ZDM Mathematics Education (2009) 41:263–277
DOI 10.1007/s11858-009-0168-6

ORIGINAL ARTICLE

Mathematics classroom instruction excellence through the platform of teaching contests

Yeping Li · Jun Li

Accepted: 6 February 2009 / Published online: 3 March 2009

Abstract In this study, we aimed to examine features of mathematics classroom instruction excellence identified and valued through teaching contests in the Chinese mainland. By taking a case study approach, we focused on a prize-winning lesson as an exemplary lesson that was awarded the top prize in teaching contests at both the district and the city level. The analyses of the exemplary lesson itself revealed important features on the lesson's content treatment, students' engagement, and the use of multiple methods to facilitate students' learning. These features are consistent with what the contest evaluation committees valued and what seven other mathematics expert teachers focused in their comments. The Chinese teaching culture in identifying and promoting classroom instruction excellence is then discussed in a broader context.

Keywords Chinese classroom · Classroom instruction analysis · Exemplary lesson · Instructional excellence · Mathematics instruction · Teaching contest

Y. Li (✉)
Texas A&M University, College Station, USA
e-mail: yepingli@tamu.edu

J. Li
East China Normal University, Shanghai, China

1 Introduction

Few would disagree that classroom teaching is key to the improvement of students' mathematics learning. However, few would agree on ways of defining and evaluating the quality of mathematics classroom instruction. Because teaching methods are highly dependent upon mathematical content, students' backgrounds, teachers' instructional styles and many other factors, it makes a unified definition of quality teaching in a country seemingly impossible. This presents a prevailing perspective in the West, where teaching is taken more as a professional activity that is unique to different classrooms (e.g., Kaiser & Vollstedt, 2008). In fact, few would sit in other's classrooms and then talk about their classroom instruction. In contrast, China has a different culture of teaching where mathematics teaching is taken as a professional activity that is open to public scrutiny and evaluation. It is a common practice for Chinese mathematics teachers not only to sit in others' classrooms and discuss teaching with fellow teachers, but also to develop and polish lesson instruction together. In particular, teaching contests are a popular professional activity that is often organized at different levels by the Chinese education administration and professional organizations. Through teaching contests, teaching principles advocated in official curriculum are instantiated, and excellent mathematics classroom instruction is identified and awarded. Thus, teaching contests also serve as a platform to value and promote mathematics classroom instruction excellence in China. In this article, we aimed to present and discuss the teaching contest as an organized professional activity in China, features of mathematics classroom teaching excellence identified and valued through the teaching contest, and cultural values embedded in judging and promoting mathematics classroom instruction excellence in China.

2 Characteristics of mathematics teaching and teaching contest as a professional activity in China

2.1 General characteristics of Chinese mathematics teaching and its culture

Cross-national studies have documented that Chinese students performed well in school mathematics in several international studies (e.g., Lapointe, Mead, & Askew, 1992; Mullis, Martin, Gonzalez, & Chrostowski, 2004; Stevenson & Stigler, 1992). Although teaching is generally taken as key to students' high learning outcomes, mathematics classroom instruction in China presents us with a conflicting picture from different perspectives. One perspective emphasizes the condition and classroom environment of teaching and learning. From this perspective, it can be noticed easily that Chinese students are taught with a traditional style of lecture, a form of classroom instruction that is not advocated in the West. Large numbers of students, often around 40–70, sit in one classroom (Ding, Li, Li, & Kulm, 2008). As commonly viewed in the West, large class size can be a detriment for achieving effective instruction in mathematics (e.g., Rice, 1999; Zurawsky, 2003). In contrast, some researchers argued that the quality of mathematic classroom instruction in China should not simply be viewed from a Western perspective (e.g., Watkins & Biggs, 2001). In particular, the teacher-dominated lecture style of traditional teaching in China does not mean decreased efforts to engage students in classroom teaching and learning activities (e.g., Li, Kulm, Huang, & Ding, 2009; Mok, 2006). By taking a cross-national comparative perspective and focusing more on the process of classroom instruction, Li (2007) argued that mathematics classroom instruction in China bears some other important characteristics that are believed to contribute to the quality of mathematics instruction. In a cross-national study that included selected first- and fifth-grade mathematics classrooms in the USA, Japan, and China, Stigler, Lee, and Stevenson (1987) found that Chinese teachers make increasingly good use of class time for academic activities. Moreover, Chinese teachers often use complex problems with variations in classroom instruction (e.g., Gu, Huang, & Marton, 2004). Classroom activities focus on discussing and solving mathematically challenging problems (Stigler & Stevenson, 1991), and engage students in solving problems with multiple solutions and justification (Fan, Wong, Cai, & Li, 2004). Consistently, Chinese teachers offer students many direct and complex explanations during classroom instruction (Perry, 2000). Mathematics lessons, overall, are coherent and polished (Stigler & Stevenson, 1991) in the form of well-organized whole-class teaching (Stevenson & Lee, 1997). These characteristics are, in fact, consistent with what has been advocated by the U.S. National Council of Teachers of Mathematics (NCTM, 1991, 2000) for developing high-quality mathematics classroom instruction.

Cross-cultural differences and similarities in viewing what contributes to high quality classroom instruction call for a better understanding of Chinese classroom instruction that goes beyond the surface features. Although existing studies have revealed some important characteristics of mathematics classroom instruction in China, much remains unclear about what can be counted as excellent classroom instruction in China. Because teaching is taken as a professional activity that is open to public scrutiny and evaluation in China (Li, Huang, Bao, & Fan, 2009), it becomes possible to get exemplary mathematics classroom instruction that is identified with public evaluation. Thus, the main purpose of this study is to present and examine characteristics of mathematics classroom instruction excellence that is valued in China.

2.2 General description of teaching contests

Cross-cultural differences and similarities in viewing what contributes to quality classroom instruction also require us to go beyond the classroom setting itself (Li, 2007). For example, it is generally agreed that teachers' mathematical knowledge and their collaborations outside of classrooms should all contribute to the quality of classroom instruction (e.g., Ma, 1999; Paine & Ma, 1993; Stigler & Hiebert, 1999). Thus, it becomes important to understand possible factors that help make quality mathematics classroom instruction possible in a specific cultural context. Towards this end, we focus on teaching contests, as a unique professional activity, which not only help identify mathematics classroom instruction excellence valued but also help us better understand the teaching culture in China.

Teaching contests among young mathematics teachers who are under the age of 40 are often organized by the education administration with different participation scopes in China. It can be a nation-wide, province-wide, city-wide, district-wide, or school-wide contest. A high-level teaching contest is often organized with contestants who were winners from the next low-level contests. For example, the secondary mathematics education committee of China Education Association organizes two teaching contests every 2 years, one for middle school teachers and the other for high school teachers. Participation of the nation-wide contests requires a sequence of bottom-up contests that are organized at different administration levels. In general, the sequence of contests starts at the district level, which will select winning teachers to participate the contest organized at the city or county level. The winning contestants will then be selected to enter the next level competition. The greatest honor for a contestant is to win the first prize at the national level.

Teaching contests now are often organized in different formats, including the traditional classroom instruction, as well as instructional design and lesson explaining. While instructional design is provided in a written form, lesson explaining contest is commonly carried out as on-site oral explanation. Initiated about 20 years ago, lesson explaining was formally developed out of teacher group analysis of textbooks in China (Peng, 2007). It has since developed into a popular professional activity for Chinese teachers to explain important features of their classroom instruction and their thinking behind, which otherwise may be unclear to others. Lesson explaining commonly contains a teacher's analysis of textbook content, instructional objectives, consideration and design of teaching methods and procedure, and the teacher's consideration about students and their learning. Because lesson explaining promotes teacher reflective practice and discussion, it is used as an important activity in many schools in China to help improve teachers' mathematics knowledge and classroom instruction (Peng, 2007).

