A Comparative Analysis of Old and New High School Mathematics Textbooks from the Perspective of Mathematics Core Literacy -- Taking the Trigonometric Function Content of the Human Education Edition as an Example

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Abstract: The promulgation of the Curriculum Standards for ordinary high School (2017 edition, 2020 revision) has effectively promoted the reform of high school mathematics classroom. In order to cope with the change of textbook content in the new curriculum reform, it has become one of the important tasks for high school mathematics teachers to implement teaching activities better and sort out and analyze the differences between the old and new textbooks. This paper analyzes the differences between old and new textbooks from the three dimensions of system structure, course content and example exercises, and gives some reasonable teaching suggestions. Among them, the new textbook uses 2019 "Ordinary High School Textbook" person-taught A version of Compulsory Mathematics 1, and the old textbook uses 2004 "Ordinary High School Mathematics Curriculum Standard Experimental Textbook" person-taught A version of compulsory Mathematics 4. In general, the adjustment of the new teaching materials is more in line with the cognitive characteristics of students, pay attention to the penetration of mathematical culture and pay attention to the development of students' mathematical core literacy.

Keywords: Mathematics Core Accomplishment; High School Mathematics; Textbook Comparison; Trigonometric Function

1. Introduction

Textbook is a bridge connecting curriculum standards and teaching implementation, and the quality of textbook writing is directly related to the implementation of curriculum concepts and the achievement of teaching objectives. It is not only the main reference basis for students' learning, but also the basis and guarantee for teachers' curriculum design and teaching process. Mathematics teaching materials also change, which is a new challenge for most teachers. Therefore, the comparative analysis between the old and new textbooks has certain significance, which can help teachers better grasp the new textbooks, compare the differences with the old textbooks, and improve teaching efficiency. Trigonometric function is the content of the fifth chapter of the new textbook for senior high school. It is an important mathematical model to describe periodic phenomena. It plays an important role in mathematics and other subjects. By learning trigonometric functions, students can develop core mathematical qualities such as logical reasoning and mathematical operations while cultivating mathematical ideas such as combination of number and form, reduction and classification and discussion [1].

2. The new and old teaching materials trigonometric function part of the system structure comparison

2.1 Comparison of the order of chapters in old and new textbooks

Students' physical and mental development has the characteristics of sequence and imbalance, which requires that the textbook

should conform to the students' cognitive law and acceptance ability when arranging chapters. Logical and systematic teaching materials play a very important role in cultivating students' core mathematical literacy. The following is a comparative analysis of the order of chapters in the "Trigonometric function" part of the new and old teaching materials, as shown in Table 1-1:

Table 1-1 Comparison of the order of trigonometric function chapters in the old and new textbooks of the Hanyu version

The new Student textbook		Old textbook	
	Chapter Five trigonometric functions		Chapter One trigonometric functions
	5.1 Any Angle and radian system		1.1Arbitrary Angle and radian system
	5.2 Concept of trigonometric function		1.2 Trigonometric function of any Angle
	Read and think about trigonometry and astronomy		Read and think about trigonometry and astronomy
	5.3 Induction formula		1.3 Induction formula of trigonometric function
	5.4 Image and properties of trigonometric functions		1.4 Image and properties of trigonometric functions
Compulsory 1	Explore and discover the period of function $y = A\sin(\omega x + \varphi)$ and function $y = A\cos(\omega x + \varphi)$	Compulsory 4	Explore and discover the period of function $y = A\sin(\omega x + \varphi)$ and function $y = A\cos(\omega x + \varphi)$
	Explore and discover the properties of sine and cosine functions by using the properties of the unit circle		Explore and discover the properties of sine function and cosine function by using trigonometric function in unit circle
	5.5 Triangular identity transformation		Information technology applications draw a function $y = \tan x, x \in (-\frac{\pi}{2}, \frac{\pi}{2})$ using a positive tangent
	Information technology application Using information technology to make trigonometric function table		1.5 Image of the function $y = A\sin(\omega x + \varphi)$
	5.6 functiony $= A\sin(\omega x + \varphi)$		Read and think about amplitude, period, frequency, phase
	5.7 Application of trigonometric functions		1.6 Simple application of trigonometric function model
	Read and think about amplitude, period, frequency, phase		Brief summary
	Brief summary		Review reference
	Review reference Question 5		Chapter three trigonometric identity transformation
			3.1 Sine, cosine and tangent formulas for the sum and difference of two angles
			Information technology application Using information to make technical trigonometric function table
			3.2 Simple triangular identity transformation
			Brief summary
			Review reference

