DEVELOPING STUDENT TEACHERS' PEDAGOGICAL VALUES: TWO INITIAL STATES AND A CO-LEARNING CYCLE

Chien Chin

Department of Mathematics, National Taiwan Normal University

To examine the possibility of introducing values to mathematics teachers, this paper describes the pedagogical values that a group of Taiwanese student teachers share, and the two competing states of, and the co-learning cycle for, values learning emerged from a study of three student teachers. Some reflections on the constraints, issues, and challenges of values education for mathematics teachers are discussed.

BACKGROUND TO THE RESEARCH

To resolve the questions of "How to help teachers become aware of and clarify their own values?" and "Through what process could teacher educators assist those teachers who are not aware of or not willing to modify their values?" concerning the issue of values education for mathematics teachers, raised in the PME 25 conference (Bishop, FitzSimon, Seah, & Clarkson, 2001; Chin & Lin, 2001a), this three-year follow-up PVIMTE (Pedagogical Values In Mathematics Teacher Education) project aimed to: examine the possibility of educating mathematics teachers about values; and develop the plausible curriculum of values education for mathematics teachers. This paper aims to describe the initial states of, and the co-learning cycle for, values learning emerged in the process of learning-to-teach from a case study of three student teachers.

Mathematics teachers may hold various beliefs that become values when enacted in their classroom teaching (Bishop et al., 2001; Chin & Lin, 2001a). For example, Rokeach (1973) suggests that values are prescriptive beliefs wherein some means or end of action is judged to be desirable or undesirable; and Allport (1961) contends that a value is a belief upon which a man acts by preference. For them, value is a preference, a desirable mode of conduct, or a desirable end-state of existence, concerning the conception of something that is importance and worthwhile of thinking and doing for the person. Thus, beliefs are more concerned with the nature of "propositions about phenomena", and values are more about the "key substances" underlying such propositions for people to think and act (Chin & Lin, 2001a). In this study, values were conceived as "teachers' pedagogical identities", referring to "their personal commitment to and action on a set of words, concerning the importance or worth of such words for thinking and practice of mathematics in the classrooms", for example the value of "individual thinking"; and beliefs as "their personal acceptance to a testable sentence, concerning the truthfulness or existence of such sentence", for instance the belief of "There is no learning if students do not think". This operational definition is in a way related to Seah and Bishop's (2000) contextualisation and de-contextualisation difference on beliefs and values, and it also echoes Aspin's (2000) distinction on the nature of beliefs and values for school contexts.

THEORETICAL CONSIDERATIONS OF THE RESEARCH

Two approaches seem to be helpful for developing teacher values (Chin, Leu, & Lin, 2001): (1) encouraging teachers to articulate the differences between one's intended and implemented, and the discrepancies between one's own and others, values; (2) developing values-related activities for teachers to model, justify, and reflect. Rokeach (1979) argues that social groups implicitly transmit, inculcate, and implement a certain cluster of specialized educational values among its members. This means that values are better developed in the process of group sharing and reflection. From a Socratic view (Ling & Stephenson, 1998), values education may involve such strategies as values clarification, critical thinking exercises and conversation in which individuals' values positions are articulated and critically examined. For Aristotle, the education of values includes debates and value examination activities; for Kant, moral reasoning within dilemma situations are useful for clarifying and developing values. Conceiving these philosophical ideas about values education, Raths' (1987) values clarification and Fraenkel's (1977) values analysis approaches were adopted in the study.

