

EQUITY, MATHEMATICS LEARNING AND TECHNOLOGY - INTRODUCTION

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The cultural association between masculinity and technology in Western societies is hard to exaggerate. It operates not only as a popular assumption ... but also as an academic 'truth' Even feminist writers, usually at the forefront of attacks on assumptions about gender, have mostly accepted the association, and, rather than challenging its existence, have sought to understand how and why this state of affairs has come about – and how it might be disrupted. (Gill & Grint, 1995, p. 3)

FROM A FOCUS ON GENDER TO BROADER ISSUES

In recent times there has been growing recognition of the many factors likely to influence mathematics learning. For example, the interactions between beliefs about mathematics and its teaching and learning have been explored from a variety of perspectives by Leder, Pehkonen and Törner (2002) and their colleagues. Attempts to explore the interaction between mathematics achievement, gender and other background variables have also intensified. Focusing on American research, Tate (1997) reviewed performance data for possible group differences in mathematics achievement linked to class, race, gender, and ethnicity and concluded “that over the last 15 years all demographic groups have improved in mathematics achievement – specifically in basic skills” (p. 652). He also argued forcefully that equity related recommendations in the *Professional Standards for Teaching Mathematics* (National Council of Teachers of Mathematics [NCTM]) are potentially useful but are all too frequently ignored. Cooper and Dunne’s (2000) monograph exploring the effect of gender and social class on the mathematics performance of school students in England has received considerable attention. Briefly, they found that the trend towards the use of “realistic” test items can mask rather than facilitate students’ performance, and illustrated that invalid measurement problems vary across gender and social background. In a review of recent Australian research, Forgasz, Leder and Vale (2000) noted:

Increasingly, attempts (have been) made to gauge the impact on mathematics learning of both patriarchal and class domination and to recognize their multiple effects in any interventions planned to redress inequities. Thus the concerns ... voiced in the community at large, that females from working class backgrounds are often particularly disadvantaged in the home, in the labour force, in access to leisure pursuits, affected work in mathematics education. Sincere efforts (have been) made to mirror as comprehensively as possible the complex web of factors - personal, situational, and social - which might shed light on issues of gender and mathematics. ...No longer do we simplistically assume that the planning, execution, reporting, and interpretation of research are value free. (p. 309)

Thus more careful attention is being paid to the definitions and dimensions of equity, and to the interactions of these dimensions. In response, mathematics education researchers have adopted a wider range of research designs to explore equity issues.

A FOCUS ON TECHNOLOGY

According to Tooke (2001) “mathematics gave birth to computer science, but together they have both developed significantly. All of this has certainly had an impact on many areas of mathematics education, including the mathematics curriculum, mathematics instruction, and mathematics learning” (p. 2). Waits and Demana (1998) argued that the impact on the mathematics curriculum of “the computer’s little sibling”, the hand held calculator, should not be underestimated. “More than a quarter of the mathematics taught before the arrival of the scientific calculator” Tooke (2001) noted, “is not being taught today” (p. 3).

An indication of the proliferation of research on gender issues and information technology can be gleaned from Volman and van Eck’s (2001) recent review of such work. Although these authors are located in a non-English speaking European country, the bulk of the work reviewed is readily accessible to native English speakers.

Volman and van Eck indicate that their review built on an earlier one by Sutton (1991). The latter attempted to include gender, race, and class as critical variables in her survey of work concerned with the use of computers in schools, but concluded that research concerned with gender equity issues dominated. Volman and van Eck also focus on gender issues in their review of the literature, but where possible on research examining applications of information and communication technology (ICT) in education and differences in outcomes or in affect based on gender, race and class. The change in terminology – from learning about computers in the early 1980s, to computer-aided instruction in subsequent work, to ICT in more recent years – is a useful reminder of the rapid development and changing applications of the use of computers in schools. Particularly pertinent for this Research Forum are Volman and van Eck’s (2001) conclusions that

- although gender and ICT in education appears to be emerging as a field of interest to a diversity of researchers, the field is not strongly developed theoretically or conceptually (p. 628);
- there has been insufficient diversity (e.g., school types and levels, different cultures, different local contexts) in the settings in which research has been carried out (p. 628);
- whether particular ICT applications in schools foster or diminish gender equity has not been explored in sufficient depth (p. 628) - in terms of achievement outcomes, approaches to problem solving, affective reactions, and age related factors;
- ICT applications in education may both promote and hinder the achievement of (gender) equity – “new inequalities may emerge” (p. 627). This last point warrants a further illustration.

A brief aside

An innovative feature, an International Round Table [IRT], was introduced at the 9th International Congress on Mathematical Education [ICME-9], held in Tokyo in 2000. The purpose of the IRT was twofold: to create public awareness of critical issues and new directions in mathematics education and to display the power of technology, by having speakers and audiences located in Tokyo, Washington, and Singapore interact via a teleconference hook-up. “How has the introduction of technology affected instruction and curriculum? What are we doing and what should we be doing?” were among the

questions raised by the IRT Chair to the panelists. During the ensuing discussion among the panelists and among the audience it became clear just how much the nature and extent of the use of technology in mathematics classrooms vary between and within nations. Also emphasized was the fallacy of the assumption that facilities available in developed nations were equally accessible and affordable in developing countries. Thus the introduction of technology into schools and more broadly may exacerbate rather than diminish inequities in some settings.

SCOPE OF THE RESEARCH FORUM

It is not possible to address in this Research Forum all the issues highlighted by Volman and van Eck (2001), as well as others identified as warranting attention in future research. Those we, the contributors to this report, would like to highlight include the following:

- Does access to the technology per se promote mathematical learning, as is often proclaimed and generally assumed?
- In this changing learning environment, what are the implications for mathematics teaching and learning of gender, culture/ethnicity/race, and socio-economic background/class?

The advent of particular technologies in classrooms raises other vital questions related to equity.

- Do all students have equal access to the technology?
- Are all students advantaged by the use of technology as they learn mathematics?
- If not, are there new privileged and new disadvantaged groups?

In the formal presentations made as part of the Research Forum we focus on students' beliefs about the use of computers linked to gender, SES, ethnicity, age, and location factors (Helen Forgasz), on the applications of ICT in higher education, and in particular its effectiveness in attracting females to engineering (Christine Keitel), and the availability and sustainability of delivering technological resources to developing countries such as South Africa (Mamokgheti Setati). We also grapple with theoretical issues: the use of feminist frameworks for researching equity and mathematics learning (Gabriele Kaiser), designing research to ensure equity in mathematics learning when teaching with technology (Colleen Vale), and reflections on themes and issues in researching equity and transforming education (Walter Secada). Not able to be predicted at this stage are the additional perspectives on equity, mathematics learning and technology we anticipate will be contributed by other participants in the Research Forum.

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