International Journal of Early Years Education
Vol. 19, No. 2, June 2011, 133–143

Cultural differences in early math skills among U.S., Taiwanese, Dutch, and Peruvian preschoolers

Jae H. Paik[a]*, Loes van Gelderen[b], Manuel Gonzales[a], Peter F. de Jong[b] and Michael Hayes[a]

[a]*Department of Psychology, San Francisco State University, San Francisco, California;* [b]*Research Institute of Child Development and Education, University of Amsterdam, Amsterdam, The Netherlands*

(*Received 23 September 2010; accepted 1 April 2011*)

East Asian children have consistently outperformed children from other nations on mathematical tests. However, most previous cross-cultural studies mainly compared East Asian countries and the United States and have largely ignored cultures from other parts of the world. The present study explored cultural differences in young children's early math competency prior to their school entry among U.S., Taiwanese, Dutch, and Peruvian four-year-olds. Results showed that the Taiwanese children performed better than U.S., Peruvian, and Dutch children. No difference was found between U.S., Peruvian and Dutch children. In addition, results revealed that more Taiwanese four-year-olds were able to count up to at least 21 when compared with children from the other three countries. We discuss varying cultural factors (e.g. language and parental support) as contributing reasons for East Asian children's high mathematical skills at an early age.

Keywords: mathematics; cross-cultural; conceptual development; early childhood mathematics education

Over the last few decades, cross-national comparisons have consistently shown East Asian students' superior performance on numerous mathematical tasks compared to their international peers (Organisation for Economic Co-operation and Development n.d.; National Center for Education Statistics n.d.). Various factors related to both home and school experiences have been postulated in attempting to explain this international mathematics achievement gap. For one, East Asian students have been found to spend more time on math instructions, working on math homework at home, and solving challenging problems in comparison to U.S. students (e.g. Stigler and Hiebert 1999). Related to home experiences, studies have shown that parental attitude and practices also vary greatly where East Asian parents show high expectations for their children's mathematics education and provide more support and encouragement when compared to U.S. parents (e.g. Zhou et al. 2006). Further, East Asian teachers have been found to possess in-depth knowledge of mathematics and provide multiple strategies and modes for solving a single problem (e.g. Ma 1999).

Abundant cross-cultural studies have been conducted in order to examine how various cultural factors such as attitude, education system, instructional, and parental

*Corresponding author. Email: jaepaik@sfsu.edu

ISSN 0966-9760 print/ISSN 1469-8463 online

http://dx.doi.org/10.1080/09669760.2011.600276
http://www.tandfonline.com

practices affect mathematical development. Most of these cross-cultural comparisons have been done with elementary or middle school age students where the international mathematics achievement gap is present (e.g. fourth and eighth grades from TIMSS, IEA 2006; 15 year olds from PISA, OECD 2006). However, recent studies suggest that an international mathematics achievement gap is already taking shape even before children start their formal instructions in school. For example, already in first grade Chinese children have been found to outperform Western children in various mathematical tasks such as counting, number formation and comparisons, single digit addition and subtraction, and problem-solving strategies, all before the time of school entry (e.g. Geary, Fan, and Bow-Thomas 1992). In another study, Siegler and Mu (2008) found that Chinese kindergarteners' number estimation skill – ability to estimate where number *n* should be positioned on a number line between 0 and 100 – was considerably more advanced than those of U.S. kindergarteners'. In fact, Chinese kindergarteners' number estimation skills have been found to be similar to the skills observed in U.S. second graders; best fitted on a linear function, which indicates a more accurate representation of number magnitude (Siegler and Booth 2004).

Cross-cultural differences in younger children's mathematics ability indicate that East Asian children are entering formal schooling with an apparent advantage. These findings further imply that children's experience during their formal schooling may not fully portray how East Asian students come to excel in mathematics relative to their international peers. It seems as though young East Asian children are already forming a strong foundation of mathematical knowledge prior to school entry and are better prepared to learn formal mathematics in school. East Asian children's superior mathematical skills have led several researchers and educators to investigate various contributing cultural factors.

