

A DISCUSSION PAPER ON THE STATE OF RESEARCH ON EQUITY IN MATHEMATICS EDUCATION AND ARISING CHALLENGES

VERSION 1

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A discussion paper for the Topic Study Group 33, Equity in Mathematics Education (Including Gender) at the International Congress of Mathematics Education 13, July 24-July 31, 2016, Hamburg, Germany. This is a living document. Future versions will include comments sent by academics from around the world that would contribute to the discussion of issues related to equity in mathematics education (including gender). Please forward your contributions to b.atweh@oneworldripples.com

The Topic Study Group 33 at ICME-13 (TSG33) provides a venue for discussion by researchers and practitioners from different countries who are passionate about issues of equity and are working in their particular settings toward achieving the goal of *mathematics for all*. While the equity agenda has changed over the last few ICME conferences, we envision this TSG as an all-encompassing group in which we can discuss issues that traditionally have been included under labels such as inclusive education or diversity as well as equity and social justice. Certainly variations exist among countries in the terms used and the categories pertinent to the local educational setting. Indeed, our understanding of the complexity of issues related to opportunity to learn, participation in, and achievement in mathematics have also changed as new theoretical models have informed our collective work.

Gender is a special category in both the title and the functioning of the TSG33 to acknowledge the past work of researchers and activists on issues of gender, and to focus on the continuing imbalance in many countries in achievement and participation in mathematics of girls and women. The group will also provide opportunities to discuss contemporary theorizing in gender and mathematics education that goes beyond the binary understanding of gender and beyond the mere gaps in achievement and participation. We are especially interested in work that examines equity issues as they relate to other social constructs, such as socioeconomic status, ethnicity, culture, language minority status, alternative physical and mental abilities and sexual identities and orientations.

The aims of TSG33 sessions include, but are not limited to, the following:

- Problematize the equity agenda itself, as increasing and sometimes competing demands for social justice from different groups require attention;
- Examine new theoretical frameworks that help us understand and study equity;
- Consider the prevalence of (in)equity around the world;
- Analyze intervention programs around the world with an eye to identifying characteristics of successful interventions that may transfer to different cultural settings; and,
- Query equity in participation in mathematics education research and international dialogue, with a focus on who is excluded from participation.

In this short paper, we do not attempt to present a comprehensive review of the current state of theorizing equity nor the international status of research on equity in the practice of mathematics education. In many ways, the deliberations in this Topic Study Group, and the resulting book publication, may contribute to such an extensive survey. Rather, our task is to point out a few key challenges to theorizing and researching equity that may guide our deliberations in the TSG33 towards the increased effectiveness of our collective understanding and action for more equitable and socially just mathematics education.

The structure of this paper is as follows. Section I below presents some of our own observations about the equity agenda in mathematics education as we have experienced it developing the past few decades. In particular, Section II, discusses some developments in theorizing equity in mathematics education, and Section III discusses some developments in research on gender in different contexts and presents different challenges to be managed by researchers in the area. Finally, Section IV identifies some silences in the international research and policy arenas in equity by providing two examples of social groups not often discussed in the literature in mathematics education.

I. GENERAL OBSERVATIONS ON THE EQUITY AGENDA IN MATHEMATICS EDUCATION

We note four observations about the equity agenda and mathematics education in the past few decades. First, in spite of the contention that Secada made in 1989 that equity in mathematics education remains under-theorized, Secada, Cueto and Andrade (2003) noted that “the viewing of group-based inequality as an issue of equity has a long tradition within policy-relevant social science research ... and in different forms of educational research in particular” (p.108). At the risk of oversimplification, the pioneering research on equity in mathematics education in the 1970s has been concerned with access and achievement in the learning of mathematics of segments of the school populations - and particularly girls. Although different criteria to indicate lack of equity were used by different authors, Hart (2003) presented a multidimensional definition of equity as equal opportunity, equal treatment and equal outcomes. Further, such pioneering research discussed some implications for curriculum and pedagogy in terms of alternative modes of presentation and assessment, avoidance of bias and stereotypes and an increase of focus on the affect in mathematics teaching.

