



Research on the Usage of PPT in Mathematics Teaching in China

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

With the advent of the information age, information technology has been widely used in mathematics classroom teaching. How to use PowerPoint (hereinafter referred to as PPT) effectively in mathematics teaching has received more and more attention. At present, there has been much research on it in China, however there is no complete overview and organized literature in this regard. This paper sorts out and summarizes the previous relevant studies and draws the following conclusions: (1) Previous studies on the usage of PPT in mathematics teaching mainly focus on three aspects: the value of PPT, the use of PPT and the use skills of PPT. (2) Previous research methods were single, and suggestions were mainly made through literature research, and the research conclusions were concentrated. The research on the value of PPT has not been deeply discussed and analyzed, so it lacks completeness. Most of the studies only focus on students, and there is no excessive and in-depth discussion on teachers' ability requirements. In addition, the research on the use skills of PPT has not been further implemented and verified, so the feasibility of the conclusion cannot be guaranteed. (3) There are still some gaps in the research on this topic. Most studies focus on the compulsory education stage, and there are few studies on the senior high school stage; Previous studies rarely discussed the disadvantages and shortcomings of PPT, and then did not discuss the problems that teachers should pay attention to avoid when using PPT; There are no relevant surveys and studies on students' attitudes towards PPT.

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1. INTRODUCTION

With the rapid development of modern information technology, human beings have ushered in the information age [1]. The "Compulsory Education Mathematics Curriculum Standards (2022 edition)" states that modern information technology should be used rationally and the reform of mathematics teaching methods should be promoted [2]. The "Mathematics Curriculum Standards for Ordinary High Schools (2017 edition, 2020 revision)" states that it is necessary to adhere to the requirements of The Times and pay attention to the teaching reform under the information environment [3]. As a kind of demonstration tool, PowerPoint (hereinafter referred to as PPT) can assist teachers in teaching knowledge through specific functions, so PPT is of great significance for mathematics teaching [4]. However, how to effectively use PPT in mathematics teaching to get a better teaching effect is a problem that has always puzzled many mathematics teachers [5]. Therefore, the research on the usage of PPT in mathematics teaching is critical. At present, there has been much research on it, but there is no literature that fully summarizes this aspect. Therefore, to fully understand the research status in this area, this paper intends to conduct a comprehensive review and summary of the previous research. By reviewing the previous studies and systematically sorting out and summarizing the results of previous studies, it can not only help teachers understand the application of PPT in mathematics teaching to obtain better teaching results, but also find out the gaps and shortcomings in it, and promote researchers to carry out more in-depth and detailed research in this aspect.

The research question of this paper is: What is the current status of the research on the usage of PPT in mathematics teaching? It specifically includes the following two aspects:

- (1) What aspects have scholars studied on the usage of PPT in mathematics teaching?
- (2) What are the shortcomings and gaps of previous studies?

2. METHODS

2.1 Data Source

This paper selects the literature in the database of China National Knowledge Infrastructure

(CNKI) as the data source. China National Knowledge Infrastructure is the most authoritative literature retrieval tool for Chinese academic journals, which includes all the contents of Chinese journals. The selection of this database can ensure the persuasiveness and reliability of the research.

2.2 Data Collection

To avoid omissions and make the data collection more comprehensive and complete, we adopted an advanced retrieval function, respectively with the theme of "Using multimedia for mathematics teaching" and "using PPT for mathematics teaching", and searched with the keyword "PPT". Finally, 36 papers were determined to meet the research criteria and were used as the data sources for this study.

2.3 Data Sorting

By carefully reading the literature and taking notes, we summarized and sorted out the previous research methods, research contents and research results.

3. RESULTS

After summarizing the previous studies, it can be found that previous studies on the usage of PPT in mathematics teaching in China mainly focused on the value, use and skills of PPT. Among them, most scholars adopted the method of literature research, and many conclusions were also concentrated.