Teaching contests can also be organized with other professional contests for selecting key teachers. The selected key teachers are often required to provide instructional training for school teachers in the area. For example, in a big southern city of China, a teaching contest is organized once every 3 years as part of identifying and selecting ten best middle school mathematics teachers and ten best high school mathematics teachers in that city. In particular, teaching contestants are required to be winners of at least second-class awards in other two relevant contests: mathematics teachers' problem solving contest and mathematics teachers' education article contest.

Although there are some variations across different teaching contests in terms of contest focus and their organization specifics, they are similar in taking teaching as a professional activity that can afford public examination and evaluation. In general, teaching contests are a well-organized formal professional activity. They are all organized and carried out with pre-specified procedures in China. Their detailed organization procedures suggest not only the formality of the teaching contests established by Chinese education administration, but also the broad support and participations from teachers themselves. In the following section, we will discuss further how the participating teachers' instructional competence is typically examined in the teaching contests in China.

2.3 Examining video-taped mathematics classroom instruction and teaching contests as cultural activities: a case study

Because the video captures well what was going on in classrooms, video-taped lessons have been widely used in China since 1980s. At the beginning, video was mainly used to record master teachers' lesson instruction. Now, it is widely used in teacher education, demonstrating and discussing lesson instruction. In fact, the video-taped lesson has also been used in teaching contests in China, especially in selecting good teachers at district level or city/county level. The method is different from the traditionally used approach, when contestants are asked to carry out his/her planned lesson often with another unknown group of students at the competition site.

In this study, we planned to focus on a prize-winning video-taped lesson as an exemplary lesson from the Chinese Mainland. Through taking the case study approach, we aimed to examine the exemplary lesson that was identified and valued through teaching contests. In particular, by taking mathematics classroom teaching and teaching contests as cultural activities, we collected rich data around the lesson and the contest. Mail surveys with the prize-winning teacher and contest organizers were carried out to collect information about the prize-winning lesson development, the contest organization and the contest evaluation. Finally, the video-taped lesson was also mailed to seven mathematics education experts and teachers in China, who were not involved in the teaching contests, to get their evaluation and views about excellence in mathematics classroom instruction.

3 Research questions

This study aimed to examine features of mathematics classroom teaching excellence valued and identified through the teaching contest, and cultural values embedded in judging and promoting such excellence in mathematics classroom instruction in China. In particular, we planned to take a case study approach to focus on a prize-winning mathematics lesson as an exemplary lesson. Through collecting data around the lesson case, this study was designed to address the following three questions:

1. What are the characteristics of the exemplary mathematic classroom instruction that was awarded through teaching contests in China?
2. What features in the exemplary lesson were valued and focused in the teaching contests in China?
3. What features in the exemplary lesson were identified and valued by other mathematics teachers and educators in China?

4 Methodology

4.1 Participants and context of the case

This study focused on a prize-winning lesson as an exemplary lesson taught by a Chinese middle school mathematics teacher, Mr. Zhang.[1] We chose this lesson partly due to the convenience of obtaining this prize-winning video-taped lesson, and collaborations of the teacher and teaching contest organizers.

Like many other mathematics teachers in China, Mr. Zhang obtained a bachelor's degree in mathematics from a teacher preparation program in a normal university. He began to teach at a middle school in a big city of southern part of China upon his completion of the 4 years' teacher preparation program study. According to Mr. Zhang, he also obtained the second-class instructor certificate of International Mathematical Olympiad issued in China right before he began to teach in a middle school. This suggests that Mr. Zhang had a strong mathematical content preparation and was good at solving mathematics problems. At the time when he developed and taught this prize-winning mathematics lesson, Mr. Zhang was a junior teacher who only had less than 3 years' teaching experience. At that time, Mr. Zhang like other teachers in the school was also a member of two different teaching research organizations in that school: (1) *the teaching research group* that is often content subject-based organization contrived in a school, and (2) *the lesson preparation group* for teachers teaching at the same grade level as a sub-organization of the teaching research group (e.g., Ma, 1999; Wang & Paine, 2003). According to Mr. Zhang, he received a lot of help and suggestions from his colleagues from time to time, especially his mentor who happened to be the head of the teaching research group that he belonged to.

Mr. Zhang participated in two teaching contests, one at the district level and the other at the city level. The school district that Mr. Zhang belonged to was a big school district with 56 middle schools. The contest was organized as a two-level contest. The first level was carried out as an initial contest within sub-districts of middle schools that were grouped in terms of geographical areas. In principle, all teachers were eligible to participate in the initial contest. And the No. 1 winner at the sub-district level would be eligible to join the final contest at the whole district level. For the final contest, the contestant did not need to teach a lesson again, but let the district's evaluation committee watch the video-taped lesson made for the initial contest. Moreover, the final contest required the contestants to take the lesson explaining contest in front of the district's evaluation committee, and the instructional design contest. The contestants' performance were then evaluated in terms of these three different contests, and summarized for an overall judgment. The contestants' performance summaries resulted in awards for three classes. There were two winners awarded for the first class, and four winners awarded for each of the second and the third classes. Mr. Zhang won the first-class award at the whole district level, and was actually the winner with the highest overall score in three contests of classroom teaching, lesson explaining, and instructional design.

The contests organized at the city level contained "lesson explaining contest" and "video-taped lesson instruction contest under the new curriculum". The contest results from different school districts formed the base for the competition at the city level. With his contest result at the district level, Mr. Zhang joined these two contests at the city level. Similar to the final contest organized at the district level, the city-level contest also resulted in three classes of awards, with a ratio of awardees of 2:3:5. Mr. Zhang won a first-class award for the video-taped lesson instruction, as well as a second-class award for his lesson explaining at the city level.

Based on Mr. Zhang's own explanation, the process of generating the lesson was a continuous refinement that involved many others' help. Mr. Zhang developed the first version of the lesson plan and used it in teaching one of his two classes. As Mr. Zhang indicated, he was not happy with the instructional effects. After consulting with other members of his lesson preparation group especially his mentor, he revised the lesson plan substantially and taught it again with another class that was not his own. He was almost satisfied the second time, but some minor changes were needed. Thus, he further revised the lesson plan through the next three versions, and eventually had the fifth version as the final one. Based on the last version of the lesson plan, Mr. Zhang then taught the lesson with his one remaining class and also video-taped it for the teaching contest.

