

A Postcard from a Primary Mathematics Classroom in Chongqing, China



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We often hear about how well other countries are performing in international tests such as PISA. In this article, Stephen Norton and Qinqiong Zhang describe a classroom and a tutor session from a Chinese setting. They describe the amount of time spent in class and out of class working on mathematics. Also they explain how learning is highly valued in the Chinese context.

Introduction

This paper, a snapshot of mathematics classrooms in a large Chinese city, is set against the growing interest in educational processes in east Asia, prompted by the dominance of these cultures in international mathematics tests. For example, Shanghai-China ranked first in mathematics proficiency, followed by Finland, Korea and Hong Kong, while Australia ranked 15th (Program for International Student Assessment (PISA), 2009).

The educational processes presented here are in the Chinese industrial city of Chongqing (population 28 million). The sample school and tutor school were chosen as a matter of convenience and may or may not be representative of the broader school system, although there is some evidence to suggest that the educational settings were above average but not typical of top schools that are better resourced.

The key participants in this story are the teachers of the children of the Year 2 and Year 3 classes, both regular school and tutor school. Classes are not streamed in this school as is the case in most Chinese Government schools. However, not all schools have the same status and an element of school streaming exists due to market forces where parents compete to enrol their children in primary schools with the best reputation. The subject school is not an elite school, but it was considered a fairly good school and is set in a metropolitan area close

to the University of South West China which by Chinese standards is mostly middle class.

Explanation of the authors' observations and questions are provided by four experienced mathematics teachers in a range of provinces. In the main, their commentary was mutually supportive; where a unique viewpoint was presented, as was the case in the tutor school, the contributor is identified.

Classroom observations

Observing a Year 2 classroom

The 50 students sat in rows of 4, with three rows across the room. There was a blackboard and a white screen onto which digital images were projected. Posters hung about the room but there was no evidence of materials typically seen in an Australian Year 2 class such as bundle sticks, place value charts, educational games, or other physical or educational props.

The lesson was conducted by the teacher who used a microphone to explain aspects of multiplication and division problems that were projected onto the screen. The range of problems included the following:

- One book costs 8 RNB, how much is needed to buy 5 such books?
- There were 45 cabbages; they have to be put into 5 baskets, what will the number of cabbages be in each basket, if they all have the same number?

Students were directed to discuss operations and solutions in small groups, and



Figure 1. Year 2 students present a justification for solving a multiplication problem.

then they reported their views to the class. In Figure 1, it can be seen that two teams of children were selected to argue the case for division or multiplication as the operation to solve a problem.

Figure 2 illustrates the class configuration where students worked on consolidation problems towards the end of the mathematics lesson.



Figure 2. Students consolidate with independent work.

There was no evidence of off-task behaviour and the children appeared happy and were highly engaged with the mathematics.

Observing a Year 3 classroom

In the second observation, a Year 3 class was developing a calendar. Before introducing this lesson, the teacher led the class in exercise and a song. This appeared to be a tool to generate enthusiasm. In Figure 3, the teacher and an observing teacher can be seen leading the exercise routine and song.



Figure 3. Teacher and observing teacher lead the children in song and exercise.

The class started with a discussion about what needed to be known to be able to construct a calendar. The children then set about constructing a calendar using scissors and coloured paper. There was considerable student argument, some of which appeared passionate, about particular calendar detail. As was the case in the Year 2 class, there was strong evidence of highly motivated students working hard on a well-constructed and managed lesson plan.

Samples of student work and teacher corrections

Teachers attempt to cater for each student's needs by correcting their work every day. A sample of a Year 3 student's work is illustrated in Figure 4 below. Question 2(1) "If nine books can be placed on each shelf, four shelves are needed. How many shelves will be needed if six books are placed on each shelf?"

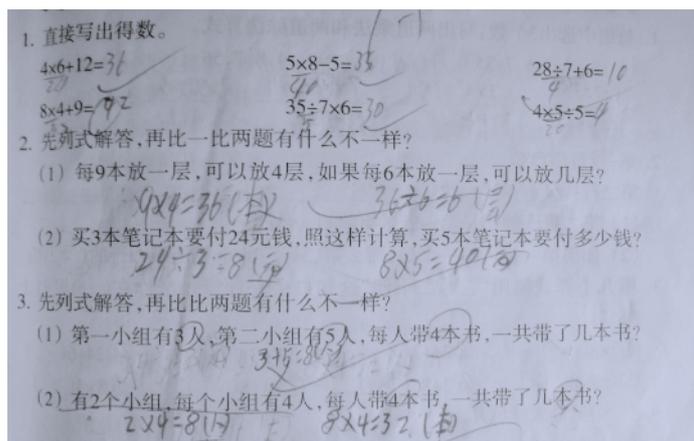


Figure 4. Student homework correct by the teacher.

