

# THE MATHEMATICS PEDAGOGICAL VALUES DELIVERED BY AN ELEMENTARY TEACHER IN HER MATHEMATICS INSTRUCTION: ATTAINMENT OF HIGHER EDUCATION AND ACHIEVEMENT

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## Abstract

This paper investigates the values implied in the mathematics instruction of an elementary school teacher in charge of fifth and sixth grade. The major research methods were classroom observation and interview. The research results discovered that the foremost mathematics pedagogical value of the teacher in this case study was “a good learning in mathematics makes easier for students to attain a higher education and for those who are able to attain a higher education can achieve a respectable social status and a successful life more easily.” This value is an influence from one of Confucian dogma that it’s extremely important for traditional Chinese intellectuals to pass the imperial examination and to earn a respectable social status. This paper also presents a brief discussion on the relationship between the values of mathematics instruction upheld by elementary teachers and the curriculum reform.

## Introduction

The New Elementary Mathematics Curriculum (NEMC) in Taiwan was launched in 1996 and the primary educational goal of this reform was to “guide children to obtain mathematics knowledge from their daily life experiences and to develop the attitudes and abilities to apply mathematics effectively to solve problems they encounter in real life.” Furthermore, it was to “nurture the attitude of respecting others through the practice of understanding and evaluating other students’ solving process” and to “develop the consciousness to communicate, discuss, rationalize and criticize in mathematics language” (ME, 1993, p.91). The reform-oriented modes of teaching moved away from teacher-centered instruction toward pupil-centered learning and emphasized more group discussions than classroom lecturing. The Old Elementary Mathematics Curriculum (OEMC) emphasized on calculation skills but the NEMC focuses on problem solving ability.

Starting in 2001, there has been another reform in mathematics curriculum at the elementary and junior high school level in Taiwan; it is named as “Mathematics Learning Area in Grade 1-9 Curriculum” (MLAGC). The curriculum goals of MLAGC preserve the ones of NEMC, which emphasize on the ability of problem

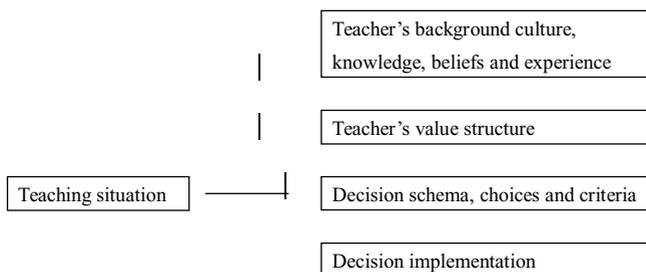
solving, communicating and reasoning. However, one thing new and different about MLAGC is that it stresses on the cultivation of mathematics competencies, besides the acquirement of mathematics knowledge (ME, 2000).

The curriculum goals of both NEMC and MLAGC were influenced by the mathematics curriculum standards in the U.S. (NCTM, 1989, 2000). This paper addresses some of the socio-cultural issues related to the importation of curriculum and instruction from one country to another country with inherently different beliefs and values. For an instance, most people agree with the statement “mathematics is important”. But what are some important goals of mathematics teaching? Is it the development of students’ calculation skills? Or is it the ability of problem solving? Or is it the competence of communication and critical thinking? And if any one of them is the core of mathematics teaching, why is it so? Is it because “mathematics has importance for all learners who wish to get on in our society” or it is because “mathematics has importance for all learners in our society, because it helps them to understand and critique many of the structures of our society” (Bishop, 2001, p.234)? This research inquiry explores the personal values delivered by an elementary teacher in her mathematics teaching, especially the ones related to the aspect of “mathematics is important”.

### ***Theoretical Framework***

Ernest (1991) indicated that every mathematics curriculum implies certain values and ideologies. Ideology is “an overall, value-rich philosophy or world-view, a broad inter-locking system of ideas and beliefs.” (Ernest, 1991, p.111). Therefore, one can say that a mathematics curriculum reform signifies a change in values and ideologies.