4.2 Types of data collected

The prize-winning lesson was a public lesson that was made available through the teaching contest organizers at the city level. After obtaining the consent from all participants (including Mr. Zhang, two contest organizers at the district and the city levels, and other seven mathematics educators), further data collection was carried out to get relevant information about the lesson and teaching contests. All participants were informed that the data collection was for a research purpose only. Because all the participants stayed at many different places across the country, it was almost impossible to collect all the data through face-to-face interviews. Moreover, we tended to provide participants ample time in thinking about relevant questions. In this way, the participants were able to write up detailed responses when they had free time. Thus, the method of mail surveys (Berends, 2006) was used to collect relevant data in this study. At times when some clarifications became necessary, we contacted the teacher and

[1] All the names used here or in the other places of this article are pseudonyms.

contest organizers again and collected all the information that was needed for the study. In particular, the following three types of data were collected in this study:

1. The mail survey of the teacher who designed and taught the prize-winning lesson in focus. A questionnaire was designed to collect relevant information about the prize-winning lesson directly from the teacher himself. In particular, we obtained the background information about the teacher himself, his thinking when he selected and structured the content topic for the lesson, the process of developing the prize-winning lesson, his lesson reflections, and his views about the value of teaching contest.
2. The mail surveys of the two contests' organizers who also served on evaluation committees. A questionnaire was also designed to collect information about the teaching contests at both the district and the city levels. The information collected include the procedure of organizing the teaching contest, any requirements for teachers' participation, evaluation components and criteria used in teaching contests, committee's evaluation of the prize-winning lesson in focus, and their views about the value of teaching contest in promoting classroom instruction excellence.
3. The mail survey of seven mathematics educators and expert teachers to obtain their views of the prize-winning lesson in focus. The video-taped lesson was provided to seven other mathematics educators and expert teachers in different cities who were not part of the teaching contests. Without telling them that the video-taped lesson was a prize-winning lesson, these mathematics educators and teachers were asked to watch the video-taped lesson and then share their views about the lesson by filling out a specifically designed questionnaire. In particular, these mathematics educators and teachers were asked to comment on the lesson in terms of its strengths, weaknesses, and possible changes for improvement, if any. We intended to use open-ended questions in the questionnaire so that the respondents can comment on the lesson based on what they value. In this way, the respondents' comments can help reveal not only their lesson evaluations but also the focal aspects in their evaluation. Moreover, the respondents were also asked to provide an overall evaluation score for the lesson (with 1 as the lowest score and 5 as the highest score) and explain their rationale.

4.3 Method of data analysis

All the data for this study were analyzed in the original language of Chinese. Selected data were translated to English to provide evidence in the later sections of this article. In particular, the lesson is transcribed verbatim, along with some contextual information and time recording for all the conversations that happened in the class. To address our first research question directly, we analyzed Mr. Zhang's prize-winning lesson both holistically and analytically (see, Stigler, Fernandez, & Yoshida, 1996). While the holistic approach was used to provide an overview of what was happening in the exemplary mathematics lesson (see Sect. 5.1), the analytic approach aimed to provide a closer look at several different aspects. Because the classroom instruction is a complex process that involves different agents, cultural artifacts, and their interactions in the classroom setting, we took a similar lens as the 1999 TIMSS video study to focus on the aspects of content, students, and instruction (Hiebert et al., 2003). In particular, they include (1) content aspects: the lesson's content treatment, tasks used and connections made; (2) student aspects: students' learning and engagement in lesson activity; (3) instruction aspects: the teacher's use of instructional methods and discourse in content introduction and activity arrangement, lesson coherence, and activity variations. The mail survey with the teacher was examined to supplement and triangulate the lesson analysis.

The mail surveys with the teaching contest organizers and seven other mathematics teachers were analyzed to highlight what features were identified and valued for the exemplary lesson. While the survey data were examined holistically, particular attention was also given to the three aspects: the mathematics content, students' learning and participation, and the teacher's classroom instruction. Through this analysis, we attempted to identify cultural values that were embodied in the contest evaluations and other mathematics teachers' views. Finally, the teacher and contest organizers' comments about teaching contest and its value were also discussed.

The following three sections are organized in an order corresponding to the three research questions. At first, we provide an overview of Mr. Zhang's prize-winning lesson, and analyze its main features. Then, we discuss how the lesson was evaluated in the teaching contests. In the second section, we analyze and report the survey data collected from seven other mathematics educators and expert teachers to further our understanding about possible cultural values embedded in judging the merit of mathematics classroom instruction in China. In the final section, we synthesize our findings and discuss the implications of this study.

5 The exemplary mathematics lesson: the computation of powers

Because the contest organized in that district allowed the contestants to select their own content topics, Mr. Zhang selected the lesson's content topic by himself. At that time when he learned about the initial teaching contest at the district level, Mr. Zhang was finishing a chapter on one-variable linear inequalities. The next chapter in the textbook was about the multiplication of integral expressions that include powers. Students had been introduced the concept of power but not its computations. The first section of the chapter is "the computation of powers", and Mr. Zhang chose the content topic for developing the lesson for the teaching contest.

In Mr. Zhang's class, 32 students were sitting in pairs at desks arranged in six rows facing a teaching podium at the front. The class was organized as having eight groups for possible group discussion once needed, with each group having two pairs of students seated in proximity to each other. Some teachers were also sitting in the classroom to observe the lesson.

5.1 Overview of the exemplary lesson

Taking a similar segmentation approach used in the TIMSS video study (Hiebert et al., 2003), we identified and divided the lesson into three segments (see Table 1): (1) introducing the topic—presenting a problem in real world context together with reviewing previous content that relates to solving the new problem, (2) developing rules of power computation—letting students solve sample problems and discussing their solutions, (3) reinforcing and practicing—solving various sets of problems and sharing solutions. This sequence of lesson activity is common in China for lessons that introduce new content. The teacher often begins the lesson with a problem and/or content review, and the rest of the lesson is oriented toward developing new content and reinforcing students' learning through varying problems and discussing various solutions (e.g., Gu, Huang, & Marton, 2004).

By showing the video clip of Chinese rocket launching, Mr. Zhang started the lesson by recalling the event of launching the Chinese rocket, Shenzhou No. 6, into space and posing the problem "the rocket had flown at the speed of 7.9×10^3 m/s for almost 5 days, adding up about 4.1×10^5 s, how many meters had it flown in total?" After discussed with the whole class, Mr. Zhang provided the formula on a computer's monitor in the form of PowerPoint slides for solving this problem, and stated "We can write the expression for this problem, but it seems new for us to do the computations. In order to compute the distance that Shenzhou No. 6 traveled, we will need to learn the computation of powers today." Then, Mr. Zhang asked students to review how to write number multiplications using exponents. One is to write 2 as multiplied by itself 5 times, the other is to write 'a' multiplied by itself 'm' times. Then, Mr. Zhang reviewed the definition of power, base, and exponent.

After reviewing, Mr. Zhang asked students to try to solve two sets of computation problems (see problem groups A and B in Fig. 1) using previous knowledge by themselves first, and then to discuss their solutions within their own groups.

One and half minutes later, Mr. Zhang chose one group's answers and showed their answers on an over-head projector for the whole class discussions, together with some explanations provided by that group. Then, Mr. Zhang asked the students to observe these answers and posed the follow question: "Now we know that these answers are correct, please observe these two sets of the problem, can you tell me what changed and what did not change after the computations?" After getting responses from the class by chorus, Mr. Zhang concluded the students' answers: "Yes, we noticed that for both group A and group B, the base did not change and the exponents changed after the computation, right? How did they change? Group A is (with the class) to add the exponents together, and group B is (with the class) to multiply the two exponents."