Findings in the literature of value change suggest that values may be re-considered by individuals through cognitive and affective incongruity or inconsistency of some kind. For instance, if persons are induced to behave in a manner incompatible with their values; or expected to new information, including evaluations, from significant others that is inconsistent with one or more central values; or exposed to information about inconsistencies already present among their values, then the persons' values are expected to be changed. It is the resulting conceptual and behavioural change from incompatibilities, dissonances, and incongruities that would enable individuals to re-assess, re-organize, and re-construct their values (Rokeach, 1973). There are in my views three major phases for developing pedagogical values with mathematics teachers (Bishop, 2001; Chin et al., 2001): (1) sensitising them to values issues through the analysis of and reflection on value-loaded teaching activities; (2) showing them examples of approaches to mathematics teaching at which differ markedly in the values aimed; (3) helping them clarify and modify their initial values, they might be in a better position to re-construct, re-organize, or re-assess a coherent values structure for their own classroom teaching. As a result, the provision of critical incidents and the creation of doubt; the clarification of one's own values positions; and the justification and criticism on value-related classroom teaching activities in a collaborative working-and-discussion team, were used to develop teachers' pedagogical values. The scheme addresses the socially shared and personally constructed nature of values development, in which the processes of values clarification, argumentation, identification, and action are central.

RESEARCH METHOD

The Teacher Participants

A questionnaire (Chin & Lin, 1998), concerning varying views of mathematics and mathematics teaching using 5-point Likert format, was used to select the participants

from two in and pre service teacher groups. 42 secondary school mathematics teachers, enrolled in the Master of Teaching program in the Department of Mathematics, National Taiwan Normal University, played as the sample for in-service side. A class of 24 student teachers at the third year of teacher education program, joined in the author's "methods of mathematics teaching" course, acted as the cohort for pre-service side. Two in-service and three pre-service teachers were selected according to the resulting factorial structures of the item responses. The case study and action research methods (McNiff, Lomax, & Whitehead, 1996; Yin, 1994) were used as the major approaches of enquiry to explore the values learning of the five teacher participants. The author played as a collaborator with two teachers and as a coach with three student teachers. The major purposes were to examine the possibility of introducing a set of selected pedagogical values and developing the curriculum for them to learn.

A Framework for Developing Teachers' Pedagogical Values

A two-level learning cycle, consisting of the resources of and scaffolding for learning values, was developed in terms of the first year data. The value-loaded activities, the teacher's reflective journals, and self-descriptive written interview data developed in the former study (Chin & Lin, 2000, 2001a, 2001b), including the topics of mathematical induction, permutations, trigonometric functions, and equation of circles, were used as the materials for value dialogues within a co-learning team. Before the participant teachers taught the topics, videos of that topic provided by Ming (see Chin et al., 2001) were playing back, discussed, and criticized within the team, and later the written self-descriptive interview data were provided for discussion and reflection. In addition, a topic-related values questionnaire was administrated for examining their value preferences. Therefore, we have four whole topics of audio-video records and written data prepared, accompanied with the topic-specific value preferences surveys for group discussion and reflection. The working-and-discussion team, including one teacher educator (the author), one mentor (Ming), two experienced (T_1, T_2), three student teachers (ST_1, ST_2, ST_3), and one independent observer (O), was formed for the learning of values. Those ideas related to Schön's (1987) intelligent action, reflection-in-action and knowing-in-action, Vygotsky's (1978) social formation of individual concepts, and the three pillars - construction, narration, and reflection - suggested in Dutch Standards of mathematics teacher education (Goffree & Dolk, 1995), are all the alliances of this framework.

In the scaffolding, construction, reflection, narration, and diagnosis are the four major activities for learning-to-teach values. In reading, observing, and criticising the learning resources in such a co-learning team, the participants would be in a good position of using and constructing their own narratives about teaching. They could also re-consider the possibilities of rectifying their classroom values teaching. This self-and-collective regulation process, in which reflection and communication are two major activities of values clarification, and narration and metaphor are two indicators of a value communicator (Chin & Lin, 2001b), may create space for teachers to diagnose their values teaching. Two aspects about teacher intrinsic motives (awareness

and willingness) derived from a comparison between Taiwanese and Australian teacher values research (see Chang, 2000; Chin & Lin, 2001b; Leu & Wu, 2000; and Bishop et al., 2001) play as two affective requirements of learning-to-teach values. One is concerned with teacher awareness of values in classroom mathematics teaching and the other is about their willingness to teacher that values. Moreover, thinking and action are two recursive levels of learning-to-teach values. It is very important to take the aspect of action into serious consideration, and to separate implicitly mental thinking from the enactive aspect of values practices. Thus, I used the procedure of values construction focusing strictly on the content of mathematics, from observation, simulation, micro teaching, to that of teaching practice and actual classroom teaching, to develop the three student teachers' content-specific pedagogical values.

