number of times that option appeared in the total questionnaire. The weighted average score of each problem is further obtained. Specific data are shown in table 1.

Table 1. Summary of data before class.

Question Number		1	2	3
A: Absolutely Agree	Number of People	2	0	9
	Percentage	5.56	0.00	25.00
B: Agree	Number of People	13	8	20
	Percentage	36.11	22.22	55.56
C: Uncertain	Number of People	12	19	5
	Percentage	33.33	52.78	13.89
D: Disagree	Number of People	9	9	2
	Percentage	25.00	25.00	5.56
E: Absolutely Disagree	Number of People	0	0	0
	Percentage	0.00	0.00	0.00
Average		3.22	2.97	4.00

It can be seen from the data in the table that most students can prepare relevant learning materials autonomously before class, and the average score is 4 points, which indicates that most students have a high autonomous ability to prepare relevant learning materials.

For the second question, we can see from the data in the table that most students choose the C, and the average score is 2.97. It shows that the students' autonomous ability to determine their learning goals is not high very much.

5.2. During Class

In the investigation of autonomous learning ability in class, we set up three investigation questions: Question 4 investigates the students' ability to think autonomously. Question 5 investigates the students' ability to participate in class discussions autonomously. Question 6 investigates the students' ability to

take notes autonomously. And then we count the number of times each option appeared in 36 questionnaires, and calculate the percentage of the number of times that option appeared in the total questionnaire. The weighted average score of each problem is further obtained. Specific data are shown in table 2.

Table 2. Summary of data in class.

Question Number		4	5	6
A: Absolutely Agree	Number of People	3	1	8
	Percentage	8.33	2.78	22.22
B: Agree	Number of People	17	23	21
	Percentage	47.22	63.89	58.33
C: Uncertain	Number of People	14	12	7
	Percentage	38.89	33.33	19.44
D: Disagree	Number of People	2	0	0
	Percentage	5.56	0.00	0.00
E: Absolutely Disagree	Number of People	0	0	0
	Percentage	0.00	0.00	0.00
Average		3.58	3.69	4.03

It can be seen from the data in the table that in the classroom, most students can think autonomously, participate in the classroom discussion autonomously, and take good notes on their own. Therefore, it can be clearly seen that students have a high autonomous learning ability in the classroom.

5.3. After Class

In the investigation of autonomous learning ability after class, we set up five investigation questions: Question 7 investigates the students' ability to finish their homework autonomously. Question 8 investigates the students' ability to do extracurricular exercises autonomously. Question 9 investigates the students' ability to test the learning effect autonomously. Question 10 investigates the students' ability to summarize learning content autonomously. Question 11 investigates the students' ability to take measures to make up for the deficiencies autonomously in the study. And then we count the number of times each option appeared in 36 questionnaires, and calculate the percentage of the number of times that option appeared in the total questionnaire. The weighted average score of each problem is further obtained. Specific data are shown in table 3.

Table 3. Summary of data after class.

Question Number		7	8	9	10	11
A: Absolutely Agree	Number of People	9	2	1	5	4
	Percentage	25.00	5.56	2.78	13.89	11.11
B: Agree	Number of People	23	5	5	13	11
	Percentage	63.89	13.89	13.89	36.11	30.56
C: Uncertain	Number of People	4	17	16	11	13
	Percentage	11.11	47.22	44.44	30.56	36.11
D: Disagree	Number of People	0	12	12	1	8
	Percentage	0.00	33.33	33.33	19.44	22.22
E: Absolutely Disagree	Number of People	0	0	2	0	0
	Percentage	0.00	0.00	5.56	0.00	0.00
Average		4.14	2.92	2.75	3.44	3.31

It can be seen from the data in the table that most students can finish their homework autonomously, summarize their learning contents autonomously, and take measures to make up for the deficiencies autonomously in the study. It can be seen that students have high autonomous learning ability after class.

For the two aspects of doing extracurricular exercises autonomously and testing the learning effect autonomously, most students choose the C or D. It can be seen that the students' autonomous ability to choose extracurricular exercises and test the learning is not high.

5.4. Learning Plan

In the aspect of making and implementing the learning plan in non-classroom learning, three investigation questions are set up. Question 12 investigates the students' ability to make their own learning plan. Question 13 investigates the students' ability to finish the learning content autonomously. Question 14 investigates the students' ability to check the implementation of the study. And then we count the number of times each option appeared in 36 questionnaires, and calculate the percentage of the number of times that option appeared in the total questionnaire. The weighted average score of each problem is further obtained. Specific data are shown in table 4.

Table 4. Summary of learning plan data.