Compulsory 2	The sixth chapter is scalar orientation and its application 6.4 Application of plane vectors	Comp ulsory 5	Chapter 1 Solving triangles 1.1 Sine theorem and cosine theorem Further discussion of exploring and discovering the solution triangle 1.2 Application Examples Reading and thinking by Helen and Qin Jiushao 1.3 Internship Brief summary Review reference

According to the above table, it can be found that in the old textbooks, the knowledge point of "trigonometric function" is divided into three parts: "Trigonometric function" in chapter 1 of Mathematics Compulsory Course 4, "Trigonometric Identity Transformation" in chapter 3, and "Solving triangle" in chapter 1 of compulsory Course 5. The new textbook integrates the two parts of Chapter 1 and Chapter 3 of Compulsory 4 into the fifth chapter of compulsory Volume 1, "Trigonometric Functions".

2.2 Comparative analysis of content deletion and change in teaching materials

Comparing the two textbooks, it is found that the new textbook has deleted the content of "Solving triangles" in the first chapter of compulsory 5, and put the sine theorem and the cosine theorem into the sixth chapter of "Plane Vectors and their Applications" in the second volume of compulsory textbook, so that they are no longer an independent chapter [2]. In the section "The image of function y=Asin(ωx+φ)", the section "Mathematical model of uniform circular motion" has been added. In terms of information technology, the content of "Drawing functions with positive tangential lines" and "functions of y=tanx,x∈(−π2,π2)" have been deleted from the new textbook, emphasizing the reasoning function of triangular identity transformation. It shows that the new teaching material has shifted its focus on the cultivation of mathematics core literacy, gradually transiting from the old teaching material to the cultivation of students' reasoning ability, which meets the training requirements of the six major mathematics core literacy proposed by the new curriculum standard.

3. Comparative analysis of course content

3.1 Comparative analysis of chapter introduction and chapter header

At the beginning of each chapter, the mathematics textbook is equipped with a chapter header diagram and introduction, which aims to explain the main learning content of the chapter, make students clear about their learning motivation and goals, and stimulate their learning interest [1]. Senior high school mathematics teachers should be familiar with the compilation of textbooks, make full use of the pre-chapter part of textbooks, set up reasonable teaching situations, and develop students' core quality of mathematics. For the chapter head picture, generally choose the picture related to the knowledge point of this chapter, reflect a certain mathematical beauty, let students feel that mathematics comes from life.In the trigonometry teaching section, both the old and new textbooks use the day-night alternation caused by the earth's rotation and the four-season alternation caused by the revolution, which are closely related to students' daily life. In the section at the beginning of the chapter, the new textbook only sets the chapter title and deletes the six section titles of the old textbook, which have been shown in the catalog. The new textbook avoids unnecessary repetition. In the section at the beginning of the chapter, the new textbook simply summarizes the knowledge of this chapter and points out that the trigonometric function describing the rule of periodic change can be learned by using the experience of learning functions. Reduce students' learning burden while permeating the mathematical idea of analogy [3].

3.2 A comparative analysis of the contents of old and new textbooks

3.2.1 Column setting

Column setting is one of the important parts of the textbook, which helps the teacher to teach and also leaves the space for students to learn independently. Through comparison, it is found that the old and new textbooks have set up columns such as exploration, thinking, narration and induction, while the new textbooks also set up introductive language in each section. The new teaching materials focus more on inquiry and reduce the thinking part, and introduce new knowledge in the form of inquiry, so that

students can take the initiative to learn, which puts forward different levels of requirements on students' knowledge and ability. The inquiry-based and heuristic learning methods can fully mobilize students' enthusiasm for learning. In addition, the new textbooks are more concise in language expression and more reasonable in color matching.

3.2.2 Comparative analysis of the summary of this chapter

The summary of this chapter is a compound habit column, which aims to guide students to sort out the key content learned in this chapter. The content arrangement is in line with the basic concept of the new curriculum, and is a good material for implementing the new curriculum concept. In the summary part of this chapter, both the new and old textbooks are composed of two parts: "Knowledge structure of this chapter" and "Review and reflection". Among them, "Knowledge structure of this chapter" is presented in the form of mind map, so that students can intuitively see the whole content of this chapter, which helps students quickly identify the core content and establish a systematic knowledge system [4]. The old textbook directly lists seven points in the form of questions, which refer more to whether students can generalize certain content by themselves. The new textbooks summarize more and add examples to arouse students' memories of knowledge points; Then six questions are given to guide students to review the whole chapter. Compared with the old textbook, the new textbook is more concise in the question setting, which helps students to reflect on the learning effect and deepen the understanding of knowledge points