Mathematics curriculum is realized by mathematics instruction and mathematics teaching carries implicit and explicit values (Bishop, 1988; Bishop, FitzSimons, Seah, & Clarkson, 2001; Chin, & Lin, 2001; Leu, & Wu, 2002; Swadener, & Soedjadi, 1988). Bishop (2001) proposed a diagram to illustrate how teacher’s value structure affects mathematics instruction (i.e. decision implementation) (p.241).



According to the diagram, Bishop stated “the teacher’s value structure monitors and mediates the on-going teaching situation, constructing options and choices together with criteria for evaluating them. The teacher thus is able to implement the

decisions in a consistent manner.” (Bishop, 2001, p.241) Consequently, mathematics teaching is not value-free.

In this study, the valuing theory (Raths, Harmin, & Simon, 1987) served as the foundation for exploring teachers’ value-driven mathematical teaching. Values are any beliefs, attitudes, activities or feelings that satisfy the following three criteria: choosing, prizing and acting (Raths, et al., 1987). The criterion of choosing includes choosing freely, choosing from alternatives and choosing after thoughtful consideration of the consequences of each alternative. The criterion of prizing includes prizing, cherishing and affirming. The criterion of acting includes acting upon choices and repeating.

### ***Methodology***

In this case study, data were collected by various methods over a variety of schedules and topics including once-a-week, whole-unit and un-scheduled observations, and interviews to prevent the unjustified influence of any single method, mathematics topic or instructional event and to allow the triangulation of data and claims across multiple sources.

The research team met monthly with an external panel of three researchers with expertise in mathematics pedagogical values of Taiwanese secondary school teachers. Research data and interpretations were shared with the panel and discussed to improve data analyze, interpretations and research procedures.

The research subject of this case study is Ms. Lin, who has had nine years of teaching experiences in elementary school. She is currently teaching a class of twenty-seven fifth graders. Besides teaching mathematics, Ms. Lin was also responsible for Mandarin, Ethics, Health and some other subjects for her class. She was also responsible for monitoring and correcting her students’ behaviors and conducts. At the time Ms. Lin was involved in the research, students from first to third grade in Taiwan were learning the NEMC while students from fourth to sixth grade were learning the OEMC.

This research is to investigate the values upheld by Ms. Lin about her mathematical teaching. According to Bishop’s diagram on teacher’s value structure (Bishop, 2001), researchers can retrace Ms. Lin’s value structure through her mathematics instruction (i.e. decision implementation). Based on Raths et al’s theory, researchers used classroom observations to notice repeated behavioral patterns during her mathematics lessons. The purpose of the interviews is to recognize the reasons why Ms. Lin developed these behavioral patterns and to formulate some value indicators, as well as to examine if the value indicators met the criteria of “choosing” and “prizing”.

The time length for this research is one year. Ten lessons were observed and eighteen interviews were conducted. The topics covered in the ten lessons

area of a circle, direct proportion, inverse proportion, scale on the map and the concept of probability.

### **Research Results**

According to research data, it suggested that Ms. Lin's mathematics pedagogical value is that a good learning in mathematics makes easier for her students to advance for higher education (ex. college/university) and it's easier for a person with higher education to achieve a respectable social status and a successful life. This value of "one is to learn mathematics well as efforts to be successful" shares much similarity with one of the Confucian dogma "Those who excel in their study should become official."

How did Ms. Lin accomplish the mission of making her students learn mathematics well? The teaching behaviors and rationales of Ms. Lin' mathematics teaching can be analyzed from three perspectives: before class (preview), during the class (classroom instruction) and after class (review and assessment). The reasons provided by Ms. Lin were put in quotation mark.

**From the perspective of previewing before class:** Ms. Lin requested her students to preview and the purpose of preview is so that "students can have a better understanding when I explain the solving strategy provided in the textbook." Another purpose of preview is "...to invite those students who preview to take the role of a teacher and let them explain the solution in front of the class." Ms. Lin's criteria for choosing the presenters were "those who are confident in expressing his/her thoughts and who can express ideas/concepts clearly." Ms. Lin would not pick those students who she believed were incapable of delivering a clear explanation because she was afraid that "they would delay the schedule and/or ruin the atmosphere in the class". From her above statement, it is evident that Ms. Lin didn't value the cultivation of students' ability of communicating and reasoning as one of the goals in learning mathematics because she regarded this kind of practice as a possible destructor to the progress of a lesson. One may wonder if the progress of a lesson is such a major concern to Ms. Lin, then why didn't she teach the whole lesson by herself so that she could have a complete control? That's because Ms. Lin found out that students were more open and daring to ask questions during students' presentations, compared to her lecturing.