Researchers claim parental involvement and practices as one of the major contributing factors for young East Asian children's advanced math skills prior to formal school entry (Zhou et al. 2006). Because almost all children rarely experience direct instructions on mathematics in preschool or other childcare settings, much of their early number knowledge is communicated through a wide range of mathematical relevant interactions embedded in their everyday activities with their parents. Studies are beginning to show that East Asian parents are providing substantially more practice with numbers and offer more positive attitudes towards math activities than Western parents, even with very young children. For example, Zhou et al. (2006) found that Chinese parents engaged their four-year-olds in more math-related events (e.g. counting, naming shapes, using ordinal numbers and spatial words, grouping and comparing object size) when compared to Canadian parents. Similarly, Huntsinger et al. (1997) compared parental practices among Chinese-American, Taiwan-Chinese, and Euro-American children and found that Chinese-American and Taiwan-Chinese parents provided more formal mathematics instructions to their kindergarteners and presented more encouragement and support for their involvement in math-related activities.

It is not trivial that more exposure to math activities at home would lead to better mathematical skills in young children. Thus, parents may play a crucial role in preparing their children to learn formal mathematics in school. This claim is further boosted by the findings of Blevins-Knabe and Musun-Miller (1996) that the amount of exposure to number-related activities with parents is a strong predictor for U.S.

children's math performance. Although this study only included U.S. children and parents, such findings illuminate the possible impact of cross-cultural variations in parental practices on children's mathematical development.

As another possible explanation, researchers have investigated the role of mathematical language across culture (e.g. Fuson and Kwon, 1992). Some languages reflect simpler mathematics systems than others. The fundamental idea is that children may learn mathematical concepts easier if mathematical language is straightforward and/or systematically structured. Consider the counting systems of East Asian languages such as Chinese. These counting systems are highly transparent and systematically structured (see Table 1). While the English counting system has irregularly formed decade names (e.g. *twenty*) and *teen* structures (e.g. *eleven*), the Chinese counting system is regularly structured (e.g. 11 is called *ten-one*). Thus, once the number words for *one* through *ten* are acquired, most of the higher numbers can be formed in a systematically structured manner (e.g. 99 is called *nine-ten-nine*). Numerous studies have shown that such systematic counting systems in many East Asian languages facilitate understanding of number concepts and place-value, help develop counting skills, and promote faster and more accurate computational skills (e.g. Miller et al. 1995).

Despite the increased interest in early childhood mathematical competency and experience, there are still limited cross-cultural studies that investigate the similarities and differences in children's math skills and its contributing cultural factors (e.g. Towse and Saxton 1997). Further, most of the previous cross-cultural studies mainly compared East Asian and western cultures and have largely ignored cultures from other parts of the world. More comprehensive cross-cultural comparisons in this area will provide opportunities to reflect upon our own and other cultures' beliefs and practices about early mathematics development, and offer ways of improving young children's experiences that are most conducive for learning. In the present study, we further explored cultural differences in young children's early math competencies (see NCTM 2000, principles and standards recommended for preschoolers) prior to their school entry among U.S., Taiwanese, Dutch, and Peruvian four-year-olds. Early math competencies were conceived in the current study because children during the preschool years mostly lack formal instructions on math. The results from the present study will shed insights towards understanding cultural factors contributing to young children's early math skills. Further, because we examined four distinct cultures with varying language and cultural practices, the results will provide a more extensive picture of the international differences that may exist among young children. Based on previous cross-cultural studies, we expected to find that Taiwanese preschoolers would perform better on math tasks, in comparison to their U.S., Dutch, and Peruvian peers. We also reasoned that Dutch children may perform better than U.S. and Peruvian children, given the findings that older Dutch students consistently perform high on international math tests (e.g. Dutch students ranked 5th while U.S. students ranked 36th on PISA, 2007). However, Dutch students' superior mathematics performance may not begin to show until students enter formal schooling. If so, Dutch four-year-olds should perform the same as the U.S. and Peruvian children.

