PRACTICE MAKES PERFECT ON THE BLACKBOARD:
A Cultural Analysis of Mathematics Instructional Patterns in Taiwan

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ABSTRACT

Taiwanese students' math achievement ranked the 3rd among the 38 countries participating in the 1999 Third International Math and Science Study (TIMSS-R). This study aims to show how Taiwanese teachers teach math so as to produce such a remarkable achievement. Math teachers in the middle school in Taiwan were videotaped giving instruction on a math concept. The videotapes were reviewed and analyzed by using both the quantitative (Teacher Observation Schedule) and qualitative methods (observation notes). The results show that Taiwanese teachers focus more on demonstrating math procedures rather than on math concepts and tend to ask students to practice both on the blackboard and at their seats. Moreover, Taiwanese teachers are inclined to ask their students to offer the "right" answer to questions on the blackboard after individual practice at their seats. Cultural beliefs including "practice makes perfect," "one standard for all," and "motivation by wish for self-improvement" underlying the Taiwanese instructional patterns are discussed.

Key Words: Mathematics teaching, instructional pattern, Taiwan, cultural analysis

1. Introduction

According to the TIMSS 1999 Math Report (Mullis et al., 2000), there is a sharp difference in math achievement between students in the U.S. and students in several East Asian countries, amongst them Taiwan, where student math achievement ranked the 3rd among the 38 participating countries. This difference in achievement was discussed earlier in Stevenson and Stigler's (1992) work on the "learning gap" in student performance with reference to differences in teacher practice and parental rearing patterns between the West (American) and East (Chinese and Japanese).

Stigler and Hiebert (1999) now further contend that while teachers' general practices do make a difference to students' performance, it is the processes of teaching in the classroom that might really bring about the differences in students' learning. By analyzing TIMSS videotapes on math instruction given by teachers in Japan and the U.S., they have found a "teaching gap" between cultures. While American teachers focus more on procedural skills, Japanese teachers emphasize more on conceptual understanding. Thus, in an American math class, students spend most of their time acquiring isolated skills through repeated practice, whereas in a Japanese classroom, students devote as much time to solving challenging problems and discussing mathematical concepts as they do practicing skills. It can be concluded that teachers in different countries display markedly different teaching patterns, which result in very different approaches to how students learn math. Different teaching methods need to be understood in relation to the cultural beliefs and assumptions imbedded in different countries. Thus, teaching appears as a cultural activity. It would be interesting, then, to know how Taiwanese teachers teach math so as to produce such a remarkable achievement for their students in international math competition. The purpose of this study is to discover the instructional pattern shaped by teachers in Taiwan.

2. Research Design

Due to the prevailing reservations of Taiwanese teachers toward being videotaped in the classroom, the researchers had tried very hard to recruit teachers to participate in the study, and could finally obtain agreement from three math teachers in two middle schools in the Taipei area. This sample of three teachers showed a variation in age and gender. While the two male teachers were beginning teachers, the female teacher had more than 20 years of experience.

The data sources for this study were videotapes of the teachers' instruction and observation notes made by independent observers in the classroom. The researchers videotaped instruction on a math concept, lasting for 3-4 periods (hours), given by each teacher. The videotapes were reviewed and analyzed using both the quantitative and qualitative methods. A Teacher Observation Schedule, adapted from Stallings Observation System (Freiberg and Waxman, 1988; Stallings, 1986) was used to quantify the number of instructional activities and teacher-student interactions in the classroom. Three members of the research team coded the occurrences of different types of instructional activities and teacher-student interactions at the frequency of two times each five minutes. A high consistency was reached among the three raters with a .90 inter-rater reliability. Also, a close review of each segment of the videotapes was conducted to yield rich qualitative data. Extensive observation notes were taken on the instructional flow, student-teacher interaction and classroom atmosphere to discover the

distinctive characteristics of the instructional patterns common to three math teachers.