In the past decades, equity has become mainstream in mathematics education in the sense that it is an integral part of curriculum documents and policy in many countries, many research and professional conferences, and professional publications in the field. Here, it is relevant to note in particular a pattern highlighted by the previous ICME 10 in Mexico where the agendas of equity and quality were seen as two sides of the same coin (Atweh, Graven, Secada, & Valero, 2011). However, in the ever increasing dominance of educational testing as a springboard for education policy and evaluation that often equates educational outcomes with the results on standardized testing in many countries, Clarke (2014) observed that "equity has been colonized by, and subordinated to, discourses of quality in education, becoming, in a sense, another form of accountability, if one with a conscience" (p.594).

Second, and perhaps related, is that discussion of equity has been an integral part of other areas of theory and the implied curriculum approaches in the discipline as articulated by critical mathematics education, ethnomathematics, culturally relevant mathematics education, political and social justice approaches, and, sociocultural and sociopolitical perspectives to mathematics education. These traditions of research and critique are strongly committed to equity concerns even though they may have focused on its different aspects or understandings. It is worthwhile to note that, although these areas have developed strong research traditions, some have been reflected in national and international policy formulations and wide adoption in practice more than others.

Third, we observe that understanding of equity has varied across the different authors as reflected in the language used to talk about it, from equity, diversity, inclusion, social justice and, more recently, ethics, as well as the theories (often from outside mathematics education) that are used to construct the research and debates about equity concerns. Similarly, while, arguably, equity historically has arisen out of research and action by a group of women educators on issues related to gender, it has diversified to include all areas of exclusion based on race, indigeneity, socioeconomic background, physical and cognitive disabilities, to name a few. While the social histories and issues faced by each of these groups and the appropriate remedies vary, this diversity is enriching to the equity issues. However, it also raises concerns as to type of theorizing, policies and practices that are appropriate in managing teaching in increasingly diversified classrooms in many nations as well as some silences of the equity agenda as discussed below.

Based on these observations, we posit the following questions for the mathematics education community.

Question 1. In the contexts of diversity of student populations in many classrooms around the world, how do we understand and promote equity that goes beyond mere academic and critical deliberations towards policy and practice?

Question 2: What synergy exists between our understanding of quality and equity in mathematics education?

II. CONTEMPORARY CHALLENGES TO THEORIZING EQUITY

Here we identify two challenges to understanding equity as access, participation and outcomes, discussed above, that were raised by a variety of authors in more recent literature - from post-structural and from sociopolitical perspectives respectively.

On one hand, recent literature in equity and mathematics education provided alternative understanding of the concept of identity as seems to be assumed in the approaches identified above. In the pioneering understanding of equity, identity and group belonging were taken as fixed and given. This may be termed as a 'realist' understanding of identity. However, from a postmodern perspective(s) identity, of students and teachers, is seen as "multiple, fluid, or contradictory" (Gutiérrez, 2011, p.21). One concern about the realist stance to identity and exclusion is that it "draws upon one-time cross sections of data, it offers little more than a static picture of inequities with inadequate information about how those inequities were created" (p. 23). Gutiérrez adds "while documenting the inequities that marginalized students experience daily in mathematics education could be seen as the first step towards addressing hegemony, most research stops there" (p. 22) Theories from post-structural perspectives view identity as a 'discursively' constructed and point to the way discourse in which children are inserted in their earliest educational years is reflected in their identity. However, as Gill and Tanter (2014) noted "such developments were harder to capture in measurable terms and hence less likely to be written into policy" (p.281).

Perhaps it is relevant here to point out that while this theoretical divide between the so-called realism and discursive interpretations of identity remains open in mathematics education, in other fields this divide can be bridged by the writings of 'critical realism' that denounces the essentialism implied by the realist perspective, but falls short of accepting that identity as a mere narrative, thus denying it of a 'reality.' Commenting on the book entitled *Reclaiming Identity* (Moya & Hames-Garcia, 2000), Stone-Mediator (2002) eloquently raises the questions "How for instance can we demand more truthful representations of the world, if we view all truth claims as equally unreliable? How can we defend a politics committed to social justice, if we see moral norms as mere conventions?" and "How can we address our oppression as members of specific social groups, if we treat identity as fiction?" (p. 126).

