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Research on Mathematical Problem-solving Based on Fragmented Learning of Middle School Students

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Abstract

Mathematical problem-solving is an important task for middle school students in math learning. With the rapid development of the Internet, it is becoming more and more common for middle school students to solve math problems through fragmented learning. This study uses the method of the questionnaire to explore the current situation of mathematical problem-solving based on the fragmented learning of middle school students and draws the following conclusions: (1) In the process of using problem-searching software to solve mathematical problems, middle school students mostly aim at completing assignments. (2) Most students use problem-searching software to solve mathematical problems because they do not understand the questions, have no problem-solving ideas, and have poor computing skills. (3) The use of problem-searching software to solve mathematical problems does not make students form a good cognitive structure. (4) The use of problem-searching software to solve mathematical problems does not make students develop a better mathematical problem-solving habit. (5) the use of problem-searching software to solve mathematical problems has not significantly promoted students' mastery of problem-solving methods. Therefore, teachers should strengthen students' application of search software, teach students to use problem-searching software reasonably, and not rely too much on problem-searching software to solve mathematical problems.

Keywords

Fragmented Learning, Mathematics, Problem-solving, Problem-searching Software

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1. Introduction

Mathematical problem-solving is an important task for middle school students in mathematics learning [1]. In the past, students often used pen and paper to solve mathematical problems. At present, with the rapid development of Internet technology, more and more students try to solve mathematical problems with the help of problem-searching software, which is called fragmented learning. Does this form affect students' learning of problem-solving? This article intends to analyze it by investigating the status of students' use of problem-searching software.

2. Literature Review

2.1. Research on Fragmented Learning

There are many studies on fragmented learning, including research on the connotation, advantages, and disadvantages of fragmented learning.

Regarding the study of the connotation of fragmented learning, Wang and Li believe that fragmented learning is to use the fragmented time to conduct short, smooth and fast learning, which is reflected in the discontinuity of learning time [2]; Zhang believes that fragmentation refers to the fragmentation of learning content, fragmentation of learning time, and fragmentation of learning space [3].

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Regarding the advantages and disadvantages of fragmented learning, Qin put forward the following views: firstly, the time of fragmented learning is flexible and the content segmentation is easy to obtain, but disadvantages of fragmented learning are that the learning time is not guaranteed and the connection between knowledge fragments is weakened. Secondly, the communication carriers of fragmented learning are rich, and the knowledge is generated quickly, but the disadvantages of fragmented learning are that the information is complex and difficult to retrieve, and the learners are easily distracted and the learning is not systematic [4].

2.2. Research on Mathematical Problem-solving

There is much research on mathematical problem-solving, which is mainly divided into teaching strategies, influencing factors, and teaching design of mathematical problem-solving.

Regarding the research of teaching strategies of mathematical problem-solving, Zhang and Pei point out that to improve the ability of mathematical problem-solving, teachers should skillfully set up problem situations, stimulate students' enthusiasm for learning, guide students to explore independently, reflect on problem-solving ideas [5]. Li combines specific cases and proposes to improve the ability to solve mathematical problems by encouraging students to solve problems independently and guiding students to solve problems by various methods [6].

Regarding the research of the influencing factors of mathematical problem-solving, Wang finds that problem representation, cognitive structure, thinking set, metacognition, interest, and motivation, personality differences, and the different interactions between teachers and students will affect the ability of mathematical problem-solving [7]. Wu believes that we should pay attention to improving the ability of mathematical problems-solving by cultivating students' non-intelligence factors [8].

Reviewing the previous researches, it is found that the research on fragmented learning and mathematical problem-solving is more comprehensive, and few studies combine fragmented learning and mathematical problem-solving. This study intends to use empirical methods to investigate the current situation of mathematical problem-solving based on fragmented learning of middle school students, and then explore countermeasures according to the current situation and provide a scientific basis for teaching.

3. Theoretical Basis

3.1. Fragmented Learning

The definition of fragmented learning is mainly reflected in the discontinuity of time, space, and knowledge under the background of the Internet. Wang proposes that fragmented learning refers to a learning method that according to self-learning needs in natural situations, learners use fragmented learning media, scattered time, and distributed spaces to learn fragmented knowledge [9]. Wang proposes that fragmented learning refers to the way of learning knowledge and skills through a variety of media at will, anytime, and anywhere in social life [10].