3. Research Outcomes

From analysis of videotapes, we found that the instructional pattern common to the three teachers consisted of the following six steps: (1) review of previous materials, (2) presentation of the topic for the day, (3) presentation of definitions of terms and rules, (4) demonstration with examples, (5) practice, and (6) assignment of homework. At the beginning of a class, the teacher usually starts with a check of the homework assignment or gives a quiz to review material taught in the previous period. He/she usually calls on students to write up the procedures and solutions on the blackboard and then checks if the students give the right answers. When the teacher moves on to the new topic, the students "automatically" take out the math textbook and turn to the exact page from which the new topic begins. The teacher then presents the new terms and rules by either contrasting them with the previously established ones which can not apply to the new situation or by highlighting the "knack" of deriving correct answers to math problems in the new section being studied. At this stage, the teacher usually asks some closed questions to check if students get the point. The teacher provides little context relevant to the students' previous experiences and raises few questions to arouse students' interest or curiosity on the topic. Most students appear to show a "readiness to learn."

He/she then demonstrates with two to four problems with different degrees of difficulty to show how to apply the rules to get the answer. All of the three teachers tend to use the deductive, rather than the inductive, approach to math instruction. To check if students have learnt the rules and skills, the teacher calls on some students to practice problems from the textbook on the blackboard while other students do the same problems at their seats. The teacher usually calls upon students by drawing lots or based on a certain sequence so that each student has similar opportunity to practice on the blackboard. Usually several students are called upon at a time to solve problems of various types and/or degrees of difficulty. If students at the blackboard are stuck, the teacher usually helps them by giving out some hints. If the students get the wrong answers, the teacher will correct the mistakes and remind the whole class to be aware not to make the same errors. In the case of "hopeless" students, the teacher will solve the problem for the students. With the correct procedures and answers listed on the board, the teacher will then ask the whole class to check their own answers against the "standard" ones. This cycle of teacher demonstration and student practice at the board and in seats is usually repeated several times, occupying the major block of time in an instruction period. At the end of the class, the teacher usually gives homework either from the textbooks or from self-produced worksheets. He/she may also announce a quiz to be held in the next period on the topic just taught.

4. Discussion

4.1 Comparison with the American and Japanese instructional patterns

Comparing our findings with those of Stigler & Hiebert's (1999), it is found that math teachers in the U.S, Japan, and Taiwan all review previous materials, present the problems, and have students practice problems at their seats. It is the process of presenting the problem that reveals a great difference among the three countries. Similar to American teachers,

Taiwanese teachers focus more on demonstrating procedures rather than on math concepts and ask students to practice procedural skills rather than understanding of the reasoning behind the procedures. However, American students tend to practice procedures at their seats, while Taiwanese students practice both on the blackboard and at their seats. Both Japanese and Taiwanese teachers present questions and call students to present their answers on the blackboard. However, Japanese teachers encourage students to offer alternative solutions to the questions after their group discussions, while Taiwanese teachers ask their students to come out with the "right" answer to the question after individual practice at their seats.

4.2 Cultural beliefs underlying the Taiwanese instructional patterns

Concurring with Stigler and Hiebert's (1999) argument that teaching is a cultural activity, it is of interest to consider the cultural beliefs underlying the distinctive Taiwanese math instructional pattern.

4.2.1 Practice makes perfect

The reason why practice plays such a major role in math instruction may lie in the deep-rooted conviction that "*shou neng sheng qiao* (practice makes perfect)." Many Chinese idioms express a concept that places "practice" in the pivotal role in human learning. It is believed that only through constant practice can a task of learning be perfected. Therefore, in the context of a math classroom, only through repeated practice on the problem can a student master the skills to solve the problem. Such a cultural belief can be seen as embodying a view of an "incremental" perception of intelligence that characterizes human intelligence as a malleable quality that can be increased through effort, in contrast with an "entity" theory that sees human intelligence as a fixed permanent entity that cannot be changed (Dweck, Chiu, and Hong, 1995; Hong, Chiu, and Dweck, 1995). From this perspective, one possible explanation for the reason why the Taiwanese teachers tend to ask their students to practice repeatedly is that they may believe that students' intelligence is malleable and can be increased through such constant practice.

