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The studies on the problems of application of equations in junior high school

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Abstract
The application of equations plays a very important role in junior high school algebra and is one of the difficulties in junior high school algebra. At present, a series of related studies have emerged. In order to enable students to better learn equations, this paper reviewed and collated existing studies and put forward the direction of further studies in the future.

Keywords: junior high school, the application of equations

1. Introduction
It is an indisputable fact that teachers are difficult to teach application problems about equation and students are difficult to learn them. The application of equations about equation runs through the whole junior high school. It is a mathematical model describing the quantitative relationship in the real world, the basis of learning the function and inequality application problems, and also an important object of the middle school examination. Through the study on the application of equations, some real-life problems can be solved initially, and students' ability to analyze and solve problems can be cultivated to serve other subjects (Hong, X. J., 2012) [1]. In order to draw experiences and lessons from previous studies and help students learn application problems about equation, this paper summarized the existing studies.

2. Obstacles encountered by junior high school students in solving application problems about equations
2.1 Understanding the meaning of the problem
Huang Ruijie, Tang Yunxiu, Su Lihua and Hong Xuejiao believed that junior high school students' language comprehension ability was not high. If they were unfamiliar with the background and context of the application problems, they often had no way to understand the meaning of the problem or to misunderstand the meaning of the problem. The specific performances were: the understanding of the problem was not careful; the consideration was not comprehensive; the thinking was confused; the idea was not clear; the choice of the method to understand the problem was not appropriate (Hong, X. J., 2012; Huang, R. J., 2016; Tang, Y. X., 2013; Su, L. H., 2017) [1-4]. Wang Haonan believed that students' inadequacies in mastering some basic non-mathematical professional nouns would lead to errors in solving the problems about equation (Wang, H. N., 2017) [5]. In addition, Zhang Yinpei believed that when the problem was longer or the data was more, students would have fear, which led to students' unwillingness to start or fear the hands-on (Zhang, Y. P., 2011) [6].

2.2 Listing equations
Hong Xuejiao believed that when junior high school students set the unknown, they often forget the unit of the unknown and the expression of the unit was wrong. What's more, many students did not know how to choose the unknown or choose the wrong one (Hong, X. J., 2012) [1]. Fu Xiaojun also believed that in the process of solving the problem, the unknown set by junior high school students was obviously unclear or wrong. And Students took it for granted that what we were going to set was what we wanted to ask for, which formed the confusion of thinking and affected the problem solving (Fu, X. j., 2018) [7]. Hong Xuejiao and Wang Ri also believed that in solving application problems about equation, there would be problems such as no way to find equivalence relationship or to find wrong equivalence relationship, the meaning was different or the unit was inconsistent on both sides of the equation, the algebraic expression was wrong and so on (Hong, X. J., 2012; Wang, R., 2016) [1, 8].

2.3 Solving equations
Hong Xuejiao and Huang Ruijie believed that it was not difficult for junior high school students to solve the linear equation in one unknown. But for the linear equation in two unknowns, some students did not know how to solve. When solving the quadratic equation in one unknown, students used the quadratic formula of root or the method of completing square, resulting in an increase in the amount of calculation, and some students even mistook the formula (Huang, R. J., 2016; Su, L. H., 2017) [2, 4]. Li Qingshe, Chen Liang and Feng Jingjing believed that when students solved the equation with the denominator, there would be errors. When the denominator was removed, the constant missed the common denominator and the molecules were polynomials without parentheses, and both sides of the equation were divided by the possible zero algebraic expression at the same time. In the process of inspection, because the concept of adding root was not understood, the double root inspection was not tested or ignored (Li, Q.S., 2010; Chen, L., 2016; Feng, J.J., 2012) [9-11].

Wang Haonan believed that students also had errors in solving complex equations (groups) such as proportions and percentages (Wang, H. N., 2017) [5].

Fu Xiaojun and Wang Ri believed that when students wrote problem solving steps, they would have errors in format and expressions: errors in format were sometimes expressed in writing irrelevant steps, sometimes the equation was not the simplest form; errors in expression were expressed in setting unknown and answering, students usually omitted to write the unit or write the unit incorrectly or students simply did not set the unknown or did not answer (Fu, X. J., 2018; Wang, R., 2016) [7, 8]. Wang Ri, Hong Xuejiao and Huang Ruijie also believed that most of the students did not test whether their solutions were consistent with the actual meaning, but they answered directly. What's more, some students would left out answers or units; some students would test when they did the problems, but their so-called "test" was based on the original, and sometimes can not find errors (Hong, X. J., 2012; Huang, R. J., 2016; Wang, R., 2016) [1, 2, 8].