Table 1. Rules for number formation in Chinese and English.

Counting to ten										
English:	One	Two	Three	Four	Five	Six	Seven	Eight	Nine	Ten
Chinese:	yì	èr	sãn	sì	wu	liù	qi	bã	jiu	shí
Ten to twenty										
English:	Eleven	Twelve	Thirteen	Fourteen. . .	. . .Nineteen	Twenty				
Chinese:	shí yì	shí èr	shí sãn	shí sì. . .	. . .shí jiu	shí èr				
Twenty to one hundred										
English:	Decade name	+	'–ty'	+	unit:	'twenty-seven'				
Chinese:	Decade unit	+	shí	+	unit:	èr shí qì				
Beyond one hundred										
English:	Hundreds unit	+	hundred	+	decade name	+	'–ty'	+	unit:	'one hundred thirty one'
Chinese:	Hundreds unit	+	'bal'	+	decade unit	+	shí	+	unit:	yì bal san shí yì

Method

Participants

Twenty-one Taiwanese (*M* = 52 months; *SD* = 3), 21 U.S. (*M* = 53 months; *SD* = 4), 20 Peruvian (*M* = 51 months; *SD* = 3), and 24 Dutch (*M* = 53 months; *SD* = 2) four-year-olds attending preschools participated in this study. Children were recruited from preschools that served middle to upper middle class families. All preschools were situated in or near one of the major cities (i.e. Taipei, Taiwan; San Francisco Bay Area, U.S.; Lima, Peru; and Amsterdam, the Netherlands). Approximately an equal number of boys and girls participated in this study. Making comparisons across cultures can be a difficult task because of the many variables involved in cross-cultural research. Therefore, in an attempt to reduce the number of differences, every effort was made to match participants based on age, SES, and sex.

Procedure

All children were individually tested on the Test of Early Mathematics Ability – Third Edition (TEMA-3) developed by Ginsburg and Baroody (2003). The TEMA-3 assessed both formal and informal mathematical knowledge (e.g. counting, number literacy, seriation, and calculation skills). The TEMA-3 has been standardised with children between 3 and 8 years of age, purports to be free of sex and ethnic biases, and has shown a strong internal reliability ($\alpha = 0.92 \sim 0.96$). Further, scores on TEMA-3 have been found to correlate significantly with other measures of mathematical achievement and academic aptitude tests (Ginsburg and Baroody 2003). For the purpose of our study, TEMA-3 was translated from English to Chinese, Spanish, and Dutch by native speakers of these languages. Then, translated versions of TEMA-3 were translated back into English by another native speaker of these languages. Any discrepancies were then discussed with the authors of this paper and the translators.

The TEMA-3 consists of 72 items. The standard procedures as defined in the TEMA-3 manual and the examiner's kit were utilised. The TEMA-3 includes a mixture of informal and formal mathematical items. Informal mathematical items are designed to examine children's informal concepts and skills that children do not learn in the context of formal schooling; rather, acquired through various informal ways (e.g. self-initiated or spontaneous interaction with the environment, observations and reflections on their everyday activities, and informal play or conversations with adults). Some of these informal mathematical items include children's ability to perceive more or less, understand the cardinality rule, and verbal counting up to 21. In contrast, formal mathematical items test children's varying knowledge related to number and arithmetic skills taught through formal instructions (e.g. knowledge of written symbols or conventions, number facts, and rationale for procedure). Sample items include reading and writing numbers and children's understanding of symbolic additive commutativity (see Ginsburg and Baroody 2003 for more information).

In every country, a native speaker administered the test. Children were escorted individually from his/her classroom to another testing room. The researcher and the child sat facing each other with the testing material placed evenly between them. The testing time varied depending on how far each child was able to perform on TEMA-3. However, all children completed the test between 15 and 45 minutes. All children spoke the national language of their country as their native language and no children were excluded from the test.

