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Review of *Critical Issues in Mathematics Education: Major Contributions of Alan Bishop*

Editors: **Philip Clarkson & Norma Presmeg**
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As the subtitle "Major Contributions of Alan Bishop" indicates, the book is meant as a Festschrift to honor a respected academic in the field of mathematics education. As the editors, Philip Clarkson and Norma Presmeg, explain, however, in Chapter 1, it is a "Festschrift with a Difference." It has a definite structure, inviting academic colleagues of Alan Bishop to contribute to a volume that focuses on the ideas developed over the last 40 years by Bishop; where and how they were developed; and what became of those ideas through the years. The volume is an important contribution as mathematics education is, in most parts of the world, a new field of study and research, which is still in the process of defining itself. By tracing the developments in mathematics education emanating from and relating to key contributions of Alan Bishop, the book helps pull together key themes in mathematics education research. Bishop is one of the key figures in the shaping of the focus and agenda of mathematics education, with a particular concern for the classroom teacher and for cultures on the periphery.

After an introduction by Philip Clarkson to Alan Bishop (Chapter 2) and a summary of milestones in his development and work as a mathematics educator, the volume is structured into six sections, focused on issues which have been at the center of Bishop's research interests:

- Teacher decision-making
- Spatial abilities, visualisation and geometry
- Cultural and social aspects of mathematics education
- Socio-political issues for mathematics education
- Teachers and research
- Values and teaching mathematics

Alan Bishop is perhaps best known today for his contributions to the study of the role of society and culture in mathematics education. It is interesting that this focus came about from his encounter with the spatial abilities and visualisation skills of the totally different cultures of Papua New Guinea. His work in this area has found great resonance in the mathematics education world. From the beginning, the recurring theme in Bishop's work is the central role of the teacher-practitioner and the critical need for mathematics education researchers to have the teacher-practitioner as a key point of reference in their research. This has found less resonance in mathematics education research and a rather large gap remains between mathematics educators and teacher-practitioners.

Teacher Decision-Making and Teachers and Research

I place together Section II on "Teacher Decision-Making" and Section VI on "Teachers and Research" as they address a key and recurring concern of Bishop as mentioned above. One of the ways Bishop used early in his research career to study the improvement of mathematics teaching from the teacher's perspective was to study teacher decision-making. Section II of the book is dedicated to this topic. In the introductory paper of Bishop "Decision-Making, the Intervening Variable" (Chapter 3), published in 1976, he notes that from his experience, "teaching methods" is not a particularly helpful way to approach the improvement of teaching. He found that teachers resonated more with questions regarding their way of making decisions – in the face of student errors, student questions or when they realise that the lesson is not getting through. This approach leads to a way of training novice teachers analogous to a flight simulator for novice pilots. One finds that when presented with situations to which they must respond, experienced teachers have "a smile of recognition" – they have seen something like that before and know how to respond. The challenge is to develop mathematics teacher training "flight simulators" to bring novice teachers to this expert stage.

In Chapter 4, Hilda Borko, Sarah Roberts and Richard Shavelson discuss the development of research on teacher decision-making, in particular the work of Bishop, Shulman and Shavelson. While Bishop's approach came more directly from his experience with teachers, Shulman and Shavelson came from the culture of cognitive psychology. They looked at teachers' reasoning and decision-making as similar to that of physicians and other

professionals, who develop "schemas" to classify and respond to the diverse situations they face in their work. A serious limitation to this study of teacher decision-making was that it did not connect teachers' decisions to student learning. The Chapter goes on then to subsequent developments which move from teacher decision-making to teacher knowledge, specifically to mathematical knowledge for teaching. This comes closer to a dominant concern of Bishop's, namely "a theory that describes what teachers need to know in order to teach effectively, as well as how that knowledge is manifested in classroom practice." (p. 64)

Section VI is on "Teachers and Research" and develops further Bishop's concern that mathematics education research must eventually lead to more effective mathematics teaching. In his introductory paper "Research, Effectiveness and the Practitioners' World",(Chapter 13) he points out that the culture of meetings of mathematics education researchers tends to center on analyses and critiques, on differences, rather than on syntheses and consensus that may eventually lead to better practice in the teaching and learning of mathematics. The paper reminds researchers that reform and improvement in mathematics teaching and learning are ultimately in the hands of teachers and practitioners and so researchers need to engage the practitioners' knowledge and situations in a stronger way than they have been doing. Mathematics education researchers also need to collaborate more with other researchers, e.g., sociologists and anthropologists, and to give greater prominence to institutional context and constraints.

Chapter 14, "Practicing Research and Researching Practice", by Jeremy Kilpatrick, and Chapter 15, "Reflexivity, Effectiveness and the Interaction of Researcher and Practitioner Worlds" by Kenneth Ruthven, while agreeing with Bishop's concern that researchers need to take more account of the "practical concerns of teachers", bring out that there are other key players influencing the practice of mathematics teaching. Kilpatrick mentions mathematicians in particular. Ruthven has a thought-provoking analysis of the role of government, contrasting the Cockcroft Committee Report of the 1980s, which gave a prominent role to professional consensus and the development of a network of advisory teachers and university-based mathematics educators, with the centralised approach of the "Numeracy Task Force" of the 1990s. A key lesson learned is that mathematics education research that seeks effective improvement of the teaching and learning of mathematics needs to take serious account of official agencies and policy-

making bodies. From my own personal experience of mathematics education reform in the Philippines, I could not agree more. Much of my work is in seeking to influence these official agencies and policy-making bodies.