3. Causes of errors in junior high school students' application problems about equation

3.1 Non-cognitive factors

Wang Ri believed that students' lack of interest in equations affected their learning. On the one hand, students found that this part of the content was too difficult for them to be competent. On the other hand, the problems given by teachers are not closely related to their own lives, so students think it was useless to learn them (Wang, R., 2016) [8]. Wang Haonan and Fu Xiaojun also believed that most teachers ignored the cultivation of junior high school students' interest in learning. They just blindly taught students how to solve problems and constantly cited typical examples to let them calculate, resulting in the lack of thinking ability of students and unable to really understand the internal relationship between arithmetic and equation. Different subjects were not synchronized, teachers do not teach seriously, and students do not develop good learning habits in and out of class, which will also affect students' learning of application problems about equation (Wang, H. N., 2017; Fu, X. J., 2018) [5, 7]. Feng Jingjing also believed that students' weak motivation and weak learning willpower also affected students' learning (Feng, J. J., 2012) [11].

Hong Xuejiao believed that the presentation of application problems about equation would affect students' understanding of the meaning of the problem. Some students felt that the problems in tabular form were easier to understand than those in pure text form, and whether there was language ambiguity in the setting of the problem and whether the expression was clear would also have a great impact on students' problem solving. Through interviews with students and teachers, we knew that when we encountered more complex application problems about equation, some students felt afraid and some students relied directly on the teacher (Hong, X. J., 2012) [1]. Su Lihua also believed that junior high school students were not active in solving problems. They generally relied on teachers, lacked of initiative in learning and innovation, and always expected teachers to sum up what they have learned. When solving problems, they wanted teachers to give solutions and they were used to memorizing and formatting solutions, so they were not flexible (Su, L. H., 2017) [4]. Wang Haonan found that the reason why students relied on teachers to summarize knowledge was that they feared that their solutions to problems were unclear or inaccurate or had no time to sum up (Wang, H. N., 2017) [5].

3.2 Cognitive factors

3.2.1 Thinking set

Wang Ri and Zhang Yinpei believed that junior high school students were in the transitional stage of two stages. Although the students in the second stage have already touched the algebra and equation, they did not formally enter the field of algebra until junior high school. Therefore, when solving problems, most students preferred to use arithmetical method (Zhang, Y. P., 2011; Wang, R., 2016) [6, 8]. Hong Xuejiao and Huang Ruijie believed that in filling in the blanks, most students used arithmetic to solve the problem, especially the proportion problem. It was difficult for students to convert from arithmetic to equality, the main reason was that they could not convert the unknown into the known to deal with (Hong, X. J., 2012; Huang, R. J., 2016) [1-2]. Fu Xiaojun also believed that they were not accustomed to using letters in formulas and could not effectively understand the true meaning of problem, resulting in the inability to list accurate or simple equation (Fu, X. J., 2018) [7].

3.2.2 Not rich life experience

Wang Ri believed that junior high school students were relatively young and had little experience in life. They were very unfamiliar with some application problems about equations with life background (Wang, R., 2016) [8]. Min Yanxia and Hong Xuejiao also believed that when students read problems, they often misunderstood the meaning of key words and confused related concepts because they were unfamiliar with the background of the problem, which led to misunderstanding of the meaning of the problems. Therefore, it was impossible to restate and sort out the problems in our own language, which led to the failure to find the equivalence relationship in the application problems about equation and failure to list the correct equation (Min, Y. X., 2017; Hong, X. J., 2012) [1, 12]. In addition, Fu Xiaojun believed that because junior high school students had poor comprehension and poor logical thinking ability, they often did not understand the quantitative relationship in application problems about equation clearly (Fu, X. J., 2018) [7].

3.3.3 Poor mathematical ability

Hong Xuejiao and Huang Ruijie believed that they could not abstract practical problems into mathematical problems because of their poor mathematical ability, which also led to junior high school students unable to achieve the transformation between natural language and mathematical language and between mathematical language, especially the transformation from mathematical symbols to form literal

language symbols. Ultimately, students were unable to list algebra to solve problems (Hong, X. J., 2012; Huang, R. J., 2016) [1-2].

