Original Research Article

Cognition of Pre-service Mathematics Teachers about the Usage of PowerPoint (PPT) in Mathematics Teaching in China

ABSTRACT

Under the background of the information age, information technology has gradually been widely used in mathematics classroom teaching, and how to use PowerPoint (hereinafter referred to as PPT) in mathematics teaching has received great attention. At present, many scholars have carried out research in this aspect, but there is no research on the cognition of pre-service mathematics teachers about the usage of PPT in mathematics teaching. This paper adopts open interview to investigate 32 pre-service mathematics teachers in China. It was found that:(1) Current pre-service teachers' view the value of PPT mainly for teaching and knowledge presentation.On how to make better use of PPT, the pre-service teachers mainly use PPT for presentation. (2) The pre-service teachers do not have a comprehensive understanding of using PPT for mathematics teaching. Although the dimensions they pay attention to are consistent with previous studies, there are still many aspects that they do not know. (3) The pre-service teachers do not have a deep understanding of the usage of PPT in mathematics teaching, and there are many contradictory views in different dimensions. Based on the findings, the following suggestions are given: (1) Teacher educators should systematically teach them how to operate PPT and assign them a series of tasks to enhance their ability of information resource mining and integration and improve their understanding of PPT. (2) Teacher educators should show the different effects of PPT on pre-service teachers, and lead them to explore the techniques and principles to achieve these effects.This will enable them think about the integration measures of PPT and mathematics teaching, to improve their ability of independent learning and development. (3) Educators should increase practical training and provide more opportunities for pre-service teachers to use PPT in mathematics teaching, to let them feel the value of PPT in practice and explore the best time to use PPT, and finally enable them to master the method of using PPT in mathematics teaching.

Keywords: Pre-service Teacher, Mathematics Teaching, PowerPoint, Information Technology

1. INTRODUCTION

With the continuous update and development of information technology, teachers' classroom teaching methods have gradually become more diverse. The "Compulsory Education Mathematics Curriculum Standards (2022 edition) of China" states that it is necessary to make reasonable use of modern information technology, provide rich learning resources, design vivid teaching activities, and promote the reform of mathematics teaching methods [1]. PowerPoint (hereinafter referred to as PPT) is a presentation tool, it can play its specific functions to effectively assist teachers in achieving better teaching results, so it is of great significance for mathematics classroom teaching [2]. However, the current mathematics teachers often have a series of problems when using PPT to teach mathematics, which always bothers them and deeply affects the teaching [3]. It can be seen that although current mathematics teachers generally have an awareness of using PPT for mathematics teaching, they are unable to obtain ideal teaching results in practice. What are the reasons for this situation? How should mathematics teachers effectively use PPT? This paper adopts open interviews to investigate the pre-service mathematics teachers. Based on the comparison of previous studies, this paper discusses the cognition of pre-service mathematics teachers on the usage of PPT in mathematics teaching and puts forward relevant suggestions to help mathematics teachers find solutions to problems and promote them to get better teaching results.

The objectives of this study are:

(1) What are the main aspects of pre-service mathematics teachers' understanding of the usage of PPT in mathematics teaching?
(2) Comparing with previous studies, is the current pre-service mathematics teachers' understanding of the usage of PPT in mathematics teaching comprehensive?
(3) Comparing with previous studies, is the current pre-service mathematics teachers' understanding of the usage of PPT in mathematics teaching reasonable?

2. LITERATURE REVIEW

At present, there has been many research studies on the usage of PPT in mathematics teaching. It can be found that previous researches on this topic mainly focus on the value, use and skills of PPT in mathematics teaching.

2.1 Research on the Value of PPT in Mathematics Teaching

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

2.1.1 The value of PPT on students' learning

Cui, Wu, Zhang, Liang pointed out that PPT can stimulate students' interest in learning [4-24].Cui, Chen, Li, Guo pointed out thatPPT can encourage students to understand and remember knowledge [4,12,14,15,16,18,24,25].Zhang, Hong, Lan, Chen, Du pointed out that PPT can attract students' attention [6,9,19,20,23,26].Zhang, Yang, Chen, Li, Guo and Liu pointed out that PPT can cultivate students' mathematical logical thinking [6,10,12,14,24,25].Huang and Liu believe that PPT can promote students' active participation in learning and cultivate students' creative spirit and ability [8,11]. Zhang believes that PPT can cultivate students' ability to independent learning [6].

2.1.2 The value of PPT to mathematics classroom teaching

Cui, Hong, Liu, Zhang, Wang, Du, Ma pointed out that PPT can improve the efficiency of classroom teaching [4,11,15,16,19,20,21,24,26,27,28,29].Hong, Liang, Liu, Hong, Ma, Ren and other 14 scholars believe that PPT can expand the capacity of courses and enrich teaching [7,11,19,20,21,23,24,26,27,28].Gong, Liang, Chen, Li, Zhang and other 10 scholars believe that PPT can make classroom teaching more vivid [7,12,13,22,24,25,30,31,32]. Zhang, Liu, Wang, Qiao, Ma and other 10 scholars pointed out that PPT can improve the quality of classroom teaching [6,11,16,20,22,23,29]. Huang, Yang, Liu, Chen, Guo pointed out that PPT can invigorate the classroom atmosphere [8,10,11,12,14,18,19,21,23].Hong, Du, Ren pointed out that PPT can save teachers' time and improve classroom teaching efficiency [19,21,22,23,26,28].Gong, Chen, Wu and Song pointed out that PPT itself is simple, convenient and functional, which is helpful for teachers' classroom teaching [9,22,29,30].Hong, Lan, Wu and Song pointed out that PPT is convenient for students to review and consolidate knowledge [26,29].

2.1.3 The value of PPT for knowledge presentation

Cui, Chen, Yang, Li, Huang pointed out that PPT can highlight key points and break through difficulties [4,8,9,10,19,24,25,27,29].Wu, Huang, Chen, Li, Wang, Ren pointed out that when teachers face abstract mathematical knowledge, PPT can help teachers present it intuitively [5,8,12,16,21,23,25,28,32].Du, Ma, Hu and Zhang pointed out that PPT can dynamically display mathematical knowledge [19,20,27].Ma and Hu pointed out that PPT can quickly present mathematical knowledge [20].

2.2 Research on the Use of PPT in Mathematics Teaching

Through sorting out the previous studies, it is found that the predecessors gave many suggestions on how to use PPT in mathematics teaching and the aspects that should be paid attention to when using 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.

2.2.1 The aspects to pay attention to when using PPT

Hong, Liang, Cui, Liu, Chen, Li pointed out that teachers should combine PPT with traditional blackboard writing in teaching [7,11,12,20,21,22,26,31,33].Wu, Ma, Zou, Wu pointed out that teachers should gradually play PPT and by the order of the course content [5,20,22,29,32]. Zhang, Liu, Chen, Du, Li pointed out that teachers should pay attention to the interaction with students when using PPT [6,11,12,19,23,24,34].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 [20,22,29].Liu, Chen, Li and Liu pointed out that teachers should pay attention to students' feedback when using PPT [11,12,23,34].Cai, Wang and Liu pointed out that teachers should combine their explanations when using PPT in teaching [16,24,35].Liu pointed out that when teachers use PPT to review knowledge, they should try their best to delete words, graphics and symbols that have nothing to do with teaching objectives [34].Wu pointed out that teachers should be familiar with the content of PPT before classroom teaching [22].