In what might be the sole article on critical realism (also known as post-positivist realism) in mathematics education, Nunez (2015) argues that

[a] possible Achilles' heel of postmodernism arises when ontology is left out in favour of a uniquely discursive world. In other words, the world and indeed the objects of scientific research appear as sole constructions of society by means of concepts. For critical realism, this conflation of the dimension of ontology into language is argued to be an error in argumentation exemplifying the linguistic fallacy. The issue is not that concepts and discourses are necessarily social constructions by their nature; rather, the main point is that there exist real phenomena, that is, real mechanisms with causal implications relatively or absolutely independent of our concepts and discourses about them. (pps. 192-193)

On the other hand, some authors writing from sociopolitical perspectives have raised questions about the im/possibility of understanding and remedying equity with an intrinsically unequal society. Martin (2015) pointed out, perhaps with some irony, "[t]he hard truth is that the outcomes and inequities lamented over in *Principles to Actions [Ensuring Mathematics Success for All]*, (National Council of Teachers of Mathematics, 2014) and previous documents are precisely the outcomes that our educational system is designed to produce" (p.21). He argued that the equity principles promoted by the high status policy statement reflect white rationality and promote the participation in a system that has long oppressed African American and Latin@s¹ students. By its silence on critical mathematics that aims at empowerment of marginalized students and their societies, it promotes an educational system that is more colonizing rather than liberating. Although using different social theories of oppression, similar

¹ Latin@ has been used by Martin (2015) and others as a gender-neutral combination of the masculine and feminine forms of Latino/a in Spanish

concern is expressed by Pais and Valero (2011) who point out that the questions that often remain unraised with regards to equity are: "Why is there inequity? Why is there a gap at all? That is, why does school (mathematics) systematically exclude/include people in/from the network of social positionings? ... Why does school perform the selective role that inevitably creates inequity?" (p.44). The authors go on to add "[a]s far as society remains organized under capitalist tenets, there will always be exclusion because exclusion is not a malfunction of capitalism, but the very same condition that keeps it alive" (p.44).

In the light of these challenges to the pioneering work on equity, we point to one promising understanding of the construct as presented by Gutiérrez (2002). Here, we use the descriptor 'promising' due to its commitment to exposing and struggle against exclusion and inequality within mathematics education as well as in its commitment to social change through mathematics. First, the author defines equity in the negative as "being unable to predict student patterns (e.g., achievement, participation, the ability to critically analyze data or society) based solely on characteristics such as race, class, ethnicity, sex, beliefs and creeds, and proficiency in the dominant language" (p. 153). However, this lack of ability to predict is not restricted to access, participation and outcomes. Rather it includes further practice of mathematics to analyze, reason about, and especially critique knowledge and events in the world and the erasure of inequities between people on the planet. As such it is in harmony with both the critical mathematics (Skovsmose, 1994) and the mathematics for social justice (Gutstein, 2006) in its focus of reading and writing the word through mathematics.

Question 3. What theoretical perspective(s) to understand equity (and identity) from the competing perspectives mentioned above (or new ones) can be productive for achieving policy and practice reform?

Question 4: what is the relationship between working for equity in education and working for equity in society?

III. PERSISTENCE OF THE NEED TO FOCUS ON GENDER

Among the various equity issues, gender has received the attention of researchers for about five decades now and rightly so. The rich research on gender differences in performance in mathematics - mainly from western countries- has helped to uncover various dimensions that contribute to differential performance and to foreground the role of sociocultural factors in determining attitude and approach towards teaching-learning mathematics. However, issues of gender in mathematics education remains under-researched on many counts.