The last question, 3(2), can be translated as follows: "There are two groups of four people, and each person has four books. How many books are there in total?" The reader will notice that while the solutions are correct, there are crosses on the student's working. This is because the teacher has marked incorrect two solutions and the student has rubbed out those solutions and reworked the problem. A curriculum leader commented that, "Chinese teachers need to mark and comment on students' homework every day and will need to have some explanations on the homework in class if necessary. Correcting mistakes is very important part in China's mathematics lessons."

A significant portion of the teacher's day is taken up with the regular correction of student homework and classwork. This practice is one of the main means of getting to know each student's mathematical level and providing timely feedback. If it is found that the student continues to struggle, the teacher will make up simpler questions that are similar to those that the student made mistakes with, and the children repeat these. This is called "teaching with variation": the structure of the problems remains the same but the numbers and context changes.

Observing the tutor school for Year 3 students

The tutor school was taught by Dafang, an experienced mathematics teacher. The class size was limited to 10 students and all were Year 3. The class was conducted on Sunday afternoon for two hours in a living room located in an apartment block. Students were delivered there by their parents. Most of the two hours was spent with the teacher writing problems on the blackboard; students would then attempt the problems and the teacher would question them on their thinking. The tutor set and checked homework each week and about 30 minutes was allocated to this task. Figure 5 illustrates the setting.



Figure 5. Sunday afternoon at the tutor school (25 December 2011).

The tone of the lessons in the tutor school was upbeat, largely driven by the enthusiasm of the tutor. The boy depicted in the background of Figure 4 shouts his solution.

Figure 6 is an example of the problem-solving that this tutor was using to extend her students.

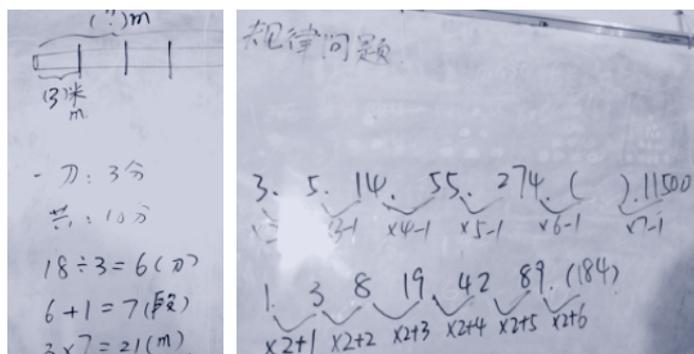


Figure 6. Tutor school problem-solving using proportional reasoning and problems introducing algebra (Year 3).

Interviews with teachers

Following is an interview with the teacher from the tutor school.

Interviewer: Dafang, why did you give a proportional reasoning question to Year 3 students?

Teacher: In your country, mathematics has been made easy for students but they still do not understand because there is too much play, play, play and many children do not like mathematics. In China, mathematics is much harder and deeper, but many students still like mathematics because children like to think deeply and succeed on hard mathematics. Every child is an explorer; they feel proud and happy when they notice they can solve such hard questions and think more deeply. This is still whole numbers, but I extend the children deeply with such questions and the beginning of algebra.

Interviewer: I did not see any calculators in the primary schools I visited or in your school. What is your view on the use of calculators in primary school?

Teacher: Calculators are useful in middle school. However, in primary school students need to use their head more and more. They need to be able to do mental and written calculations very efficiently and to know their facts and procedures very well. They do not need calculators for this.

Interviewer: Dafang, I did not see bundle sticks, base 10 materials and other concrete materials used in teaching number in your school or in the Year 2 class I observed. Can you comment?

Teacher: Materials are useful in prep and Year 1 but in Year 2 and Year 3, children need to know number facts and processes. Chinese students are not fearful of difficulty. They must think deeply and use their head.

In the next section, the observations regarding mathematics teaching and learning in Chinese schools are explored through the responses of four experienced primary teachers gained in a series of interviews. Their responses are synthesised.

Interviewer: Are the observed teachers typical of the quality in this school and how did they come to the teaching profession?

Teacher: Teacher training and selection is a very competitive process. These teachers are good teachers but they are not top teachers. Teaching is regarded as a status career since it is stable and is a noble endeavour; the salary is above average.

While undertaking teacher preparation the hopeful teachers are enrolled in the department of mathematics at university, where they have the same basic university mathematics as those students who intend to become engineers. In addition, they complete further courses on curriculum and pedagogy or curriculum reform. Finally, 120 hours is allocated to understanding the intention of the mathematics curriculum because of the recently introduced curriculum reforms. Attaining a teaching certificate also depends upon proficiency in three key areas: Mandarin language, ICT, and mathematics. In official Chinese schools, ongoing professional development is mandatory and a requirement

of teacher certification. Typically this development is 60 hours each year. Since these teachers only teach mathematics, most of this professional development would be related to their mathematics teaching.

Interviewer: What checks are there to maintain the quality of teaching?

Teacher: Once employed, a teacher has considerable job security. Still, a non-performing teacher is subject to ongoing assessment and pressure from the school administration and also their students' parents and grandparents.

