Statistics Education for Junior High Schools in China

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Abstract

The Ministry of Education of China is pushing a reform to include statistics and probability in its national elementary and secondary curriculum. The new Standards, Standards-based textbooks, and some preliminary feedback from teachers will be illustrated in this paper.

Introduction

Overall, the Chinese education system is a national system governed by a Ministry of Education (MOE). Table 1, below, presents a simplified framework for the Chinese education system.

Table 1
A simplified framework for the Chinese education system

Age	Grade	Structure	Notes
21 20 19 18		Universities, Colleges, Polytechnics	
		University Entrance Examination	End of secondary education
17 16 15	G12 G11 G10	Advanced Senior High Schools, Ordinary Senior High Schools, Vocational / Technological Schools	
		Streaming Examination (for Senior High School or Vocational School)	End of compulsory education
14 13 12	G9 G8 G7	Junior High schools	Stage3
11 10 9 8 7 6	G6 G5 G4 G3 G2 G1	Primary schools	Stage2 Stage1
5 4 3		Kindergartens, Nursery Schools	

Before 1986, only one series of mathematics textbooks, compiled and published by People's Education Press, were used in all schools in China. In the 1990s, the system was changed and some of the central control made less rigid. For example, Shanghai was allowed to have its own local official curriculum and to organize separate university entrance examinations for Shanghai senior high school students. Also, other publishing houses were permitted to create and publish school textbooks.

By 2002, there were 456,900 primary schools with an enrollment of 121,567,100 students, 65,600 junior high schools with an enrollment of 66,874,300 students, and 58.3 percent of the junior high school graduates continued their study in senior high schools (www.moe.edu.cn/news/2004_01/02.htm).

Mathematics is a required course for all students from Grade 1 to Grade 10, and its instructional contents are officially mandated by the National Curriculum Syllabus/Standards issued by the MOE. However, since the contents required by National Curriculum Syllabus/Standards or textbooks are basic and are insufficient for students to solve problems that appear in exams, schoolteachers always add some more complicated materials in their teaching. Such additions by teachers are encouraged in China, provided that they are extensions of, rather than deviations from, the approved teaching aims.

Influenced by the movement growing world wide to introduce elements of statistics and probability into the school curriculum, the MOE is pushing a reform to include statistics and probability in its national elementary and junior high school curriculum (MOE, 2001b). The innovation started in 2001, but it is spreading very quickly throughout mainland China. In 2002, about 15 percent of Grade 7 students were studying the new curriculum with a goal of 100 percent in 2005. After three years of schooling, the first group of students educated under the new curriculum will graduate from junior high schools in 2004.

Actually, this is not the first time that China has introduced statistics and probability into its secondary school education. In 1980, the MOE issued a syllabus that arranged about 10 total teaching hours in grade 9 to study descriptive statistics and another 10 teaching hours in grade 12 to study classical probability. The introduction of statistics succeeded but that of probability failed. In the 1990s, Shanghai included 10 teaching hours of probability in grade 12 in its senior high school curriculum. Prior to 2001, all Chinese students had about 10 teaching hours' statistics education in grade 9, but most of them had no probability learning experiences at the secondary school level.

The saying that "what you test is what you get" is very true in China. Schoolteachers describe the streaming Examination after grade 9 and the National University Entrance Examination after grade 12 as the baton to a band. In Shanghai, in each of the 1998 and 1999 National University Entrance Examinations, only four out of 150 marks were allotted to probability. Since statistics was not a teaching topic in senior level, it was not examined. Two items cited from the Examination test papers are presented below. Students were required to fill in the blanks.

> There are 4 white marbles and 3 black marbles in a bag. Pull out 3 marbles randomly. The probability that you get only one black marble is ______. (Shanghai Municipal Educational Examinations Authority, 1998)

> Roll a die twice and take the two numbers m, n as co-ordinates of point P. The probability that the point P is located within the circle $x^2 + y^2 = 16$ is ______. (Shanghai Municipal Educational Examinations Authority, 1999)

These sample items illustrate the low position of statistics education at that time and suggest that the teaching approach of probability was similarly theoretical and oriented toward numerical calculation. However, since the middle of the 1990s, the voices saying that statistics education must be radically redesigned are becoming stronger and stronger.

