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**Introducing Investigations Math Games in China:  
Successes and Surprises**

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The power of games in mathematics classrooms has been widely recognized due to how it impacts student engagement and learning. At our own school, we utilize games developed through our mathematics curriculum to engage learners, pull small group strategy lessons for remediation, and develop skills. Recently, we had an opportunity to visit Chinese classrooms, during which, we had an opportunity to teach benchmark games for grades 2nd through 4th, presenting math games to students, teachers, and administrators. This cross-cultural experience leads us to explore math games in a cross-cultural setting. In particular, we ask two research questions (a) how do Chinese students perform with the games used in US classrooms? (b) how do Chinese educators view the US games used with their students?

### **Literature Review**

The value of games centers around engagement and giving formative feedback to impact instruction. According to Rutherford (2015), math games are engaging and motivating. They not only encourage students to develop their mathematical understanding and reasoning, but also afford opportunities for students to work collaboratively and thus deepen their discussions about mathematics with their peers. Rutherford argued that through social interactions, students engage with the content and are more apt to learn. As such, games have become an important tool for learning in our U.S. elementary school math classrooms.

In recent studies about digital games, Gresalfi (2018) stated that “New games are being developed every day that claim to support learning of academic skills and concepts... they are good at capturing attention, sustaining engagement, providing interesting contexts, and giving feedback about performance.” (pp. 408-410). Even though games are well valued by literature and widely used in many US classrooms, we are curious about whether they will work in the same way in Chinese classrooms, given that potential cross-cultural differences.

## Methods

We, a group of elementary teachers from the same school teaching grades 2-4, conducted an action research that includes five-step procedure: planning, presenting, teaching, discussing, and reflecting upon the teaching of math games as detailed below.

(1) Plan. We met to discuss and choose the games for grades 2 - 4 to be presented to Chinese students. We chose games that would be most engaging and purposeful for benchmark objectives for each grade level. Figure 1 illustrates the math games chosen for each grade level from Pearson's Investigations Curricula. For the 2nd grade classroom, we selected "Get to 100," which aims to give students practice in fluently adding and/or subtracting within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction. For the 3rd grade classroom, we brought Array Cards to compare. Array Cards provide students with a way to practice and learn their multiplication combinations. They also help children develop an understanding of the operation of multiplication, its properties, and the relationship between multiplication and division. For the 4th grade classroom, we selected "Multiple Turn Over." This game encourages students to become more fluent with multiplication facts up to  $9 \times 9$  using a variety of mental strategies; multiplying two-digit whole numbers by one-digit whole numbers.