3.1 The Value of PPT in Mathematics Teaching

Based on previous studies, the research on the value of PPT in mathematics teaching mainly focuses on three aspects: student learning, classroom teaching, and knowledge presentation.

3.1.1 The value of PPT on students' learning

Cui, Wu, Zhang, Liang, Huang, Chen and other 27 scholars all pointed out that PPT can stimulate students' interest in learning [6-26]. 11 scholars such as Cui, Chen, Li, Guo, Zhang, Wang and Yang pointed out that PPT can help students understand and remember knowledge [6,14,16,17,18,20,26,27]. Zhang, Hong, Chen,

Du and other 8 scholars mentioned that PPT is helpful to attract students' attention [8,11,21,22,25,28]. Zhang, Yang, Chen, Li, Guo and Liu pointed out that PPT helps cultivate students' mathematical logical thinking [8,12,14,16,26,27]. Huang and Liu believe that PPT can encourage students to actively participate in learning and help cultivate students' creative spirit and ability [10,13]. Zhang believes that PPT can cultivate students' ability to independent learning [8].

3.1.2 The value of PPT to mathematics classroom teaching

Cui, Hong, Liu, Zhang, Wang, Du and other 19 scholars pointed out that PPT can improve the efficiency of classroom teaching [6,13,17,18,21,22,23,26,28,29,30,31]. Hong, Liang, Liu, Du, Ren, Li and other 14 scholars believe that PPT can expand the capacity of courses to enrich and improve teaching [9,13,21,22,23,25,26,28,29,30]. Gong, Liang, Chen, Li, Zhang and other 10 scholars believe that PPT can make classroom teaching more vivid [9,14,15,24,26,27,32,33,34]. Zhang, Liu, Wang, Qiao, Wu and other 10 scholars pointed out that PPT can improve the quality of classroom teaching [8,13,18,22,24,25,31]. Huang, Yang, Liu, Chen, Guo, Du and other 10 scholars pointed out that PPT can activate the atmosphere of classroom teaching [10,12,13,14,16,20,21,23,25]. Hong, Du, Ren and other 8 scholars proposed that PPT can help save teachers' time and improve classroom teaching efficiency [21,23,24,25,28,30]. Gong, Chen, Wu and Song pointed out that PPT is simple, convenient and fully functional, which is helpful for teachers' classroom teaching [11,24,31,32]. Hong, Lan, Wu and Song pointed out that PPT is convenient for students to review knowledge [28,31].

3.1.3 The value of PPT for knowledge presentation

Cui, Chen, Yang, Li, Huang, Du, Wu and other 12 scholars pointed out that PPT can highlight key points and break through difficulties [6,10,11,12,21,26,27,29,31]. Wu, Huang, Chen, Li, Wang, Ren, Ma and other 10 scholars pointed out that PPT can intuitively present abstract mathematical knowledge [7,10,14,18,23,25,27,30,34]. Du, Ma, Hu and Zhang pointed out that PPT can dynamically display mathematical knowledge [21,22,29]. Ma

and Hu pointed out that PPT can quickly present mathematical knowledge [22].

3.2 The Usage of PPT in Mathematics Teaching

As for how to use PPT in mathematics teaching and what to pay attention to when using PPT, predecessors have given different suggestions and views based on their understanding of PPT. Among them, previous studies mainly involve three aspects: what teachers should pay attention to when using PPT, what teachers should pay attention to when designing PPT, and teachers' attitudes and ability requirements for using PPT.