It can be seen that fragmented learning refers to a learning mode that students can flexibly choose learning time and space, extract useful information from the network with the help of modern information tools, and store, internalize and construct the acquired knowledge and methods. Therefore, The way that students use problem-searching software for discontinuous problem-solving learning must belong to the category of fragmented learning.

3.2. Mathematical Problem-solving

There is no unified viewpoint on the definition of the concept of mathematical problem-solving. Based on the understanding of the process, Tu proposes that mathematical problems-solving is the process of finding and identifying mathematical problems in specific mathematical situations, and applying mathematical knowledge and skills to analyze and solve the mathematical problems [11]. Based on an understanding of the psychological activity, Dewey, an American educator, sees problem-solving as a conscious, carefully considered process, the process is accompanied by a series of psychological activities. Based on the understanding of mathematical ability, Cao and others point out that mathematical problem-solving refers to the ability of individuals to use mathematical knowledge to solve problems in real situations [12].

It can be seen that mathematics problem-solving should be a process in which students use mathematics knowledge, methods, and skills to analyze and solve problems through a series of thinking operations in the daily mathematics learning process.

Regarding the process of mathematical problem-solving, Zhang thinks that mathematical problem-solving includes four stages: clarifying the problem (searching for key information, connecting with mathematical concepts), formulating the plan (selecting appropriate strategies), implementing the plan (calculating, drawing, logical skills), reviewing and reflecting (testing, improving methods,

expanding applications) [14]. Also besides, many people have given their own opinions, however, currently, Polia's problem-solving steps is the most popular, namely "understand the problem", "devise a plan", "carry out the plan", and "look back" [13].

4. Methods

4.1. Samples

100 students from a senior high school in China are selected as the research samples. They include 48 students in class 9 of Senior 2 and 52 students in class 10 of Senior 2.

4.2. Instrument

This study uses a questionnaire that is self-made based on reference materials. The questionnaire contains 16 questions in 5 areas, which include the basic situation of mathematical problem-solving using fragmented learning (1-4 questions), the current situation in the stage of reading and understanding problems of middle school students (5-7 questions), and the current situation in the stage of implementing problem-solving plans of middle school students (8-10 questions), the current situation in the stage of review and reflection of middle school students (11-13 questions), and current situation of the effectiveness of mathematical problem-solving using fragmented learning of middle school students (14-16 questions).

4.3. Data Collection

In this study, the contents of the questionnaire are entered into the "questionnaire star" to generate a questionnaire, and then the link is distributed to the students. Students are required to complete the questionnaire within half an hour and submit it online.

4.4. Data Processing

We calculate the percentage of the questionnaire with the help of the "statistic star" data statistics function.

5. Results

5.1. The Basic Situation of Mathematical problem-solving Using Fragmented Learning

According to the statistical results, more than 80% of the students occasionally directly copy the answers when using the problem-searching software; 77% of the students "often" or "sometimes" use the problem-searching software to check the answers of the problems; 89% of students "often" or "sometimes" use problem-searching software to look at ideas and methods of problem-solving when they are unable to solve problems; 72% of students occasionally rework and reflect problems after reading the analysis of problems on the problem-searching software. Details are shown in Table 1.

Table 1. The Basic Situation.

	1. Copy the answer directly when using problem-searching software	2. Use problem-searching software to check homework answers	3. Use problem-searching software to look at ideas and methods	4. After reading the analysis on problem-searching software, rework and reflect problems
Often	8%	34%	38%	28%
Sometimes	47%	43%	51%	42%
Seldom	35%	18%	8%	24%
Never	10%	5%	3%	6%

5.2. Current Situation in the Stage of Reading and Understanding Problems of Middle School Students

According to the statistical results, About 70% of the students "often" or "sometimes" use the problem-searching software because they can't understand the math problems; 75% of students occasionally use problem-searching software because they cannot convert written language into mathematical language when solving mathematical problems; 80% of students occasionally use problem-searching software because they do not know what knowledge to use to solve problems when solving mathematical problems. Details are shown in Table 2.

Table 2. Current Situation in the Stage of Understanding problems.

	5. Use problem-searching software because the problems are not understood	6. Use problem-searching software because language cannot be converted into mathematical language	7. Use problem-searching software because I don't know what knowledge to use to solve the problems
Often	28%	25%	20%
Sometimes	41%	24%	45%
Seldom	16%	43%	18%
Never	15%	8%	17%

5.3. Current Situation in the Stage of Implementing problem-solving Plans of Middle School Students

According to the statistical results, 77% of students occasionally use problem-searching software because they cannot perform calculations when solving problems; 90% of students occasionally comprehensively apply knowledge and form a system when using problem-searching software to solve problems; 83% of the students are able to occasionally solve the similar problems after using the problem-searching software. Details are shown in Table 3.