Section III is on "Spatial abilities, Visualisation and Geometry", an area of research of Bishop's in the 1960s. His introductory paper "Spatial Abilities and Mathematics Education – A Review" (Chapter 5) argues for many spatial abilities rather than a single spatial ability and compares the work of various groups, factor analysts, the Piagetian school, Bruner and others.

Chapter 6, "Spatial Abilities Research as a Foundation for Visualisation in Teaching and Learning Mathematics" by Norma Presmeg is an extensive review of research on the roles of logical/analytical thinking and visual thinking in mathematics teaching and learning. Notable in particular is the framework given by Krutetskii on individual differences due to the different balances of logical versus visual thinking in individuals.

Chapter 7, "Spatial Abilities, Mathematics, Culture and the Papua New Guinea Experience," by Ken Clements tells the story of the transforming experience of Alan Bishop with Glen Lean at UNITECH in Lae, Papua New Guinea. It led Bishop and others after him to focus on the social and cultural aspects of mathematics education.

Chapter 7 thus segues into the next section, Section IV "Cultural and Social Aspects" and in Chapter 8, "Visualising and Mathematics in a Pre-Technological Culture", Bishop recounts his experience in Papua New Guinea. This was a turning point for him and brought him to the centrality of society and culture in the teaching and learning of mathematics. I personally relate to this article, as I attended a lecture in Australia in the 1970s on the study described here. I was very much struck by how our teaching and learning of mathematics is so culturally conditioned from the Papua New Guinea examples. The work of Bishop on the social and cultural aspects of mathematics education has found great resonance in much mathematics education research, as for example in the development of ethnomathematics.

The development of ethnomathematics is taken up in detail in Chapter 9, "Cultural and Social Aspects of Mathematics Education: Responding to Bishop's Challenge," by Bill Barton. He shows how ethnomathematics has progressed beyond showing examples of mathematics latent, for example,

in street vendor calculation and weaving, to the development of new mathematics from ethnomathematical considerations.

In "Chinese Culture, Islamic Culture and Mathematics Education," (Chapter 10), Frederick Leung writes on the social and cultural context and values underlying the well-known high achievement of students in the Confucian Heritage Cultures. The importance of beliefs and values among teachers, parents, pupils and in the larger society has been pointed out in the comparative studies between the Confucian Heritage Cultures and the West. Leung notes, in particular, the role of language, instructional practice and teacher knowledge. The section on teacher knowledge for effective teaching and learning, as developed in the Confucian Heritage Culture tradition, should be read together with the concern in Chapter 4 on going beyond teacher decision-making and developing mathematical knowledge for effective teaching. There is also a short section on Islamic Contribution to Pedagogy.

Section V on "Social and Political Aspects" brings us to the arena of many major debates on mathematics education, much of it heightened by international assessments of mathematics achievement. In his 1990 paper "Mathematical Power to the People", (Chapter 11) Bishop studies in detail two major reform initiatives in the U.S., "Everybody Counts: A Report to the Nation on the Future of Mathematics Education" by the National Research Council and "Curriculum and Evaluation Standards for School Mathematics" by the National Council of Teachers of Mathematics (NCTM). The question Bishop asks is the likelihood that the reforms would be implemented. He notes the number of players who would have to align themselves with the reform initiatives (textbook publishers, state adoption boards, teacher training institutions, testing boards) and expresses his concern that the NCTM locates reform simply in improving teacher-student interaction and pays scant attention to the larger social context.

In their study of where Bishop's 1990 paper has gone, "Mathematical Power as Political Power – The Politics of Mathematics Education" (Chapter 12), Christine Keitel and Renuka Vithal begin by noting Bishop's expression of disappointment 10 years later during ICME 9 with the lack of success of the reforms studied in his 1990 paper. Keitel and Vithal then review "the politics of mathematics education" through different centuries and socio-political situations and in different countries. Their main point echoes Bishop's earlier comment that mathematics education research has not

sufficiently engaged key policy makers and politicians. They add that international testing regimes have filled the gap left by mathematics educators and influence major policy in many countries.

Section VII, "Values", looks at the influence of Bishop's work on whether and how values have a role in mathematics teaching and learning. Bishop in "Mathematics Teaching and Values Education – An Intersection in Need of Research" (Chapter 16) argues that the study of values in mathematics teaching and learning is important and has been given little attention. In "Valuing Values in Mathematics Education" (Chapter 17), Wee Tiong Seah discusses how we might go about doing the needed research on values in mathematics education. Wee analyses what we might mean by values in mathematics education, how we might measure these values, and how we can apply the knowledge derived from these studies to improve mathematics teaching and learning.

The articles in the book show how much work and progress has been achieved in the last 40 years in understanding better how to bring about effective reform in mathematics teaching and learning. At the same time, it shows how difficult this terrain is. There are so many players that influence policy and practice in mathematics education. Getting them to work together towards a common purpose is rarely achieved. The differences of situations and cultures are also immense. So much work remains to be done.

The articles in the book also show how much can be achieved by the ideas and drive of an individual and is a wonderful tribute to the ideas, person and work of Alan Bishop. It shows how a community of scholars has come together through the ideas and personal care and concern of a great scholar. I believe this volume will lay the seeds for much future work and research. Together with the contributors to this volume, I would like to pay tribute to Alan, for his abiding concern for mathematics education in developing countries and for his support and encouragement of my own work in mathematics education reform.