3.2.1 What should be to pay attention to when using PPT

Hong, Liang, Cui, Liu, Chen, Li, Ma and other 13 scholars pointed out that teachers should combine PPT with traditional blackboard writing for mathematics teaching [9,13,14,22,23,24,28,33,35]. Wu, Ma, Zou, Wu and other 7 scholars pointed out that teachers should gradually play PPT and by the order of the course content [7,22,24,31,34]. Zhang, Liu, Chen, Du, Li and other 7 scholars pointed out that teachers should communicate and interact with students when using PPT [8,13,14,21,25,26,36]. Ma, Hu, Wu and Song pointed out that teachers should pay attention to the rhythm of PPT, which should not be too fast or too slow [22,24,31]. Liu, Chen, Li and Liu pointed out that teachers should pay attention to students' reactions when using PPT [13,14,25,36]. Cai, Wang and Liu pointed out that teachers should pay attention to combining explanations when using PPT so that students can understand knowledge more easily [18,26,37]. Liu pointed out that when teachers use PPT to review knowledge, they should try to delete words, graphics and symbols that have nothing to do with teaching objectives [36]. Wu pointed out that teachers should carefully understand the content of PPT before class [24].

3.2.2 What should to pay attention to when designing PPT

Cui, Kang, Huang, Wang, Du, Wu, Ma, Hu and other 12 scholars pointed out that the presentation of PPT should be simple and intuitive and highlight the key points [6,10,18,21,22,31,35,38]. Wu, Zhang, Huang, Chen, Yang, Qiao, Wu and other 13 scholars

pointed out that the design of PPT content should conform to the age characteristics of students [7,8,10,11,12,14,19,22,23,26,38]. Cui, Liang, Chen, Yang and other 8 scholars pointed out that the font size of a PPT presentation should be moderate [6,9,11,20,38]. Cui, Chen, Liu, Yang, Wu and other 7 scholars pointed out that teachers should pay attention to the color matching of PPT content, and the font color should adapt to the background color [6,11,13,20,38]. Cui, Zhao, Kang, Wu and Song pointed out that the animation presented by PPT should be smooth and novel [6,31]. Liang, Cui, Chen, Wang and Liu pointed out that the presentation of PPT should be concise and beautiful [9,11,18,36]. Huang, Chen, Li, Ren and Ma pointed out that the design of PPT should meet the learning needs of students [10,14,23,33]. Cui, Zhao, Kang and Wu pointed out that the content capacity of PPT should be moderate [6,38]. Hong, Lan, Ma and Hu pointed out that teachers should pay attention to the logical correlation among PPT contents [22,28]. Liang, Cui, Chen and Wu pointed out that the content of PPT cannot be completely copied from textbooks, and it needs to be expanded [9,14,24]. Wu, Liang and Cui pointed out that teachers should make full use of different fonts and colors in PPT to emphasize key points [7,9]. Liang and Cui also believe that teachers should pay attention to the visual impact that PPT brings to students [9]. Hong and Lan pointed out that teachers should arrange PPT contents by mathematical logic sequence [28]. Hong and Lan continued to point out that teachers should design PPT as a thinking guide for teaching and learning, and have the art of "leaving blank" [28]. Chen pointed out that teachers' PPT content must be based on the textbook [14]. Qiao pointed out that teachers should ensure that the content of PPT is rigorous and scientific [19]. Liu pointed out that when designing each PPT page, teachers can sketch on the paper to clarify their ideas [39].

3.2.3 Teachers' attitude and ability requirements for using PPT

Gong, Zhang, Huang, Liu, Li, Wang, Wu and other 12 scholars pointed out that teachers should be proficient in using PPT [8,10,13,18,24,25,26,27,31,32,34]. Liu, Chen, Du, Ma, Hu, Wu and other 8 scholars pointed out that teachers should regard PPT as a teaching auxiliary tool [13,14,21,22,24,26,36]. Chen, Liu, Qiao and Du pointed out that teachers should improve their ability to make and design PPT

[11,13,19,21]. Li, Wu, Sun and Zhang point out that teachers should avoid relying too much on PPT [27,29,35,38].

3.3 The Usage Skills of PPT in Mathematics Teaching

The research on the skills of using PPT in mathematics teaching mainly focuses on three aspects: presentation of PPT, application of PPT, timing of using PPT and requirements for teachers.

