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Why do Taiwanese children excel at math?

Distinctive cultural values underlie instructional differences in how math is taught and how children are expected to achieve.

Taiwanese children excel in mathematics, often receiving top scores in international competitions. Fourth graders from Taiwan ranked third on the most recent Trends in International Mathematics and Science Study (2007) with only Hong Kong and Singapore scoring higher. Taiwanese 8th graders did even better, ranking first with an average scale score of 598. The average scale score for American 8th graders was 499, slightly below the TIMSS scale average of 500. So, why don't American children perform as well as Asian children on these international tests?

Cultural differences

Tsao's (2004) study of academic achievement discrepancies in children indicates that both intelligence and the learning environment influence academic achievement. Do these findings suggest that Taiwanese children are inherently more intelligent in mathematical reasoning than American children or that the learning environment in Taiwanese homes and classrooms is more supportive of mathematical learning? Because no scientific evidence indicates that American children are less intelligent than Taiwanese children, the key difference must be the mathematical learning environment, at home and at school.

Parents, especially mothers, exert a strong influence on a child's early learning experiences. There is, however, a cultural difference in how Taiwanese mothers and American mothers view the connection between effort, intelligence, and learning. Research suggests that most American mothers believe a child's mathematical performance primarily depends on intelligence and innate math ability; Asian mothers believe effort is more important for academic success (Stevenson, Chen, & Lee, 1993; Stevenson & Lee, 1990; Stevenson, 1992; Stevenson & Stigler, 1992). This difference in maternal perception may affect the learning experiences mothers provide for their young children.

In Taiwan, academic achievement is widely believed to hold the promise for a successful future. Taiwan is a small, densely populated island of over 23 million people. As a result, individual beliefs and values tend to be shaped by a socioeconomic context that often encourages competition. In Taiwan, parents, especially mothers, are highly involved in a child's schooling and play a key role in the child's academic achievement (Fejgin, 1995; Zellman & Waterman, 1998). This parental involvement

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may appear to be very intense, and Western observers often have difficulty comprehending the level of influence and control that Asian parents have on their children from an early age through college. For example, most Taiwanese mothers force their children to participate in after-school tutoring programs to enhance mathematical achievement; in addition, as Taiwanese students prepare for college, they usually select their university and major based on the preference of their parents. Given the cultural differences in parent involvement and competition, it's not surprising that Taiwanese parents approach learning with a sense of urgency and are often viewed as pushing children to learn academic subjects during preschool. Mathematical reasoning is highly valued and encouraged at a young age because it provides a foundation for a broad spectrum of future academic learning (Liu, 2006; Hess, Chang, & McDevitt, 1987).

Taiwanese children begin a formal math curriculum in kindergarten. In addition to math instruction in school, over one-fifth of kindergartners receive after-school instruction (Huang, 2010) that usually focuses on preteaching and reteaching concepts and skills that are part of the classroom curriculum. The number of students attending after-school tutoring programs increases as children get older. Even in the United States, research indicates that after-school tutoring provides a significant increase in understanding math concepts, problem solving, computation, and overall math achievement for struggling math students (Lalley & Miller, 2006). By the time they enter college, almost all Taiwanese students have attended many years of supplemental tutoring beyond the school day.

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Even Taiwanese college students continue to rely heavily on tutoring to achieve academic success.

Taiwanese children are raised in a seemingly democratic and liberal society, enjoying more freedom than past generations. But, their independence is more financial than psychological, especially when considering their parents' academic expectations. The pressure to achieve academically results in limited time for other experiences beyond schooling. In Taiwan, children spend many more hours in school than do students in the United States. For example, Taiwanese middle school students typically leave home at 7 a.m. and return at 10 p.m., even during weekends. For most Taiwanese, obtaining a solid education and graduating from an elite school holds the promise of a secure future and is traditionally regarded as the best way to bring honor to one's family. Thus, even in a rapidly changing society, many Taiwanese continue to place central importance on academic achievement.

Skills versus creativity

Although American children do not score as well as Taiwanese children on international math competitions, adult mathematicians and researchers in the United States excel beyond their Taiwanese counterparts in prestigious competitions, such as the Nobel Prize (Wei, 2002). This paradox may be due to the differences in mathematical curriculum.

Taiwanese mathematical curriculum emphasizes computational skills while math curriculum in the United States often focuses on higher-level thinking skills. Studies indicate that math instruction in Taiwan is often drill and repetition of skills, which results in a lack of motivation for students (Huang, 2010; Wei, 2005). Perhaps encouraging higher-level thinking, including mathematical creativity, rather than computational drills, provides an answer to the paradox.

The fundamental purpose of education has long been debated in Taiwan. This ongoing debate has led to a learning system that overemphasizes academic performance and neglects other dimensions of learning. To encourage a greater emphasis on creative thinking, the government has held thousands of meetings and conferences to develop new goals, policies, and principles for educational reform, but sweeping changes remain elusive. One barrier to reform is that high schools continue to admin-

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ister the National Entrance Examination, a key requisite for acceptance at a highly competitive school.

Until recently, Taiwanese curriculum emphasized the memorization of facts, tables, and formulas. Using a behaviorist approach, most Taiwanese schools continue to be highly competitive academic environments where correct answers are rewarded. In other words, Taiwanese schools prepare students well for the international competitions.

School reform

In 1993, the Taiwanese government adopted the use of a constructivist approach to teaching mathematics. This new approach to teaching and learning focuses on the "whole child." The primary goal for teachers is to provide instruction that considers the developmental level and interests of students, especially in the early grades. Teachers are required to pay closer attention to the learning process and children's conceptualization of content and ideas rather than focusing on simply attaining the correct answer. These instructional changes are especially evident while teaching mathematics.

Although there's a strong theoretical basis for curricular change and this "new math" has the academic community's support, implementing this new instructional approach is problematic for many teachers. The traditional methods of teaching mathematics are rigid and often boring for students, but it's easier to teach when the focus of instruction is only on the correct answer. New math opponents argue that these new methods should only be used for children with developmental delays. They believe new math was originally designed for children with math learning problems (Ma, 1999).

Gradually, a child-centered, constructivist approach to teaching mathematics is gaining acceptance. In a recent study by Huang (2010), 89.6% of the 2,051 Taiwanese parents surveyed indicate they believe their children's interest in learning math is more important than their actual performance. Also significant is the change in parents' attitudes. The study suggested that 92.3% of the parents supported a multiple-methods approach to instruction to spark their children's interest in learning math.

The many years of early childhood research firmly support the reforms to the mathematics curriculum in Taiwan (Wei, 2005). In fact, many Taiwanese kindergartens already use a constructivist approach where children learn through hands-on activities, projects, and play. How the "new math" approach to learning will impact the ranking of Taiwan in international mathematics assessments is yet to be seen. K

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