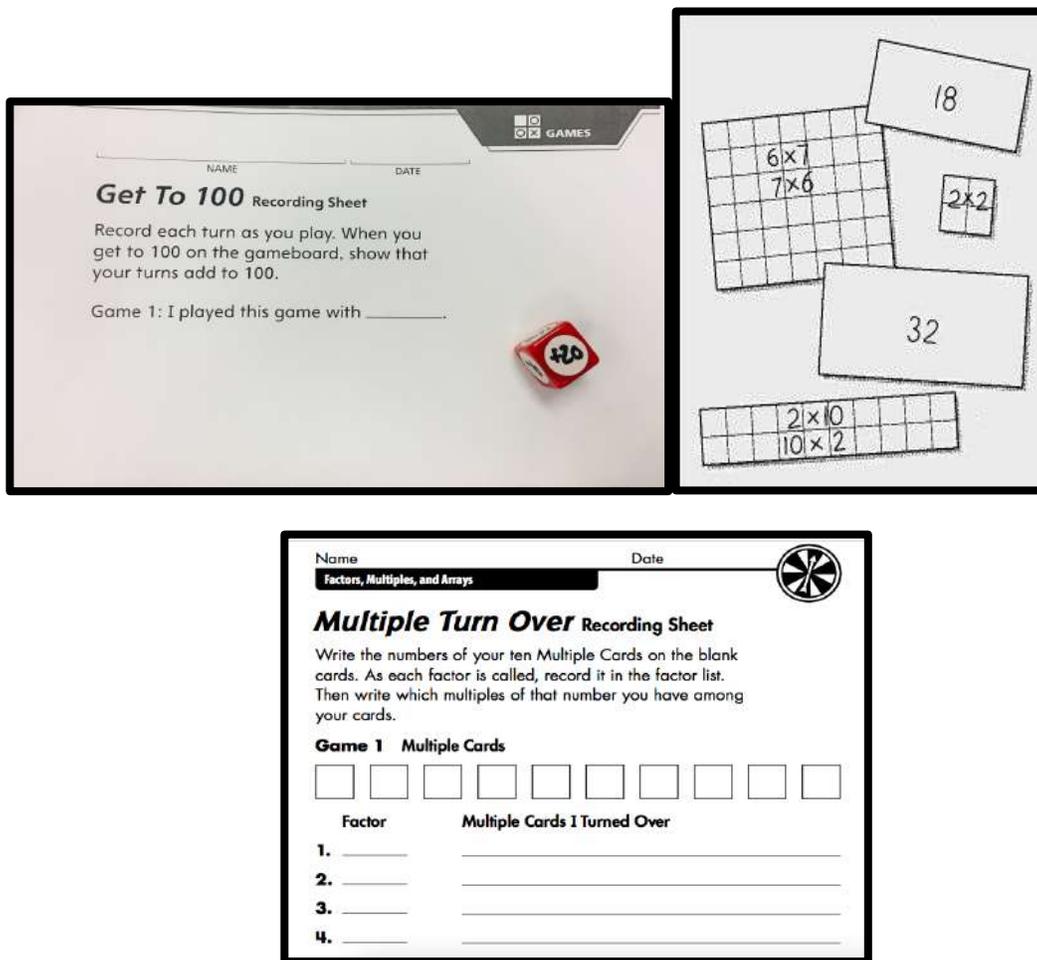


Figure 1. Selected 2nd, 3rd, and 4th grade games from Investigations Curriculum to teach Chinese students.

(2) Present. One of our first opportunities in China was to be a part of an educational conference during which, we presented on a panel to discuss concepts we were exploring in mathematics education in the United States. In particular, the authors of this action research presented a talk centering on the importance of playing games during the math block (see Figure 2).



*Figure 2.* Authors of this action research presented a talk about math games.

(3) Teach. We presented math games for 2nd, 3rd, and 4th grade classes in China. As introduced above, each game involved students working with partners using dice, 100 charts, digit cards and/or array cards. The games were based on reviewing math concepts or help children build math fluency. All of the lessons were videotaped. Figure 4 illustrates a few images from the third grade lesson.



*Figure 3.* Third grade teachers introducing arrays through an array card game.

(4) Discuss. After presenting our games, we focused our discussion with our Chinese teacher colleagues and school administrators around the math games we presented. Using the game lessons as a starting point, our conversation went beyond games to include the exchanges

of our math teaching philosophy between two countries. Figure 5 illustrates a moment of our post-lesson discussion.



*Figure 4. Teachers convene to discuss lessons and talk about instructional practices.*

(5) Reflect. At the end of our trip, we had a group discussion amongst U.S. participants about the lessons learned including the value and purpose of games.

All of our planning and teaching were documented; our presentations, the teaching of games to Chinese students, and discussion about games with Chinese colleagues were videotaped. In the end, our group reflections were audiotaped. These documentations and tapes formed sources of data, which were first viewed by the authors and then qualitatively analyzed by memoing and theme-seeking.

## **Results**

Our findings were straightforward; yet they indicated both successes and surprises. Below we report our findings based on our two research questions.

### **How do Chinese Students Perform with the Games Used in US Classrooms?**

We found that Chinese students were receptive to the games. They told us they had fun playing them and enjoyed competing against each other to show their fluency. In each classroom

we taught, the children were overwhelmingly engaged in the math games. Much like students in the United States, you could hear chatter of excitement from the Chinese students playing the game. Students sat facing their classmates, engaged in conversation about the games, interacting with the game pieces, and intent on studying each others' moves. The moments in *Figure 5* indicate Chinese second, third, and fourth graders' engagement in the games we brought to China.



*Figure 5.* Chinese 2nd, 3rd, and 4th graders were engaged in playing Investigation math games from the United States.

## **How do Chinese Educators View the US Games Used with Their Students?**

Our Chinese counterparts did acknowledge the power of games and importance of engaging students. For instance, the principal of the school we taught the game commented, "... for play, the (children) were very interested..."