Results

The primary goal was to compare mathematical abilities of preschool children in Taiwan, U.S., Peru, and the Netherlands. Figure 1 shows children's mean raw scores on TEMA-3. A Univariate Analysis of Variance was conducted on children's raw scores on TEMA-3 with nation as the between-subjects factor (i.e. Taiwan, U.S., Peru, and Netherlands). The ANOVA revealed a main effect of nation, $F(3, 81) = 15.30$, $p < 0.001$. Follow-up post-hoc analysis (Tukey) indicated that Taiwanese children ($M = 21.76$, $SD = 6.08$) performed significantly better than U.S. ($M = 11.67$, $SD = 4.82$), Peruvian ($M = 10.25$, $SD = 5.14$), and Dutch ($M = 12.13$, $SD = 7.03$) children, all ps < 0.0001. There was no difference between U.S., Peruvian, and Dutch children's performance. According to the normative scores set by TEMA-3 (Ginsburg and Baroody 2003), it was found that U.S., Peruvian, and Dutch children were performing at the standard level for the given age group, while Taiwanese
four-year-olds were performing at the level of five-year-olds. However, these results must be taken with caution as TEMA-III scores were standardised using U.S. children alone.

As mentioned earlier, it has been postulated that East Asian children's superior performance on mathematics are due to their systematic counting system (e.g. Fuson and Kwon 1992). If so, Taiwanese four-year-olds should show superior counting abilities compared to that of other peers. We have specifically examined one test item on TEMA-3 that examined whether or not children were able to count up to at least 21. For each nation, the number of children who were able to count up to at least 21 (a.k.a., Counters) and the number of children who failed to count up to at least 21 (a.k.a., Non-Counters) were tallied. Although most children did reach this test item, if children did not reach this test item, they were counted as Non-Counters. Table 2 shows the percentage and the number of Counters and Non-Counters for

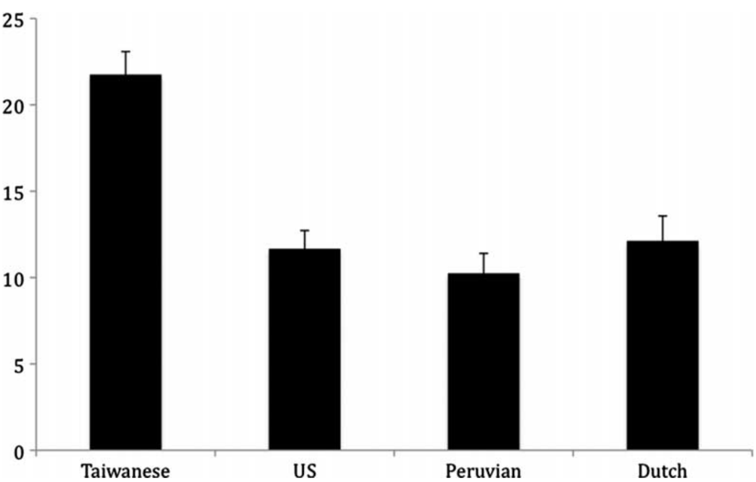

Figure 1. Children's mean performance scores on TEMA-3.

Table 2. Percentage and number of children who were and were not able to count up to 21.

	Counter	Non-Counter
Taiwanese	76.62% ($n = 16$)	23.38% ($n = 5$)
U.S.	9.52% ($n = 2$)	90.48% ($n = 19$)
Peruvian	20% ($n = 4$)	80% ($n = 16$)
Dutch	29.17% ($n = 7$)	70.83% ($n = 17$)

each nation. Indeed, the Chi-square test revealed a significant difference among these nations, $\chi^2(3,\ N = 86) = 17.75,\ p < 0.001$. A series of Wilcoxon-Mann-Whitney tests indicated that the variability was due to more Taiwanese children counting up to at least 21 than U.S., Peruvian, and Dutch children, all ps < 0.01. No differences were found between other nations.