New Standards

The Process of Developing the Standards

In the middle of 1980s, the government of China decided to universalize nine years compulsory education in whole country. The MOE organized two large-scale national surveys in 1980s. One is the survey on the demands for mathematical knowledge and skill of the Chinese developing social economy. The other is the survey on mathematics education for junior high school. The results of the two influential surveys indicated that the majority of mathematics taught at the school level was fundamental and important. The results of these surveys also showed that about one-third of grade 9 students did not achieve the required level prescribed by the syllabus, and 10% of the students felt the contents were too simple and wished to learn more mathematics at school (Zhang, 1993). Some new topics such as statistics, calculus, and optimal strategy were proposed as additions to the curriculum (Dai, 1994).

In 1996, the MOE organized another survey on the practical curriculum of nine-year compulsory education and published the research report in 1997. The Report indicated some urgent problems, such as curriculum aimed at accumulating knowledge but ignoring other aims. The content of the curriculum was heavy, complicated, obsolete, and turned out to be too formal for students. In addition, written examination was almost the only measure when assessing student achievement. The Report was expanded to "An agenda of curriculum reform for basic education (on trial)" (MOE, 2001a), which set the general principles of the curriculum reform.

International comparative studies also played an important role in forming the new curriculum. The Syllabus/Standards issued in other countries or areas such as Australia, Britain, France, German, Hong Kong, Japan, Korea, Russia, Singapore, Sweden, Taiwan, and the United States were studied carefully. Some monographs such as "Mathematics as an Educational Task" (Freudenthal, 1973), the "Mathematics Counts" (Cockcroft, 1982), "Everybody Counts" (NRC, 1989), and some textbooks such as UCSMP (The University of Chicago School Mathematics Project) were translated or introduced to China. We also learned a lot from other countries through international exchange such as ICMI-CHINA Regional Conference on Mathematical Education, which was held in 1994.

In 1999, a Standards Writing Group was formed. One year later, the preliminary version of the Standards was released for feedback. Compared to the syllabi issued in the past, the Standards had a lot of changes including the title, structure, format, and length of the document. The MOE strongly encouraged both professional and public participation. In 2001, the trial draft of the Standards was published. In the same year, two sets of standards-based textbooks, approved by the MOE, were put into experimental use in some areas. The process of developing the standards lasted more than 10 years.

The Aim of Statistics Education

According to the National Standards issued in 2001, nine-year compulsory education in China is divided into three stages: the stage from grade 1 to 3, form grade 4 to 6, and from grade 7 to 9. Statistics and probability standards are involved in all the three stages. This paper focuses mainly on the third stage, which is the junior high school level.

Similar to many other countries, the main aim of enhancing statistics education in China is to develop public statistical literacy to meet students' and future employers' needs. The MOE emphasized the following three components of statistical literacy (MOE, 2001b):

1. Familiarity with using statistical thinking to deal with problems containing data.
2. Appreciating the role statistics plays in decision making by going through the process of collecting, displaying, analyzing data, and making reasonable decisions.
3. Being able to critically read data resources, data analyses, and summarized information.

The Contents of Statistics Education

In grades 7-9, all students are expected to develop techniques for organizing and displaying data. Pie charts, the concept of the weighted mean, range, and variance are introduced in this stage. Students are also expected to use calculators and computers to process data so they can pay more attention to learning to select appropriate measures, such as mean, median and mode, in given situations. They are expected to learn to distinguish a sample from a population, to understand the necessity of sampling, and learn to use information from samples to make conjectures about a population. Both theoretical and experimental approaches to teaching probability should be used in this stage. All students are expected to learn to calculate probabilities by analysis of equally likely events and learn to estimate probabilities by long-run relative frequencies. They are also expected to go through the whole process of solving some practical problems, encouraged to give presentations to other students, and expected to become critical readers of reports based on data.

