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The Research on How to Teach Analytic Geometry in Universities in China

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Abstract

Analytic Geometry is one of the main basic courses for mathematics majors in universities. In recent years, to adapt to social development and popular education, colleges and universities continue to reduce the class hours of traditional professional courses to increase the public class hours. Therefore, how to ensure the teaching quality of Analytic Geometry has become an important problem. Although there are a lot of researches on how to teach Analytic Geometry in universities, there is no summary literature in this field. This paper reviews and sorts out the previous literature through the method of literature research, and draws the following conclusions: (1) Predecessors studied from seven aspects: students, teachers, assessment, curriculum, teaching content, teaching method, and educational thoughts. Among them, the research involving teaching content is the most, and the research involving students and teaching methods is relatively more; the research involving assessment, curriculum, and educational thoughts is relatively few. (2) In terms of research results, students, teachers, teaching content, and teaching methods get more results, while assessment, curriculum, and educational thoughts get fewer results. In the future, we can do more in-depth research in these aspects, in order to get more research results. (3) The strategy of teaching analytic geometry in universities proposed by predecessors involves a wide range of aspects, but it still has the following shortcomings: there is little research on assessment and only a few schools change the assessment method of the final paper and pencil examination; the research methods is lack of experimental demonstration since they are mostly proposed from the perspective of speculation. (4) Therefore, future research can break through the following aspects: combining theory with practice, putting the proposed strategies into teaching; launching the effectiveness experiment of relevant strategies to obtain scientific data, to make the demonstration more sufficient.

Keywords

Analytic Geometry, Teaching, Literature Method, University

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1. Introduction

Analytic Geometry is a basic course in higher mathematics teaching, which builds a bridge between elementary mathematics and higher mathematics, so it plays an important role in higher mathematics learning [1]. However, due to the strong abstraction of the Analytic Geometry course itself, and the change of the curriculum arrangement in recent years, the class hours are reduced. In addition, the teaching methods are not updated in time, and the teaching efficiency is low, so the students' learning effect is poor [2-3]. Although there is no lack of research on how to teach Analytic Geometry well in universities, there is no complete summary of relevant literature. Therefore, this paper reviews and sorts out the previous research, to summarize the effective improvement measures proposed by predecessors and find the blank points of current research, to guide the future research direction.

The research question of this paper is: "the research on how to teach Analytic Geometry in University" which aspects have been studied before? What are the main research aspects?

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What aspects of the current research on Analytic Geometry teaching are good? What is not good? Where are the gaps?

2. Method

2.1. Data Sources

This article adopts the literature method and uses the literature in the CNKI database as the data source. CNKI is the most authoritative document retrieval tool for Chinese academic journals. It basically contains all the contents of Chinese journals. It includes 168 professional subject digital libraries, covering documents in various disciplines, and is a highly authoritative document retrieval platform. The choice of this database in this article can ensure the persuasiveness and reliability of the research.

2.2. Data Collection

When collecting data, this article uses "title" as the search term and "Analytic Geometry, Teaching" as the keyword. Considering the timeliness of the article, the author chooses the articles published from 2018 to 2020 as the target documents for the research. Because some articles were about the content of analytic geometry in senior high school or only involved in the teaching of a certain chapter of analytic geometry, they were deleted and 25 articles were reserved for study.

2.3. Data Processing

Through the intensive reading of the literature and taking notes, this paper summarizes the research aspects, research results, and research methods in past research.

3. Results

3.1. Statistics of Research Aspects

According to the collation and summary of the existing research, we found that the previous research mainly involves seven aspects: students, teachers, assessment, curriculum, teaching content, teaching method, and educational thoughts. Among them, the research involving teaching content is the most, and the research involving students and teaching methods is relatively more; the research involving assessment, curriculum, and educational thoughts is relatively few. The details are shown in Table 1.

Table 1. Aspects and Number of Literature.

Aspects	Students	Teachers	Assessment	Curriculum	Teaching Content	Teaching Method	Educational Thoughts
Number of Literature	9	6	5	4	22	11	5

3.2. Statistics of Research Results

Through the analysis of the corresponding results of seven research aspects, the author found that most results were concentrated in four aspects: students, teachers, teaching content, and teaching method. The results of the assessment were relatively less, and the results of the curriculum and educational thoughts were the least. The details are shown in Table 2.