3.3.4 Weak foundation

Huang Ruijie, Hong Xuejiao and Wang Ri believed that junior high school students did not have strategic knowledge in solving problems: they did not combine rough reading with careful reading; they did not use circuit diagrams and tables to understand the meaning of the problems; and they did not master skills in setting the unknown and solving the equation(Huang, R. J., 2016; Hong, X. J., 2012; Wang, R., 2016) [1, 2, 8].

3.3.5 Bad learning habits

Wang Ri believed that students' bad learning habits often led to the phenomenon of right but incomplete in examinations. Most students listed equations in notebooks when doing application problems about equation and they essentially omitted steps to set the unknown and write the answer. At the same time, some teachers did not have a standard problem solving steps on the blackboard, so students did not have a reference standard. In the end, the students' writing was not standardized (Wang, R., 2016) [8]. In addition, Hong Xuejiao and Feng Jingjing believed that the lack of monitoring of problem solving process at the stage of understanding the meaning of the problem, listing the equations, post-solution review and post-solution research, would also lead to errors in problem solving (Hong, X. J., 2012; Feng, J. J., 2012) [1, 11].

4. Suggestions on improving the students' ability to solve application problems about equation

4.1 Suggestions for teachers

Fu Xiaojun believed that interest was the best teacher and students' inner motivation for learning. Teachers could create a good environment to enhance students' interest in learning, let students fully experience the charm of mathematics, further stimulated the formation of students' independent thinking and felt the inner relationship between life and mathematics (Fu, X. J., 2018) [7]. Wang Ri believed that in teaching, teachers could break the heavy classroom atmosphere by using humorous and interesting language, and could also teach knowledge by means of allegorical sayings, compiling formulas, compiling songs and so on, so as to stimulate students' interest in learning mathematics (Wang, R., 2012) [8]. In addition, Hong Xuejiao also believed that teachers should choose appropriate application problems about equation in teaching, then pay attention to the activities and exchanges between teachers and students in the process of teaching togive students more time to think,and try to use heuristic teaching methods to guide students to analyze problems and break through difficulties, so that students could experience the joy of success and enhance their confidence in learning application problems about equation (Hong, X. J., 2012) [1].

Hong Xuejiao believed that teachers should encourage students to read more in-class and out-of-class materials to improve their reading comprehension. When it came to the teaching of application problems about equation, students should first read roughly and then read intensively to reduce the examination time, and strengthen visual stimulus to help understand the meaning of the problems by making annotations at the key points (Hong, X. J., 2012) [1]. Wang Ri believed that teachers should pay attention to cultivating students' good habits of understanding the meaning of the problems and teaching methods of understanding the meaning of the problem, so as to improve students' ability of understanding the meaning of the problem and mathematics. He also put forward that in teaching, students should be urged to look at units, keywords, drawings, lists or other ways to understand the meaning of the problems (Wang, R., 2016) [8]. Zhao Wenna believed that teachers could not only teach this concept directly in teaching, but also pay attention to examples, including positive examples and counter examples. In teaching, let students participate in analysis and interpretation and translate concepts into their own cognitions (Zhao, W. N., 2018 [13]. Wang Haonan believed that teachers could help students understand non-mathematical terminology by using noun discrimination maps and balancing learning progress among different disciplines (Wang, H. N., 2017) [5].

Hong Xuejiao, Tang Yunxiu and Huang Ruijie believed that in teaching, teachers should strengthen the interchange between algebraic expression and real language. Students should not only transform the language of life into mathematical language, but also express algebraic formulas in literal language (Hong, X. J., 2012; Tang, Y. X., 2013; Huang, R. J., 2016) [1-3]. Zhang Yinpei and Fu Xiaojun believed that teachers should first guide students to form the thinking of solving practical problems through list equations and then teachers should let students discuss and list the algebraic formulas representing the unknown according to the relationship between numbers, so that students could correctly reflect the complex quantitative relationsip by algebraic formula. Finally, teachers used different exercises to help students to master the methods of analyzing quantitative relationship and finding out the relationship (Zhang, Y. P., 2011; Fu, X. J., 2018) [6-7]. By analyzing the specific examples, Wang Ri gave the skills of listing algebraic expressions about sum and difference problems, the remaining and shortage problems, route problems, engineering problems, sales problems, calendar problems, digital problems, geometry problems, program design problems, complex route problems, and matching problems (Wang, R., 2016) [8]. Zhao Wenna gave the growth rate formulas and the engineering problem formulas, and believed that in order to improve the students' ability of listing algebra, teachers should strengthen student's multi-analytical ability by means of images, tables, lines (Zhao, W. N., 2018) [13].

