A 4-dimensional Analysis of the Practice in Mathematics Education

Po-Hung Liu

National Chin-Yi University of Technology, Taiwan

liuph@ncut.edu.tw

As the most important international institution serving for improving worldwide mathematics education, ICMI is expected to respond to diverse calls and needs among all regions. Nonetheless, the goal of mathematics education is subject to contemporary educational issues, epistemological interpretation of knowledge, and social needs at the time. For reaching the established goals, any forms of practice in mathematics education (researches, curriculum development, teaching and learning) are supposed to react to aforementioned variables. Otherwise, a failure of any mathematics education reform would be expected if a balance cannot be achieved.

The need for mathematics in this changing world has never been greater. However, the reasons for the need are varied across cultures and an agreement is hard to reach. Some people see this issue in the lens of realism, stressing the importance of mathematics in daily life and workplaces, and some others stress its significance in the information age. Still others call for an attention to the nature of mathematics and cultural aspects. For seeking to establish an appropriate ICMI perspective, this paper proposes a 4-dimensional analysis for the practice in mathematics education which consists of four components: Global Vision (GV), Local Focus (LF), Mathematical Knowledge (MK), and Time Span (TS), as Figure 1 shown.

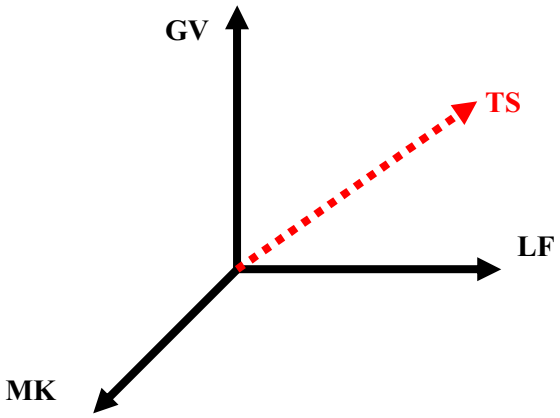

Figure 1

Global Vision (GV)

A global village is forming along with the frequent international communication and powerful technology. The conception of world as a one is gradually shaping a worldwide value of human behavior and education is the most appropriate means for carrying out such value. Robitaille and Travers (1992) indicated that mathematics education perhaps is the most international subject of higher education. Such a phenomenon may be due to a widely held belief that mathematics is a universal language and the highly homogeneous mathematics curriculum at the college level. In terms of such two facts, establishing a global vision of mathematics education no doubt is a significant task ahead. Global vision represents a consensus view of how mathematics education should be carried out among international societies. In some sense, it suggests a state-of-the-art perspective and sets up a high guidepost of contemporary mathematics education. However, a misunderstanding of the purpose of global vision may cause problems in the practice of mathematics education. For instance, any international attempt to reform mathematics education typically initiates new and creative solutions to educational issues and dedicates to innovation. Nonetheless, such an aspiring effort might ignore various perspectives on mathematics education. Kaiser and Sriraman (2006) proposed three main perspectives in mathematics education (pragmatics perspective, scientific-humanistic perspective, and integrative perspective), which are all subject to different educational goals (such as pedagogical, psychological, subject-related, and science-related). The compatibility between international innovative ideas and diverse perspectives is a serious issue should be taken into account.

Local Focus (LF)

Local focus on the practice in mathematics education directly reflects the various needs of local societies for which mathematics education is supposed to serve. Compare to global vision, showing more idealistic spirit, local focus normally demonstrates a feature of realism and is usually a result of compromise. Global community is mainly constituted by mathematics education researchers, having relatively high common concerns on educational issues. Yet, heterogeneous members of local community, including politicians, researchers, teachers, and parents, represent mixed positions and are more difficult to reach agreement. Based upon the belief of “no one left behind”, certain parties see education as an instrument in pursuit of an egalitarian society (Gates, 1997). Nonetheless, it is also a sound belief in several societies that some students are born to lead and others to follow (Rogers, 2002). With the frequent communication among different areas, there is a seemingly convergent trend in research issues and methodologies, which result in a wide spread acceptance of epistemological position, such as constructivism (Atweh & Clarkson, 2002a). The educational

cultures between GV and LF may be incompatible, if not contradicted, with each other.