The Research Instruments

Six questionnaires were developed for eliciting the participants' pedagogical values. One of the two general values surveys is to explore their degrees of agreement on the 25 propositions using 5-point Likert format. The second parts of the questionnaire ask teachers to select and rank 5 from the 25 statements according to the most/less importance for them, and describe reasons for the rankings. The second questionnaire asks teachers to rank the 14 values according to the degrees of importance for them in lesson planning and classroom teaching, for example the values of felt pleasure. The 4 remaining questionnaires address different values for each of the 4 teaching topics.

SOME PRELIMINARY RESULTS

An initial analysis of the questionnaire surveys, classroom observations, and interviews with the student teachers showed two initial states of, and a co-learning cycle for, values learning. The statistical procedure of factor analysis (SPSS, 1994) with principal components extraction and varimax rotation was used and tested on the item responses of the student teacher group. In comparison with the results produced by oblimin rotation, the factorial structure was almost identical. The resulting six-factor model, explaining 77.44% of total variance, was used to construe their shared beliefs. For example, the six items with highest loadings (>0.82) on the first factor suggest that the first belief proposition is "To teach mathematics, teachers should recognise beforehand student backgrounds/needs of learning". The remaining 5 beliefs can be found in Chin (2001).

Underlying pedagogical values nominated and taught by ST_1, ST_2, and ST_3

The values of mathematical forms and abstraction seemed to be the best stands for ST_1 and ST_2 to organise and teach mathematics. ST_1's first two choices out of 14 values in the second questionnaire were mathematical forms and contents; and the last three options were about the affective aspects of learning mathematics, for example, felt pleasure, felt happiness, and willingness to learn mathematics. He said, "No matter students would be pleasant or not, as a teacher, I should teach them some mathematical forms and also try to force them to learn the forms" and "We should also make very good use of some typical

mathematical exemplars and to build student knowledge on that particular exemplars." ST_2 ranked hardworking, intellectual growth, and creating mathematical abilities, higher than the values of practical knowledge and felt interest to the knowledge. For him, "Forms and exercises are more practical for classroom realities of mathematics teaching." and he felt that "Students will be very happy if they feel that their teachers teach them more mathematical content than other classes." and "The affective factors are the most difficult things for me to control in teaching, therefore, it is better to teach the mathematical contents more." In the microteaching, ST_1 started with the example $\sum_{k=1}^{n} \frac{1}{k(k+1)} \equiv \frac{n}{n+1}$ to introduce the mathematical induction. The reason to do so was "It is better for them to learn new concepts from a well known example, otherwise, classroom situations would not be able to under my control." For him, classroom orderliness and the understanding of mathematical forms are more important than just playing some artificial mathematical games. He said, "There are not much value to introduce mathematical concepts using games or pseudo-artificial activities, I would rather spend my time on demonstrating as clearer as possible the mathematical forms and rules." As a result, his teaching relied much on forms and exercises. If students couldn't get the sense he would "Give them five seconds to think, and then I will solve the problem and show them the solution. It is no way for me to stop and wait there." ST_2 took over the lesson by introducing the formal proof of mathematical induction although this idea was criticized by T_1 and T_2, he still insisted to do so, because "It is absolutely necessary for students to understand logic necessity and existence within the system of mathematical knowledge." Therefore, the values of mathematical proofs, forms, and rules were addressed because "The concept is very rigorous and beauty in the sense of its structures."