Now, Mr. Zhang posed two other problems on a big screen using the symbolic representation (i.e., $a^m \cdot a^n = ?$ $(a^m)^n = ?$). He worked together with the students to come up with $a^m \cdot a^n = a^{m+n}$ on the blackboard, and called it *multiplying two powers with the same base.* After

Table 1 Overview of the exemplary lesson on the computation of powers

Segment	Length (min)	Description
1	6	Introducing the topic—showing a video clip to present a problem of computing a rocket traveling distance that involves power computations (4.5 min), and reviewing concepts of power, base and exponent (1.5 min)
2	15	Developing rules of power computation—letting students solve several problems and the class discussing their solutions that lead to the formation of power computation rules (a combination of individual efforts and group sharing)
3	24	Reinforcing and practicing—letting students practice new content through solving problems that vary in several different ways and discussing their solutions (23 min), and having a summary (a bit less than 1 min)

Computing and giving your result in the form of power:

Group A:	**Group B:**
1. $5^3 \times 5^2 =$	4. $(5^3)^2 =$
2. $b^5 \cdot b^4 =$	5. $(b^5)^4 =$
3. $a^6 \cdot a^2 =$	6. $(a^6)^2 =$

Fig. 1 First two sets of computation problems

providing this guidance, Mr. Zhang asked students to take the same process to find out the computation formula for another problem $(a^m)^n$. Students worked individually or in groups for a few minutes. Mr. Zhang later chose an answer from one group and put it on the OHP for discussions. Then, Mr. Zhang summarized the process to the students. "In this case, the base is a^m, and we have a total of n times of a^m. We can use *multiplying two powers with the same base* to add the powers together. There are n of m, therefore, it should be a^{mn}". Mr. Zhang then asked whether there is another way for solving this problem. Another group of students brought their answer to the platform and one student explained to the whole class. The answer is $(a \cdot a \cdots a)(a \cdot a \cdots a)(a \cdot a \cdots a) \cdots (a \cdot a \cdots a)$. Mr. Zhang then summarized the rule for computing *the power of powers*. He further pointed out that "we can see the computation here, if it is to multiply the powers with the same base, we change the multiplication to addition; and if it is the power of powers, we change the power to the multiplication. This reflects a transforming thinking in mathematics. That is, we transform a high-level computation to a lower-level one."

For the next 24 min Mr. Zhang provided three more sets of computation problems first that vary in performance requirements (see Fig. 2). For the first set of computation problems, Mr. Zhang asked one group to answer one question in turn. The second set of problems was to find errors and Mr. Zhang asked students to compete with each other for speed (*qiangda*) in providing their answers with explanations. Moving on to the third activity, Mr. Zhang showed four computation problems as written on the blackboard, and asked four students to work on the blackboard and the rest of the class to do it on their own worksheets. The teacher then led the class to solve the rocket traveling problem presented at the beginning of the lesson. With some practice and discussion in power computation, the class finished the computation quite quickly. The teacher then provided two more problems that were open-ended in nature (see Fig. 2), and students' trials and discussions helped push students to think beyond the case of positive integers for power computations. Finally, Mr. Zhang finished the lesson by reviewing the power computation formulas (as shown on PowerPoint) with students, and asked students to complete their worksheet.

I. Computing and giving your result in the form of power:

1. $a \cdot a^5 =$	2. $(y^2)^5 =$
3. $(3^3)^4 =$	4. $b^3 \cdot b^3 =$
5. $10^{2004} \times 10^{2005} =$	6. $(x^3)^3 =$
7. $c^x \cdot c^2 =$	8. $(b^y)^3 =$

II. Judging whether the following computations are correct, and explaining why.

1. $a^4 \cdot a^4 = a^{16}$	2. $a^2 + a^2 = a^4$
3. $(a^3)^5 = a^8$	4. $4a^2 - a^2 = 4$
5. $a + a^2 = a^3$	

III. Computing:

1. $a^2 \cdot a \cdot a^4$	2. $(y^3)^2 \cdot (y^2)^3$
3. $(m^2)^3 \cdot (m^2)^2$	4. $(a^3)^3 + a^8 \cdot a$

Two open-ended problems

1. fill-in blanks:

$$a^{12} = a \cdot a^{(\ )} \cdot a^5 = (a^2)^4 \cdot a^{(\ )} = (a^3)^2 \cdot (a^2)^{(\ )}$$

2. Please use what you have learned today to write out multiple expressions of a^6

Fig. 2 Problems used during the third segment

5.2 The lesson's main features

From the surface, it seems that the lesson itself is straightforward. It shows a young and energetic teacher who made good use of information technology to teach an otherwise purely mathematical content topic. Much of the class time was spent on students' solving problems and the teacher's explanation. However, if we look further beyond the surface, our analyses of its three aspects (content, student, and instruction) indicate that the lesson contains several features that contributed to this lesson's success.

5.2.1 The lesson's content

In general, this is a goal-oriented lesson with its outcomes positively demonstrated throughout the lesson, especially at the end. The students were able not only to respond actively and correctly to most questions posted along the instruction process, but also to differentiate these two computation rules and use them with possible extensions at the end. The lesson shows a clear and focused treatment of the mathematics content that emphasizes knowledge connections and differentiations. The lesson instruction overall is coherent with the content being developed (not simply stated) in the lesson. Students' positive learning suggests that content treatment and requirements were suitable to students' situation. In particular, we identified two content-related aspects and give further discussion below.

5.2.1.1 Content treatment According to the textbook, the first section of "the computation of powers" contains three knowledge points: (1) the multiplication of powers with the same base, (2) the power of powers, and (3) the power of products. Mr. Zhang thought that the rule for computing the power of powers is induced from the meaning of power and the rule for multiplying powers with the same base. Thus, he decided to re-structure the textbook content and combine the first two knowledge points as taught in the same lesson. Mr. Zhang believed that such a content re-structuring could allow students to develop a better understanding of the connection and differences between these two computations.

With this content restructuring, Mr. Zhang believed there are two important content points of teaching for this lesson: (1) knowing the process of deriving the computational rules of "the multiplication of powers with the same base" and "the power of powers"; (2) the applications of these two computation formulas. There are also two difficult content points of teaching: (a) the induction of the computational formulas of "the multiplication of powers with the same base" and "the power of powers"; (b) the differentiations between these two computations. Apparently, the two important content points of teaching refer to the same knowledge mathematically but different aspects in comparison to the two difficult points of teaching. Based on Mr. Zhang's written explanation, we draw Fig. 3 to show their connections and differences.

It is clear that Mr. Zhang was able to identify and articulate the important and difficult points of teaching with the same content as placed in the center oval. The teacher placed a great deal of thinking in differentiating the closely related aspects of the mathematics content from the curriculum perspective (i.e., the two important points of teaching at the left side), as well as from students' perspective (i.e., the two difficult points of teaching at the right side). In fact, the two important points of teaching are also related along the process of lesson instruction (shown as a dotted arrow line in Fig. 3), the same goes for the case of the two difficult points of teaching. The identification of the important and difficult content points of teaching is a necessary step in preparing lesson instruction for Chinese school teachers.

5.2.1.2 Mathematics problems used and their sequence The lesson is devoted to the solving and discussing several sets of computation problems. Based on the lesson's transcript, we put together the information about the problems used and their sequence and purposes as presented in Table 2.

Table 2 shows that a total of 28 computation problems were solved and discussed throughout the lesson. The teacher organized 23 of these 28 problems into five sets and used them in segments 2 and 3. These problems are varied not only in terms of their difficulty, but also their performance requirements. The teacher put them nicely together to serve different instructional purposes in the lesson. Thus, the class was not presented as a traditional "drill and practice" lesson. Rather, students developed the two power computation rules through solving and discussing two sets of carefully selected problems, and furthered their understanding and skills through solving other three sets of problems with gradually increasing difficulty.