Discussion

The results from the present study revealed a clear picture of cross-cultural differences in young children's math ability prior to their school entrance. We did find superior math skills in Taiwanese preschoolers when compared to those of U.S., Dutch, and Peruvian preschoolers. Such a finding is consistent with overwhelming data that shows how older Taiwanese students are dominating the top spots on various international mathematics tests. However, there was no difference in math skills among U.S., Dutch, and Peruvian preschoolers. This result is not in line with the finding that older Dutch students have been found to outperform U.S. students on various international mathematics tests. Similarly Peruvian preschoolers' equal-leveled performance with their U.S. and Dutch peers is not in accordance with Peruvian school-aged students having been found to underperform on many international mathematics tests. In fact, in a study conducted by UNESCO, Peruvian third and fourth graders were ranked 11th and 12th, respectively, among the 12 participating Latin American countries (UMC and GRADE, 2001). Taken together, the findings from the present study suggests that cross-cultural patterns of preschooler's math performance do not completely mirror and, thereby, cannot fully account for the well-established international trends that we find with older school-aged students.

The present findings seem to suggest that perhaps over-achieving math abilities among young children may only be limited to East Asian cultures such as Taiwan. However, it is still early to make such a conclusive claim as the current field lacks comprehensive cross-cultural comparisons among young children. As far as we know, the present study is one of its first to include four cultures from four different continents. There are a number of previous cross-cultural studies that have also found young East Asian children's superior math skills (e.g. Zhou et al. 2006). However, these studies mainly compared East Asian and western cultures and have largely ignored cultures from other parts of the world. Indeed, future research investigating the cultural differences in young children's math abilities and math-related experiences seem promising.

It was evident that Taiwanese preschoolers had superior early mathematical skills. Not only did Taiwanese children perform significantly better on TEMA-3 overall, the majority of Taiwanese children breezed through counting up to 21 while an overwhelming number of the U.S., Dutch, and Peruvian children failed to count up to 21. Many have argued that the systematic numbering system in the Chinese language is largely responsible for Taiwanese children's advanced math skills at such a young age (e.g. Fuson and Kwon 1992). Inclusion of the three other cultures with distinct languages (i.e. English, Dutch, and Spanish) in the present study provides additional support for this idea; namely, because both Dutch and Spanish numbering systems are also irregularly structured. Similar to the English numbering system, the Dutch numbering system also contains an irregular teen structure and improper decade names. In fact, the Dutch numbering system may be even more confusing for young learners as the ordering of the *tens* and *ones* units shifts suddenly for numbers higher than 20 (e.g. 21 is spoken as *one-and-twenty*). The Spanish numbering system is also similar to the English numbering system, containing an irregular teen structure and improper decade names, which makes it difficult for young learners to perceive and acquire the organisation of their numbering system. The fact that English, Dutch, and Spanish numbering systems are irregularly structured and the findings that preschoolers from these cultures all performed at the equal level on TEMA-3 seems to be consistent with the idea that numbering systems may play a role in the development of early mathematical skills.

However, interpreting any cross-national comparisons should be made with caution, as there exist various confounding cultural variables. More specifically, it is possible that other cultural differences such as parental practices and preschool systems may play an even more profound role in young children's mathematical development than systematic numbering systems. Thus, in order to better control for these cultural variables, it may be beneficial to examine children living in close proximity in one culture but learning both systematic and irregular systems. For example, Welsh number words are similar to that of Chinese numbering system, and are formed by re-organisation of the words for 1 to 10. Dowker, Bala, and Lloyd (2008) compared children who spoke Welsh at both home and school (WW), children who spoke Welsh at school and English at home (WE), and children who spoke both English at home and school (EE) and found that the WW group performed best and EE group performed worst at recognising numbers and comparing two-digit numbers. Taken together, the present results and previous studies suggest that there is value in further examining the role of language on learning mathematical concepts. Some researchers and educators have already proposed putting efforts into making the base-10 structure of numbering systems more transparent and accessible to those children who are learning the irregular numbering system, such as children in the U.S., and examining improvement in their math skills (e.g. Miller et al. 1995). These innovative educational approaches will help researchers better understand the magnitude of language effects on learning various mathematical skills.