2.2.2 The aspects to pay attention to when designing PPT

Cui, Kang, Huang, Wang, Du pointed out that the presentation of PPT should be simple and intuitive and important knowledge should be highlighted [4,8,16,19,20,29,33,36].Wu, Zhang, Huang, Chen, Yang, Wu pointed out that the content design of PPT should conform to the age characteristics of students [5,6,8,9,10,12,17,20,21,24,36].Cui, Liang, Chenreportedthat the font size of PPT should be moderate [4,7,9,18,36].Cui, Chen, Liu, Yang pointed out that teachers should pay attention to the color matching of content, and the font color of PPT should adapt to the background color [4,9,11,18,36].Cui, Zhao, Kang, Wu and Song pointed out that the animation presented by PPT should be smooth and novel [4,29].Liang, Cui, Chen, Wang and Liu pointed out that the presentation of PPT should be concise and beautiful [7,9,16,34].Huang, Chen, Li, Ren and Ma pointed out that the design of PPT should meet the learning needs of students [8,12,21,31].Cui, Zhao, Kang and Wu pointed out that the amount of PPT content should be moderate [4,36]. Hong, Lan, Ma and Hu pointed out that teachers should strengthen the logical correlation between various parts of PPT [20,26]. Liang, Cui, Chen and Wu pointed out that the content of PPT should not be completely copied from textbooks, and it should be expanded [7,12,22]. Wu, Liang and Cui pointed out that teachers should use different fonts and colors in PPT to emphasize important knowledge [5,7].Liang and Cui also pointed out that teachers should pay attention to the visual impact that PPT brings to students [7].Hong and Lan pointed out that teachers should arrange the content of the PPT in the order of mathematical logic [26].Hong and Lan pointed out that PPT should be designed as a thinking guide for teachers and students to teach and learn, and "blank" art should be included in it [26].Chen pointed out that PPT content

should be based on teaching materials [12].Qiao pointed out that teachers should ensure that PPT content is rigorous and scientific [17].Liu pointed out that before designing a PPT, teachers can create a sketch on paper to clarify their ideas [39].

2.2.3 Teachers' attitude and ability requirements for using PPT

Gong, Zhang, Huang, Liu, Li pointed out that teachers should master the operation technology of PPT [6,8,11,16,22,23,24,25,29,30,32].Liu, Chen, Du, Ma and other 8 scholars pointed out that teachers should regard PPT as a teaching auxiliary tool [11,12,19,20,22,24,34].Chen, Liu, Qiao and Du pointed out that teachers should improve their ability to make PPT [9,11,17,19].Li, Wu, Sun and Zhang point out that teachers should avoid relying too much on PPT[25,27,33,36].

2.3 Research on the Use 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.

2.3.1 PPT presentation skills

Liu pointed out that teachers can use the "trigger" and "custom animation" of PPT to display the symmetry, expansion and translation of graphics [11].Liang, Cui and Liu pointed out that teachers can add audio and video content in PPT to better serve teaching [7,11].Wu, Song and Liu pointed out that teachers can use the font color of PPT to highlight key knowledge [29,34].Wu and Sun pointed out that teachers can use PPT to show the mathematical operation process [5,33].Liang and Cui pointed out that teachers insert bar charts and bar charts into PPT to help students integrate what they have learned [7].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, and the rest of the process should be written on the board [26].Sun pointed out that teachers could use PPT to directly and quickly present mathematical problems to improve teaching efficiency [33].

2.3.2 PPT application skills

Huang, Chen, Ma, Hu and Ren pointed out that content related to students' daily life can be incorporated into PPT [8,12,20,21].Chen, Yang, Liu, Ma and Hu pointed out that teachers can use PPT to create relevant problem situations and learning tasks to attract students and stimulate their learning interest [9,10,11,20].Gong, Wu and Song pointed out that teachers can combine PPT with other software to enrich teaching [22,29,30].Liang, Cui, Liu and Chen pointed out that teachers can use PPT to show the mind map of knowledge in the summary [7,11,12].Gong pointed out that the geometric drawing board software could be inserted into the PPT to teach

mathematics [30].Liu also proposed that teachers can use PPT to present the knowledge system of a class for students to help students systematically master what they have learned [11].Cai pointed out that PPT can be used to present relevant content and important and difficult points in advance and explain them to lay a good foundation for classroom teaching [35].Gong, Huang and Qiao pointed out that teachers can use the resource-sharing platform to select appropriate content to put into their PPT [8,17,30].Gong and Zou pointed out that teachers can use PPT to create interactive projections to increase the interactive effect of PPT [30,32].Chen and Liu pointed out that teachers can use PPT to design exercises of different degrees for different students [9,11].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 [20].Gong pointed out that teachers can use PPT to edit mathematical formulas [30].Liu pointed out that teachers can use PPT to appropriately expand teaching content [11].Yang pointed out that teachers can insert hyperlinks in PPT and jump in time when needed [18].Cai pointed out that teachers can use PPT to sort out the contents of a chapter before learning it, and briefly introduce the key points in the chapter [35].Xu pointed out that teachers can make a series of small games around the teaching content to attract students' learning interest and enable students to master knowledge in a relaxed atmosphere [38].

2.3.3 PPT uses timing and other aspects

Huang, Chen, Yang, Wang, Ren and Ma pointed out that when confronted with complex and abstract mathematical knowledge, teachers can choose to use PPT for visual presentation [8,9,10,16,21,24,34].Zhang, Chen, Qiao, Ma, Hu, Liu and Zhang pointed out that teachers' use of PPT should be determined according to the teaching content [6,9,17,20,24,27].Wei pointed out that after teaching the new course, teachers can directly present exercises through PPT for students to practice, and then present problem-solving steps to strengthen classroom training [37].Liang and Cui pointed out thatto better use PPT, teachers should strengthen the management and maintenance of hardware equipment [7].

Through sorting out previous studies, it can be found that the current scholars' research on the usage of PPT for mathematics teaching mainly focuses on the value of PPT, the use of PPT and the use skills of PPT. For the use skills of PPT, many scholars provide a lot of suggestions based on their understanding.However, it can also be found that the previous research methods are single, the survey method is rarely used for research, and the research on teachers' understanding of the usage of PPT in mathematics teaching is still blank.At present, teachers often encounter many problems when using PPT to teach mathematics, which makes it difficult for teachers to obtain good teaching results. However, it can be known from the existing research that teachers' understanding of information technology will deeply affect the integration of information technology into classroom teaching, so it is an important factor affecting the teaching effect [40].Therefore, it is of great significance to study

teachers' understanding of the usage of PPT in mathematics teaching.

3. METHODS

3.1 Sample and sampling procedure

To truly reflect the pre-service mathematics teachers' understanding of the usage of PPT in mathematics teaching, we used random sampling method to select 32 education masters from the subject teaching (Mathematics) major of the School of Mathematics and Statistics of Shandong Normal University as research objects, including 28 female students and 4 male students.This sampling method can be more convenient to select representative samples. Participants all have mathematics teaching certificates and have the intention to engage in mathematics teaching in middle school in the future.

3.2 Instrument

To accurately know the understanding of pre-service mathematics teachers on the usage of PPT in mathematics teaching, this paper adopts open interviews to investigate them.Three questions were designed for the interview. The first question was "What do you think is the value of PPT in mathematics teaching?"The second question was "What do you think should be paid attention to when using PPT in mathematics teaching?"The third question was "How do you think PPT can be better used in mathematics teaching?"The questions were subjected to expert scrutiny.According to the evaluation of experts, these questions have high validity and credibility, which can effectively let us know the relevant understanding of pre-service mathematics teachers.The open interviews were used because it is more flexible, which helped the researchers conduct an in-depth investigation and ensure the authenticity and trustworthiness of the information collected.

3.3 Data Collection

In this study, the open interview was conducted face-to-face with 32 pre-service mathematics teachers. Each interview lasted for about 10 minutes.After obtaining the consent of the interviewees, the interview was recorded to ensure the integrity of the data.

3.4 Data Processing Method

First, the data was coded based on the research questions using A, B and C respectively to represent the pre-service mathematics teachers' understanding of the value of PPT, their understanding of the use of PPT, and how to better use PPT in classroom teaching. Besides the modal words such as ah, um, and uh, the recorded

content of the interview is converted into text and sorted out strictly according to the original words in the interview.Data was analyzed to further extract and categorize participants' core ideas.This was done by classifying different dimensions in different problems. The different dimensions and specific contents were coded after classification, and represented them with serial numbers in turn.Next, the researchers calculated the number of people under each view and the total number of people holding all views under each dimension, and then calculated the percentage corresponding to each content and the percentage of each dimension in the total number of people holding all views under this problem, and finally made a statistical table.