Table 2. Aspects and Number of Results.

Aspects	Students	Teachers	Assessment	Curriculum	Teaching Content	Teaching Method	Educational Thoughts
Number of Results	7	6	5	3	8	8	1

3.3. Statistics of Research Methods

Through reading these 25 articles, the author found that the previous literature on how to teach Analytic Geometry well in universities involves three research methods: the experimental method, the case analysis method, and the speculative method. Among them, the article that uses the speculative method is the most. The frequency of these methods is shown in Table 3.

Table 3. Research Methods and Number of Results.

Research Methods	The Experimental Method	The Case Analysis Method	The Speculation Method
Number of Literature	1	3	21

3.4. Current Main Points

3.4.1. Students Aspect

In terms of students, Wang Youde, Tan Jian, Tuo Qiuju, Wang Rui, and Zhang Shan all proposed that students' learning initiative and interest should be enhanced, students should be encouraged to participate in the classroom, and passive learning should be changed into active learning [3-7]. Tuo Qiuju also proposed that students should strengthen their understanding and application awareness of theoretical knowledge [5]. Zhang Shan proposed to improve students' hands-on ability and scientific research and innovation ability and pay attention to the cultivation of students' mathematical thinking and mathematical methods [7]. Xu Yinling suggested

that students should be trained to examine analytic geometry problems with an algebraic perspective [8]. Both Qin Guiming and Zhu Yuqing believe that we should pay attention to the cultivation of students' overall mathematical thinking, and students can only have a deep understanding of knowledge after they have a good understanding of the overall analytic geometry [9, 10]. Yang Lijuan also put forward the viewpoint of cultivating students' spatial imagination ability [11].

3.4.2. Teachers Aspect

In terms of teachers, Wang Rui believed that teachers should establish a democratic and fair teaching model and actively guide students to take the initiative to think in the classroom [6]. Xu Yinling suggested that teachers should pay attention to the interactive application of algebra and geometry when teaching [8]. Zhu Yuqing suggested that teachers should pay attention to the two-way interaction between teachers and students when teaching in the classroom, and should prepare electronic courseware and teach in a multimedia classroom [10]. Cai Shanshan suggested that a teacher training system should be established and for young teachers [12]. Wang Yiming proposed that the teacher should fully understand the knowledge points of teaching, innovate teaching methods, and effectively integrate the content of the two courses of algebra and geometry [13]. Ma Huilong believes that teachers' ability improvement and guidance in relatively weak and backward areas should be strengthened [14].

3.4.3. Assessment Aspect

In terms of the assessment aspect, Guo Aili proposed that the assessment methods should be diversified, and a combination of open-book and closed-book assessment methods can be used [2]. Wang Youde suggested that the course of analytic geometry should not only use a single assessment method. The assessment form should include the usual grades, the ability of software programming, and the ability of model building and system design [3]. Zhu Yuqing proposed that the assessment methods should be reformed and the usual assessment efforts should be strengthened [10]. Zhou Jian believes that procedural assessment should be emphasized [15]. Xu Chuanyou suggested building a network platform and improving evaluation management [16].

3.4.4. Curriculum Aspect

In terms of curriculum, Guo Aili, Tuo Qiuju, Xu Yinling, and Sun Wenfeng have all put forward the view that the curriculum is unreasonable in their research. Tuo Qiuju suggested that the Analytic Geometry course could be transferred to the first semester of sophomore so that the knowledge of the higher generation could be applied. Xu Yinling suggested combining Advanced Algebra and Analytic Geometry [2, 5, 8, 17].