The present findings also beg for comprehensive cross-cultural studies that investigate the role of early formal math-related experience on children's future mathematics achievement. Because we tested four-year-olds who most likely have had limited exposure to formal instructions on number concepts in their preschools, it is reasonable to assume that most of the formal math skills that are involved in the TEMA were acquired through math-related activities initiated by their parents at home (e.g. counting, using ordinal numbers, grouping, and comparing object size). Although limited, cross-cultural studies already show a discrepancy in the amount of activities related to the acquisition of formal math skills that parents provide to their children among East Asian and Western countries (e.g. Zhou et al. 2006). Further, East Asian parents have been found to be more knowledgeable about mathematics and provide higher quality of instructions to their young children when compared to Euro-American parents (e.g. Huntsinger et al. 1997). Through parental support and direct instructions, East Asian children may have more opportunities to develop various skills (e.g. number recognition, counting, and simple arithmetic) that are critical for the emergence of more advanced mathematical skills. The importance of early math activities is also supported by other studies showing that young U.S. children's math skills are directly related to the amount of math activities they engage in (e.g. Siegler and Ramani 2008). Longitudinal studies have demonstrated that if children enter primary school with apparent gaps in their mathematics ability, these gaps continue to increase as they proceed to higher grade levels (e.g. Geary 2006) and it would be important to examine the types of math activities and materials East Asian parents provide to their children in everyday settings.

Lastly, it may be important to compare the amount and the type of math-related activities that are covered in preschool settings across cultures. Based on cultural values and educational systems, preschool education takes different roles in supporting children's learning in early mathematical skills cross-nationally. Many U.S. early childhood educators practice child-centred and self-discovery approaches to math development rather than imposing knowledge directly on children (e.g. Brewer 1992). Some teachers take an even more radical approach where math-related activities are completely eliminated from their classrooms as they view them as formal activities that are inappropriate for young developing children (e.g. Pramling and Pramling Samuelsson 2008). In contrast, general cultural attitudes towards high expectations for mathematics education in East Asian cultures may also steer the ways early childhood educators design their activities and materials in their classrooms. In fact, a recent cross-cultural observational study has found that Taiwanese preschool teachers presented more math-related instructions and activities to their preschoolers than U.S. and Peruvian teachers (Gonzales and Paik 2011). Further, Taiwanese teachers seem to have higher expectations from their preschoolers than U.S. and Peruvian teachers. For example, it was found that Taiwanese preschool teachers were covering higher numbers (e.g. numbers above 20) while the highest number covered by U.S. and Peruvian classrooms was 16. Future studies further examining the role of preschool instructions and math-related activities provided to children across cultures will be important especially in developing preschool curriculum that will facilitate early mathematical development.

We acknowledge that many cultural factors combined together come to influence the development of early math skills and understanding. However, it is clear that many East Asian children are entering primary school with an apparent advantage compared to the rest of their international peers. The cross-cultural mathematics achievement gap is taking shape as early as the preschool years and this gap may continue to grow during later academic years. In an attempt to reduce the international mathematical achievement gap, we suggest it is pertinent to study cultural factors that may bring about this gap in the first place. To this end, efforts aimed at improving early childhood mathematics education and incorporating effective math-related activities would be important steps towards improving children's mathematics skills in the United States as well as other parts of the world.

References

Blevins-Knabe, B., and L. Musun-Miller. 1996. Number use at home by children and their parents and its relationship to early mathematical performance. *Early Development & Parenting* 5: 35–45.

Brewer, J.A. 1992. *Introduction to early childhood education: Preschool through primary. Grades*. Boston, MA: Allyn and Bacon.

Dowker, A., S. Bala, and D. Lloyd. 2008. Linguistic influences on mathematical development: How important is the transparency of the counting system. *Philosophical Psychology* 21: 523–38.