4. RESULTS

4.1 Cognitive Content

A total of 32 pre-service mathematics teachers were investigated in this study.Three aspectsof PPT usage were investigated:pre-service mathematics teachers' understanding of the value of PPT in mathematics teaching, their understanding of the use of PPT in mathematics teaching, and their understanding of how to better use PPT in mathematics classroom. According to the results obtained after the survey, the following is summarized.

4.1.1 Cognition of the value of PPT in mathematics teaching

In this regard, a total of 24 views were put forward by pre-service teachers, with a total of 101 people holding these views. It is found that pre-service mathematics teachers' views were mainly concentrated in four aspects, which are the value of PPT in knowledge, students' learning, teachers and teaching.

In terms of knowledge gain with PPT,19 pre-service mathematics teachers (59.38%) realize that PPT can visually and dynamically present knowledge, 15 pre-service mathematics teachers (46.88%) realize that PPT can promote students' understanding of knowledge (35.64%).In terms of students' learning, 5 pre-service mathematics teachers (15.63%) think that PPT can help attract students' attention, 4 pre-service mathematics teachers (12.5%) think that PPT can stimulate students' interest in learning. In terms of teachers, among which 10 (31.25%) believe that PPT can save time for teachers to write on the blackboard, and several persons hold this type of view 12.87% of the total.In terms of teaching, there are 12 views, among which 19 people (59.38%) believe that PPT can improve the efficiency of classroom teaching, and some people express their views from the perspectives of teaching quality, teaching form, teaching interaction, etc. The details are shown in table 1.

It wasfound that pre-service teachers' views on the value of PPT in mathematics teaching were mainly focused on teaching and knowledge, and the most abundant

views mentioned were on teaching.Among all the above views, there are two views with the largest number of holders, which are that PPT can present knowledge intuitively and dynamically and that PPT can improve the efficiency of classroom teaching, from which it can be known that most of the pre-service teachers think that the value of PPT is mainly embodied in the efficiency of teaching and the presentation of knowledge.However, during the interviews and analysis, it was found that pre-service teachers had more difficulty in distinguishing between the role of PPT and its advantages, and it appeared in the interviews that they confused these two aspects.

Table 1: Descriptive statistics on pre-service teachers' recognition of the value of PPT

Dimension	Label	Content	Number	Percentage	Percentage
A1 knowledge	A11	It can promote students' understanding of knowledge	15	46.88	35.64
	A12	It can display knowledge intuitively and dynamically	19	59.38	
	A13	It can show the knowledge block diagram	1	3.13	
	A14	It can emphasize key knowledge	1	3.13	
A2 students' learning	A21	It can attract students' attention	5	15.63	11.88
	A22	It can stimulate students' interest in learning	4	12.5	
	A23	It is convenient for students to review what they have learned	2	6.25	
	A24	It can deepen students' memory of knowledge	1	3.13	
A3 teachers	A31	It can help teachers accumulate teaching resources	1	3.13	12.87
	A32	It can save the time of teachers writing on board	10	31.25	
	A33	It can help teachers master the teaching process	1	3.13	
	A34	It can help teachers prepare lessons	1	3.13	
A4 teaching	A41	It can make classroom teaching more efficient	19	59.38	39.60
	A42	It can enrich teaching	4	12.5	
	A43	It can be used repeatedly	1	3.13	
	A44	It can provide a more realistic situation	1	3.13	

A45	It can improve the quality of classroom teaching	1	3.13
A46	It can make teaching more interesting	1	3.13
A47	It can increase the interaction between teachers and students	2	6.25
A48	It can show more content	2	6.25
A49	It can provide convenience for teaching	2	6.25
A410	It can enrich the teaching form	2	6.25
A411	It can make the classroom teaching more organized	1	3.13
A412	The content presented can be designed in advance	4	12.5

4.1.2 Cognition of the use of PPT in mathematics teaching

In this regard, a total of 35 views were raised by pre-service teachers, with a total of 135 pre-service mathematics teachers holding these views. After sorting out, it is found that these views mainly focus on three aspects, which are the aspects to be paid attention to when using PPT, the aspects to be paid attention to when designing PPT and the attitude of teachers towards PPT.

There are 15 opinions on the aspects that should be paid attention to when using PPT, among which 24 pre-service mathematics teachers (75%) mentioned that teachers should combine blackboard writing in mathematics teaching when using PPT, and 11 pre-service mathematics teachers (34.38%) realized that teachers should explain more when using PPT, 8 pre-service mathematics teachers (25%) realized that the use of PPT should be determined according to the needs of teaching content, 8 pre-service mathematics teachers (25%) believed that teachers should grasp the rhythm of PPT, and the number of pre-service mathematics teachers holding this type of view is 55.56% of the total.17 opinions should be paid attention to when designing PPT, among which 14 (43.75%) realize that the content of PPT should be streamlined, 6 (18.75%) realize that teachers' thoughts should be integrated into PPT, and 6 people (18.75% of the total number) think that the key knowledge presented by PPT should be highlighted, and the number of pre-service mathematics teachers holding this type of view is 33.34% of the total.In terms of teachers' attitudes towards PPT, there are three opinions, among which 7 pre-service mathematics teachers (21.88%) think that PPT should be used as an auxiliary tool, 4 pre-service mathematics teachers (12.5%) realize that teachers should not rely on PPT, and only 2 pre-service mathematics teachers (6.25%) realize that teachers need to master the operation of PPT,and the number of persons holding this type of view is 9.62% of the total.The details are shown in table 2.

It can be seen that pre-service mathematics teachers have a rich understanding of the aspects that should be paid attention to when using PPT.Among all the opinions, the opinion held by the largest number of people is that teachers should combine blackboard writing when using PPT in mathematics teaching.

Table 2: Descriptive statistics on pre-service teachers' recognition of the use of PPT

Dimension	Label	Content	Number	Percentage	Percentage
B1 Aspects to pay attention to when using PPT	B11	The use of PPT should be determined according to the needs of the teaching content	8	25	55.56
	B12	Turn on the PPT when the teacher needs it and turn it off when not in use	1	3.13	
	B13	The use of PPT in mathematics teaching should be combined with blackboard writing	24	75	
	B14	Teachers should grasp the rhythm of PPT	8	25	
	B15	Teachers should pay attention to students' feedback when using PPT	4	12.5	
	B16	Teachers should pay attention to the interaction between teachers and students when using PPT	4	12.5	
	B17	Teachers should emphasize key knowledge repeatedly when using PPT	4	12.5	
	B18	Teachers should have clear directions when using PPT	2	6.25	
	B19	Teachers should be familiar with the content of PPT before teaching	3	9.38	
	B110	Teachers should use PPT to present complex content	2	6.25	
	B111	Teachers should give students time to think when using PPT	1	3.13	
	B112	Teachers should guide students to learn when using PPT	1	3.13	
	B113	Teachers can not directly present the answers when using PPT to present the examples	1	3.13	
	B114	Teachers should use PPT in	1	3.13	

		combination with learning plans			
	B115	Teachers should explain knowledge when using PPT	11	34.38	
	B21	The presentation of PPT should be beautiful	4	12.5	
	B22	Teachers' thoughts should be incorporated into the PPT	6	18.75	
	B23	The content of PPT should be concise	14	43.75	
	B24	The key knowledge presented by PPT should be highlighted	6	18.75	
	B25	The content of the PPT cannot be completely copied from the textbook	1	3.13	
	B26	PPT animation presentation should not be too much	2	6.25	
	B27	Teachers should pay attention to the color collocation of PPT presentation	1	3.13	
B2 Aspects to pay attention to when designing PPT	B28	Teachers should appropriately use sound and dynamic effects to present knowledge with PPT	1	3.13	33.34
	B29	The presentation of PPT should be novel	1	3.13	
	B210	PPT presentation content should be complete	1	3.13	
	B211	PPT presentation content size should be moderate	2	6.25	
	B212	The content of the PPT should be gradual	2	6.25	
	B213	Teachers should update the content of PPT in time	1	3.13	
	B214	The content of PPT should conform to the psychological characteristics of students	1	3.13	
	B215	The presentation of PPT can be varied	1	3.13	
	B216	The PPT played by the teacher should be combined with pictures and text as far as possible	1	3.13	
	B217	PPT content should be coherent	2	6.25	
B3	B31	Teachers can't rely on PPT	4	12.5	9.62
Teachers'	B32	Teachers should master the	2	6.25	

attitude towards PPT	B33	operation of PPT Teachers should regard PPT as an auxiliary tool	7	21.88

4.1.3 Cognition of how to better use PPT in mathematics teaching

On how to better use PPT in mathematics teaching, pre-service teachers presented a total of 18 viewpoints, and the total number of people who presented these viewpoints was 53.After sorting out, it can be seen that the views of pre-service teachers mainly focus on three aspects, which are the presentation of PPT, the use of PPT and the use time of PPT, but the number of people who hold these views in this regard is not very large.