5.2.2 Students' learning and involvement

To provide some objective measures of students' involvement, we examined students' learning and involvement in terms of the lesson time spent to involve students, students' efforts in problem solving and their involvement in sharing solutions. In particular, we divided and coded the use of lesson time into three types of lesson activities: (1) the teacher's talk that provides problem/concept explanation, activity transition, or non-mathematical statements; (2) the teacher–student public exchange that clearly involves students in developing ideas and/or discussing solutions, etc.; (3) student-centered activity that includes seatwork, students' group discussions, and putting solutions on

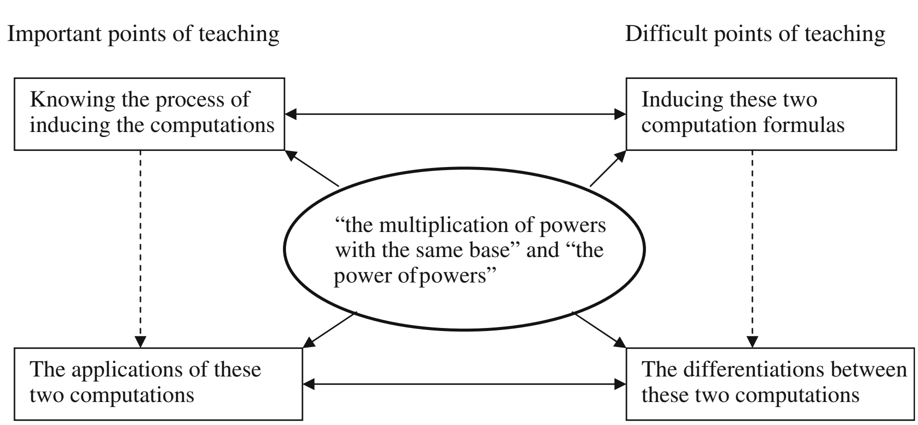

Fig. 3 Relationships between the important and difficult content points of teaching

Table 2 Problems used and their sequence and purposes in the lesson

Segment	Problem used	Instructional purpose
1	One power computation problem from the real world, two fill-in-the-blank review problems	Introducing the topic—need to compute a rocket traveling distance that involves power computations, together with content review
2	Two sets (with three computation problems in each set)	Developing two rules of power computation through solving and comparing these computation problems
3	Three sets (first set: eight simple power computation problems; second set: five computation judgment problems; third set: four mixed power computation problems), plus the problem given at the beginning and two open-ended problems	Reinforcing and practicing with the first set is on simple applications of two different computation rules, the second on differentiating and judging the correctness of given computations, and the third on the mixed use of these computation rules. The final two open-ended problems further develop students' flexible use of these computation rules

blackboard. The results are summarized in Table 3 for each lesson segment and the whole lesson.

Table 3 shows that the teacher–student exchange used the highest percentage of lesson time (45%) among these three types of activity, followed by the student-centered activity (28%) and the teacher's talk (27%). The results indicate that the teacher tended to engage students throughout the lesson, not only through frequent public exchanges with students but also through providing students problems to solve and discuss. In fact, students' seatwork in the lesson happened at the beginning (i.e., solving computation problems for developing the rules of power computation), middle, and the end. The distribution of lesson time use across the three lesson segments suggests that students were heavily involved in initial warm-up activity and developing the power computation rules, while the teacher had more explanation when presenting sets of problems and activity transitions.

Moreover, the teacher engaged his students in problem solving activities in various ways. Table 4 shows that the students were asked to solve all the given problems by themselves, but with the beginning three sets of problem solving followed by group sharing of students' own solutions. Students continued to get involved as their solutions were shared to the whole class. The teacher used different methods to help involve students, asked for reasoning behind solutions, and also encouraged students to come up and discuss different approaches.

Taken together, students in the class were motivated to explore, induce, compare, and use the two power computation rules. Students' interest and engagement were cultivated through the teacher's careful design and use of several sets of computation problems, as well as his frequent interactions with students. Students were kept on task through solving and discussing these computation problems with an increasing and adequate difficulty level to them. Multiple solutions to the same problem were greatly encouraged and shared in the class. Students assumed the responsibility to come up with and justify their solutions. They enjoyed these activities even more when experiencing success with their own efforts along the way.

5.2.3 The lesson's instructional features

A lesson's success relies on the teacher's design and capability in carrying out the lesson. According to Mr. Zhang, he purposefully used two instructional methods in order to teach the lesson's two important content points well. The first was to generalize from specifics, let students solve new and specific problems based on the meaning of power and then generalize and derive the computation formulas. This approach aimed to address the first important content point of teaching. The second approach was to design and use three sets of computation problems with gradually increasing difficulty, and let students solve these

Table 3 Lesson time used for the teacher's talk, teacher–student exchange, and student-centered activity

Segment	Teacher's talk	Teacher–student exchange	Student-centered activity
1	0:56 (17%)[a]	2:34 (42%)	2:30 (42%)
2	2:00 (13%)	8:08 (54%)	4:52 (32%)
3	9:07 (38%)	9:33 (40%)	5:20 (22%)
Total	12:03 (27%)	20:15 (45%)	12:42 (28%)

[a] 0:56 means 0 min and 56 s, and the percentages in each row may not add to 100% due to rounding errors

Table 4 Efforts required for solving problems and sharing solutions during the lesson

Segment	Problem sets	Problem-solving efforts	Ways of sharing solutions
2	1 and 2	Individual, then group sharing	The teacher shows students' work, and class discussion
3	3	Individual, then group sharing	Individual representing each group to report
	3	Individual	Individual competing to provide answers quickly
	4	Individual	Individual competing to provide answers quickly and to explain to the whole class
	5	Individual	Four students solving problems on blackboard, then evaluated and (if needed) corrected by other students

computation problems as to stress the second important point of teaching.

Mr. Zhang also put forward two methods for addressing the lesson's two difficult content points of teaching. The first method was to take the induction of these two computation formulas one by one. He planned to guide students to derive the computation formula of "the multiplication of powers with the same base" first, then let students have group explorations and model the process to derive the second formula. The method also tended to foster students' participations and collaborations, and let them experience success through explorations. The second method was to design and use three sets of computation problems, with the first set was on simple applications of these two different computation rules, the second on differentiating and judging the correctness of given computations, and the third on the mixed use of these computation rules. In fact, students' four common mistakes in power computations were all addressed: $a \cdot a^3 = a^{0+3} = a^3, a + a^2 = a^{1+2} = a^3, a^3 \cdot a^3 = a^{3\times3} = a^9, (a^3)^5 = a^{3+5} = a^8$. The teacher's content treatment and proposed instructional methods show his in-depth thinking about the content, students, and what he can do through classroom teaching.

Consistently, we noticed that Mr. Zhang did not simply tell students the power computation rules. Rather, he provided students opportunities to explore, share, and discuss different solutions to generate knowledge. He also employed multiple methods to facilitate frequent and various interactions with students that helped keep them on task and to obtain feedback for adjusting his instruction progress. The teacher not only used the common methods of questioning, discussions, and having individual students come to share their solutions on the blackboard, but also adopted small group collaborations, group and individual competitions, and the adequate use of information technology. The teacher tried to bring the lesson together later by solving the problem posed at the beginning. Although the teacher used multiple methods in teaching, the lesson overall was coherent and focused in content. It shows that the teacher handled well in piecing together different aspects to reach good instructional effects.

This exemplary lesson embodies many features that were revealed by others in previous studies about Chinese mathematics classroom instruction, as summarized in Sect. 2.1. Even more, the lesson also shows the importance of instructional content treatment. While the design and use of challenging tasks and exercise problems are important as also pointed out by others (e.g., Fan, Wong, Cai, & Li, 2004; Stigler & Stevenson, 1991), our analyses of this lesson and data collected from the teacher suggest that the task design and use need to be based on the teacher's in-depth understanding of the content topic in relation to students. In fact, the tasks and exercise problems were not randomly chosen, nor simply because they are fun or interesting. Task design and selection as shown in this lesson were deliberated to serve the needs of achieving the lesson's objectives.

5.3 The lesson's quality as evaluated through teaching contests

5.3.1 Main components of evaluation used in the teaching contests

Based on the specific requirements of a contest, different components of teaching evaluation were developed and used to judge the quality of the contested aspects. It should be noted here that the evaluation criteria, reflecting new and updated instruction ideology, are evolving over time. The contestants knew what aspects were commonly evaluated in teaching contests during that period, although they might not have the exact criteria used in the contest evaluation. The contest announcement specified the purpose, scope, and the timeline of the contest, and what the contestants need to prepare and/or submit for joining the contest.