Standards-based Textbooks

From 2001, several publishing houses have compiled or are in the process of compiling new textbooks basing on the new National Standards introduced above. Two sets of the textbooks are currently in the trial phase in mainland China, except Shanghai. Another four sets will join in the experiment in next September. The list of experimental textbooks is available on the MOE web site (www.moe.edu.cn/base/jcjiaocai/14_1.htm). Since the Standards did not stipulate the order of topics appearing within a stage or the teaching hours for a given topic, the arrangement for the different sets of textbooks is not the same. I would like to discuss characteristics of the new curriculum with reference to the textbook on which I am working (Wang, 2001).

Textbook writing

There are two semesters per school year and we use one textbook in each semester. We have to say that the time for the Standards developing was sufficient, but that for textbook writing was too short. As mentioned above the trial draft Standards document was issued in 2001 and the standards-based textbooks were put into use in some experimental areas in the same year. So in the first two years of the experiment, the whole textbook series was not ready. As a result, teachers did not have the next year's or the next two years' textbooks to consult. They were only informed of the outline of the other books. This made some teachers feel confused in planning their classes, especially for those topics designed in a spiral way.

We have a textbook writing team with almost 20 members, including university faculty members, teaching researchers, school teachers, and editors. More than 10 persons worked on each book. Careful revisions are made when we have new students. Therefore, the seventh graders are using the third version of the textbook, the eighth graders are using the second version, and the ninth graders are using the first version. The newest version of the textbook is currently ready and will be put into use in next September. The changes between the different versions are minimal but necessary and include changes such as data updating or language editing. In addition, we also write teacher's manuals and student exercise books. All answers or explanations to the questions, exercises, and problems that appeared in our textbook were provided in the teacher's manuals.

Guidelines for curriculum design

In order to improve students' statistical thinking, we made the several special efforts. These included greatly increasing teaching time for statistics and probability, trying to make learning mathematics attractive, and utilizing more experiential learning processes and less lecture.

Teaching Time for Statistics and Probability

Before 2001, most Chinese students only had about 10 teaching hours of statistics education in grade 9. However, in our textbook, the teaching time allotted to statistics and probability is increased to 69 total teaching hours at the junior high school level (grades 7-9). For all the 6 semesters, the teaching hours allotted to introduction, algebra, geometry, project learning, and stage review were 4, 156, 133, 24 and 24, respectively, with each teaching hour lasting 45 minutes.

The arrangement for the different sets of textbooks might be different but should be roughly the same. The contents of every book include algebra, geometry, statistics, and project learning. This is the result of changes that occurred both inside and outside of statistics education. The new Standards decrease the role that numerical calculations play in statistics education and place more emphasis on developing students' statistical literacy. In statistics instruction, the connection between mathematics and reality, the comprehension of concepts, investigative and cooperative learning, and formative assessment are generally emphasized. This is also true for other topics in teaching mathematics. In algebra and geometry, overly complicated and inauthentic formal calculations and proofs are limited and sometimes dropped.

Making Mathematics Learning Attractive

Although Chinese students are very diligent and hardworking, they are also increasingly drawn to the fun things around them, such as television programs and computer games. Textbooks used in the past several decades overemphasized the accumulation of knowledge and ignored the connections between what was being taught and students' realities. Here, "reality" means two things. One is students' mathematical reality (cognitive structure), and the other is students' living reality (the real world). We are making efforts to change the situation.

Our efforts include working to make our textbook interesting for the students. We include content related to favorite cartoons and films, the fairness of games, and the probability of winning a big prize. We also added reality-based and science-related content related to the air pollution index in various Chinese cities, the arrangement of characters on a keyboard, the effects of the density of cigarette water on the sprouting of buds, and many other interesting topics.

One example of how the textbook content tries to make learning mathematics more attractive is based on an activity related to a popular game. "Run to 30" is a game known by many Chinese, and it was selected as one of the games to use in the discussion of the fairness of games with the seventh graders. The game is a two-person game. Two Players count numbers quickly from 1 to 30 by turns. Each player is allowed to count one or two numbers in each turn. The player who "catches" the number 30 will be the winner of the game. After playing the game, we lead the students to consider that they can "catch" the number 30, if they "catch" 27, and that they can "catch" 27 if they "catch" 24, and so on. Then the students will easily find that the game is unfair and it favors the second player. A schoolteacher told me that her students were very interested in playing the game, and they even created new games such as "Run to 50".