3.4.5. Teaching Content Aspect

In terms of teaching content, Huang Kun, Guo Aili, Cai Shanshan, Xu Chuanyou all proposed that the content of the analytic geometry course should be optimized [1, 2, 12, 16]. Tuo Qiuju and Zhu Yuqing both pointed out that mathematical modeling examples should be integrated into the teaching process [5, 10]. Huang Kun, Wang Youde, Tuo Qiuju, Wang Rui, Xu Yinling, Qin Guiming, Yang Lijuan, Cai Shanshan, Sun Wenfeng, Li Tiyao, Du Yun, Zhong Junping, Yang Yongge, Yan Jing, and Huang Yuan all mentioned the use of mathematical software such as MATLAB when talking about how to teach Analytic Geometry well in universities [1, 3, 5, 6, 8, 9, 11, 12, 18-24]. Wang Youde, Cai Shanshan, and Yang Yongge suggest introducing knowledge about the history of mathematics [3, 12, 22]. Xu Yinling suggested that textbooks suitable for the characteristics of the students of the school should be compiled according to the training objectives [8]. Zhu Yuqing, Zhou Jian, Li Tiyao, Xu Chuanyou, Liu Haiqin suggested that Analytic Geometry knowledge should be mutually infiltrated with other knowledge such as Advanced Algebra [10, 15, 16, 18, 25]. Zhu Yuqing also proposed that the applicability of course content should be improved [10]. Ma Huilong suggested that domestic and foreign high-quality educational resources should be introduced into the teaching process to promote the improvement of teaching quality [14].

3.4.6. Teaching Method Aspect

In terms of teaching method, Guo Aili, Zhang Shan, Qin Guiming, Zhu Yuqing, Ma Huilong, Zhou Jian, Xu Chuanyou all put forward the view of combining traditional teaching methods with modern teaching methods and using multiple teaching methods in their research [2, 7, 9, 10, 14-16]. Tan Jian proposed the concept of hierarchical teaching and suggested schools should provide after-school guidance [4]. Tuo Qiuju emphasized the combination of number and shape [5]. Zhang Shan believes that the heuristic teaching method not only inspires students' in-depth understanding of course knowledge but also inspires students' love of course content. And he also proposed the mode of group teaching [7].

3.4.7. Educational Thoughts Aspect

In terms of educational thoughts, Huang Kun, Wang Rui, Qin Guiming, Cai Shanshan, and Huang Yuan all proposed that we should pay attention to the infiltration of mathematical thinking methods, which is widely respected by all [1, 6, 9, 12, 24].

4. Discussion

4.1. Discussion on Research Aspects

According to the collation and summary of the existing

research, it is found that the previous research mainly involves seven aspects: students, teachers, assessment, curriculum, teaching content, teaching method, and educational thoughts. Among them, the research involving teaching content is the most, and the research involving students and teaching methods is relatively more. However, there are few studies related to assessment, curriculum, and educational thoughts, which can be further studied in the future.

4.2. Discussion on Research Results

Through the above summary and analysis, we get seven, six, five, three, eight, eight, and one result respectively from seven aspects of students, teachers, assessment, curriculum, teaching content, teaching method, and educational thoughts. Among them, we get more results in terms of students, teachers, teaching content, and teaching method, which is of great guiding significance to the teaching of Analytic Geometry in the future. The results of the assessment, curriculum, and educational thoughts are less, which can be taken as the focus of our research in the future.

4.3. Discussion on Research Methods

As far as research methods are concerned, there are three research methods were used in 25 articles. They are the experimental method, the case analysis method, and the speculative method. Among them, Only 1 article uses the experimental method, 21 articles adopt the speculative method. We can conclude that the research method is relatively single, and most of the results are not supported by scientific data, which makes the whole demonstration process lack persuasion.

5. Conclusion

By analyzing the research on how to teach Analytic Geometry well in university, we can draw the following conclusions:

(1) Predecessors studied seven aspects: students, teachers, assessment, curriculum, teaching content, teaching method, and educational thoughts. Among them, the research involving teaching content is the most, and there are relatively more researches involving students and teaching methods; but there are relatively few researches involving assessment and evaluation, curriculum, and educational thoughts. Therefore, we can seek more breakthroughs in these aspects in the future.

(2) In terms of research results, we get more results from students, teachers, teaching content, and teaching method, while we get fewer results from the assessment, curriculum, and education ideas. In the future, we can do more in-depth research in these aspects, to get more research results.

(3) Most of the research methods are speculative, and the results are summarized by experience which lacks proof of data. The above results in the lack of persuasion in the process of argumentation.

(4) Therefore, future research can break through the following aspects: Teachers combine theory with practice and put the proposed strategies into teaching. Researchers launch the effectiveness experiment of relevant strategies to obtain scientific data, to make the demonstration more sufficient.

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