**From the perspective of in-class instruction:** Ms. Lin would stick to the teaching plan she prepared in advance and present the content of the textbook in a systematical order. Ms. Lin stated, "I'm really afraid not following the teaching plan I prepared in advance. I'm afraid that I would forget to say something important or lose control of the teaching procedures and/or the flow of instruction. I don't want this kind of situation to happen because it is as if I take away some of my students' rights to learn". What is the reason behind Ms. Lin's apprehension about ruining her students' right? That's because the questions on the mathematics exams are similar to the questions on the textbook and Ms. Lin had the concern that her students would be

at a disadvantage if she had not clearly and effectively taught the solutions provided in the textbook. And why is it that questions on the mathematics exams are similar to the questions on the textbook? That's because there is only one unified version of midterm/final for all the students on the same grade (even though each class has a different mathematics teacher, usually their homeroom teacher) and there is a possibility that students' performance would suffer if the test-maker designed questions unlike the ones on the textbook. If the situation is to happen, then parents may accuse teachers for not teaching well enough and teachers would in turn blame the test-maker.

Ms. Lin strictly demanded her students to be attentive during the math class. She said, "I cannot stand even one sentence from my students during the class time. Students absolutely cannot talk. If one student talks for the first time, I would call up his/her name and give him/her a serious warning. If he/she does it the second time, then sometimes I would reprove. Or if the weather is not bad, I would ask him/her to stand on the hall as a punishment. The reason I'm doing this is that I believe students cannot understand because they don't listen carefully. If they concentrate to my lecture, then they can understand."

**From the perspective of reviewing:** After a lesson is complete, Ms. Lin would ask students to do four or five math problems during the morning hours and she would also photocopy the questions on the exams from previous years as in-class practice or homework. Ms. Lin distributed a math review sheet almost daily during the first semester and she reduced it to two sheets per week during the second semester. However, she hardly handed out any review sheet for other subjects. Ms. Lin explained, "Mathematics cannot be learned in a day or two. For all the subjects studied at the elementary school level, mathematics requires the most time and effort to learn and practice". She stated, "I made great emphasis to my students that they need practice more. With more practice, it comes faster calculation. Consequently one can learn more in a given time." She asserted, "Repeated practice is important for mathematics learning, besides understanding the concepts. In order to demonstrate one's understanding and calculation skills promptly during a test, he/she needs to practice over and over again". Ms. Lin further pointed out, "There are students in my class who can do every problem right if they have time but they can only finish two third of the test questions within the test time and they get only two third of the grades. There are always time limits for the entrance exams of senior high school and college in Taiwan. It's such a great pity if one cannot finish all the test questions he/she can solve correctly within the test time constraint. Therefore I encourage my students not only to understand the concepts but also to speed up their answering time. That's why I ask my students to practice repeatedly".

In addition to the regular review, Ms. Lin would spend about a week before the midterm/final for some extensive review. She stated, "There are several teachers who do not review for their students. They regard review as students' own responsibilities. I cannot dismiss the job of reviewing for my students. I take

students' grades as my own responsibility. Since I am a teacher for fifth and sixth grade, I should prepare my students ready for junior high school so that they will perform well. I cannot say I don't care if my students get bad grades at the junior high school, even though they are no longer my students. The feeling is especially intense when I hear some graduates complain about their elementary teachers not teaching them well enough. If I can be more responsible and watchful about their academic performance, they may have a better and easier learning time at junior high school." From this quote, it shows that Ms. Lin cared about not only her students' grades but also other people's judgment about her. There are some researches suggested that Chinese teachers care more about other's judgment about them than the western teachers (Biggs & Watkins, 2001).

