

The Investigation of Statistics Teaching about New Mathematics Curriculum of Senior High School in China

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What is the relationship between teachers' teaching of statistical content in high school curriculum and the objectives and requirements in "high school mathematics curriculum standards (experimental)"? Through questionnaires and individual interviews, we found that although teachers are more agreeable to curriculum and requirements of statistical content, but there still exist some problems: some updating teachers' old ideas and lack of curriculum resources. Therefore, changing concepts and focusing on training statistical thinking, stimulating students' learning motivation and interest with concrete cases, providing practical opportunities for students to undergo the entire process of statistical work, using technology to teach statistics, is very worthy to be learned and grasped by our teachers.

Key Words: high school mathematics, statistics teaching, teaching suggestion.

Background and Issues

The ministry of Education issued "high school mathematics curriculum standards (Experimental)" (Herein after referred to as the "standard") in 2003, it pointed out that the "double base" of mathematics is advancing with the times. High school mathematics curriculum introduced statistics as a new basic knowledge and basic skills to a compulsory modules curriculum, and this part has changed from concept to content and requirements (Ministry of Education of PR. China, 2003). However, under the curriculum reform of basic education, the teaching situation of statistical content is still unknown. The corresponding studies place more concern on the teaching methods and teaching strategies, ignoring the teachers' own understanding of the statistical

content and statistical concepts (Nie, 2004; Zhang & Ma, 2005; Shi, Kong, Qin, & Yang, 2005). Therefore, this study focuses on the differences between curriculum setting and curriculum implementation, then investigates the teaching status quo of statistics in the senior high school. It has important significance not only for mathematics curriculum setting and implementation, but also for teachers and effective teaching.

Designs and Implementation

Tool

The questionnaire is divided into two parts; the first part surveys the basic situation of teachers, including gender, seniority, title, etc. The second part surveys the present conditions of teaching statistical content in the mathematics curriculum. It includes the following: (1) teachers' teaching literacy, attitudes and understanding of statistical content, (2) teachers' cognition of teaching materials and exercises, (3) teachers' teaching difficulties in statistical practice, (4) teachers' self-evaluation of teaching effectiveness. Meanwhile, we designed the interview outline based on the questionnaire, and then interviewed part of the mathematics teachers.

Implementation and Analysis Methods

Considering the typical problems of being tested, this study selected five high schools of different levels in Nanjing as a sample group through a random sampling method. The author sent out questionnaires to the above-mentioned five high schools' mathematics teachers through field visits between November and December in 2009. 115 questionnaires were sent out and 109 available questionnaires were retrieved; the effective rate was 94.78%. The questionnaire data was analyzed by descriptive statistics; the percentage in the frequency distribution table was obtained by frequency distribution analysis.

Results and Analysis

The Basic Situation of Teachers

The subjects' gender, seniority, title and other basic conditions is shown in Table 1.

Table 1
Basic Situation of Teachers

	Male		Female	
Gender	64 (58.72%)		45 (41.28%)	
Seniority	5 years and below	6-10 years	11-20 years	20 years and above
	15 (13.76%)	40 (36.70%)	33 (30.27%)	21 (19.27%)
Title	Second-class teacher	First-class teacher	Senior teacher	Special-class teacher and above
	19 (17.43%)	47 (43.12%)	42 (38.53%)	1 (0.92%)

Teachers' Attitudes and Understanding of Statistics

Attitude is a unique consistent and lasting psychological and behavioral tendencies that treat individual person and object. Teachers' attitude of statistics directly influenced the choice and judgment of statistical content, and thus potentially affected the conduct of teaching statistics. The survey found that most teachers held a positive attitude for introducing statistics into high school mathematics curriculum. Meanwhile, teachers are greatly interested in statistics at the emotional level. In addition, teachers' understanding of statistical background and statistical content was quite sufficient. (see table 2)

Table 2
Teachers' Understanding of Statistics

Statistics in High School Mathematics Curriculum				The understanding of statistical requirements in the curriculum standard			
Very necessary	necessary	Does not matter	Not necessary	Very clear	Clear	Learn about	Do not quite understand
12.8%	67.0%	15.6%	4.6%	11.9%	47.7%	34.9%	5.5%
Interest in statistics				The understanding of logical relationship of the statistical content structure			
Very interested	Does	Not		Very	Clear	Learn	Do not

interested		not matter	interested	clear		about	quite understand
3.7%	55%	31.2%	10.1%	12.8%	43.1%	38.5%	5.5%
The understanding of statistical background				The understanding of statistical content teaching materials and teaching requirements in middle school			
Very clear	Clear	Learn about	Do quite understand	not	Very familiar	familiar	Basic familiar Not familiar
3.7%	30.3%	55.0%	11.0%	11.9%	28.4%	33.9%	25.7%