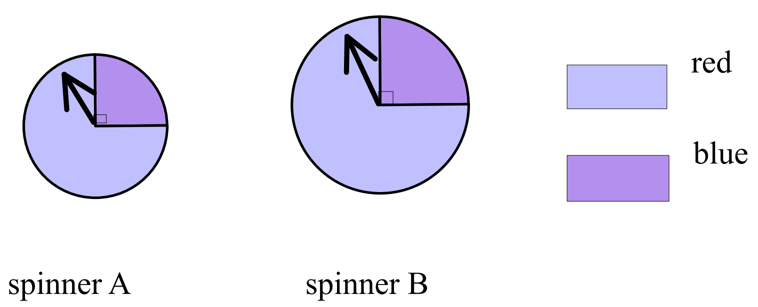
In our textbook we encourage students to use calculators or computers to perform calculations, simulations, and make statistical graphs. According to the new Standards, all junior high school students should be able to use scientific calculators to process data. Calculators capable of generating random whole numbers are currently available in the market. These enable students to explore probability problems by simulations. In addition, detailed information about how to make statistical graphs and calculate measures of center or spread with Excel are presented as reading materials in our textbooks. The publishing house also provides electronic teaching materials for teachers and students. After engaging in actual experiments, teachers can run computer simulations on big screens to let the students see what will happen after a long run.

Our textbook also contains content for classroom discussions or after-school explorations that relates to student misconceptions that we observed in our own research, as well as those reported in the literature. Among the misconceptions we selected are:

- All events are either possible events or impossible events,
- Chance cannot be quantified,
- All chancy events have an equal probability of occurring,
- Rare events are impossible events and highly frequent events are certain events,
- To increase repetitions has no effect on predicting,
- After a long run of one outcome the bias will either rectify itself or continue in the future,
- Probability is calculated by part-part ratio,
- The reliability of a conjecture about a population increases linearly along with the increment of sample size, and
- Simple random sampling is not reliable.

Usually, in our textbooks, we cite some students' incorrect responses observed in the research and ask our students to, first, think about these sayings, then examine and discuss them based on data they have collected in activities. For example, researchers found that some students thought spinner size decided the probability of an arrow landing on a particular color (Li, 2000). In Book 3 (for 8th graders) in the chapter titled "Relative Frequency and Chance", we suggest an activity to check that belief (Figure 1).

Spin each spinner's arrowhead as hard as you can. Suppose you want the arrowhead to stop in the blue part. Which spinner will give you more chance to be successful?



Consideration the following two responses given by students:

(a) Spinner B gives a greater chance because the spinner is bigger and has more blue part.

(b) The two spinners give the same chance because there are only two possible outcomes: land on red or blue. Each spinner has 50% chance to be successful. So it doesn't matter whether you choose the big one or the small one.

Figure 1. Activity Used to Address Misconceptions about Chance

To examine their opinions, the students were asked to perform the experiment in pairs. Each student was required to spin 25 times with each spinner and write down the number of successes for their partner. Then, students' data were pooled and students were asked to make a cumulative relative frequency graph with two different colored pens to illustrate the chance for each spinner. After the activity, teacher organized a whole class discussion. Students were required to report their own findings obtained from the activity and give their comments on the two responses cited above.

Finally, another spinner with eight equally divided sectors (four red sectors and four blue sectors) was shown to students and they were asked whether they could predict the chance the spinner would land on one of the sectors colored red without performing the experiment. At the time of the activity, students had not yet been taught to calculate probability theoretically. However, when students reflected on the conclusion of the previous problem, realizing that both the spinners yield a 25 percent chance of successful, they solve the new spinner problem easily. We believe it is an important approach to develop students' understanding by posing some challenging tasks to them. Many such questions can be found in our textbooks' margins.