3.3.1 Presentation skills

Wu, Cui, Huang, Chen, Wang, Hu and other 15 scholars pointed out that teachers should give full play to the dynamic display function of PPT to show the process of knowledge formation [7,9,10,11,13,18,20,22,23,25,34,36]. Liu further pointed out that teachers can make full use of the "trigger" and "custom animation" of PPT to display the symmetry, expansion and translation of graphics [13]. Liang, Cui and Liu pointed out that teachers can add audio and video content in PPT to better serve teaching [9,13]. Wu, Song and Liu pointed out that teachers can make full use of font colors in PPT to highlight key knowledge [31,36]. Wu and Sun pointed out that teachers can use PPT to show the mathematical operation process [7,35]. Liang and Cui pointed out that teachers insert bar charts and bar charts into PPT to help students integrate what they have learned [9]. Hong and Lan pointed out that the content of the PPT presentation should be simplified, only the important and difficult points and exercises should be presented as far as possible, and the process should be written on the board [28]. Sun pointed out that teachers can use PPT to directly and quickly present math problems to improve teaching efficiency [35].

3.3.2 Application skills

Huang, Chen, Ma, Hu and Ren pointed out that content related to students' daily life can be incorporated into PPT [10,14,22,23]. Chen, Yang, Liu, Ma and Hu pointed out that teachers can use PPT to create relevant problem scenarios and learning tasks to attract students and stimulate their learning interest [11,12,13,22]. Gong, Wu and Song pointed out that teachers can combine PPT with other software to enrich teaching [24,31,32]. Liang, Cui, Liu and Chen pointed out that teachers can use PPT to show the mind map of knowledge in the summary [9,13,14]. Gong pointed out that the

geometric drawing board software could be inserted into the PPT for mathematics teaching [32]. Liu also proposed that teachers could use PPT to present the knowledge system of this lesson to students and help them systematically learn the knowledge of a lesson [13]. Cai pointed out that PPT can be used to present relevant content and key and difficult points in advance to lay a good foundation for future classroom teaching [37]. Gong, Huang and Qiao pointed out that teachers can make full use of the resource-sharing platform to select appropriate content to put into their own PPT [10,19,32]. Gong and Zou pointed out that teachers can use PPT to create interactive projections to increase the interactive effect of PPT [32,34]. Chen and Liu pointed out that teachers can use PPT to design exercises of different degrees for different students [11,13]. Ma and Hu pointed out that teachers can often use PPT to explain conceptual knowledge, and also proposed that PPT can be combined with objects for teaching [22]. Gong pointed out that teachers can use PPT to edit mathematical formulas [32]. Liu pointed out that teachers can use PPT to expand the teaching content appropriately [13]. Yang pointed out that teachers can insert hyperlinks in the PPT and make timely jumps when they need to use other software [20]. Cai pointed out that teachers can use PPT to sort out the content of this chapter in the pilot lesson to briefly introduce the key points in the chapter [37]. Xu pointed out that teachers can make a series of small games in the teaching content to attract students' learning interest and enable students to master knowledge in a relaxed atmosphere [40].

3.3.3 Timing and others

Huang, Chen, Yang, Wang, Ren, Liu, and Liu pointed out that when teachers face complex abstract mathematical knowledge, they can use PPT to display it intuitively [10,11,12,18,23,26,36]. Zhang, Chen, Qiao, Ma, Hu, Liu and Zhang pointed out that teachers' use of PPT should be determined according to the teaching content [8,11,19,22,26,29]. Zhang, Chen, Qiao, Ma, Hu, Liu and Zhang pointed out that the use of PPT should be decided according to the teaching content [8,11,19,22,26,29]. Wei pointed out that after teaching new knowledge, teachers can directly present exercises through PPT for students to practice, and then present problem-solving steps to strengthen classroom training [41]. Liang and Cui pointed out that to better use PPT, teachers should strengthen the

management and maintenance of hardware equipment [9].