4.2.2 Student practice on the blackboard

Further, for reason why Taiwanese teachers tend to call upon students to demonstrate on the chalkboard so frequently, several possible explanations can be offered: first, teachers use this method to check if most students understand what is taught. Faced with Taiwanese students who are characterized as "passive and reluctant" to speak out in class, the teachers may feel that they need to call upon individual students to see if they really understand. An experienced teacher may ask a student whose math achievement level is in the middle of the class to come to the board, to, in effect, see if half of the students could understand what is taught. Moreover, the teacher may use this "blackboard" method to save time and energy. When teachers call upon several students to practice a variety of math problems on the board at one time, they can see if students have mastered different types of skills or if they make the same or different types of errors. Within a relatively short period of time, command of a variety of skills can be demonstrated and errors can be corrected. This is an efficient way of instruction given time constraints. Third, the teacher may use this method to provide the "standard" answer for the whole class to check against their own answers. If students do not know how to solve the problems, they can copy down the standard procedures and answers. Lastly, the teacher may use this method to caution the whole class from making the same errors committed by individual students. When a student on the board is stuck or produces wrong answers, the teacher usually capitalizes on this opportunity to elaborate on the right procedure and caution against possible mistakes.

Two cultural beliefs underlying this work on the blackboard are, first, an orientation to conformity by establishment of a standard criterion for individuals to compare against; second, an inclination to self-improvement through constant comparison of self achievement with the standard criterion. Based on their work on personality traits in East Asian countries, Kitayama et al. (1997) and Heine et al. (1999; in press) report that individuals in these countries are encouraged to identify socially shared images of ideal and to compare the state of self with this ideal. Individuals seek and discover the externally set standards of excellence, critically assess themselves to determine what they are missing, and endeavor to eliminate the perceived deficit. This practice of self-improvement through constant self-comparison and self- criticism gradually leads the individual closer to the ideal criteria, and thus build his/her self-esteem in the process. As a country in the East Asian Confucian Circle, Taiwan shares the cultural beliefs of "common standard" and "self-improvement." These cultural beliefs penetrate into the actual classroom practices of the math instruction when the teacher asks the students to practice on the blackboard. The standard answer on the board serves as the "ideal criteria" for students to compare against their own. Through constant comparison, students can finally make improvement on their math performance.

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REFERENCES

-Dweck, C. S., Chiu, C. Y., Hong, Y. Y. 1995, " Implicit theories: Elaboration and extension of the model", *Psychological Inquiry*, **6** (4), 322-333.

-Freiberg, H. J. and Waxman, H. C., 1988, " Alternative feedback approaches for improving student teachers' classroom instruction", Journal of Teacher Education, **39** (4), 8-14.

-Heine, S. J., Lehman, D. R., Markus, H. R., Kitayama, S., 1999, "Is there a universal need for positive self-regard", *Psychological Review*, **106** (4), 766-794.

-Heine, S. J., Kitayama, S, Lehman, D. R., Takata, T., Ide, E., Leung, C., Matsumoto, H., (in press), "Divergent consequences of success and failure in Japan and North America: An investigation of self-improving motivation and malleable selves", *Journal of Personality and Social Psychology*, xx (x), xx-xx.

-Hong, Y. Y., Chiu, C. Y., Dweck, C. S.,1995, Implicit theories of intelligence: Reconsidering the role of confidence in achievement motivation. In M. H. Kernis (ed.), *Efficacy, Agency and Self-esteem*, New York: Plenum Press, pp. 197-217.

-Kitayama, S., Markus, H. R., Matsumoto, H., Norasakkunkit, V., 1997, "Individual and collective processes in the construction of the self: self-enhancement in the United States and self-criticism in Japan", *Journal of Personality and Social Psychology*, **72** (6), 1245-1267.

-Mullis, I. V. S., Martin, M. O., Gonzalez, E. J., Gregory, K. D., Garden, R. A., O'Connor, K. M., Chrostowski, S. J., Smith, T. A., 2000, *TIMSS 1999: International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade*. The International Study Center, Boston College, Lynch School of Education.

-Stallings, J. A. ,1986, Using time effectively: A self-analytic approach. In K. K. Zumwalt (ed.), *Improving Teaching*, Alexandria, VA: Association for Supervision and Curriculum Development, pp. 15-27.

-Stevenson, H. W., Stigler, J. W., 1992, *The Learning Gap*. New York: Simon & Schuster.

-Stigler J. W. & Hiebert, J., 1999, *The Teaching Gap*. New York: The Free Press.