Interviewer: Are all teachers in this school paid the same?

Teacher: Teacher performance contributes to their salary. The basic salary is 70 per cent; the remaining 30 per cent is proficiency-based. Student performance on tests provides data to evaluate students and this is considered when evaluating teacher proficiency.

The school has a head of mathematics (HOM) whose job it is to ensure that the curriculum is implemented effectively. The HOM will observe the teacher teaching, perhaps formally once a term but sometimes informally, just passing by and sitting in on the class. The principal also inspects lessons.

Interviewer: Who was the additional teacher in the Year 3 classroom?

Teacher: The school has a policy of peer assistance. Teachers view each other's classes then they discuss ways to teach better. Peer observation happens often, maybe once a week.

Interviewer: The teachers in this study seemed to have a tightly organised lesson sequence planned out: is that a correct observation?

Teacher: Yes, planning is very important. The teacher should have a very elaborate lesson plan; it should

be very detailed and should be checked, by the HOM or the principal on a regular basis.

Interviewer: Please tell me a typical day in the life of the teacher.

Teacher: The teacher usually has only two classes to teach and they are in the same grade. Typically a teacher will follow the class from Year 1 to Year 6. In this way, preparation would be incremental and the material similar to the previous year. The purpose of this policy is to make it easier for the teacher to understand the teaching and prepare for student questions.

Mathematics teachers are specialists. Apart from teaching the two mathematics lessons, the rest of the teacher's day is taken up with lesson planning, curriculum planning, marking student homework or tests, mathematics staff meetings or consultation with parents.

Interviewer: There were 50 students in the class but it appeared they all worked hard and there were no problems with classroom management. Can you explain this?

Teacher: These children are already in Year 2 and Year 3 and so they know how to behave. They understand it is very important to succeed at school. In China there is a proverb: "Education changes people's lives." This is why the children of China work so hard at study. In your country, Australia, a parent might feel if a child is overworked at school, he or she might consider that overwork caused the child to be unhappy. By contrast, the typical Chinese parent would consider, "If I let my child be happy now, he or she will be very unhappy in their future life." If a child's parents or grandparents are called to the school because their child has not worked hard or has disturbed the

class, the adults will ‘lose face.’ Parents understand that a good education is very important to the child’s future and the children understand this as well.

Interviewer: The students seemed to be doing work a year or so in advance of what I would expect in an Australian school. Can you comment on the curriculum and why this might be the case?

Teacher: Most Chinese students work hard in class and, on average, each primary child would receive 150 hours of mathematics instruction each year and would be set about 100 hours of formal mathematics homework. On top of this, most children undertake several hours of additional mathematics tuition at private after-school classes. In this school region, approximately 50 per cent of Year 3 students would attend tutor schools, but by Year 6, the percentage of students attending tutor schools could be as high as 90 per cent.

Synthesis and summary of observations

The high academic learning time may well be the single most important variable accounting for the high performance of many Chinese students in international tests (e.g., PISA, 2009). It was not simply a matter of the high time on task in school lessons, but also the additional learning time associated with focused homework and after-school tutorials. Children were expected to deal with the abstraction of whole number computation, algebraic concepts and proportional reasoning without the support of material props usually recommended in early childhood teaching of mathematics in Australian settings. The high level of engagement observed in large classes and in the tutor school can be linked to two important variables: teacher quality and cultural pressure. Teacher quality was facilitated by

the necessity of primary mathematics teachers having high levels of mathematical knowledge and being able to specialise in mathematics education during their training and subsequent professional development. Competition for government recognised teaching positions enabled employers to select highly qualified graduates with demonstrated knowledge and pedagogy. Once employed, teachers were motivated via financial reward to teach to a very high standard. In this endeavour, teachers were supported by the school administration and peers via a peer review process. The limited class contact time enabled the teachers to devote considerable energy into planning, marking, and delivering quality lessons. Daily marking of student homework and classwork, and providing written feedback was a major mechanism to get to know the academic ability of individual students and provide pertinent feedback. It also enabled the teacher to plan to remediate student mistakes in subsequent lessons.

The interview data revealed that strong cultural pressures supported education in China. Learning was highly valued, as was social responsibility. Children simply expected to work to the best of their ability and in the main lived up to this expectation. The pressures to do so were extrinsic in the form of potential access to superior educational opportunities and subsequently employment. In addition to this, as the tutor explained, many students were motivated to excel for the sake of excellence.

According to the four teachers interviewed, the major challenge for Chinese education was to maintain the quality of fundamental mathematics and add a layer of creativity to this. The level of argumentation and justification among students in each setting was a reflection of the Chinese government’s emerging focus on student-centred learning to help meet this goal.

Reference

Program for International Student Assessment. (PISA). (2009). *Results: What students know and can do: Student performance on reading, mathematics and science Volume 1*. Accessed at <http://www.oecd.org/dataoecd/10/61/48852548.pdf>