4. DISCUSSION

Through the sorting and analysis of the previous studies, it can be found that the predecessors have conducted many studies on the use of PPT in mathematics teaching from different angles, and the research conclusions are relatively concentrated. At present, the research of scholars mainly focuses on three aspects: the value of PPT in mathematics teaching, the aspects that should be paid attention to when using PPT and the use skills of PPT. Among them, most scholars' research mainly focuses on the mathematics classroom in the compulsory education stage, while a few scholars research the use of PPT in mathematics teaching at the university stage.

As for the value of PPT in mathematics teaching, previous research mainly focuses on three aspects: student learning, classroom teaching and knowledge presentation. By organizing this aspect, it is found that most scholars briefly explain the value of PPT in mathematics teaching, to provide the corresponding basis for the measures proposed later. Among them, most scholars believe that the value of PPT is to stimulate students' interest, while some believe that the value of PPT is to improve the efficiency of classroom teaching and expand the capacity of courses to enrich teaching. Therefore, it can be seen that previous studies on the value of PPT pay more attention to classroom teaching and students' learning. In this regard, scholars have relatively consistent views, but these views are only briefly described, and the value of PPT is not specifically discussed and analyzed in more detail. Moreover, there is almost no research and discussion on the disadvantages and shortcomings of PPT, so the previous research on the value of PPT lacks integrity and depth.

In terms of the use of PPT, previous studies mainly focus on three aspects: what teachers should pay attention to when using PPT, what teachers should pay attention to when designing PPT, and teachers' attitudes and ability requirements for using PPT. After reviewing the previous studies on this aspect, it is found that the predecessors have explained in detail and comprehensively the aspects that should be paid attention to when using PPT for mathematics teaching, and have also given many effects that

PPT should present. Among them, most scholars proposed that the presentation of PPT should be concise, intuitive and focused, to facilitate students to remember knowledge. Many scholars also pointed out that the content of PPT should adapt to the age characteristics of students. It can be seen that predecessors were mainly concerned about the impact of PPT on students, and there was little discussion about how to improve teachers' ability in PPT operation.

As for the use skills of PPT, the previous research mainly focuses on the presentation of PPT, the application of PPT and the use time of PPT. Among them, some scholars put forward relevant measures from the perspective of PPT operation technology, while others provide relevant suggestions from the perspective of teachers' teaching. According to the discussion on the use skills of PPT, it can be found that most scholars pay more attention to the application and presentation skills of PPT, and most of the suggestions put forward are to highlight the key points, break through difficulties and enrich teaching. Among them, scholars mainly believe that since mathematics knowledge is relatively abstract, teachers can give full play to the dynamic display function of PPT to show the formation process of mathematical knowledge, which will help students to understand and remember knowledge. However, through sorting out previous studies, it is found that almost no scholars carry out further verification of the conclusions obtained for different operation skills, so the feasibility of the conclusions cannot be guaranteed.

5. CONCLUSION

Through sorting out and analyzing previous studies on the usage of PPT in mathematics teaching, the following conclusions are drawn:

- (1) Previous studies on the usage of PPT in mathematics teaching mainly focus on three aspects: the value of PPT, the use of PPT and the use skills of PPT.
- (2) Previous research methods were single, and suggestions were mainly made through literature research, and the research conclusions were concentrated. The research on the value of PPT has not been deeply discussed and analyzed, so it lacks completeness. Most of the studies only focus on students, and there is no

excessive and in-depth discussion on teachers' ability requirements. In addition, the research on the use skills of PPT has not been further implemented and verified, so the feasibility of the conclusion cannot be guaranteed.

- (3) There are still some gaps in the research on this topic. Most studies focus on the compulsory education stage, and there are few studies on the senior high school stage; Previous studies rarely discussed the disadvantages and shortcomings of PPT, and then did not discuss the problems that teachers should pay attention to avoid when using PPT; There are no relevant surveys and studies on students' attitudes towards PPT.

Therefore, it is necessary to carry out further research based on previous studies and use more diversified research methods to study the use of PPT in mathematics teaching from different angles, to encourage scholars to put forward more targeted suggestions in this aspect, and effectively help teachers learn to use PPT correctly for mathematics teaching to get a better teaching effect.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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