On the presentation of PPT, there are 13 opinions, among which 8 pre-service mathematics teachers (25%) realize that PPT can be used to present complex and abstract mathematical knowledge, 6 pre-service mathematics teachers (18.75%) think that PPT can be used to display three-dimensional graphics intuitively, 4 pre-service mathematics teachers (12.5%) think that PPT can be used to show example problems, 4 pre-service mathematics teachers (12.5%) think that PPT can be used to show dynamic knowledge,pre-service teachers also put forward many other views, but the number of people holding these views is small and the views expressed are not specific, and the number of persons holding this type of view is 67.92% of the total.In terms of the use of PPT, there are 2 opinions, among which 3 pre-service mathematics teachers (9.38%) think that teachers can use PPT to interact with students, and 1 person (3.13%) thinks that they can use PPT in combination with other software, and the number of persons holding this type of view is 7.55% of the total.In terms of the timing of using PPT, there are 3 opinions, among which 5 pre-service mathematics teachers (15.63%) think that PPT can be used more in the teaching of new courses, 5 pre-service mathematics teachers (15.63%) think that PPT can be used more in the introduction process, 3 pre-service mathematics teachers (9.38%) think that PPT can be used as much as possible in the review process,and the number of persons holding this type of view is 24.53% of the total.The details are shown in table 3.

It can be seen from this that pre-service mathematicsteachers have few views on how to better use PPT in mathematics teaching,their viewsmainly focus on the presentation of PPT, and many of their views are not specific.In this regard, the most popular opinion is that teachers can use PPT to present complex and abstract mathematical knowledge, but the number of people who hold this opinion is not more than 25% of the total number.In the process of interview and arrangement, it is also found that most people have only a simple understanding of how to better use PPT, and some people can only give vague opinions and lack a clear understanding of the use of PPT during the interview. Some people even clearly say that they do not know how to better use PPT, so they cannot give answers.

Table 3: Descriptivestatistics on pre-service teachers' recognition of how to use PPT better

Dimension	Label	Content	Number	Percentage	Percentage
C1 Presentation of PPT	C11	Teachers can use PPT to present complex and abstract mathematical knowledge	8	25	67.92
	C12	Teachers can use PPT to present the specific calculation process and method	3	9.38	
	C13	Teachers can use PPT to show examples	4	12.5	
	C14	Teachers can use PPT to visually show solid geometry	6	18.75	
	C15	Teachers can use PPT to show dynamic knowledge	4	12.5	
	C16	Teachers can properly use PPT to expand mathematical knowledge	3	9.38	
	C17	Teachers can use PPT to present math problems and concepts	2	6.25	
	C18	Teachers can try more novel PPT presentation skills	1	3.13	
	C19	Teachers can use PPT to show students' excellent homework	1	3.13	
	C110	Teachers can appropriately add dynamic effects to attract students	1	3.13	
	C111	Teachers can use PPT to highlight key knowledge	1	3.13	
	C112	Teachers can add audio and video to PPT to enrich their teaching	1	3.13	
	C113	Teachers can use PPT to show the summary of lesson	1	3.13	
C2 The use of PPT	C21	Teachers can use PPT for interaction between teachers and students	3	9.38	7.55
	C22	Teachers can combine the use of PPT with other software for teaching	1	3.13	
C3 Timing of PPT use	C31	Teachers can use PPT more often when teaching new lessons	5	15.63	24.53
	C32	Teachers can use PPT more in	5	15.63	

	the introduction process			
C33	Teachers can use PPT more when leading students to review knowledge	3	9.38	

4.2 Review of Previous Studies

In this paper, previous studies on the usage of PPT in mathematics teaching are sorted out and counted. To facilitate the comparison of data information between predecessors and samples, the aspects studied by predecessors are represented by D, E and F respectively, and the different dimensions of the research results of each aspect are classified and represented by serial numbers in turn. Finally, 76 items are summarized.The details are shown in table 4.

Table 4: Statistics of previous studies on the usage of PPT in teaching mathematics

Theme	Dimension	Label	Content	Number	Percentage
D Research on the value of PPT in mathematics teaching	D1 Students learning	D11	PPT can stimulate students' interest in learning	27	60
		D12	PPT can help students understand and remember knowledge	11	24.44
		D13	PPT can attract students' attention	8	17.78
		D14	PPT can help cultivate students' mathematical logical thinking	6	13.33
		D15	PPT can promote students' active participation in learning and cultivate students' creative spirit and ability	2	4.44
		D16	PPT can cultivate students' ability of independent learning	1	2.22
	D2 Classroom teaching	D21	PPT can improve the efficiency of classroom teaching	19	42.22
		D22	PPT can expand the capacity of the course and enrich the teaching	14	31.11
		D23	PPT can make classroom teaching more vivid	10	22.22
		D24	PPT can improve the quality	10	22.22

			of classroom teaching		
		D25	PPT can liven up the classroom atmosphere	10	22.22
		D26	PPT can save teachers' time	8	17.78
		D27	PPT is simple, convenient and functional, which is helpful to teachers' classroom teaching	5	11.11
		D28	PPT is convenient for reviewing knowledge	4	8.89
		D31	PPT can highlight key knowledge and breakthrough difficulties	12	26.67
	D3 Knowledge presentation	D32	PPT can show abstract mathematical knowledge intuitively	10	22.22
		D33	PPT can dynamically show mathematical knowledge	4	8.89
		D34	PPT can quickly present mathematical knowledge	2	4.44
		E11	When teachers use PPT, they should combine it with blackboard writing to teach mathematics	13	28.89
		E12	Teachers should pay attention to playing the PPT gradually according to the content order	7	15.56
		E13	Teachers should pay more attention to communicate and interact with students when using PPT	7	15.56
E Research on the use of PPT in mathematics teaching	E1 The aspects to pay attention to when using PPT	E14	Teachers should grasp the rhythm of PPT playback, not too fast or too slow	5	11.11
		E15	Teachers should pay attention to students' feedback when using PPT	4	8.89
		E16	Teachers should pay attention to the teacher's explanation when using PPT	3	6.67
		E17	When using PPT to guide students to review knowledge, teachers should try to delete words, graphics and symbols that are not	1	2.22

		related to the teaching objectives		
	E18	Teachers should be familiar with the content of PPT before teaching	1	2.22
	E21	The presentation of PPT should be concise and intuitive, and the key knowledge should be highlighted	12	26.67
	E22	The content of PPT involves adapting to the age characteristics of students	13	28.89
	E23	PPT presentation font size should be moderate	8	17.78
	E24	Teachers should pay attention to the color matching of the PPT content, and the theme color should also adapt to the background color	7	15.56
E2 The aspects to pay attention to when designing PPT	E25	The animation of the PPT presentation should be novel	5	11.11
	E26	The presentation of the PPT should be simple and beautiful	5	11.11
	E27	The design of PPT should meet students' learning needs	5	11.11
	E28	The amount of PPT content should be moderate	4	8.89
	E29	Teachers should strengthen the logical correlation between each part of the PPT	4	8.89
	E210	The content of the PPT can not be completely copied from the textbook, and there should be a relevant expansion of the content	4	8.89
	E211	Teachers should use different fonts and colors in PPT to emphasize key knowledge	3	6.67
	E212	Teachers should pay attention to the visual impact of PPT for students	2	4.44
	E213	Teachers should arrange the	2	4.44