Utilizing More Experiential Learning and Less Lecture

As we know, understanding of how to find the mean, median, mode, variance, and standard deviation of a given set of data is easy to test in a pen and paper examination. Understanding how to get an appropriate sample to survey or why we use such a complicated formula to measure the spread of a set of data is not so easy to examine in a one-hour pen and paper examination. In order to help their students get high marks on examinations, most schoolteachers in China spend a lot of teaching time in lecture and doing exercises. They are usually reluctant to organize classroom activities that they think are not efficient in promoting learning. However, teaching and learning for examinations is definitely in conflict with the principles claimed in the new Standards. Also, according to the literature, students' intuitions cannot be modified by verbal explanations alone, and teachers should create situations to encourage students to examine, modify, or correct their own beliefs by the use of real data, activities, and visual simulations (Fischbein & Gazit, 1984; Li, 2000).

Take the teaching of standard deviation formula as an example. A few years ago, the following item was typical in streaming examinations after grade 9:

Two groups of students took an examination, and their scores are as follows:
Group A: 76 90 84 86 81 87 86 82 85 83
Group B: 82 84 85 89 79 80 91 89 79 74
Which group of students' scores is more stable?

Obviously, the task primarily examines whether the students could calculate standard deviations correctly according to the formula and know that the group with the smaller standard deviation is more stable. To develop students' better understanding of the formula, the problem "could you find any measures that could be used to describe the spread of a set of data" was posed in Book 4 (for the 8th graders). Students were expected to explore how the formula might be derived.

To do this, first, the average daily temperatures in Singapore and Beijing in 2001 were presented graphically. Students were required to talk about the information they obtained from the graph. The concept of "range" could be introduced naturally when students measured the difference between the highest and the lowest temperature in each place during the year. To find out the other measures of spread, it was better to deal with a smaller data set (Figure 2).

Two boys' marks recorded during a sport training course were given in a table.

Test	1st	2nd	3rd	4th	5th
Ming	13	14	13	12	13
Bing	10	13	16	14	12

Figure 2. Activity for Exploring the Spread of Data

Students find that the average (mean) score for the two boys is equal, but Ming's score seemed less variable in a graph. Since the measure "range" is only decided by two extreme values, the students were required to look for a more sensitive measure. Some students suggested comparing the following two sums:

$$(13-\overline{x_1})+(14-\overline{x_1})+(13-\overline{x_1})+(12-\overline{x_1})+(13-\overline{x_1}) \quad \text{and}$$

$$(10-\overline{x_2})+(13-\overline{x_2})+(16-\overline{x_2})+(14-\overline{x_2})+(12-\overline{x_2})$$

But after the calculation, they found that the measure only had one value: 0. Students were encouraged to reflect on what they had learned from this failure and try to find a better measure. The following two sums were found:

$$(13-\overline{x_1})^2+(14-\overline{x_1})^2+(13-\overline{x_1})^2+(12-\overline{x_1})^2+(13-\overline{x_1})^2 \quad \text{and}$$

$$(10-\overline{x_2})^2+(13-\overline{x_2})^2+(16-\overline{x_2})^2+(14-\overline{x_2})^2+(12-\overline{x_2})^2$$

We then asked students to suppose that 7 tests were given during the training course, but Ming missed two tests due to illness. Did they think that their measures would still be appropriate in the new situation? To answer this question they learned that it is necessary to divide the sum of the squares by the number n. The whole class then discussed why it seems reasonable to take the square root. Such teaching design intends to help students learn to value mathematics and let them feel their learning is meaningful. Student consciousness of how to use statistics to solve problems is enhanced by involving them in the collection, description, organization, and summarization of data.

The developmental structure of statistical thinking is a hierarchical structure, and curriculum design should reflect the research results. Take probabilistic experiments as an example. At first, dice, cards, coins and some other materials are used to collect data. Then students are required to look for replacements for experiments if some materials they need are not available. At last, they are taught how to perform experiments (simulations) with calculator.

Teachers' Teaching

By 2002, China had 3,467,700 full time junior high school teachers and 90.28 percent of them had achieved the requirement to be a junior high school teacher (i.e., graduated from junior college or university) (see www.moe.edu.cn/stat/tjgongbao/report_2002.doc). Many of them are inadequately prepared both in their knowledge of statistics and probability, and in pedagogy. Even among teachers who have received some exposure to statistics and probability in either pre-service or in-service training, the programme is usually dominated by theory, with no experience with activities or simulations. The failure to introduce probability in the 1980s suggests that a formal teaching approach may be impractical.