Particularly, teacher belief about curriculum reform is another critical concern. Ross, MacDougall, & Hogaboam-Gray (2002) reviewed a great amount of research studies and found that the main obstacle to implementation reform curriculum was teachers' beliefs about mathematics teaching. Local focus deeply affects the width of range of a reforming practice (i.e., the degree of acceptability by local community), thus a comprehensive negotiation between GV and LF is necessary for building up a rational middle ground.

Mathematical Knowledge (MK)

Mathematical knowledge, closely related to GV and LF, determines the depth of the practice in mathematics education. All mathematics education reform would be in vein without having an appropriate understanding and interpretation of mathematical knowledge. However, the interpretation of mathematical knowledge in education is always a controversial issue. In what ways and to what extent various areas of mathematical knowledge is integrated into curriculum often cause hot debates among mathematics education researchers, mathematicians, and school teachers. Current epistemological views of content in mathematics have shifted away from an absolute and objective knowledge to a dialectical and subjective subject matter, which have significant implication in the practice of mathematical teaching and learning. Different interpretations regarding the scientific discipline, however, may occur among different parties. Mura (1993; 1995) reported different images of mathematics held by university teachers of mathematical sciences, which is more deductive and culture-free, and by university teachers of mathematics education, which is more inductive and culture-based. French mathematician Rene Thom (1973) pointed out: "whether one wishes it or not, all mathematical pedagogy, even if scarcely coherent, rests on a philosophy of mathematics" (p. 204). In a similar sense, mathematics education researchers, mathematicians, and teacher's sense of mathematical enterprise may profoundly determine the nature of curriculum and classroom environment. Accordingly, as Hersh (1986) indicated, it may be said the issue is not "What is the best way to teach and learn?" but "What is mathematics really all about?".

Time Span (TS)

Time span represents the life-cycle of a reforming practice in mathematics education. At what moment a reform should occur usually is hard to determine and predict since it is mostly subject to local focus dimension. Nonetheless, a significant change in global vision may also exert an influence on time span. For instance, the rise of constructivism triggered curriculum

reform in several areas during late 1990s and early 2000s. However, an insufficient communication and understanding between local focus and global vision could curtail the lifespan of such a reforming practice. Critical issues of debates are mostly related to the interpretation of mathematical knowledge, as aforementioned.

Conclusion

In this paper, four dimensions, Global Vision (GV), Local Focus (LF), Mathematical Knowledge (MK), and Time Span (TS), are taken into account for the practice in mathematics education. The main doctrine is any attempt in reforming curriculum and school teaching may not be successful without considering the respective culture of global, local, and mathematical community. A rational balance among the three dimensions would be helpful to construct a stable "educational tetrahedron" for the development of curriculum (Figure 2). Otherwise, any practice could just be built upon insecure base (Figure 3). Furthermore, global vision may also dangerously lead to a global curriculum. As Usiskin cautioned, the new world order should not result in a world-wide curriculum (cited in Atweh & Clarkson, 2002b). It is a reality that western educational thoughts have a significant effect on the current practice in mathematics education across different cultures. We had better remind that contemporary theories about learning are "founded in a model of the European Rational Man, and that this starting point might well be inappropriate when applied to other cultures" (Roger, 1992, p.22).

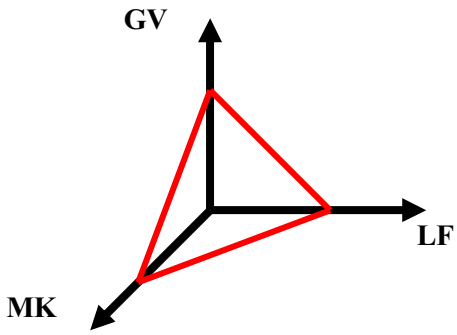

Figure 2

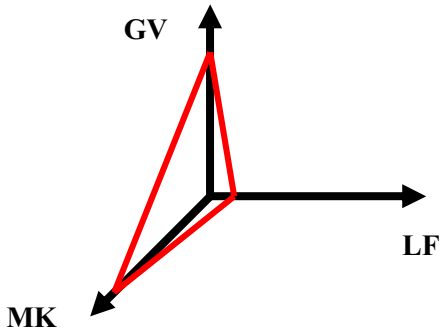

Figure 3

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