The values of pleasure and practical knowledge were central for ST_3. ST_3's first two choices out of 14 values in the second questionnaire were practical knowledge and felt interest to the knowledge; and the last two options were about the formal aspects of mathematics learning, for example, logic reasoning and orderliness. He hoped that "Students are the focus of my classroom teaching, and I will try very hard using daily life examples and student practices in which I can talk to students and to initiate their thinking." One central tenet of teaching for him was "increasing students' mathematical abilities using practical and realistic knowledge from daily life." In the microteaching, ST_3 used a self-made teaching resource, a clock like plate, to introduce the definition of angle through visualisation. After that, he gave some questions for the students to solve. He said, "I really wanted to use some real staffs, helping students access to and make sense of the mathematical concepts. I hope that they can learn from the realistic aspects of mathematical knowledge through practices and reflections." Therefore, there are two sets of pedagogical values emerged from the questionnaire surveys and interviews. One set of values, as ST_1 and ST_2 exemplified, includes mathematical forms, rules, and proofs, and abstractness; the other set, as ST_3 showed, consists of felt pleasure and practical knowledge.

Two competing states of values learning portrayed by ST_1, ST_2, and ST_3

A shared understanding, emerged in the process of learning values, is the recognition of "felt easy to know but difficult to act". As they all hesitated to use felt pleasure in the

classroom, because "These ideas although are very important for teaching and learning, but, it seems very difficult for me to teach such a value, for example, feeling pleasure. Don't you think?" There are two initial states of learning-to-teach pedagogical values, in which one values the formal and logic-structural aspects of mathematics and the other values the practical aspects of mathematics and intrinsic motivation for learning. The most important tasks for ST_1 and ST_2 were to learn about "How to get more insight into the formal and abstractive nature of mathematical system and help them create approaches for teaching students understanding of such system?" They hoped that T_1 and T_2 could help them construct the strategies for introducing mathematical concepts. Their present states show a limited extension of visions about values, although they feel that it is useful to consider values in mathematics teaching. This suggests that they are in a "felt difficult to act however unwilling to act" state. What most important for ST_3, was "How to collect more examples of designing mathematical activities for students to learn?" He expected that $T_1$and T_2 could help him develop the situations to increase student pleasure in learning mathematics. Although these values positions were not observed in his classroom teaching practice, but he wanted to do so. In this case, his present state of values learning is in a position of creating value visions but with limited teaching experimentations. This suggests that he is in a "felt difficult to act and yet willing to act" state.

A co-learning cycle for learning-to-teach pedagogical values

To help them moving from the base of "felt easy to know but difficult to act", through the present states of "felt difficult to act however unwilling to act" and "felt difficult to act and yet willing to act", to "knowing is action", a co-learning cycle for learning-to-teach pedagogical values is developed as the following Figure 1 shows.

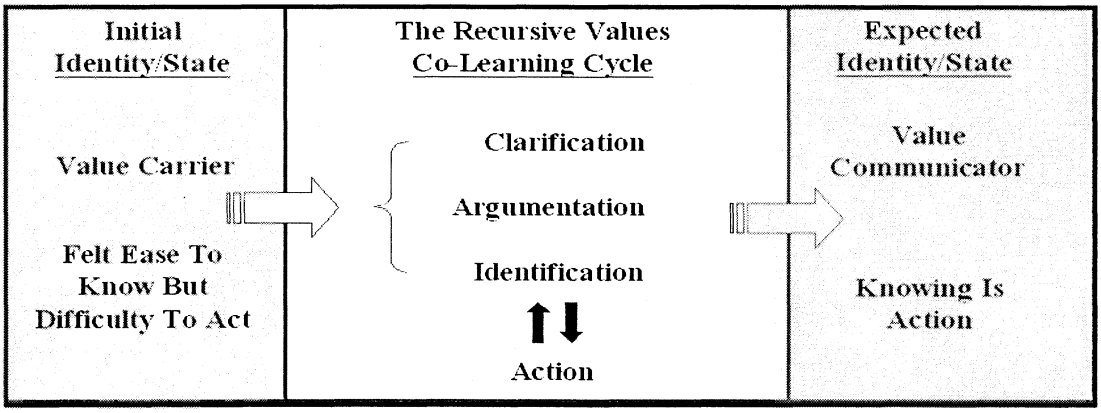

Figure 1: A Co-learning Cycle for Learning-to-Teach Pedagogical Values

In the values co-learning team, I was a participant observer and an action researcher; Ming acted as a values demonstrator; T_1, T_2, ST_1, ST_2, and ST_3 were the practitioners of values; and O played as an observer. To monitor them transferring from values carriers to values communicators (Chin & Lin, 2001b), the recursive learning cycle including the activities of clarification, argumentation, identification, and action was developed for thinking and practising of pedagogical values. Two substantial layers are underlined in the cycle: the thinking aspect in the process of learning-to-teach, and the enactive aspect of the values learning process. These two layers are implicitly