4. Comparative analysis of example problem and exercise system

4.1 Arrangement form

The set of exercises is mainly for students to master the relevant knowledge points of this lesson and deepen their understanding of the knowledge. There is little difference between the new and old textbooks in the arrangement of exercises, which is mainly reflected in the review of reference questions. The old textbooks divided the exercises into A group and B group, and the content was also based on the difficulty of the exercises. The purpose was to identify students' learning ability from the difficulty of the review questions. In terms of review questions, the new textbook changes the original grouping form and divides it into three sections: "review and consolidation", "comprehensive application" and "expansion and exploration" [5], in which the difficulty level of each section is progressive, and this arrangement form develops students' core mathematical literacy from different levels of problem solving.

4.2 Volume comparison

The right amount of practice can effectively consolidate the learning content, but excessive practice will increase the burden of students. Compare the differences in the number of exercises between the new and old versions of the textbook "Trigonometric Functions", as shown in Table 3-1:

Table 3-1 Comparison of the number of exercises

		New teaching material		Old textbook	
		quantity	percent	quantity	percent
	example	45	16.92%	52	15.95%
	practice	97	36.47%	92	28.22%
exercises	Session exercises	90	33.83%	124	38.04%
	exercises	34	12.78%	58	17.79%
	total	266	100%	326	100%

It is found that the two textbooks have little difference in the amount of questions, and the new textbooks are more reasonable in arrangement. Among them, the new textbook reduces 7 examples, increases 5 exercises, reduces 34 exercises, and reduces 24 chapter exercises, because the "triangular identity transformation" in the old textbook is a separate chapter, and the new textbook combines it into a subsection, the "triangle area formula" is deleted and the "triangle solution" part is merged, so the number of questions is reduced more. The new textbooks weaken the algebraic operation of trigonometric functions and pay more attention to the students' learning of mathematical ideas and methods.

4.3 Question type comparison

Comparing the teaching materials, it is found that the old and new textbooks mainly focus on calculation problems, followed by drawing problems and proof problems. The exercise Settings of the new textbooks are more in line with students' learning rules and pay attention to the cultivation of students' mathematical operation ability and logical reasoning ability. Among them, the examples of old textbooks are mainly in the form of "question + answer" or "question + answer + summary". On the basis of the old textbook, the new textbook adds an "analysis" link to some more abstract mathematical problems and examples containing complex realistic background, which becomes the example setting form of "problem + analysis + solution + summary". This link not only alleviates students' understanding of the example problems, but also enables students to disperse their thinking and think independently through the "analysis" part.

5. The teaching suggestions under the comparison of old and new curriculum standards

The new curriculum standard puts forward some curriculum concepts such as core quality orientation, curriculum structure and emphasis on discipline practice in the aspects of curriculum objectives and implementation. Teaching materials are of profound significance in promoting the transformation of discipline knowledge into core literacy and guiding the teaching reform of discipline practice [6]. Based on the new curriculum standard, teachers cultivate students' mathematics core quality in the teaching process. Please refer to the following:

Emphasis on practice, experience to strengthen the understanding and application of formulas. Logical reasoning ability and mathematical operation ability are one of the basic mathematical abilities that students must have, which requires teachers to keep pace with The Times in the teaching process, and consciously cultivate students' logical reasoning ability and mathematical operation ability in the process of preaching and teaching. There are many formulas in the "trigonometric function" section, and the derivation and understanding of formulas is a big difficulty for students. When teaching, teachers should lead students to deduce formulas, perceive the origin of mathematical formulas, and strengthen their understanding of formulas.

Second, we should dig deeply into the teaching materials and innovate the situational classroom teaching. Teaching materials are important tools for both teachers and students. In mathematics teaching, teachers should, on the one hand, study the teaching materials deeply, dig out the core quality of mathematics contained therein, design teaching objectives based on the actual situation of students, break the traditional teaching mode, create learning situations based on real life, create an active learning atmosphere for students, and enable students to flexibly apply mathematics knowledge to practice. In this process, improve students' mathematical thinking ability and cultivate good mathematical core literacy.

Optimize the teaching mode and design diversified teaching methods. Diversified teaching refers to the teaching method that ADAPTS to different students' learning characteristics and needs through a variety of different teaching methods and strategies to improve students' learning interest and participation. With the implementation of the new curriculum standards, the reform and innovation of educational methods have become particularly important. Mathematics teachers should change the single teaching mode in the teaching process, combine research and innovation, and aim at developing students' innovative ability, so that students can continuously improve their core mathematics literacy in the process of practice and innovation

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