			content of PPT according to the logical order of mathematics		
		E214	Teachers should design the PPT into a thinking guide for teachers and students to teach and learn, and there should be "white space" art	2	4.44
		E215	The content of PPT should be based on the textbook	1	2.22
		E216	Teachers should ensure that the content of the PPT is rigorous and scientific	1	2.22
		E217	Before designing each slide, the teacher can create a sketch on the paper to clarify the idea	1	2.22
	E3 Teachers' attitude and ability requirements for using PPT	E31	Teachers should be proficient in the operation of PPT	12	26.67
		E32	Teachers should regard PPT as a teaching aid	8	17.78
		E33	Teachers should improve their ability to make PPT	4	8.89
		E34	Teachers can't rely too much on PPT	4	8.89
F Research on the use skills of PPT in mathematics teaching	F1 PPT presentation skills	F11	Teachers should use the dynamic display function of PPT to show the formation process of knowledge	15	33.33
		F12	Teachers can use the "trigger" and "custom animation" functions of the PPT to show the symmetry, expansion and translation of the graphics	1	2.22
		F13	Teachers can add audio and video content to PPT to better serve teaching	3	6.67
		F14	Teachers can use the font color of PPT to highlight key knowledge	3	6.67
		F15	Teachers can use PPT to show the mathematical operation process	2	4.44
		F16	Teachers can insert bar charts	2	4.44

		and other content in the PPT to help students integrate what they have learned		
	F17	The content of the PPT presentation should be simplified, and only the key knowledge and difficulties should be presented as far as possible. The rest of the PPT should be written on the board	2	4.44
	F18	Teachers can use PPT to show math problems quickly and improve teaching efficiency	1	2.22
	F21	Teachers can integrate content related to students' daily life into PPT	6	13.33
	F22	Teachers can use PPT to create relevant problem scenarios and learning tasks to attract students and stimulate students' interest in learning	5	11.11
	F23	Teachers can combine PPT with other software to enrich their teaching	4	8.89
F2 PPT application skills	F24	Teachers can use PPT to show the mind map of knowledge in summary	4	8.89
	F25	Teachers can insert the geometric drawing board software in PPT to teach mathematics	1	2.22
	F26	Teachers can use PPT to present the knowledge system of a lesson to students	1	2.22
	F27	Teachers can use PPT to present key knowledge and difficulties before class and explain them to lay a good foundation for classroom teaching	1	2.22
	F28	Teachers can use the resource-sharing platform to	3	6.67

		choose the appropriate content to put in their PPT		
	F29	Teachers can use PPT to create interactive projections, to increase the interactive effect of PPT	2	4.44
	F210	Teachers can use PPT to design exercises of different levels for different students	2	4.44
	F211	Teachers can use PPT frequently to explain conceptual knowledge	2	4.44
	F212	When teachers use PPT to teach mathematics, they can combine it with real objects	2	4.44
	F213	Teachers can use PPT to edit mathematical formulas	1	2.22
	F214	Teachers can use PPT to expand the teaching content appropriately	1	2.22
	F215	Teachers can insert hyperlinks in the PPT so that they can jump in time when needed	1	2.22
	F216	Teachers can use PPT to sort out the content of a chapter before students learn, and briefly introduce the key knowledge in it	1	2.22
	F217	Teachers can make a series of small games around the teaching content to attract students' interest in learning	1	2.22
F3 PPT uses timing and other aspects	F31	In the face of complex abstract mathematical knowledge, teachers can use PPT to display it intuitively	8	17.78
	F32	The teacher's use of PPT should be determined according to the teaching content	7	15.56
	F33	After teaching new knowledge, teachers can use PPT to directly present exercises for students to	1	2.22

	F34	practice To make better use of PPT, teachers should strengthen the management and maintenance of hardware equipment	2	4.44

4.3 Cognitive Comprehensiveness

Based on the previous studies, this study compares pre-service teachers' cognition of the usage of PPT for mathematics teaching with the previous studies to find out whether pre-service teachers' cognition of PPT has been covered in all the previous studies and to determine whether pre-service teachers' cognition of PPT is comprehensive or not.

4.3.1 The value of PPT in mathematics teaching

There are a total of 18 contents in the previous studies on the value of PPT in mathematics teaching. Comparing the pre-service teachers' cognition of the value of PPT in mathematics teaching with the previous studies on this aspect, it can be found that the current pre-service teachers recognized 12 items in the previous studies, accounting for 66.67% of the total.

In the aspect of students' learning, the predecessors put forward 6 contents, and the pre-service teachers can recognize 3 of them, accounting for 50.00% of the total.In terms of classroom teaching, 8 items were proposed by predecessors, and 5 items were recognized by pre-service teachers, accounting for 62.50% of the total.In terms of knowledge presentation, predecessors proposed 4 contents, and pre-service teachers recognized all the contents of this part, accounting for 100.00% of the total.In addition, the current pre-service teachers also explained the value of PPT from the dimension of teachers and put forward many other views on this aspect, but the meanings of these views are very similar and can be considered almost the same point of view.

It can be seen that current pre-service teachers do not have a comprehensive understanding of the value of PPT in mathematics teaching, but they have a very comprehensive understanding of the value of PPT in the presentation of knowledge.According to the data obtained, current pre-service teachers only recognize many superficial values of PPT but fail to recognize many deep-seated values of PPT in mathematics teaching, among which many key points have not been mentioned.Although some people explain the value of PPT from a new dimension, the meaning of these views is very similar.The details are shown in table 5.

Table 5: Statistics on the comprehensiveness of pre-service teachers' recognition of the value of PPT

Dimension	Recognizing Points	Total	Percentage	Recognizing Points	Total	Percentage
Studentslearning	3	6	50.00			
Classroom teaching	5	8	62.50	12	18	66.67
Knowledge presentation	4	4	100.00			

4.3.2 The use of PPT in mathematics teaching

There are a total of 29contents in the previous studies on the use of PPT in mathematics teaching. Comparing the pre-service teachers' cognition of the use of PPT in mathematics teaching with the previous studies in this aspect, it can be found that the current pre-service teachers recognize a total of 17 items in the previous studies, which accounts for 58.62% of the total.

In terms of the aspects that should be paid attention to when using PPT, a total of 8 contents were proposed by predecessors, and 7 contents were recognized by pre-service teachers, accounting for 87.50%.In terms of the aspects that should be paid attention to when designing PPT, there were 17 contents in the previous research, and preservice teachers recognized 7 contents of the previous research, accounting for 41.18%.In terms of teachers' attitudes toward PPT and ability requirements, there were 4 contents in previous studies, and preservice teachers could recognize 3 of them, accounting for 75% of the total.The dimensions considered by pre-service teachers in this aspect are more comprehensive.However, it can be found from the obtained data that the main reason why many viewpoints of pre-service teachers cannot match the previous research content is that their understanding of this aspect is very vague and not in-depth.

It can be seen from this that the current pre-service teachers do not have a comprehensive understanding of the aspects to pay attention to when designing PPT, which is less than half of the contents studied by predecessors, but they have a comprehensive understanding of the aspects to pay attention to when using PPT and the attitude and ability requirements of teachers towards PPT.However, except for a few opinions, the number of people holding other opinions in this regard is not large, so their overall understanding of the use of PPT in mathematics teaching is not comprehensive.The details are shown in table 6.