Hong Xuejiao believed that teachers should pay attention to the teaching of thinking process and the infiltration of mathematical thinking method in the teaching of equation model. About the teaching of understanding the meaning of the problem: highlighted the thinking process and showed the analysis methods of application problems about equation with typical examples, so as to improve students' thinking ability of

solving equationn application problems. About the teaching of finding equivalence relationship: Firstly, for the common model of application problems about equation, it was better to help students remember the equivalence relationship of common model of application problems about equation by filling in the basic quantitative relationship form. Secondly, teachers should help students learn how to use translation method, graphic method, tabulation method and so on to find equivalence relationship. In addition, we could also find equivalence relationship by grasping invariants, keywords and mathematical formulas. Teachers should constantly infiltrate the method of finding equivalence relationship into students through good examples in teaching. About the teaching of setting the unknown: through typical examples to guide students to master the methods and skills of setting the unknown. There were direct setting, indirect setting and auxiliary setting. Through examples, students could understand the advantages of different setting methods and master the skills of setting the unknown. About the teaching of problem solving steps: paid attention to the mistakes in the students' problem solving steps and correct them in time. In teaching, teachers should standardize students' problem solving steps and pay attention to students' mistakes (Hong, X. J., 2012) [1]. Wu Shengdong believed that teachers could exercise students' thinking flexibility through giving multiple solutions to a single problem, and tested whether they break through the thinking set by means of self-reflection and self-correction (Wu, S. D., 2017) [14].

Wang Ri believed that teachers could mobilize students' enthusiasm by using games, competitions, rush-to-answer, deskmate competitions, time-limited oral arithmetic and so on, so as to stimulate students' interest in computing. By supervising students to listen carefully in class, used their brains to think, had a standardized calculation process, and actively checked after calculation to cultivate students' good calculation habits. In order to make students understand the methods, ideas, steps and quick calculation skills, teachers should set an example and have standard steps in teaching. In order to improve students' calculating ability, teachers should make students firmly master the order and rules of operation and teach students various kinds of calculating methods and scientific thinking methods, that is, look at the topic and think about the algorithm, and choose the best calculating method (Wang, R., 2016) [8]. Wang Haonan believed that for the calculation problems with percentage and proportionality which seldom appear in the normal examination, teachers should pay attention to increasing the calculation problems with denominator or parentheses to help students practice perfectly in many exercises, so as to improve students' calculation ability (Wang, H. N., 2017) [5].

Wang Hao-nan believed that after explaining one type of problems, teachers should not only generalize the methods of solving problems to help students solve the problems, but also try to encourage students to analyze the solutions of common types of problems to improve their inductive ability. At the same time, teachers should help students review and summarize the relevant knowledge structure in a holistic and systematic way. Review not only reflected the review before the new lesson and exercises, but also included the review at the end of the chapter (Wang, H. N., 2017) [5].

Wang Hao-nan, Ju Mingjie and Zhao Wenna thought that teachers should emphasize students' error-prone places in time and repeatedly in the course of teaching, so as to enhance students' self-monitoring consciousness and help students avoid some problems in solving application problems about equation. For example, it was necessary to check whether the results of calculation valid, whether the results conformed to the actual situation, whether the units in problem setting and problem answering were consistent with the problem, and whether the answers were consistent with the problem setting (Wang, H. N., 2017; Ju, M. J., 2016; Zhao, W. N., 2018) [5, 13, 15]. Wang Ri believed that teachers needed to teach students how to reflect. First, they should guide students to reflect on the problem-solving process and know that in the process of problem-solving they would not only harvest knowledge, but also master mathematical thinking and methods. Secondly, teachers should guide students to reflect on the problem-solving methods and guide students to find a problem can have multiple solutions. Finally, teachers should guide students to reflect on their own problem-solving errors and let students reflect on the causes of problem-solving errors, so as to summarize experience and methods to reduce the possibility of making similar mistakes in the future. At the same time, teachers should also learn to reflect in teaching. By analyzing students' errors, teachers could understand how students' learning state was and what difficulties they had in solving problems, so as to reflect on teaching strategies, and then improved teaching strategies to improve students' ability to solve problems (Wang, R., 2016) [8].