Table 3. Current Situation in the Stage of Implementing problem-solving Plans.

	8. Use problem-searching software because I cannot perform calculations	9. Using problem-searching software for problem-solving can comprehensively apply knowledge and form a system	10. Similar problems can be solved smoothly after solving mathematical problems using problem-searching software
Often	23%	10%	17%
Sometimes	39%	37%	59%
Seldom	23%	40%	19%
Never	15%	13%	5%

5.4. Current Situation in the Stage of Review and Reflection of Middle School Students

According to the statistical results, 80% of the students occasionally reflect on the method of solving the problems after using the problem-searching software to solve mathematical problems; 75% of students occasionally comb and summarize wrong questions and examples; 84% of the students occasionally comb and summarize the mathematics knowledge implied in error-prone questions. Details are shown in Table 4.

Table 4. Current Situation in the Stage of Review.

	11. Reflect on the solution methods after solving mathematical problems using problem-searching software	12. comb and summarize the wrong questions and examples	13. comb and summarize the mathematics knowledge implied in error-prone questions
Often	20%	25%	16%
Sometimes	46%	38%	48%
Seldom	26%	27%	26%
Never	8%	10%	10%

5.5. Current Situation of Effectiveness of Mathematical Problem-solving Using Fragmented Learning of Middle School Students

According to the statistical results, 77% of students can only master half or even a small part of the content after using problem-searching software to solve mathematical problems; 85% of the students show that storage time of knowledge and memory obtained by the use of problem-searching software is within one week; 91% of the students have no impression or some impression of the problem searched by problem-searching software after one week, but they can't solve the problem or only can solve part of it. Details are shown in Table 5.

Table 5. Current Situation of Effectiveness.

14. How much content can I use to solve math problems using problem-searching software		15. Knowledge memory storage time after using problem-searching software		16. Knowledge memory storage time obtained using mobile search software	
Master most of the learning content	23%	One day	23%	No impression at all	6%
Master half of the learning content	50%	One week	62%	Some impressions but still won't do it	29%
Remember only a small part of the learning content	22%	One month	6%	Some impressions but can only make part	56%
Basically don't remember the learning content	5%	More than a month	9%	Impressive and can complete answer	9%

6. Discussion

6.1. The Basic Situation of Mathematical problem-solving Using Fragmented Learning

From the above statistical results of the questionnaire, we can see that, firstly, when most of the students use problem-searching software to solve mathematical problems, there is a phenomenon of directly copying the answers, and the goal is to compare the answers; secondly, most students use problem-searching software to solve problems when they have no ideas for mathematical problem-solving, and only a few students can do the problem again and reflect on the idea

of solving problems. This shows that in the process of using problem-searching software to solve mathematical problems, middle school students mostly aim at completing assignments, and most students use problem-searching software to solve problems when they have no ideas for mathematical problem-solving.

6.2. Current Situation in the Stage of Reading and Understanding Problems of Middle School Students

From the above statistical results of the questionnaire, we can see that most students use problem-searching software to solve mathematical problems when they do not understand the questions, cannot convert writing language to mathematics language, and don't know what knowledge to use to solve the problem, which shows that the important reason for middle school students to ask for help with problem-searching software is that they can't understand the problems and can't think of what ideas to use.

6.3. Current Situation in the Stage of Implementing problem-solving Plans of Middle School Students

From the above statistical results of the questionnaire, we can see that, firstly, most students use problem-searching software for calculation problems; secondly, when using problem-searching software for problem-solving, most students cannot comprehensively apply knowledge and form a system; lastly, after using problem-searching software to solve mathematical problems, most students can't answer them smoothly when they encounter similar problems again. This shows that the use of problem-searching software does not make students form a good cognitive structure.

6.4. Current Situation in the Stage of Review and Reflection of Middle School Students

From the above statistical results of the questionnaire, we can see that after most students use problem-searching software to solve mathematical problems, they lack reflection on problem-solving methods, and do not sort out and summarize wrong questions, examples and their implicit mathematical knowledge. This shows that the use of problem-searching software does not make students develop a better mathematical problem-solving habit.