Question Number		12	13	14
A: Absolutely Agree	Number of People	7	4	2
	Percentage	19.44	11.11	5.56
B: Agree	Number of People	17	14	20
	Percentage	47.22	38.89	55.56
C: Uncertain	Number of People	10	15	11
	Percentage	27.78	41.67	30.56
D: Disagree	Number of People	2	3	3
	Percentage	5.56	8.33	8.33
E: Absolutely Disagree	Number of People	0	0	0
	Percentage	0.00	0.00	0.00
Average		3.81	3.53	3.58

It can be seen from the data in the table that most students can make their own study plan, carry out the study plan autonomously, and adjust the study plan autonomously. It shows that students' aspect of making and implementing the learning plan in non-classroom learning is high very much.

5.5. Learning Process

In the investigation of the learning process in non-classroom learning, four survey questions are set up. Question 15

investigates the students' ability to determine their learning goals autonomously. Question 16 investigates the students' ability to plan their learning time autonomously. Question 17 investigates the students' ability to choose learning materials autonomously. Question 18 investigates the students' ability to choose learning methods autonomously. And then we count the number of times each option appeared in 36 questionnaires, and calculate the percentage of the number of times that option appeared in the total questionnaire. The weighted average score of each problem is further obtained. Specific data are shown in table 5.

Table 5. Summary of learning process data

Question Number		15	16	17
A: Absolutely Agree	Number of People	4	5	6
	Percentage	11.11	13.89	16.67
B: Agree	Number of People	17	24	18
	Percentage	47.22	66.67	50.00
C: Uncertain	Number of People	11	4	10
	Percentage	30.56	11.11	27.78
D: Disagree	Number of People	4	3	2
	Percentage	11.11	8.33	5.56
E: Absolutely Disagree	Number of People	0	0	0
	Percentage	0.00	0.00	0.00
Average		3.58	3.86	3.78

It can be seen from the data in the table that most students can determine their learning goals autonomously, plan their learning time autonomously, choose learning materials autonomously, choose learning methods autonomously. It can be seen that students have high autonomous learning ability during the learning process in non-classroom learning.

5.6. Learning Reflection

In the investigation of the reflection in non-classroom learning, four survey questions are set up. Question 19 investigates students' ability to test learning content autonomously. Question 20 investigates students' ability to summarize autonomously. Question 21 investigates students' ability to make an objective evaluation autonomously. Question 22 investigates students' ability to regulate their learning state autonomously. Question 23 investigates students' ability to take measures to make up for deficiencies autonomously. And then we count the number of times each option appeared in 36 questionnaires, and calculate the percentage of the number of times that option appeared in the total questionnaire. The weighted average score of each problem is further obtained. Specific data are shown in table 6.

Table 6. Summary of learning reflection data.

Question Number		19	20	21	22	23
A: Absolutely Agree	Number of People	2	3	4	2	2
	Percentage	5.56	8.33	11.11	5.56	5.56
B: Agree	Number of People	7	16	20	25	20
	Percentage	19.44	44.44	55.56	69.44	55.56
C: Uncertain	Number of People	15	12	10	8	12
	Percentage	41.67	33.33	27.78	22.22	33.33

Question Number		19	20	21	22	23
D:Disagree	Number of People	10	4	2	1	2
	Percentage	27.78	11.11	5.56	2.78	5.56
E:Absolutely Disagree	Number of People	2	1	0	0	0
	Percentage	5.56	2.78	0.00	0.00	0.00
Average		2.92	3.44	3.72	3.78	3.61

It can be seen from the data in the table that most students can summarize autonomously, make an objective evaluation autonomously, regulate their learning state autonomously and take measure to make up for deficiencies autonomously. It can be seen that students have high autonomous learning ability during the learning reflection in non-classroom learning.

For the problem of autonomous detection of learning content, most students choose the C and D, which shows that the students' autonomous ability in test learning content is not high very much.

6. Discussion

6.1. Discussion on Six Aspects

6.1.1. Before Class

Through the data analysis of the three problems before class, for the ability to preview autonomously and the ability to prepare relevant learning materials autonomously, most students choose the A or B, and the score of these questions is high. Only the question of autonomous determination of learning goals does not reach the average score, and the weighted average score of this question is 2.97. It can be seen that most students have high autonomous learning ability before class, but the ability to determine their learning goals autonomously needs to be improved.

6.1.2. During Class

Through the data analysis of the three problems during class, we can see that the weighted average score of the three problems is high, especially the average score of the ability to take notes autonomously is as high as 4.03 points. And most students choose the A or B in all three questions. It can be seen that most students have high autonomous learning ability during classroom learning.

6.1.3. After Class

Through the data analysis of the five problems after class, for the ability to finish their homework autonomously, the ability to summarize learning content autonomously, and the ability to take measures to make up for the deficiencies autonomously in the study, most students choose the A or B, and we can see that the weighted average score of the three problems is high. The weight average score of the two problems of independent selection of extracurricular exercises and autonomous detection of learning content did not reach

the average score. It can be seen that most students have high autonomous learning ability after class, but the ability to do extracurricular exercises and the ability to test the learning effect autonomously still needs to be improved.