Zhao Wenna thought that in order to cultivate students' good habit of learning mathematics: teachers should always pay attention to students' listening in class, encourage students to study diligently, dare to ask knowledge that they still don't understand after explaining, put forward their own opinions or problem-solving methods in class and discuss with teachers and students; teachers should lay out homework in different levels to help students who lack basic mathematics could overcome the psychology of coping with homework and formed the habit of completing homework carefully (Zhao, W. N., 2018) [13].

Feng Jingjing believed that teachers should pay attention to the evaluation of students' learning process, including the students' performance in trying to solve problems, such as the process of exploration, the process of cooperation and communication with others, the attitude toward difficulties, the understanding of mathematical thinking methods, and the development of mathematical thinking quality. Teachers could reasonably evaluate students' basic knowledge of mathematics and skills of mathematics through multiple evaluations, rather than one evaluation (Feng, J. J., 2012) [11].

4.2 Suggestions for students

Min Yanxia believed that students must first overcame the psychological barriers that application problems were very

difficult. When they encounter difficult problems, they should actively communicate with their classmates and consult their teachers. Second, they should dare to ask more questions they don't understand and dare to try to understand them. Be good at observing in life and be good at thinking about the connection between life problems and mathematical knowledge. Finally, students needed to do more related exercises to cover more types of problems to consolidate the idea of mathematical modeling, which can also help students learn mathematics easily and happily (Min, Y. X., 2017) [12].

Wang Haonan believed that students should develop the habit of taking notes and reviewing after class to effectively master non-mathematical terms, should collect and try to analyze different types of problem-solving methods to improve their self-inductive ability, should increase exercises to improve their computational ability, should learn to use graph method to find out equivalence relationship in solving application problems about equation and analyze of the causes of errors to improve self-monitoring awareness (Wang, H. N., 2017) [5].

Wang Ri believed that students should develop the habit of reading books related to the history of mathematics at ordinary times, because it could not only broadened students' knowledge, but also stimulated students' interest in learning through short stories, so as to stimulate students' learning. At the same time, students should actively participate in outdoor activities organized by the school (spring outing, autumn outing, etc.) and actively integrate into life, which helped to touch various problems in life to increase their life experience and laid a solid foundation for problem solving (Wang, R., 2016) [8].

4.3 Suggestions for textbook compilers

Min Yanxia and Wang Ri believed that application problems about equation should be as close to the students' reality as possible under the premise of reflecting the essence of mathematics, so as to help them experience the process of abstracting mathematical knowledge and methods from realistic situations. Therefore, in the future textbook compilation, textbook compilers should strengthen communication with local front-line teachers, consider the actual situation of students as far as possible, and adapt to the development of the times to constantly update (Min, Y. X., 2017; Wang, R., 2016) [8, 12].

Feng Jingjing believed that in order to facilitate students to understand the concept of adding root, some examples about the application of adding root of fractional equation should be compiled in textbooks. In order to ensure that the students who have more ability to learn mathematics could further improve their thinking ability, typical exercises for expanding students' thinking should be designed in textbooks (Feng, J. J., 2012) [11].

5. Rational review of existing research

In summary, for the obstacles often encountered in the application problems about equation, the previous studies focus on understanding the meaning of the problems, listing equations, and solving equations. For the reasons for the errors in the application problems about equation, previous studies not only focus on the cognitive factors such as students' thinking set, mathematical ability and mathematical learning habits, but also on the non-cognitive factors such as students' interest in learning and the presentation form of application problems about equation themselves. For the suggestions of improving students' ability of formulating equations, the predecessors have made extensive research. They not only put forward various teaching suggestions to teachers, but also put forward learning suggestions to students, and put forward suggestions on textbook compilation to textbook writers.

By consulting the literature, we can see that there are few studies on the obstacles, causes and suggestions on the junior high school students' application problems about equation, especially on the causes of the obstacles of the students' application problems about equation. Even if there are, most of the studies are done by the master of education in school. Because of the limited theoretical level, the lack of teaching experience, the hasty research time, and the narrow selection of research objects, it is difficult to make a comprehensive and detailed analysis. From this we can see that it is still necessary to strengthen the study of obstacles, causes and suggestions in application problems about equation in junior high school in the future, so as to really help students better learn how to solve application problems about equation.

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