6.5. Current Situation of Effectiveness of Mathematical Problem-solving Using Fragmented Learning of Middle School Students

From the above statistical results of the questionnaire, we can see that, firstly, after using problem-searching software to solve mathematical problems, most students can only grasp half or even a small part of the content; secondly, the storage time of knowledge is within one week; lastly, after a week, most students only have some impressions about the problem solved, but they can't solve it or only can solve part of it. This shows that the use of problem-searching software for mathematical problem-solving has certain effects on student learning, but it does not last long.

7. Conclusion

According to the above analysis, the current middle school students' mathematical problem-solving based on problem-searching software has the following situations:

In the process of using problem-searching software to solve mathematical problems, middle school students mostly aim at completing assignments; Most students use problem-searching software to solve mathematical problems because they do not understand the questions, have no problem-solving ideas, and have poor computing skills; The use of problem-searching software to solve mathematical problems does not make students form a good cognitive structure; The use of problem-searching software to solve mathematical problems does not make students develop a better mathematical problem-solving habit; At the same time, the use of problem-searching software to solve mathematical problems has not significantly promoted students' mastery of problem-solving methods.

Therefore, to improve students' problem-solving ability and learn mathematics better, the following suggestions are proposed: Firstly, teachers should strengthen students' application of search software; Secondly, teachers should teach students to reasonably apply problem-searching software in combination with classroom learning and not to rely too much on problem-searching software to help solve mathematical problems; Lastly, teachers should guide students reflect on the problems and problem-solving methods after using the problem-searching software to solve mathematical problems.

In this survey, only 100 students from the Lianyungang senior high school are selected as the research object, and the sample size is small. In the subsequent research, the research sample will be expanded to broaden the conclusions of the research.

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References

[1] Sun, J. W. (2019). Thinking on the Evaluation of problem-solving Ability. Primary School Teaching Research, 40 (28): 14-17.

[2] Wang, C. B., Li, X. P., Zhao, F. N., & et al. (2015). Research on Fragmented Learning in the Age of Big Data. e-Education Research, 36 (10): 26-30.

[3] Zhang, M. F. (2016). Research on Fragmented Learning Based on WeChat Public Platform. The Chinese Journal of ICT in Education, 22 (18): 27-29.

[4] Qin, J. (2018). Analysis of Hotspots and Trends of Fragmented Learning in China. China Medical Education Technology, 32 (3): 265-266.

[5] Zhang, X. B., & Pei, Z. F. (2019). Research on problem-solving teaching strategies in primary schools under the mode of independent inquiry. Learning Weekly, 13 (8): 56.

[6] Li, L. (2018). Strategies for Cultivating Students' problem-solving Ability in Primary School Mathematics Class. Liaoning Education, 47 (12): 66-67.

[7] Wang, X. (2017). Research on the influencing factors of mathematics problem-solving ability of middle school students (master's thesis, Yanbian University). Retrieved from http://www.cnki.net

[8] Wu, J. H. (2009). Training of students' problem-solving ability in classroom teaching. Educational Research and Experiment, 27 (06): 45-49.

[9] Wang, M. (2013). Content Design of Micro Video Courses for the Era of Fragmented Learning (Docrotol dissertation, East China Normal University, Shanghai). Retrieved from http://www.cnki.net

[10] Wang, Z. L. (2016). Fragmented Learning and Countermeasures in the Era of Mobile Internet-From Zero Storage to "Internet +" Classroom. Journal of Distance Education, 34 (4): 9-16.

[11] Tu, S. Y. (2019). Analysis of the role of problem-solving in the cultivation of core literacy in senior high school mathematics. Correspondence of the Teaching of Mathematics, 41 (1): 31-32.

[12] Cao, M., & Bai, L. S. (2018). Model and application of cooperative learning process for mathematical problem-solving. e-Education Research, 39 (11): 85-91.

[13] Xiang, D. (2008). Polya's "How to Solve a Problem Table". Mathematical Physics and Chemistry for Middle School Students: Beijing Normal University Edition, 2 (12): 1-1.

[14] Zhang, Y. D. (2018). Action Research on Application of Performance Evaluation to Mathematical problem-solving (master's thesis, East China Normal University, Shanghai). Retrieved from http://www.cnki.net

[15] Hua, X. J. (2019). Research on the Strategy of Improving Junior Middle School Students' Problem Solving Ability under the Core Mathematical Literacy (master's thesis, Jinan University). Retrieved from http://www.cnki.net