connected and relatively informed each other in the co-learning process. Within the cycle, each member is a learner, learning about the concepts of values education and values teaching. The researcher learns "How to educate teachers about values teaching?", Ming learns "How to present his own values to outsiders?", the five participant teachers try to re-consider the values provided with their own. The levels within this cycle are in a way related to Jaworski's (2001) 3-level model of co-learning partnership for developing mathematics teaching for teachers, teacher-educators, and researchers. In the present study, the researcher and teacher-educator who develops one's recognition of values education within level 3a, level 3b, and level 2, focusing on the roles and activities that can be used to facilitate the participants' values learning. Ming and the five teacher participants are to enhance their abilities and recognitions about values teaching within level 2 and level 1. All the members were trying to understand other members' values and the differences that might be emerged in comparison of one's own and others' values during exchanges. To help student teachers reaching the goal of "knowing is action", all the members were trying to become value communicators through this developmental framework of values learning.

REFLECTION

To revisit the study aims, several aspects concerning the learning framework need to be re-considered. The group discussions seemed to be effective as there were different participants with different thoughts and backgrounds for student teachers to exchange, model, and reflect on their own thinking and action about values teaching. The value learning resources were effective and this might have contributed to the participants' value clarification processes. The co-learning cycle for values learning was also useful in the ways that it played in increasing participants' recognitions and awareness of thinking and practicing about values. Thus, the four main activities in the co-learning cycle seem to be useful for teacher educators to develop their student teachers' values. I would rather see it as a cyclic and recursive path for the teachers to reflect on and to learn about values, than as a static and single loop for them to go through.

The practices of educating mathematics teachers about pedagogical values that the present study describe, challenge much of our knowledge, beliefs, and values about mathematics teacher education from a very fundamental aspect, as the teachers are more seriously considered in their process of "becoming-a-teacher", related to his or her own processes of identities and values development. After all, classroom teachers are at the very hart of any curriculum reforms, not least of course in the recently launched Taiwanese New Mathematics Curriculum (ME, 2001) for the students under age of 15, in which the values of pleasure and practical knowledge are explicitly addressed. Is this a kind of "paradigm shift" for school mathematics curriculum and classroom teaching of mathematics? Or the challenge is more about the re-assessment and re-construction of teachers and educators' pedagogical beliefs and values?

Two issues concerning education of student teachers about values need to be further examined. One issue is about their willingness to teach those values in classrooms, and

the other concerns the ability to teach them. Although student interest and motivation to learn were important but they resisted doing so, as ST_1 and ST_2 showed. There were also problems related to the abilities of teaching the intended values as shown by ST_3. We have to create intrinsic motives for student teachers to teach their intended values, and to provide learning arenas to empower their abilities to implement them.

REFERENCES

Allport, G.W. (1961). *Pattern and growth in personality*. New York: Holt, Rinehart, & Winston.

Aspin, D.N. (2000). Values, beliefs, and attitudes in education: The nature of values and their place and promotion in schools. In M. Leicester, C. Modgil, & S. Modgil, (Eds.), *Education, Culture and Values* (Vol. II, pp.130-143). London: Falmer.

Bishop, A.J. (2001). Educating student teachers about values in mathematics education. In F.L. Lin, & T.J. Cooney (Eds.), *Making sense of mathematics teacher education* (pp. 233-246). Dordrecht: Kluwer.

Bishop, A.J., FitzSimon, G., Seah, W.T., & Clarkson, P. (2001). Do teachers implement their intended values in mathematics classroom? In Marja van den Heuvel-Panhuizen (Ed.), *Proceedings of the PME 25th Conference* (Vol. 2, p.169-176), Utrecht: Utrecht University.