6.1.4. Learning Plan

Through the data analysis of the three problems of learning planning and implementation, for the ability to make their own learning plan, the ability to finish the learning content autonomously, the ability to check the implementation of the study, most students choose the A or B. And we can see that the weighted average score of the three problems is high. In Feng's research, it was also concluded that the vast majority of students can make their own learning plans [17]. This conclusion is consistent with our study. It can be seen that in the process of making and implementing the learning plan, the vast majority of students have high autonomous learning ability.

6.1.5. Learning Process

Through the data analysis of the five problems in the non-classroom learning process, for the ability to determine their learning goals autonomously, the ability to plan their learning time autonomously, the ability to choose learning materials autonomously, and the ability to choose learning methods autonomously, most students choose the A or B. And we can see that the weighted average score of the four problems is high. In Wen's research, it is also concluded that most academic graduate students can arrange their time to study autonomously every day [18]. This is consistent with the results of our study. It can be seen that in the process of non-classroom learning, most students have high autonomous learning ability.

6.1.6. Learning Reflection

Through the data analysis of the five problems of reflection in non-classroom learning, for the ability to summarize autonomously, the ability to make an objective evaluation autonomously, the ability to regulate their learning state autonomously, the ability to take measure to make up for deficiencies autonomously, most students choose the A or B. And we can see that the weighted average score of the four problems is high. Only the weighted average score of testing learning content autonomously is not up to the average score, and the weighted average score of this question is 2.92. It can be seen that most students have high autonomous learning

ability, but the ability of testing learning content autonomously needs to be improved.

6.2. Discussion on Classroom Learning and Non-classroom Learning

6.2.1. Classroom Learning Discussion

According to the analysis, most students have high autonomous learning ability in the following eight aspects: (1) Most students can preview autonomously; (2) Most students can prepare relevant learning materials autonomously; (3) Most students can think autonomously; (4) Most students can participate in class discussions autonomously; (5) Most students can take notes autonomously; (6) Most students can finish their homework autonomously; (7) Most students can summarize learning content autonomously; (8) Most students can take measures to make up for the deficiencies autonomously in the study. So as you can see, students can learn autonomously in most aspects of classroom learning, and their autonomous learning ability is high. There is still a need to improve the autonomy in the three aspects of autonomous extracurricular exercises, autonomous detection of learning content, and autonomous formulation of classroom learning goals.

6.2.2. Non-classroom Learning Discussion

According to the analysis, most students have high autonomous learning ability in the following eleven aspects: (1) Most students can make their own learning plan; (2) Most students can finish the learning content autonomously; (3) Most students can check the implementation of the study; (4) Most students can determine their learning goals autonomously; (5) Most students can plan their learning time autonomously; (6) Most students can choose learning materials autonomously; (7) Most students can choose learning methods autonomously; (8) Most students can summarize autonomously; (9) Most students can make an objective evaluation autonomously; (10) Most students can regulate their learning state autonomously; (11) Most students have the ability to take measure to make up for deficiencies autonomously. So as you can see, students learn autonomously in most aspects of non-classroom learning, and their autonomous learning ability is high. In addition, students' ability to test learning content autonomously needs to be improved.

7. Conclusion

A total of 23 survey questions were designed in this questionnaire. Through the analysis and summary of the data, we can see there are 18 questions that more than half of the students choose the A and B. Therefore, it can be inferred that students can learn autonomously in most aspects. According to Zhang's research, the author also draws the conclusion that

most of academic graduate students of S University have the high autonomous ability [19]. That is consistent with the conclusion of our study.

Therefore, from the overall data, we can draw a conclusion: most graduate students majoring in mathematics in China have autonomous learning ability and their autonomous learning ability is high. Especially the ability to prepare relevant learning materials autonomously, take notes autonomously, and finish their homework autonomously is generally high. However, the ability to set learning goals autonomously, do extracurricular exercises and test learning content autonomously needs to be improved.

Although this survey has obtained more clear conclusions, there are still the following shortcomings: (1) The research object of this survey is graduate students from the school of Mathematics and Statistics of Shandong normal University. The final results of this questionnaire are lack of general adaptability. (2) The subjects of this study are students and their answers may not be accurate. This paper can expand the survey object and design the questionnaire of teachers. Reflecting the present situation of students' autonomous learning ability from the teacher's point of view can make the research results more objective and accurate. (3) The research uses questionnaire method to study the students' autonomous learning ability and the research method is relatively single. The further study can be combined with interview methods to interview students and teachers, so that the results of the study are more reliable.

Therefore, in the future, it is necessary to further study from many angles and adopt various flexible research methods about the students' autonomous learning ability, to find out more reasonable suggestions and measures.

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