Despite the acknowledgement of the game value, our Chinese counterparts in this study questioned us about our purpose for each of the games and thought that these games were not relevant for their students at the grade level we taught, because they were practicing a skill that they had already mastered. For example, the principal commented that the students in 3rd grade had already mastered multiplication, "For the Chinese students the games were very simple... but for a grade level below, it's perfect." He also talked about how Chinese teachers "may use a game during a new lesson that's more concrete, but once that's done, (the students) have very intensive practice." As a result, they may sacrifice student interest at the point of teaching and drilling new concepts.

However, when we met to debrief about the experience with our peers, most of us admitted that's simply not the reality that we are faced with in the United States. Not all of our students are intrinsically motivated to learn mathematics, and as such, we not only need to teach and drill new concepts, but we must focus on motivating and engaging our students. Bragg (2007) proposed that "Game playing has the potential for children to develop a positive attitude towards mathematics as it has the characteristics associated with a positive experience." As educators, utilizing math games in the classroom does more than simply teach and reinforce concepts, but rather encourages students to engage in mathematics in a positive way, which in turn, helps us to motivate students to do more.

## Discussion

Findings in this study resulted in two aspects of reflections on the teaching of games. First, engagement does not equate with learning. While this is not a new point of view, our Chinese trip made this point more outstanding than ever. Just because our students are engaged in a math game does not necessarily mean they are deepening their mathematical understanding. Second, it is crucial to consider the purpose of games to maximize students' learning. In our observations, we noticed that Chinese math lessons often consisted of a 40-minute block with direct instruction, partnerships or small group work, and an essential “worked example” that led to deeper understanding of one specific math concept. However, we did not witness math games in the traditional sense, but rather riddles and investigations that infused the power of play through instruction. Figure 7 illustrates an example we noticed during our Chinese classroom visit but outside the current study.



*Figure 6.* An example of Chinese games in math classrooms.

In this example, after her working in small groups, a first grader was assembling a 100's grid puzzle in front of the class as part of a teacher-led investigation. While these well-crafted, succinct lessons are more effective in delivering key concepts than our purported ideas with math games, we still think that games, if used appropriately, will help maximize students learning

potential. As pointed out by the literature, Bragg (2007) suggests that “Games may have the potential to provide students with a mathematically focused activity while engaging them through a perception of fun.” As such, “Research over many years has established that attitudes play a significant role in learning mathematics” (McLeod, 1992). There are positive correlations between attitude and achievement. We have found that games are useful tools for motivation, remediation, practicing fact fluency, and collaboration.

However, through our experience of presenting and teaching games in China and conversations with Chinese teachers and administrators, we come to realize that educators should focus more on being purposeful in developing well-crafted lessons and opportunities for the investigation of math concepts. As Lim-Teo (1991) described in his research, games can be classified in different ways based on purpose or goal. “There are many types of games which can be used in the mathematics classroom and the following is a possible classification: 1) Games from drill and practice 2) Games for concept reinforcement 3) Games which lead to concept formation 4) Games which lead to mathematical investigations 5) Games which apply mathematical knowledge 6) Games for fun.” (pp.47-48) After our discussions with Chinese educators, we realized the importance of understanding the roles of the games we include in our lessons and to share their purposes explicitly with our students. Are we playing games that are purposeful or are we playing games to occupy students who already have mastered a skill in order to have time in our schedule to work with students who need remediation? As educators, it is important for us to understand the role that math games are taking in our classroom. After our Chinese classroom visit, we sought out additional research to help outline the different roles that math games can pose in the classroom.

While thinking back about our successes and surprises in teaching games to Chinese students, we realize that a major difference that affects our use of games in our own school day is

the amount of time that is allotted for the teaching mathematics. In our school we are mandated to teach mathematics within a 90-minute block of time, unlike our Chinese counterparts who typically have a 40-minute math lesson. Our block is typically split into two, 45-minute blocks. While the first block now resembles the model lessons we have seen in China utilizing worked examples to illicit mathematical discourse, the second block of our day continues to include math games, computer-based interventions and small group instruction. Our Chinese experiences made us extremely conscious of explicitly discussing the purpose of the game, reinforcing the concepts learned through the game, and concluding the game with talks about strategies. We anticipate what we have learned from this Chinese-US collaboration experiences is informative for other classroom teachers and teacher educators who are interested in supporting student learning through math games.

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