At the district level, the contest was organized to focus on the teaching skills. The contest consisted of three parts:

lesson instruction design, lesson explaining, and classroom lesson instruction. For each part, a specific evaluation chart was used for rating. These three parts bore different weights, as specified in this case as 20, 20, and 40 points respectively. The contest results were then based on the contestants' summary points earned from all these three parts plus the contestants' self-reflections (20 points) on the lesson that was submitted.

The evaluation form for rating classroom lesson instruction places great emphases on the design of instructional content and students' learning. It is expected that the teacher needs to have accurate analyses and understanding of the textbook, identify and handle the important and difficult content points of teaching well, and set up adequate instructional objectives. At the same time, the evaluation form highlights the importance of considering students' reality and motivating them to learn. It also contains specific aspects related to the teacher's use of instructional methods, classroom environment, and instructional effects.

The contest that Mr. Zhang's video-taped lesson joined at the city level was a contest of video-taped classroom instruction under the new curriculum. An independent evaluation chart was also developed and used for judging the quality of submitted video-taped lessons. The evaluation sheet shows an equally-distributed emphasis on six aspects (i.e., instructional objectives, lesson-type characteristics and content design, instructional methods, students' activity, interactions and feedback, and classroom organization), plus one aspect with a slightly less weight (i.e., instructional effects). These seven aspects together present a broad coverage of classroom instruction components that can contribute to the lesson quality.

5.3.2 Committee's evaluation

For the final contest at the district level, the evaluation committee made a written evaluation about Mr. Zhang's video-taped lesson, his written lesson instruction design, as well as his performance in lesson explaining. The following is the committee's evaluation of Mr. Zhang's lesson instruction.

> *For the classroom lesson instruction*: Can develop a problem situation based on a novel task that is of interest to students; have natural and effective teacher-students interactions, reflect well the student-centered instructional concept in every instructional segment, can follow the eighth graders' development characteristics to satisfy their psychological needs of expressing themselves actively to demonstrate their capability of pattern discovery as well as to be acknowledged, have a harmonious classroom atmosphere, the teacher has a relatively strong capability in leading the class learning and structuring the textbook content for teaching; the teacher's language use is concise and encouraging, and the teacher can effectively use modern instructional technology; the teacher uses an analogical approach in handling the textbook content, which helps students to better understand the connections and differences between the two computations and thus overcome the difficult content point of teaching fairly well; the instruction stresses the important content points of teaching, and has good instructional effects.

The committee's evaluations basically follow the aspects provided in the evaluation form. In particular, the evaluation committee was happy with the way that Mr. Zhang introduced the content topic with a novel problem and approach, motivated students to learn through continuous interactions, and generated and followed the class's group dynamics. The committee also praised Mr. Zhang's understanding and treatment of the textbook content, and his handling of the important as well as difficult content points in teaching.

For the contests at the city level, the evaluation committee did not generate a written evaluation but formed oral evaluative comments. Because the evaluation was done more than a year ago, the contest organizer was only able to recall some evaluative comments made at that time. In general, the city-level evaluation committee's comments were consistent with the evaluation that Mr. Zhang received at the district level, except for the lesson explaining competition. The consistent evaluative comments suggest an emphasis on the teacher's understanding and handling of the instructional content as related to the specific group of students' learning, as well as the teacher's capability in employing different methods to make students' learning of such content effective.

6 Other experts' evaluation of the exemplary lesson: views and comments

In October 2007, seven mathematics educators and teachers were asked to watch the prize-winning video-taped lesson and provided their comments on a pre-designed mail survey. Although some of these educators and teachers knew each other professionally, they were invited separately for this survey. Table 5 summarizes the general background information about these seven educators and teachers.

All these experts are either experienced mathematics educators or mathematics teachers. Because China practices a professional ranking and promotion system, the

Table 5 Background information of the seven mathematics educators and teachers

Code	Professional rank	Highest degree	Years of teaching	Job nature
T1	Professor	Bachelor	40	University professor in math education, also in charge of editing the textbook
T2	Senior-rank teacher	Bachelor	27	High school teacher
T3	Exceptional teacher	Bachelor	30	Teaching researcher for middle school
T4	Exceptional teacher	Bachelor	25	Teaching researcher for middle school
T5	Professor and exceptional teacher	Bachelor	32	Teacher training school, also the writer of the chapter taught by Mr. Zhang
T6	Senior-rank teacher	Bachelor	20	Middle school teacher
T7	Senior-rank teacher	Bachelor	26	Middle (and high) school teacher

senior-rank is the highest professional rank for school teachers and the exceptional teacher is an honorary title awarded to some senior-rank teachers who are exceptionally good (e.g., Li, Huang, Bao, & Fan, 2009). Teaching researcher (*jiaoyanyuan*) is a special position similar as the instructional coordinator or supervisor in the United States. Every school district, county, and city in China establishes such a teaching research office for every school content subject, including mathematics. Teaching researchers are normally recruited and selected from school teachers who have exceptional teaching performance and/or leadership. All the teaching researchers surveyed in this study were teaching researchers with a designated focus on middle school mathematics in different cities.

Among the 7 experts, 4 gave 4 out of 5 points, one 4.6 points, and two 5 points (see Table 6). These present an average evaluation of 4.4 out of 5 points. If taking the full credit of 5 points as excellent, the numerical evaluation results suggest that all these experts rated this lesson as very good. The result is consistent with the teaching contest committee's evaluation in general.

While the numerical result presents an overall picture of these experts' evaluations, their comments on the lesson's strengths and weaknesses reflect their thinking and rationale behind their ratings. After reading through all their comments several times, we noticed that their comments vary dramatically. There are cases where two experts provided opposite comments on certain aspects of the lesson, for example using the video clip at the beginning of the lesson to introduce the topic. Nevertheless, their comments often carry a focus on either content treatment, student learning, or the teacher and his instruction. To identify which aspect these experts may pay more attention to in lesson evaluation, we thus classified these experts' comments in terms of the three aspects as used in the lesson analysis. As summarized in Table 6, we then counted the number of words used by each expert in his/her comments on different aspects.

Table 6 Number and percentage of words used by seven experts in their comments about the lesson in terms of three aspects

Code	Overall rating	Content treatment	Student learning	Teacher and instruction
T1	4	1,360 (70%)[a]	137 (7%)	437 (23%)
T2	4.6	154 (16%)	345 (37%)	453 (48%)
T3	4	109 (22%)	102 (20%)	287 (58%)
T4	5	54 (6%)	454 (48%)	436 (46%)
T5	4	147 (57%)	17 (7%)	96 (37%)
T6	5	14 (6%)	19 (9%)	183 (85%)
T7	4	2021 (71%)	346 (12%)	493 (17%)

[a] The percentages in each row may not add to 100% due to rounding errors

Table 6 shows dramatic differences among these experts in terms of the length of their comments and aspects receiving more attention. However, we also noticed that these teachers who gave the higher ratings tended to focus more on the instruction (T2, T4, and T6) and student learning (T2, T4). These aspects are consistent with what has reported in a recent study on another group of Chinese expert teachers' lesson evaluation (Huang & Li, 2009). Experts in this study especially liked Mr. Zhang's use of the novel problem and information technology for introducing the content topic, his approach in gradually unpacking the knowledge for students' learning, and fostering students' interest in exploration and their thinking. For example, the following are part of two expert teachers' comments:

> "I like this lesson. This lesson adapted an entertainment format that is attractive to current middle school students. It focused on the knowledge exploration, understanding, summarization, and reinforcement. The lesson made its progress gradually from one level to next and it was embedded in students' competitions among small groups. The lesson resulted in very good effects, and brought the teacher and students as well as students themselves closer." [T6]

> "In handling the computation problem of $(m^2)^3(m^2)^2$, the teacher paid attention to different methods. He

kept leading and encouraging students to go on blackboard to show these two different methods." [T4]

In contrast, some other experts who were more critical focused more on the content (e.g., T1, T5, T7) and somehow on the teacher's instructional skills (T3). In fact, the two experts who also developed the textbook gave their evaluation of 4 points, and questioned the teacher's treatment of the textbook content. For example, the following is part of the textbook editor's comments about the teacher's restructuring of the textbook content:

"Of course, the content treatment needs further considerations. The problem is that although these two computation rules have a close and logical connection, they stay at different levels. The first rule (the multiplication of powers with the same base) should be the base for the second rule (the power of powers), and the second rule is the application and further development of the first rule. If taking a methodological view, the first rule is the base for all the computations of powers. It is also the starting point for learning power computations, thus it is important to emphasize its learning and should not share its emphasis with the learning of other rules. …… Finally, putting these two rules together for students to learn, the teacher paid special attention to relevant exercises on comparisons, diagnoses and analyses, correcting errors, and syntheses. Thus, it seems that not enough practices and reinforcement was given to each rule individually." [T1]

In fact, T1's comments were in sharp contrast to Mr. Zhang's design idea in re-structuring the textbook content for teaching and the contest committee's evaluation. While Mr. Zhang wanted to emphasize these knowledge connections, the textbook editor believed that these knowledge points deserve different instructional attention. Interestingly, the textbook chapter writer (T5) also voiced his concerns about Mr. Zhang's content treatment, albeit in a different way.

"This lesson used the rocket traveling distance as the initial problem context, then reviewed basic concepts of power. This content arrangement may not be adequate, and lack clear requirements. For this lesson's content, it is not necessary to find and use a real-world problem as the initial context." [T5]

In summary, although all the experts valued the exemplary lesson in general, their comments present a not-so-consistent picture about the lesson's strengths and weaknesses. Based on their comments, it seems consistent in a way that the lesson is judged to be successful in terms of the teacher's instruction and students' learning. But some questioned whether the lesson's content treatment, as re-structured textbook content by the teacher, might be the best approach. Apparently, it is not possible to have an answer for such a question with this existing exemplary lesson. Nevertheless, these experts' comments echo what has been revealed from our lesson analyses about the importance of considering content treatment in a lesson design and implementation.

7 Discussion and conclusion

7.1 What can we learn from this exemplary lesson about mathematics classroom instruction excellence valued in China?

This study aimed to examine the features of exemplary mathematics lesson that was identified and awarded through teaching contest. In particular, we took the case study approach in this study. Our analysis of a prize-winning lesson suggests that the lesson contained many features that were also praised and identified by other researchers in previous studies about Chinese mathematics classroom instruction. The lesson smoothly progressed with the use of well-designed and structured computation problems. One key feature related to the lesson's content treatment is the teacher's clear identification and handling of both important and difficult points of teaching the content topic, which reflects the teacher's careful and intensive study of the textbook. By comparing with the textbook, we found that the teacher selected and used only three computation problems from the textbook. Basically, the teacher either re-designed and/or added most of the lesson's computation problems to address these important and difficult points of teaching.

Moreover, the teacher also made a good use of multiple methods to engage students, such as solving sets of problems with variations, discussions, multiple solutions to one problem, individual seatwork in conjunction with small group collaborations, and group competition. The teacher tried to transfer the knowledge development and justification responsibilities to students. In particular, the students were given opportunities to explore, discuss, share, and justify solutions. Students' knowledge development process was guided by the teacher and his use of problem sets. The lesson shows frequent and various interactions between the teacher and students, in addition to students' own efforts either individually or in groups. Overall, the lesson is coherent, polished, and focused.

Importantly, the lesson's features as summarized above are consistent with what were commonly valued in the two teaching contests in China. The emphases of these features in teaching contests support the perception that these features are not unique to the particular lesson focused on in this study. In fact, our survey with seven other mathematics educators and teachers also suggests that the lesson's quality is commonly acknowledged in China. Although there were some variations across these seven experts in terms of the lesson's design and strengths, their comments are all around some of these features. The variations presented mainly focus on alternative ways for the content treatment. The diversity in Chinese teachers' thinking about the lesson's content treatment actually suggests that a lesson's content focus and organization deserve great attention and thought.

Although the study focused on a specific lesson, what we aimed to learn from the case is not about the teacher himself, nor only about this particular lesson. Rather, what we planned to learn is what features made this particular lesson gain high evaluations. And we tried to verify whether these features were commonly recognized by different entities and individuals in China. The consistency in recognizing and valuing the features, as presented in this specific lesson, supports our assumption of what we can learn from the case study about excellent mathematics classroom instruction in China.

7.2 Teaching contest as a platform to identify and promote mathematics classroom instruction excellence

It was indicated at the beginning of this article that China has a cultural view about teaching as a profession that is different from the West. This study provided detailed information about one particular aspect of the Chinese teaching culture: teaching contests. In a way, the study helped reveal how mathematics teaching can be competed and compared and what features Chinese teachers may focus, a seemingly unrealistic undertaking in the West. In fact, the prize-winning lesson made it possible for us to learn beyond what can possibly be learned from experts' teaching in the West (e.g., Borko & Livingston, 1989; Leinhardt, 1989). While experts' teaching are commonly analyzed in terms of aspects specified by a researcher, the nature of the prize-winning lesson identified through teaching contests allowed us to learn not only about the lesson itself but also the cultural value embodied through the identification process.

Teaching contest, as a platform valued in China, also helps promote mathematics classroom instruction excellence. Surveys with Mr. Zhang and the contest organizers revealed that teaching contest promotes mathematics instruction excellence mainly in two ways. One way is to motivate teachers' participations and to further their professional development, especially for junior teachers. According to Mr. Zhang, the process of joining a teaching contest was a great learning experience. Certainly, participating teachers also need to be psychologically prepared to accept possible failures in a teaching contest. Another way is to promote discussions about classroom instruction and to identify high-quality classroom instruction for possible broad sharing and dissemination. For example, the nationwide teaching contests' organizers published and distributed selected prize-winning lesson videos after the contests. Some of the prize-winning instructional designs were also posted on the Internet. According to the contest organizers, however, more efforts would be needed to promote mathematics classroom instruction excellence identified through teaching contests at both the district and the city levels. In addition to these two ways, teaching contest has also been used implicitly or explicitly to identify and promote innovative classroom instruction, such as those valued in current school mathematics reform (Liu & Li, 2009).

At the same time, it is important to point out that there are many other aspects of Chinese teaching culture, such as teaching research group (e.g., Paine & Ma, 1993), teacher journals (e.g., Li, 2008), apprenticeship practices and professional ranking and promotion system (e.g., Li & Huang, 2008). Further studies are needed in the future to examine what aspects have been working well in promoting mathematics classroom instruction excellence in China. We believe that a better understanding of Chinese teaching culture would require us to piece together different aspects of the teaching culture.

Acknowledgments Special thanks go to the teacher who taught the exemplary lesson to share with us about himself, his lesson preparation and thinking in great details. The authors are grateful to the teaching contest organizers as well as participating Chinese mathematics educators and teachers for their time and contributions. We would also like to thank three reviewers and the journal editor for their thoughtful comments on prior drafts of this article.

References

Berends, M. (2006). Survey methods in educational research. In J. L. Green, G. Camilli, & P. B. Elmore (Eds.), *Handbook of complementary methods in education research* (pp. 623–640). Mahwah: Lawrence Erlbaum Assoc.