Table 6: Descriptivestatistics on the comprehensiveness of pre-service teachers' recognition of the use of PPT

Dimension	Recognizing Points	Total	Percentage	Recognizing Points	Total	Percentage
Aspects to pay	7	8	87.50	17	29	58.62

attention to when using PPT			
Aspects to pay attention to when designing PPT	7	17	41.18
Teachers' attitude towards PPT and ability requirements	3	4	75.00

4.3.3 How to better use PPT in mathematics teaching

There are a total of 29 contents in the previous studies in this regard. Comparing the pre-service teachers' cognition of how to better use PPT in teaching mathematics with the previous studies, it can be found that the current pre-service teachers recognize 13 items in the previous studies, accounting for 44.83% of the total.

Among them, in terms of PPT presentation skills, the predecessors put forward a total of 8 contents, 4 of which were recognized by pre-service teachers, accounting for 50.00% of the total, and many specific contents were not mentioned by pre-service teachers.In terms of the application skills of PPT, a total of 17 items were proposed by predecessors, and pre-service teachers could recognize 8 of them, accounting for 47.06% of the total. For many specific functions of PPT and how to integrate it with teaching, pre-service teachers failed to explain them in detail.In terms of the timing of PPT use and other aspects, 4 items were proposed by predecessors, but pre-service teachers only recognized 1 of them, accounting for 25.00% of the total.

It can be seen that the current pre-service teachers do not have a comprehensive understanding of the skills of using PPT in mathematics teaching.Among them, their understanding of each aspect is less than half of the previous research content, so it can be seen that most pre-service teachers do not know how to use PPT in mathematics teaching to obtain better teaching results, and many of the views they mentioned are not in-depth. The details are shown in table 7.

Table 7: Descriptivestatistics on the comprehensiveness of pre-service teachers' recognition of PPT use skills

Dimension	Recognizing Points	Total	Percentage	Recognizing Points	Total	Percentage
PPT presentation skills	4	8	50.00	13	29	44.83
PPT application skills	8	17	47.06			
PPT use timing	1	4	25.00			

From the above analysis, it can be found that a total of 76 items have been proposed in previous studies on the usage of PPT in mathematics teaching, and pre-service teachers can recognize 42 of them, accounting for 55.26% of the total.For each aspect, the dimensions they focus on are the same as those studied by predecessors, but many of the points they put forward are not in-depth, and many of the key points are not mentioned.It can be seen that pre-service teachers do not have a comprehensive understanding of the usage of PPT in mathematics teaching.The details are shown in table 8.

Table 8: Descriptivestatistics on the comprehensiveness of pre-service teachers' recognition of the usage of PPT in teaching mathematics

Theme	Recognizing Points	Total	Percentage	Recognizing Points	Total	Percentage
The value of PPT in mathematics teaching	12	18	66.67			
The use of PPT in mathematics teaching	17	29	58.62	42	76	55.26
The skills of using PPT in mathematics teaching	13	29	44.83			

4.4 Cognitive Rationality

Based on the previous studies, this study compares the pre-service teachers' cognition of the usage of PPT for mathematics teaching with the previous studies to find out whether the pre-service teachers' cognition is the same or similar to the previous studies, and ultimately to determine whether the pre-service teachers' cognition of the usage of PPT for mathematics teaching is reasonable or not.

4.4.1 The value of PPT in mathematics teaching

Pre-service teachers' cognition of the value of PPT in mathematics teaching has 12 items, and by comparing the pre-service teachers' cognition of this with the content of the previous research, it can be found that 8 items in the previous research are the same or similar to the pre-service teachers' cognition, accounting for 66.67% of the total.

In terms of knowledge presentation, pre-service teachers proposed a total of 4 views, 3 of which were involved in previous studies, accounting for 75.00% of the total.In terms of student learning, pre-service teachers proposed 4 contents, all of which were involved in previous studies, accounting for 100% of the total number of this part.In

terms of teachers, pre-service teachers proposed a total of 4 contents, and previous relevant studies involved 1 of them, accounting for 25.00% of the total. According to previous studies, teachers should regard PPT as an auxiliary tool, but some pre-service teachers regard it as a necessary tool in classroom teaching.

It can be seen that the pre-service teachers' overall understanding of the value of PPT in mathematics teaching is not reasonable, but the understanding of PPT in terms of student learning and knowledge presentation is very reasonable, andall the points mentioned in these two aspects have been covered by previous studies.However, in the aspect of teachers, it can be seen from the analysis that many views of pre-service teachers are unreasonable, among which some teachers' views exaggerate the advantages of PPT and tend to rely on PPT. The details are shown in table 9.

Table 9: Statistics on the reasonableness of pre-service teachers' recognition of the value of PPT

Dimension	Recognizing Points	Total	Percentage	Recognizing Points	Total	Percentage
Knowledge presentation	3	4	75.00	8	12	66.67
Studentslearning	4	4	100.00			
teachers	1	4	25.00			

4.4.2 The use of PPT in mathematics teaching

There are 35 contents of pre-service teachers' cognition of the use of PPT in mathematics teaching. By comparing with the contents of previous research, it can be found that 18 contents in the previous research are the same or similar to the cognition of pre-service teachers, accounting for 62.86% of the total.

In terms of the aspects that should be paid attention to when using PPT, the pre-service teachers put forward a total of 15 contents, and the previous related research involved 6 of them, accounting for 66.67% of the total, and many of the views mentioned by the pre-service teachers were vague and not deep enough.In the aspects that should be paid attention to when designing PPT, 17 contents were proposed by pre-service teachers, 9 of which were involved in previous research, accounting for 52.94% of the total.In terms of teachers' attitudes towards PPT, pre-service teachers put forward 3 contents, which are all involved in previous studies, accounting for 100% of this part.

It can be seen that the pre-service teachers' overall understanding of the use of PPT in mathematics teaching is less reasonable, and some of their views are not in-depth, but they have a better understanding of teachers' attitudes towards PPT. The details are shown in table 10.

Table 10: Statistics on the reasonableness of pre-service teachers' recognition of PPT use

Dimension	Recognizing Points	Total	Percentage	Recognizing Points	Total	Percentage
Aspects to pay attention to when using PPT	10	15	66.67			
Aspects to pay attention to when designing PPT	9	17	52.94	22	35	62.86
Teachers' attitude towards PPT	3	3	100.00			

4.4.3 How to better use PPT in mathematics teaching

There are a total of 18 contents in pre-service teachers' cognition of PPT skills used in mathematics teaching. Through comparison, it can be found that 9 contents in previous studies are the same or similar to pre-service teachers' cognition, accounting for 50.00% of the total.

In terms of PPT presentation, pre-service teachers proposed 13 contents, of which 8 were involved in previous research, accounting for 61.54% of the total.In terms of the application of PPT, pre-service teachers put forward 2 contents, 1 of which was involved in previous studies, accounting for 50.00% of the total.In terms of the timing of PPT use, pre-service teachers put forward 5 items, among which the views are very general and not specific, and previous studies have not involved any of them.

It can be seen that the pre-service teachers' overall understanding of the skills of PPT use is not reasonable, especially regarding the timing of PPT use, in which all the views have not been covered by previous studies. The details are shown in table 11.

Table 11: Statistics on the reasonableness of pre-service teachers' recognition of the skills of PPT use

Dimension	Recognizing Points	Total	Percentage	Recognizing Points	Total	Percentage
Presentation of PPT	8	13	61.54			
Application of PPT	1	2	50.00	9	18	50.00
The use of PPT timing	0	3	0.00			

From the above analysis, it can be found that there are 65 contents of pre-service teachers' understandingof the usage of PPT in mathematics teaching, 39 of which are involved in the previous research, accounting for 60.00% of the total.The dimensions they focus on are the same as those of predecessors, and some of their views are reasonable. However, from a comprehensive perspective, the overall understanding of pre-service teachers on the usage of PPT in mathematics teaching is still not reasonable. The details are shown in Table 12.