In response, our textbook is an activity-based teaching program. Theoretical analysis such as predicting probability by using simple tree diagrams is also arranged but this content appears rather late (permutations and combinations are not required). So teachers benefit from the numerical, intuitive teaching approach, too. They do not just deliver knowledge. Instead, they give support and guidance to help students to become familiar with data-based reasoning by organizing activities and chairing discussions before and after activities.

In China, teachers usually work in a big office. They are grouped either according to the subject that they teach or the grade that they teach. As a result, teachers have many opportunities to discuss teaching and learning problems. Teachers teaching in the same grade meet once a week. During the meeting, they usually share their teaching experiences and discuss their class plans for the next week. Teachers working in the same district also meet regularly and these meetings are chaired by teaching researchers in the district. Classroom teaching observations, lectures, and teaching competitions are the main activities organized in the district. In addition, the web is another communication platform for some teachers. Consequently, teachers do not feel isolated or helpless when they face the new curriculum.

Some Preliminary Feedback

China is still at the very beginning of forming its new curriculum. In order to revise the National Standards at the end of 2003, the MOE organized a survey of schoolteachers in June 2003 and a national conference in October, 2003. The data collected from the survey are presented first. Then some preliminary practical feedback from schoolteachers and other interested parties from other resources are summarized here.

The results from the survey

At the end of May, 2003, the MOE issued an official announcement to the provincial education departments and required them to organize a local survey by completing a questionnaire which available on the MOE web site (www.moe.edu.cn/base/jckecheng/16fujian/shuxue.doc). At least 20 schoolteachers and teaching researchers were required to participate in the local survey. All completed questionnaires were sent back to the MOE before July 15, 2003.

Finally, questionnaires answered by 1064 school teachers (663 primary school teachers and 401 junior high school teachers) were accepted for further data analysis (Standards Writing Group, 2003). Of the 401 junior high school teachers, 228 had one year of experience teaching with the new curriculum, and the other 173 teachers had two years of such experience. They came from 19 provinces. Some of them worked in economically and educationally developed areas, while some of them worked in undeveloped areas. Some came from urban areas, while others came from rural areas. For the 401 teachers, the percentages of graduates, undergraduates, and junior college graduates are 0.7 percent, 55.6 percent, and 41.1 percent, respectively, and 88.9 percent majored in mathematics.

The data collected from the survey shown that most of the teachers accept the big change in statistics education. Summarizing the 401 teachers' responses, only 15 teachers (4 percent) thought the aim for statistics education was too difficult to achieve, while 31 teachers (8 percent) thought the aim was too easy to achieve. Eighty-eight teachers (22 percent) thought the aim was a bit difficult to achieve while 87 teachers (21 percent) thought it a bit easy to achieve. However, the majority opinion held by 180 teachers (45 percent) was that the teaching aim for statistics and probability was appropriate. (Standards Writing Group, 2003). The main reason for teachers accepting the addition of statistics education was that teaching statistics has a realistic, concrete outlook. It is useful in the real world but easy to understand. Also, it provides opportunities for communication and cooperation between teachers and students.

The preliminary practical results from other resources

(1) Students become more active in learning.

Classroom observations show that students are very active in learning statistics and probability. They appreciate opportunities to present their own ideas, to comment on others' answers, to manipulate random generators, to check their estimations by simulations, and to solve some real problems using simulations.

(2) Class size is too big for interactive learning.

The MOE data from 2002 (www.moe.edu.cn/stat/tjgongbao/report_2002.doc) showed that there were 1,165,100 classes in junior high schools. Among these classes, 27.65 percent had 56-65 students, and 23.38 percent of the classes had even more. It is very difficult for a teacher to give appropriate timely guidance to individuals or groups in such large classes. Sometimes, teachers have to stop whole class discussions and ask the rest of the students who still want to speak to discuss their ideas after class or write down their comments in their homework.

(3) Variance among students seems larger.