Chang, C.K. (2000). Score-ism as their pedagogical value of two junior high mathematics teachers. In W.S. Horng, & F.L. Lin (Eds.), *Proceedings of the HPM 2000 Conference* (Vol. 2, pp.172-177). Taipei: National Taiwan Normal University (NTNU).

Chin, C., & Lin, F.L. (1998). Student teachers' pre-conceptions of mathematics teaching and the relationship to their prior mathematics learning in Taiwan. *Chinese Journal of Science Education*, 6(3), 219-254.

Chin, C., & Lin, F.L. (2000). A case study of a mathematics teacher's pedagogical values: Use of a methodological framework of interpretation and reflection. *Proceedings of the National Science Council Part D: Mathematics, Science, and Technology Education*, 10(2), 90-101.

Chin, C. (2001). Developing mathematics teachers' pedagogical values: Clarification, argumentation, identification, and action as co-learning cycle. Invited paper presented in The Netherlands and Taiwan Conference on Common Sense in Mathematics Education, Taipei: NTNU.

Chin, C., & Lin, F.L. (2001a). Value-loaded activities in mathematics classroom. In Marja van den Heuvel -Panhuizen (Ed.), *Proceedings of the PME 25th Conference* (Vol. 2, pp.249-256), Utrecht: Utrecht University.

Chin, C., & Lin, F.L. (2001b). Mathematics teacher's pedagogical value clarification and its relationship to classroom teaching. *Proceedings of the National Science Council Part D: Mathematics, Science, and Technology Education*, 11(3), 114-125.

Chin, C., Leu, Y.C., & Lin, F.L. (2001). Pedagogical values, mathematics teaching and teacher education: Case studies of two experienced teachers. In F.L. Lin, & T.J. Cooney (Eds.), *Making sense of mathematics teacher education* (pp. 247-269). Dordrecht: Kluwer.

Fraenkel, J.R. (1977). *How to teach about values: An analytic approach*. N.J.: Printice-Hall.

Goffree, F., & Dolk, M. (Eds.) (1995). *Standards for primary mathematics teacher education*. Utrecht: The NVORWO Commission.

Jaworski, B. (2001). Developing mathematics teaching: Teachers, teacher educators, and researchers as co-learners. In F.L. Lin, & T.J. Cooney (Eds.), *Making sense of mathematics teacher education* (pp. 295-320). Dordrecht: Kluwer.

Leu, Y.C., & Wu, C.J. (2000). An elementary teacher's pedagogical values in mathematics: Clarification and change. In W.S. Horng, & F.L. Lin (Eds.), *Proceedings of the HPM 2000 Conference* (Vol. 2, pp.178-195). Taipei: NTNU.

Ling, L., & Stephenson, J. (1998). Introduction and theoretical perspectives. In J. Stephenson, L. Ling, E. Burman, & M. Cooper (Eds), *Values and education* (pp. 3-19), London: Routledge.

McNiff, J., Lomax, P., & Whitehead, J. (1996). *You and your action research project*. London: Routledge.

Ministry of Education (2001). *Outlines of the new curriculum for primary and junior high schools: mathematics*.

Raths, L.E., Harmin, M., & Simon, S.B. (1987). Selections from values and teaching. In P.F. Carbone (Ed), *Value theory and education* (pp.198-214). Malabar: Krieger.

Rokeach, M. (1973). *The structure of human values*. New York: Free Press.

Rokeach, M. (1979). *Understanding human values: Individual and social*. New York: Free Press.

Schön, D.A. (1987). *Educating the reflective practitioner*. Oxford: Jossey-Bass.

Seah, W. T., & Bishop, A. J. (2000). Researching values with migrant/expatriate teachers of mathematics. In J. Wakefield (Ed.), *Mathematics: Shaping the future* (pp. 348-355). Melbourne: MAV.

Statistics Package for Social Sciences (1995). *SPSS advanced statistics 6.1*. Chicago: SPSS Inc.

Vygotsky, L.S. (1978). *Mind in society*. Cambridge: Harvard University Press.

Yin, R.K. (1994). *Case study research: Design and methods* (2nd ed.). London: SAGE.