Borko, H., & Livingston, C. (1989). Cognition and Improvisation: differences in mathematics instruction by expert and novice teachers. *American Educational Research Journal, 26*, 473–489.

Ding, M., Li, Y., Li, X., & Kulm, G. (2008). Chinese teachers' perceptions of students' classroom misbehaviour. *Educational Psychology, 28*, 305–324.

Fan, L.-H., Wong, N.-Y., Cai, J., & Li, S. (Eds.). (2004). *How Chinese learn mathematics—perspectives from insiders*. Singapore: World Scientific.

Gu, L.-Y., Huang, R., & Marton, F. (2004). Teaching with variation: a Chinese way of promoting effective mathematics learning. In

L.-H. Fan, N.-Y. Wong, J. Cai, & S. Li (Eds.), *How Chinese learn mathematics—perspectives from insiders* (pp. 309–347). Singapore: World Scientific.

Hiebert, J., Gallimore, R., Garnier, H., Givvin, K. B., Hollingsworth, H., Jacobs, J., et al. (2003). *Teaching mathematics in seven countries: results from the TIMSS 1999 video study* (NCES 2003-013). U.S. Department of Education, Washington, DC: National Center for Education Statistics.

Huang, R., & Li, Y. (2009). Examining the nature of effective teaching through master teachers' lesson evaluation in China. In J. Cai, G. Kaiser, R. Perry, & N. Y. Wong (Eds.), *Effective mathematics teaching from teachers' perspectives: national and cross-national studies*. Rotterdam, The Netherlands: Sense (in press).

Kaiser, G., & Vollstedt, M. (2008). Pursuing excellence in mathematics classroom instruction in East Asia—a personal commentary from a Western perspective. In O. Figueras, J. L. Cortina, S. Alatorre, T. Rojano, & A. Sepúlveda (Eds.), *Proceedings of the joint meeting of 32nd annual conference of the International Group for the Psychology of Mathematics Education and the 30th of the North American chapter* (Vol. 1, pp. 185–188). Morelia: PME.

Lapointe, A. E., Mead, N. A., & Askew, J. M. (1992). *Learning mathematics*. Princeton: Educational Testing Service.

Leinhardt, G. (1989). Math lessons: a contrast of novice and expert competence. *Journal for Research in Mathematics Education, 20*, 52–75.

Li, Y. (2007). Examining and understanding mathematics classroom instruction and possible contributing factors through a cross-national lens. *School Science and Mathematics, 107*, 308–310.

Li, J. (2008). *Chinese teachers' constructions of their roles in developing curriculum*. Paper presented at DG 17: the changing nature and roles of mathematics textbooks: form, use, access, The 11th International Congress on Mathematical Education (ICME-11), Monterrey, Mexico.

Li, Y., & Huang, R. (2008). *Developing mathematics teachers' expertise with apprenticeship practice and professional promotion system as contexts*. Paper presented at U.S.-Sino workshop on science and mathematics education, NSF-funded workshop held at Middle Tennessee State University, TN.

Li, Y., Huang, R., Bao, J., & Fan, Y. (2009). Facilitating mathematics teachers' professional development through ranking and promotion practices in the Chinese mainland. In N. Bednarz, D. Fiorentini, & R. Huang (Eds.), *The professional development of mathematics teachers: experiences and approaches developed in different countries*. Canada: Ottawa University Press (in press).

Li, Y., Kulm, G., Huang, R., & Ding, M. (2009). On the quality of mathematics lesson: do elementary mathematics teachers have similar views as students and their school? In J. Cai, G. Kaiser, R. Perry, & N. Wong (Eds.), *Effective mathematics teaching from teachers' perspectives: national and international studies*. Rotterdam: Sense Publishers (in press).

Liu, J., & Li, Y. (2009). Mathematics curriculum reform in the Chinese mainland: changes and challenges. In F. K. S. Leung & Y. Li (Eds.), *Reforms and issues in school mathematics in East Asia*. Rotterdam: Sense Publishers (in press).

Ma, L. (1999). *Knowing and teaching elementary mathematics: teachers' understanding of fundamental mathematics in China and the United States*. Mahwah: Lawrence Erlbaum.

Mok, I. A. C. (2006). Teacher-dominating lessons in Shanghai: the insiders' story. In D. J. Clarke, C. Keitel, & Y. Shimizu (Eds.), *Mathematics classrooms in twelve countries: the insider's perspective* (pp. 87–98). Rotterdam: Sense Publishers.

Mullis, I. V. S., Martin, M. O., Gonzalez, E. J., & Chrostowski, S. J. (2004). *Findings from IEA's trends in international mathematics and science study at the fourth and eighth grades*. Chestnut Hill: TIMSS & PIRLS International Study Center, Boston College.

National Council of Teachers of Mathematics. (1991). *Professional standards for teaching mathematics*. Reston: Author.

National Council of Teachers of Mathematics. (2000). *Principles and standards of school mathematics*. Reston: The Author.

Paine, L., & Ma, L. (1993). Teachers working together: a dialogue on organizational and cultural perspectives of Chinese teachers. *International Journal of Educational Research, 19*, 675–697.

Peng, A. (2007). Knowledge growth of mathematics teachers during professional activity based on the task of lesson explaining. *Journal of Mathematics Teacher Education, 10*, 289–299.

Perry, M. (2000). Explanations of mathematical concepts in Japanese, Chinese, and U.S. first- and fifth-grade classrooms. *Cognition and Instruction, 18*, 181–207.

Rice, J. K. (1999). The impact of class size on instructional strategies and the use of time in high school mathematics and science courses. *Educational Evaluation and Policy Analysis, 21*, 215–229.

Stevenson, H. W., & Lee, S. (1997). The East Asian version of whole-class teaching. In W. K. Cummings & P. G. Altbach (Eds.), *The challenge of Eastern Asian education* (pp. 33–49). Albany: State University of New York.

Stevenson, H. W., & Stigler, J. W. (1992). *The learning gap: why our schools are failing and what we can learn from Japanese and Chinese education*. New York: Simon and Schuster.

Stigler, J. W., Fernandez, C., & Yoshida, M. (1996). Traditions of school mathematics in Japan and American elementary classrooms. In L. P. Steffe, P. Nesher, P. Cobb, G. A. Goldin, & B. Greer (Eds.), *Theories of mathematical learning* (pp. 149–175). Mahwah: Lawrence Erlbaum Assoc.

Stigler, J. W., & Hiebert, J. (1999). *The teaching gap: best ideas from the world's teachers for improving education in the classroom*. New York: Free Press.

Stigler, J. W., Lee, S.-Y., & Stevenson, H. W. (1987). Mathematics classrooms in Japan, Taiwan, and the United States. *Child Development, 58*, 1272–1285.

Stigler, J. W., & Stevenson, H. W. (1991). How Asian teachers polish each lesson to perfection. *American Educator, 15*(1), 12–20. 43–47.

Wang, J., & Paine, L. (2003). Learning to teach with mandated curriculum and public examination of teaching as contexts. *Teaching and Teacher Education, 19*, 75–94.

Watkins, D. A., & Biggs, J. B. (Eds.). (2001). *Teaching the Chinese learner: psychological and pedagogical perspectives*. Hong Kong: Comparative Education Research Center, The University of Hong Kong.

Zurawsky, C. (2003). Class size: Counting students can count. *Research points: essential information for education policy, 1*(2), 1–4. Retrieved March 18, 2008 from http://www.aera.net/uploadedFiles/Journals_and_Publications/Research_Points/RP_Fall03.pdf.