**From the perspective of test assessment:** Ms. Lin would have two paper-and-pencil tests for each mathematic unit, which is about a week of class time. These tests were usually similar questions from textbook or workbook with different figures. Sometimes same questions or questions from previous test with a slight change of figures would be tested repeatedly.

Ms. Lin's criteria for grading were strict. If a student did a word problem with correct solving procedure and calculation but wrote down the answer with wrong unit, she would deduct all points. Ms. Lin stated, "My teacher told me that if there is any little mistake on a question of the entrance exam for senior high school and college, then a whole question would be marked wrong and one doesn't get any credit for it. I want my students to be familiar with this kind of grading policy used in the entrance exam." (However, this is only some impression Ms. Lin had while she was a student. It doesn't match with the reality or current situation.) In addition, Ms. Lin didn't allow students to use calculators on any math tests. She explained, "Calculators are not allowed for the entrance exam in Taiwan. I want to train my students to master calculation skills and well adapt the test system in Taiwan."

Sometimes Ms. Lin would use the class time of Ethics or Health to teach mathematics. Ms. Lin expected her students to learn mathematics well. She stated, "The notion that I convey to my students is that the fact that they live in Taiwan means that they have to compete intensively for the entrance of higher education. Mathematics and English are the two most decisive subjects. And what an elementary teacher can do is to consolidate students' mathematics". (During the research, elementary students didn't have to learn English.)

### ***Discussion***

The teaching behaviors of Ms. Lin's mathematics instruction included designing a well-organized teaching plan in advance, lecturing systematically about solution in the textbook, demanding students to be fully concentrated during the class time, providing many review sheets for students after a lesson is complete, giving tests regularly and reviewing constantly. The purpose of all these work is to strengthen students' capability in taking mathematics exams. These teaching behaviors are

common in Taiwan and they are similar to the teaching behaviors founded for the Chinese society in Mainland China and Hong Kong, which are concentrated listening, vicarious learning, careful planning, timed questioning and associated activity (Biggs & Watkins, 2001). All these three places have an exam-dominated education system.

Ms. Lin's mathematical teaching behaviors can be explained from her values on mathematics instruction, that is, "One who can learn mathematics well have a better chance to attain a higher education and it's easier for those who get a higher education to achieve a respected social status and a successful life." The urge to learn mathematics well stems from the Chinese tradition that intellectuals should study hard for the imperial exam and once they pass the exam then they can become a government official and this in turn is a glory and honor to her family name and ancestors (Huang, 1994).

The reform on the mathematics curriculum at the elementary and junior high level during the recent ten years in Taiwan is basically an implantation of western culture. During the process of reforming, teachers, parents and the mass population experience a regression in students' calculation skills. Nevertheless, the values emphasize in NEMC and MLAGC, such as "the cultivation of the consciousness of communicating, discussing, reasoning and criticizing", cannot be assessed easily by paper-and-pencil tests. Consequently, teachers, parents and the mass population cannot realize the advantages of NEMC and MLAGC. Furthermore, most of the entrance exams in Taiwan are paper-and-pencil tests. Due to the disapproval from teachers, parents and the mass population about NEMC and MLAGC and the discord/clash between the tradition of exam-dominated education system and the newly-introduced mathematics pedagogical values, there has been a growing opposition and resistance about the reform. As a response to this public resentment, the Ministry of Education in Taiwan announced a revised version of MLAGC in 2003. This latest version is similar to OEMC, which emphasizes calculation skills and advocates lecturing (ME, 2003). With this kind of inconsistency, the elementary mathematics curriculum is chaotic at the present time.

Values are implied in mathematics itself, mathematics curriculum and mathematics instruction. The reformers should thoroughly investigate the prevalent mathematical pedagogical values upheld by mathematics teachers and carefully evaluate whether the innovated values can be accepted by most of the mathematics teachers and the general public and whether they are compatible with the established education system and society structure. If the existing values and the new values disagree or even conflict with each other, then some pertinent policies and effective measures should be planned and implemented to ensure a smooth transformation. Some possible means may be inculcating the innovation ideas to the mathematics teacher education programs and/or reforming the entrance exams accordingly. It is only when teachers (parents and mass population as well) accept the new values willingly and actively can a curriculum reform become successful.

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