During the interviews with teachers, we found there are three attitudes regarding statistics: (1) those who think that statistics is new and is in close touch with our actual life, students love this part. These teachers believe that “this part is very interesting, fun, and students are interested in it”, “for students, what have never studied it, it is fresh. Unlike traditional content, statistical content is often not certain, the answer is not unique, and one cannot simply identify which answer is correct, which is wrong. It needs comprehensive information to make a reasonable decision, which is good for students’ creative thinking.” Holding this view are usually middle-aged teachers, who have some basis and a certain understanding for this part, and will accept some new ideas in reform. (2) Those who do not care about the introduction of statistical content. These teachers believe that “regardless of outline or standard, as long as the content is part of what an examination will test, I would teach it.” These teachers are engaged in teaching for a long time, have some teaching experience and have formed their own stable teaching mode. (3) Those who against the introduction of statistical content. These teachers think that such content is not conventional mathematics, therefore, there is no sense and no need to introduce statistical content into mathematics course. Moreover, the college entrance examination requirements are very low.

Teachers’ Cognition of Teaching Materials and Exercises

Teaching materials play an important role in learning and teaching, and editing teaching materials directly impacts teaching. The statistical content editing situation in teaching materials mainly investigate five areas: layout structure, difficulty level, scope or area, teaching arrangements and examples design, interviews with teachers. From the survey, teachers are quite

satisfactory with the statistics materials editing in the new curriculum. (see table 3)

Table 3
Teachers' Cognition of Teaching Material and Exercises

Layout structure of statistics				Teaching arrangements of statistics			
Very reasonable	reasonable	general	unreasonable	Very reasonable	reasonable	general	unreasonable
3.7%	33.0%	55.0%	8.3%	2.8%	36.7%	53.2%	7.3%
Difficulty level of statistics				Examples design of statistics			
Very reasonable	reasonable	general	unreasonable	Very reasonable	reasonable	general	unreasonable
0.9%	30.3%	60.6%	8.3%	2.8%	39.4%	44.0%	13.8%
Scope or area of statistics							
Very reasonable	reasonable	general	unreasonable				
4.6%	36.7%	55.0%	3.7%				

Through interviews, we found that teachers generally felt the most important statistical content is the random sampling and using samples to estimate overall. For the first section, because they have been appeared in the college entrance examination, practice in this area is more important. Section 2 mainly may be drawn from the frequency histogram. Normal practice in this regard is also more. Section 3, “relevance of variables”, has never turned up in the past college entrance examination, so many teachers think that it is not very important. Thus, teachers in general are rely on the college entrance examination, and do not start teaching from a statistical nature. Meanwhile, some more experienced teachers think that the statistical content which appears in Required Course 3 is relatively simple. For the case setting, these teachers feel it is more appropriate and is enough. But there are still some teachers have no interest in statistics. They agree that “statistics has nothing to teach in fact”. The reason is mainly that there is little statistics tested on the college entrance examination.

Teachers' Teaching Difficulties in Statistical Practice

In high school mathematics courses, statistical content is scheduled in Required Course 3 and Elective Course 1-2 or 2-3 to teach, required 16 hours, elective 8 hours, a total of 24 hours. From the survey, we found teachers' statistical knowledge comes from different areas, the largest is teaching materials, teaching reference books and teaching summaries. Teachers' teaching difficulties in practice are lacking curriculum resources, lacking guidance and students accept, and etc. (see table 4)

Table 4
Teachers' Teaching Difficulties in Statistical Practice

Teachers' learning about statistics			Statistics goes on to junior high school						
Professional learning	Self-study	Not studied	Great attention	general	Sometime attention	Not very attention			
55.1%	31.2%	13.7%	10.1%	47.7%	30.3%	11.9%			
Teachers' statistical source(multiple-choice)		statistical knowledge		Statistical background briefing					
teaching materials, reference books	Teacher training	teaching summary	Books and internet	Others	Detail intro	General intro	Litter intro	Not very intro	Do not intro
81.6%	14.7%	51.4%	24.8%	29.3%	5.5%	33.0%	31.2%	26.6%	3.7%
Statistical teaching difficulties(multiple-choice)									
Lack of curriculum resources	of	Lack of guidance	of	Students can not accept	can	Not meet their own	the statistics of	of	others
59.6%		32.1%		19.3%		11.0%			16.5%