Table 12: Statistics on the reasonableness of pre-service teachers' recognition of the usage of PPT in teaching mathematics

Theme	Recognizing Points	Total	Percentage	Recognizing Points	Total	Percentage
The value of PPT in mathematics teaching	8	12	66.67			
The use of PPT in mathematics teaching	22	35	62.86	39	65	60.00
The skills of using PPT in mathematics teaching	9	18	50.00			

5. DISCUSSION

5.1 Cognitive Content

The above analysis reveals that pre-service teachers have many different perceptions of using PPT for teaching mathematics from different perspectives, and the dimensions they focus on in this regard are largely consistent with previous research.

Regarding the understanding of the value of PPT in mathematics teaching, pre-service teachers are mainly concerned about the value of PPT in teaching and knowledge presentation, and they mainly believe that the value of PPT lies in its ability to visually and dynamically present knowledge and improve the efficiency of classroom teaching, and some of the pre-service teachers have elaborated on the value of PPT from different perspectives, which can be seen that they have different understandings of the value of PPT.However, during the interviews and collations, it was found that most of the pre-service teachers have a vague understanding of many aspects in this regard, and it is difficult for them to distinguish the value of PPT and its role, and many of them have exaggerated the value of PPT. By analyzing their views, it can be found thatmany pre-service teachers tend to rely on PPT for teaching, which will undoubtedly affect the effectiveness of classroom teaching.

On the use of PPT in mathematics teaching, most pre-service teachers pay more

attention to the aspects that should be paid attention to when using PPT, and there are also many views on the aspects that should be paid attention to when designing PPT.They mainly think that teachers should use PPT in combination with blackboard writing for mathematics teaching, and their recognition of other aspects is not specific enough. It can be seen that pre-service teachers' understanding of the use of PPT only stays in some basic aspects, and they do not pay enough attention to the details of the use of PPT.Among them, some of the views put forward by pre-service teachers are very reasonable, but through analysis, it is found that their views on different aspects are contradictory. For example, they mentioned that teachers should regard PPT as an auxiliary tool, but through analysis, it is found that they tend to rely on PPT, which indicates that many pre-service teachers can put forward some reasonable views,but their understanding of these ideas is still not deep enough.

Regarding how to better use PPT, pre-service teachers' understanding is not much and relatively single, most of them just mentioned some basic operations of PPT, and these views are mainly focused on the presentation of PPT and are very vague, they mainly think that teachers can use PPT to present complex and abstract mathematical knowledge.It can be found that pre-service teachers have a single understanding of the effects that PPT can present and are unfamiliar with many of the techniques of using PPT, which leads to the fact that they are not clear about how they should better use PPT in classroom teaching.

5.2 Cognitive Comprehensiveness

The above analysis reveals that while pre-service teachers' cognition of some aspects is consistent with the content of previous research, there is still a significant portion of many previous studies that pre-service teachers do not recognize.

On the value of PPT, pre-service teachers have a more comprehensive understanding of the presentation of knowledge.However, they did not mention many of the key points, although some of them elaborated on the value of PPT from different aspects, these views are very similar and do not have too much new significance.Therefore, pre-service teachers do not have a comprehensive overall understanding of the value of PPT in the mathematics teaching.As for the use of PPT in mathematics teaching, although pre-service teachers have a lot of recognition about the aspects that should pay attention to when using PPT and the teachers' attitude towards PPT and ability requirements, which are consistent with previous studies, the number of them holding these views is not large, so their overall understanding of the use of PPT in mathematics teaching is not comprehensive.As for how to make better use of PPT, there are not many opinions mentioned by pre-service teachers, and these opinions are relatively vague. It can be seen that pre-service teachers do not have a comprehensive understanding of how to better use PPT.

Therefore, it is known that pre-service teachers do not have a comprehensive

understanding of the usage of PPT in mathematics teaching.This finding is also consistent with the content of previous research. It can be seen from the previous research that although multimedia technology brings new opportunities for mathematics teaching, but also brings numerous challenges, many current mathematics teachers do not have a high level of information technology literacy, which restricts the in-depth application of the technology in teaching and expanding it [41].

5.3 Cognitive Rationality

Through the above analysis, it was found that the dimensions that pre-service teachers are concerned about in terms of using PPT for mathematics teaching are the same as those of previous studies, and some of these views are more reasonable, but from all aspects, the overall understanding of pre-service teachers about the usage of PPT for mathematics teaching is still relatively unreasonable.

Regarding the value of PPT in mathematics teaching, pre-service teachers have a reasonable understanding of students' learning and knowledge presentation, but many views on teachers are not reasonable, and some of them exaggerate the value of PPT and tend to rely on it, which shows that they do not understand and feel the value of PPT for mathematics teaching. Therefore, their overall understanding of this aspect is not reasonable. As for the use of PPT in mathematics teaching, although the dimensions that pre-service teachers pay attention to are consistent with previous studies, some of their views are not in-depth, so their overall understanding of this aspect is also unreasonable.For how to use PPT better, most of the views put forward by pre-service teachers are some basic operations, which obviously cannot obtain better teaching effects. Even in terms of the use time of PPT, all the views of pre-service teachers do not match the previous research.It can be seen that they do not know when it is best to use PPT and how to use PPT in teaching. Many pre-service teachers rarely describe in detail what effect PPT can bring to students when talking about the use of PPT.

From the above analysis, it can be known that pre-service teachers have a more unreasonable understanding of the usage of PPT for mathematics teaching, which is also consistent with the previous research.It can be seen from the previous research that many current mathematics teachers have many misunderstandings about the application of multimedia technology in mathematics teaching, and meanwhile the integration of multimedia technology and mathematics teaching is not deep enough, which makes multimedia technology unable to play its role in mathematics teaching [42].

6. CONCLUSION

Previous studies have shown that teachers' understanding of information technology

will affect the effect of classroom teaching.The current mathematics teacherscannot effectively use PPT for mathematics teaching, and then cannot obtain satisfactory teaching results, is this because the mathematics teachers' understanding of using PPT for mathematics teaching is not comprehensive and reasonable enough?In this study, 32 pre-service mathematics teachers were selected as the research objects, and the method of open interview was used to investigate their understanding of the usage of PPT in mathematics teaching.It was found that: (1) Current pre-service teachers' view of the value of PPT mainly for teaching and knowledge presentation. Their understanding of the use of PPT mainly focuses on the aspects that should be paid attention to when using and designing PPT. On how to make better use of PPT, the pre-service teachers mainly use PPT for presentation. (2) The pre-service teachers do not have a comprehensive understanding of using PPT for mathematics teaching. Although the dimensions they pay attention to are consistent with previous studies, there are still many aspects that they do not know. (3) Again, pre-service teachers do not have a deep understanding of the usage of PPT in mathematics teaching, and there are many contradictory views in different dimensions.

Therefore, the following suggestions are given: (1) Teacher educators should systematically teach them how to operate PPT and assign them a series of tasks to enhance their ability of information resource mining and integration and improve their understanding of PPT [43]. (2) Teacher educators should show the different effects of PPT on pre-service teachers, and lead them to explore the techniques and principles to achieve these effects. This will enable them think about the integration measures of PPT and mathematics teaching to improve their ability of independent learning and development [44]. (3) Educators should increase practical training and provide more opportunities for pre-service teachers to use PPT in mathematics teaching, to let them feel the value of PPT in practice and explore the best time to use PPT, and finally enable them to master the method of using PPT in mathematics teaching [45].

The research object of this paper is 32 graduate students majoring in subject teaching (mathematics) from the same university and the same grade, which does not involve other types of pre-service mathematics teachers, so the sample size is small and the scope is narrow.This paper adopts the open-ended interview method, which is flexible but may also ignore some important information.Therefore, in the future, it is necessary to expand the scope of the research sample and adopt various research methods to conduct more in-depth research on the cognition of pre-service mathematics teachers about the usage of PPT in mathematics teaching, to find more detailed and comprehensive results.

Ethical Approval:

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

Consent

As per international standards or university standards, Participants' written consent has been collected and preserved by the author(s).