In the past, variability in student achievement usually became obvious in grade 8 when Euclidean geometry was introduced into school mathematics. Now, teachers find that the variance seems obvious even in the first year of junior high school (grade 7). One reason for this is that some students accept a frequentist definition of probability very quickly and start to use it automatically in solving difficult problems. For example, we have the following problem in Book 1 (for the 7th graders): Here are three pictures with equal size. Split each of them equally into two pieces. Put the six pieces into a bag and mix them thoroughly. Pick out two pieces without looking. Do you think it is probable, unlikely, or equally likely for you to get a pair that makes up one of the original pictures? In response to this problem, a teacher found one of her students was trying to find out the probability of the event by performing the experiment again and again, but some slower students still did not believe that any conclusions could be drawn with certainty. The Standards encourage students' active learning and hope to reduce teacher-centered, receptive learning. So compared to before, teachers talk less during class time. This change made some students who were used to relying on teachers' lectures feel that learning had become more difficult.

(4) Needs of students from rural area are ignored

Data from China's fifth national census showed that 63.9 percent of the population lives in rural areas (www.stats.gov.cn/english/newrelease/statisticalreports/200204230084.htm), while members of the Standards writing group and textbook writers are all urban residents. As a result, the writers are more familiar with the lives of citizen's who live in cities. Some teachers indicated that references to "golf", "traffic lights" and various other features of metropolitan life were confusingly foreign to the students who live in rural areas. The realities and needs of students from rural areas are virtually ignored. Some teachers have suggested the MOE should provide alternative curricula to teachers of rural students.

(5) The Need for Teacher Preparation is Urgent

This is the first time China has introduced elements of statistics and probability into primary schools and junior high schools. The real situation is that many schoolteachers have had very little or no exposure to statistics and probability in their pre-service teacher training. Teachers who have learned statistics and probability in the university are not familiar with a numerical, experimental teaching approach. During their teaching, some of the teachers misunderstand the textbook writers' intentions, and some even gave students incorrect guidance. However, some teachers are also able to use the textbooks creatively. Take the spinner problem as an example. A teacher from Suzhou (a city near Shanghai) required each of his students to make a spinner where one sector with a central angle of 90° was colored blue and the rest was colored red. They made these at home and brought them to the class the next day. At the beginning of the class, all of the spinners were presented, and they found there are many ways to make a spinner. He picked out the biggest spinner and told the students that he thought this spinner would stop in the blue part more often, since it has more blue part on the spinner. A whole class debate began, and students tried to provide sufficient evidence to support their own opinions. Differing from the textbook writers' design, his teaching emphasized the importance of keeping the same conditions when we perform an experiment again and again.

In response to preliminary feedback, some of the changes to the Standards have been finalized, but the new version of the Standards is still in the MOE approval process.

Conclusions

Modern statistics education and research into it started in the West, but a growing movement to introduce elements of statistics and probability into the school curriculum is forming in the entire world. Based on the three-year experiment, it was found that the limitations on economy and technology should not be considered impediments to introducing statistics and probability, even such a huge developing country as China. In my opinion, the reasons by the previous efforts to introduce these topics in 1980s were rejected, but the new curriculum is being accepted relate to three big changes that took place during the past decade in China. First, there was little use of data, probabilistic arguments, and language in newspapers and other media in the 1980s, but now the public seems to accept the use of data in reasoning. Second, the numerical, experimental approach to teaching probability has been introduced into China and the visual teaching approach is more acceptable than the previous formal approach. Third, the MOE strongly pushed the reform and set aims in all the three stages. Strong government support has played a very important role.

As a textbook writer, I found literature and research to be very helpful in curriculum development. I benefit a lot from my Ph.D. research (Li, 2000) when I develop teaching materials on probability. In our textbook, (Wang, 2001) common student misconceptions mentioned earlier were addressed with students. Teachers found this information about misconceptions useful for their teaching, as they were unclear about students' main misconceptions of probability since this is their first teaching this topic. Under the guidance of the developmental structure of students' understanding of probability, our textbook structure seems reasonable. Some activities used in my former teaching intervention were also selected for our textbook. Research studies related to Chinese students' understanding of probability, sampling, and graphs are currently being conducted in China. We hope the emerging research and curriculum development efforts will add to the literature and disseminate educators' knowledge to students who have grown up in an Eastern culture.

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