Through interviews, we know teachers have almost forgotten all relevant content which they learned in the university, and they were eager for concrete and effective training. Teachers reflected what "training went on for a few days; Our understanding of statistics requires our own reading and studying." "The training should combine our practical teaching, give us good examples of learning to learn, or let us discuss in order to solve practical difficulties. We understood reports just fine when listened, but we have no practical help in teaching, and most items are theoretical." Regarding the difficulties in

teaching, teachers reflect that the greatest difficulty is lack of curriculum resources, such as “teaching reference, information is not in place, there is no suitable reference material or reference books”, “because it is new content, teaching reference is lagging behind, it is unable to meet the teaching requirements.” Another teacher reflected on practical issues and computer problems, such as “practice opportunities for students should be added to the course, then let students experience the whole process of data collection and processing.” “Lack of educational software; students are not rational.” A one year teaching experience teacher said that when he was teaching students the most difficult thing is “using samples to estimate overall”. In this part, students cannot draw a frequency histogram and have poor understanding of the variance and standard deviation. (Teachers generally felt that using a computer to teach this section would be better.) Of course, when facing doubt or confusion in teaching, teachers usually refer to books, the internet and communicate with other fellow teachers to solve the problem (Li, Zhu, Wu, & Cheng, 2009).

Teachers’ Self-evaluation of Teaching Effectiveness

This part evaluates teaching effectiveness in five areas:(1) the acceptance of students, (2) the student grasp of statistical concepts, (3)the students’ grasp of statistical skills, (4) the student grasp of statistical thinking, (5)the student experience with statistical application.(see table 5)

Table 5

Teachers’ Self-evaluation of Teaching Effectiveness

the acceptance of students					the student’s grasp of statistical thinking				
Very good	good	general	Relatively poor	poor	Very good	good	general	Relatively poor	poor
1.8%	35.8%	53.2%	9.2%	0	0	23.8%	59.6%	14.7%	1.9%
the student’s grasp of statistical concepts					the student’s experience of statistical application				
Very good	good	general	Relatively poor	poor	Very good	good	general	Relatively poor	Poor
1.8%	32.1%	59.6%	6.5%	0	0	20.2%	67.0%	12.8%	0
the students’ grasp of statistical skills									
Very good	good	general	Relatively poor	poor					

1.8%	29.3%	61.5%	7.4%	0
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As seen from Table 5, relatively speaking, students have a poorer grasp statistical thinking, followed by the experience of statistical application. Statistical concepts are mastered. This result is indeed expected. Because focusing on double-base is a Chinese mathematics education tradition, which reflected is in the statistical teaching, teachers pay more attention to statistical knowledge and concepts teaching, and more lightly grasp statistical thinking and application ability.

Conclusions and Recommendations

Conclusions

Generally speaking, the implementation of statistical contents and requirements in high school mathematics curriculum is successful. The statistical concept has been widely endorsed by teachers. Teachers agreed on the educational value of statistics, and welcomed the introduction of statistics into high school mathematics curriculum, and statistical teaching has been successfully promoted in the concept. However, there are some problems in implementation: (1) some teachers' old ideas need to be improved. The survey shows some teachers still did not update the concept; their idea of the new curriculum is not deeply understood. (2) Teachers lack support in curriculum resources. This is mainly reflected in the following two aspects: first, lack of teaching resources and reference materials; second, lack of teaching equipment.

Teaching Recommendations

Changing concepts and focusing on training statistical thinking. Statistical content is important not only in order to let students learn some basic statistical analysis methods, but the more important thing is to guide students to understand the characteristics and role of statistical thinking. In the teaching process, teachers should pay more attention to making students understand the basic ideas of statistics. Statistics teaching should provide a realistic problem situation; and appreciate the background and statistics applications both in daily life and in the scientific area. It is also necessary to let students experience the whole process of program design, data collection, data processing, decision making, etc.

Stimulating students' learning motivation and interest with concrete cases. The survey found that students generally felt that this part of knowledge is relatively simple, but statistical methods were still difficult to understand. Specific cases can help students understand the real issues and methods more easily. For the statistical cases, teachers should collect a broad range of knowledge and launch students in identifying more problems on their own, and then organize students to discuss how to resolve these problems. The aim is to stimulate students' interest in learning, and help students understand the essence of knowledge and methods better.

Providing practical opportunities for students to undergo the entire process of statistical work. The survey found that for the improvement of the statistics teaching mode, students are required to increase their hands-on opportunities. Therefore, in the process of statistical content teaching, teachers should give students more practice opportunities, and arrange students to survey, collect data, do statistical analysis as much as possible, and then let students experience the activities related to statistics. The aim is to let students learn to view issues from a statistical point, realize the essence of statistical thinking, and then improve their ability regarding anglicizing problems and solving problems (Zhang, Lv, & Zhang, 2002).

Using technology to teach statistics. The involvement of technology has injected a new force for the reform of mathematics teaching, and technology also played a decisive role in the development of statistics. Therefore, in statistical teaching, students should be encouraged to use calculators, computers, software, the internet and other mathematics education technology platform to increase their teaching capacity and learning efficiency. The aim is to understand statistical thinking better, and enhance students' learning interest and thinking mode, and to help to improve students' understanding of mathematical modeling and improve the effectiveness of their mathematics learning (Yuan, 2009).

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