Fuson, K.C., and Y. Kwon. 1992. Korean children's single-digit addition and subtraction: Numbers structured by ten. *Journal for Research in Mathematics Education* 23: 148–65.

Geary, D.C. 2006. Development of mathematical understanding. In *Cognition, perception, and language*, vol. ed. D. Kuhl and R.S. Siegler, Vol. 2, 777–810. *Handbook of child psychology,* gen. ed. W. Damon, 6th ed. New York: John Wiley & Sons.

Geary, D.C., L. Fan, and C.C. Bow-Thomas. 1992. Numerical cognition: Loci of ability differences comparing children from China and the United States. *Psychological Science* 3: 180–5.

Ginsburg, H., and A. Baroody. 2003. *Test of early mathematics ability*, 3rd ed. Austin, TX: Pro-Ed.

Gonzales, M.M., and J.H. Paik. 2011. Cross-cultural differences in general preschool teaching styles and math instruction. *International Journal of Learning* 17, no. 10: 251–63.

Huntsinger, C.S., P.E. Jose, F.R. Liaw, and W. Ching. 1997. Cultural differences in early mathematics learning: A comparison of Euro-American, Chinese-American, and Taiwan-Chinese families. *International Journal of Behavioral Development* 21: 371–88.

International Association for the Evaluation of Educational Achievement (IEA). 2006. *Mathematics achievement in the middle school years: IEA'S Third International Mathematics and Science Study (TIMSS)*. Chestnut Hill, MA: Boston College, TIMSS International Study Center.

Ma, L. 1999. *Knowing and teaching elementary mathematics: Teachers' understanding of fundamental mathematics in China and the United States*. Mahwah, NJ: Erlbaum.

Miller, K.F., C.M. Smith, J. Zhu, and H. Zhang. 1995. Preschool origins of cross-national differences in mathematical competence: The role of number-naming systems. *Psychological Science* 6: 56–60.

National Center for Education Statistics. n.d. The trends in international mathematics and science study (TIMSS) 2006. http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2005005.pdf (accessed May 2009).

National Council of Teachers of Mathematics (NCTM). 2000. *Principles and standards for school mathematics*. Reston, VA: NCTM.

Organization for Economic Cooperation and Development (OECD). 2006. *PISA 2006: Science competencies for tomorrow's world*. Paris: OECD.

Organisation for Economic Co-operation and Development (OECD). n.d. The Programme for International Student Assessment 2006 (PISA). http://www.oecd.org/dataoecd/15/13/39725224.pdf (accessed May 2009).

Pramling, N., and I. Pramling Samuelsson. 2008. Identifying and solving problems: Making sense of basic mathematics through storytelling in the preschool class. *International Journal of Early Childhood* 40, no. 1: 65–79.

Siegler, R.S., and J.L. Booth. 2004. Development of numerical estimation in young children. *Child Development* 75: 428–44.

Siegler, R.S., and Y. Mu. 2008. Chinese children excel on novel mathematics problems even before elementary school. *Psychological Science* 19: 759–63.

Siegler, R.S., and G.B. Ramani. 2008. Playing board games promotes low-income children's numerical development. *Developmental Science* 11, no. 5: 655–61.

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

Towse, J.N., and M. Saxton. 1997. Linguistic influence on children's number concepts: Methodological and theoretical considerations. *Journal of Experimental Child Psychology* 66: 362–75.

UMC & GRADE. 2001. El Perú en el primer estudio internacional comparativo de la UNESCO sobre lenguaje, matemática y factores asociados en tercer y cuarto grado [Perú in the first international comparative study of language, mathematics and associated factors for students of the third and fourth grade]. *Boletín UMC 9*. Lima: Ministry of Education.

Zhou, X., J. Huang, Z. Wang, B. Wang, L. Yang, and Z. Yang. 2006. Parent-child interaction and children's number learning. *Early Child Development and Care* 176, no. 7: 763–75.