REFERENCES

1. Ministry of Education of the People's Republic of China. Compulsory Education Mathematics Curriculum Standards (2022 Edition). Beijing: Beijing Normal University Press, 2022.
2. Fan XL., Deng YZ., and Zhao Y. Discussion on the application strategies of information technology in high school mathematics classroom teaching. Education Circle, 2022, (04):86-88.
3. Wang M. Problems and Countermeasures in the integration of Information Technology and junior middle School Mathematics Teaching. Reading and Writing, 2024, (06):29-31.
4. Cui YQ., Zhao YC., and Kang SG. Application of PPT software in Mathematics classroom. Information Recording Materials, 2019, 20(01):231-232.
5. Wu YZ. Skillfully using PPT to make Mathematics simple -- Take Su Jiao Edition second grade volume "8 Multiplication Formula" as an example. Information Records Materials, 2018, 19(10):178-181.
6. Zhang W. Application of Multimedia Technology in Primary School Mathematics Teaching. Jilin Education, 2014, (32):95.
7. Liang GZ., Cui XY. Teaching PPT Design in Middle School Mathematics. Journal of Xinxiang College, 2018, 35(03):70-72.
8. Huang YZ. Design and Application of PPT courseware for Primary School Mathematics. China Educational Technology Equipment, 2017, (21):57-58.
9. Chen YG. Analysis of the effective Application of PPT courseware in Primary School Mathematics Teaching. Zhengzhou Normal Education, 2013, 2(06):83-86.
10. Yang AQ. Discussion on the application of PPT courseware in primary school mathematics classroom teaching. Education and Teaching Forum, 2012, (07):149-150.
11. Liu ZT. Design method and application of PPT courseware for primary school mathematics. China Educational Technology Equipment, 2017, (13):55-57.
12. Chen GT. Production method and effective application of PPT courseware for

primary school mathematics. China Educational Technology Equipment, 2016, (09):60-61.
13. Zhang GY. A Brief analysis of diversified teaching in primary school Mathematics Teaching Model. Comparative Research on Cultural Innovation, 2017, 1(22):72+74.
14. Guo CH. Exploration of the integration of information technology and primary school Mathematics classroom Teaching. China Educational Technology Equipment, 2021, (21):31-32.
15. Zhang RX., Zhou JF. Application of network information resources in primary school Mathematics teaching. China Educational Technology Equipment, 2018, (03):42-43.
16. Wang LF. Problems and solutions in multimedia teaching of junior middle school Mathematics. China Educational Technology and Equipment, 2017, (07):119-120.
17. Qiao YM. Discussion on Making and Developing Skills of PowerPoint Courseware for Primary School Mathematics. Computer CD-ROM Software and Application, 2014, 17(22):222-223.
18. Yang YK. Discussion on making Math courseware with PPT. Computer CD-ROM Software and Application, 2012, (12):256.
19. Du YH. Analysis of the application of PPT in Mathematics Teaching. Science Popular (Science Education), 2013, (12):157.
20. Ma D., Hu YH. A brief discussion on the use of multimedia in primary school Mathematics teaching. Science and Technology Information, 2013, (10):349.
21. Ren SQ, Ma Yanlong. Research on the integration of PPT and Primary School Mathematics Classroom Teaching. Journal of Software Guide, 2012, 11(12):216-217.
22. Wu BY. Practice and Exploration of Multimedia Teaching in Mathematics Classroom Teaching. Journal of Shaoxing University of Arts and Sciences (Natural Science), 2012, 32(07):106-108.
23. Li Y. Research on the advantages of PPT courseware in Mathematics Teaching Application. Heilongjiang Science and Technology Information, 2012, (02):235.
24. Liu ZB. Exploration and reflection on multimedia teaching of mathematics. Education and Careers, 2011, (02):168-169.
25. Li WW. Multimedia technology and Primary school Mathematics Teaching Efficiency. China Modern Educational Equipment, 2014, (24):38-42.
26. Hong TQ, Lan CX. Research on Collaborative application teaching practice of PPT and blackboard writing based on thinking wire -- Taking higher Mathematics

classroom as an example. Advanced Mathematics Research, 2018, 21(04):100-103+118.
27. Zhang JL. Some practices and reflections on multimedia-assisted teaching of Mathematics. Audio-educational Research, 2003, (05):72-74.
28. Li C. Research on the application of modern Information Technology in Mathematics Teaching. Journal of Langfang Teachers College (Natural Science Edition), 2009, 9(06):125-128.
29. Wu DY, Song Dongzhe. Comparison and discussion of several common multimedia teaching methods in Mathematics Teaching. Journal of Jilin Radio and Television University, 2019, (02):120-121.
30. Gong X. Skills and Experience in making math courseware with PPT. Modern Communication, 2010, (04):193+192.
31. Li L. Analysis on the application of PPT in Mathematics Teaching in deaf schools. Science Popular (Science Education), 2013, (11):103+93.
32. Zou J. Application of Animation Technology in Multimedia Teaching of College Mathematics. Intelligent Computer and Applications, 2012, 2(02):78-82.
33. Sun L. On the "degree" of multimedia teaching in college Mathematics Teaching. Science and Technology Information, 2013, (35):135+127.
34. Liu JW. Teaching and diagnosis of Mathematics review course with multimedia aid. Information Recording Materials, 2018, 19(10):191-192.
35. Cai Y. Research on the application of Information Technology in senior high school Mathematics Teaching. Scientific Consultation (Education Research), 2021, (03):156-157.
36. Wu XY. Investigation report on the use of PPT courseware in classroom teaching in our school. Neijiang Science and Technology, 2014, 35(11):124+126.
37. Wei QH. A Brief discussion on the effective application of PPT courseware in Primary School Mathematics Teaching. Knowledge Library, 2021, (24):70-72.
38. Xu L. Skillfully Using PPT Animation Technology to Optimize Mathematics Classroom Teaching. New Wisdom, 2019, (13):20+22.
39. Liu QX. Research on the application of PPT Software in Mathematics Teaching in Secondary Vocational Schools. Science Garden of Middle School, 2018, 14(01):47-48.
40. Zhang FM.Research on the Integration Strategy of Information Technology and Primary School Mathematics Teaching under the Background of the New Era. Mathematics Learning and Research, 2023, (31):107-109.
41. Li WJ, Yu Shaojie.Integration Analysis of Middle School Mathematics Teaching and Information Technology Multimedia. Chinese Journal of Multimedia and

Network Teaching (Next issue), 2024, (04): 193-195.
42. Zhuang QR. Using information technology to ignite junior high school students' enthusiasm for mathematics. Literacy and Arithmetic, 2023, (29):158-160.
43. Wei J. The Professional Development of junior middle School Mathematics teachers under the environment of Information technology. Jiangxi Education, 2023, (07):23-24.
44. Du J. Improving rural teachers' Information literacy: Problems and strategies. Teaching Monthly • Middle School Edition (Teaching Management), 2023, (09):55-57.
45. Tian XM, Su Xin, Wang Yunwu. From "Information Technology" to "Information Technology": New demands for teacher professional development under the background of new curriculum standards. Electronic Education in primary and secondary schools, 2024, (Z1):96-99.
46. Chen, W., & Hendricks, K. (2014). Pre-Service Teachers' Subject Matter Competency and Quality of Teaching Practices: An Exploratory Case Study. Journal of Education, Society and Behavioural Science, 5(2), 224–236. https://doi.org/10.9734/BJESBS/2015/13306
47. Dacuycuy , M. C. A., Rabago , J. K. M., Paguyo , C. G., Fernando , S. R. I., &Lasaten, R. C. S. (2023). Constructivist Materials in Teaching Selected Topics in the Contemporary World Course. South Asian Journal of Social Studies and Economics, 18(4), 21–40. https://doi.org/10.9734/sajsse/2023/v18i4663
48. Minor LC, Onwuegbuzie AJ, Witcher AE, James TL. Preservice teachers' educational beliefs and their perceptions of characteristics of effective teachers. The Journal of Educational Research. 2002 Nov 1;96(2):116-27.