Firstly, there is very little known about gender in large parts of the world. Else-Quest, Hyde and Linn (2010), in a cross-national study of gender differences in mathematics using TIMSS and PISA data, found that while mean effect sizes in mathematics achievement were very small, national effect sizes showed considerable variability. Despite similarities in achievement, males reported more positive attitudes and affect toward mathematics. However, a recent study reports findings contrary to the ones mentioned above. Kaldo and Hannula (2014) found that in Estonia female students at university level expressed a more positive view towards mathematics. They showed more mastery orientation, valued mathematics more, felt more competent, perceived their teachers more positively, and cheated less frequently. Thus these studies demonstrate the fact that gender does not operate in the same way across different countries and as a result gender differences in performance of girls and boys in mathematics is not uniform across countries. Moreover, a large number of countries (including all the South

Asian countries) do not participate in TIMSS and PISA and hence studies such as this are silent about how gender operates in these countries.

Secondly, while there is some literature – however limited- on the intersection of gender and race/ ethnicity/class, again in very few countries, there is hardly any on the difficulties of studying gender in countries that exhibit a complex mix of issues: for example in countries where a small percentage of youth of the college going age-group access higher education, a large section of the students living in rural areas and urban slums are very poor, where the learners' socio-cultural identity (such as gender, caste or tribal back-ground) plays an important role in access to education, where more and more of the rural poor migrate in search of labor, where there is a striking difference between rural and urban regions in terms of the opportunities they offer a young person for higher education and employment, and where child labor is still a reality both in rural and urban regions.

Question 5. What models are appropriate to study gender differences in a diversity of contexts including differences in cultures, social structures and values?

Thirdly, if *mathematics for all* should include transsexual and trans-gender adolescents, then there is a need to engage with the gender question in mathematics education beyond the binaries of boys and girls. In particular, if we view sex and gender as continua, what would be an appropriate way to recast the gender question in mathematics education? These questions resonate with similar questions raised by others researchers, and call for widening our understanding of equity that goes beyond looking at binary gaps (Gutiérrez, 2011).

In some parts of the world there seems to be a decreasing interest in doing research where gender is an important variable in predicting participation and achievement. Grevholm (2012) reported several indicators of diminishing activity in research on gender equity and mathematics, both nationally and internationally. Brandell (2014) warns that systematic differences among the genders risk losing importance compared to greater differences between other groups. One could get the impression that inequities among the genders are disappearing and that research with a main focus on gender is not necessary any more. This is not correct. Brandell claims that a gendered system still exists in education and inequity in mathematics is still present. Continued research is needed in order to understand this development, and to clarify contradictory results such as those of Else-Quest et al (2010) and Kaldo and Hannula (2014).

Question 6. How much research attention is needed to continue to document and address gender differences that have been studied for several decades now? What should be the focus of such research?

IV. SILENCES IN THE EQUITY AGENDA

In spite of the diversification of social groups targeted by equity research and policy pointed to above, here we point out that these concerns within the international mathematics education community have not been comprehensive. In this context we illustrate the gaps in our research and policy by two examples.

First, as we argued above, the equity research and policy making have arisen within certain western countries and have identified social groups of students that are demonstrably excluded from participation and achievement in mathematics education within these countries. Gradually

many of these social categories have gained international recognition. However, arguably, this has occurred at the expense of neglecting the needs of students from social groups in non-western contexts. For example, caste is a form of social segregation that operates predominantly in India but also in some of the neighboring countries such as Nepal, Pakistan, Sri Lanka, as well as in a few other countries in Asia. Unlike race or ethnicity, which are modernist notions, caste has a long history and religious sanction in India. Caste stratifies people in a hierarchical order based on their traditional occupation and preserves the caste line by endogamy. Thus, while priests and those engaged with religious scriptures and philosophy are at the top of the hierarchy, the castes whose occupation is to maintain sanitation and remove the carcasses of animals are placed outside the caste structure and are treated as untouchables. Also, those at the bottom or outside the caste hierarchy are more often than not among the poorest of the poor (Ambedkar, 2014). Castes in the lower levels of the hierarchy have very little access to mathematics education. Yet hardly any research has been dedicated to their needs.

Question 7. How should research on equity in mathematics education be expanded to include social groups other than those dominant in western countries?

Secondly, at the turn of the millennium, the United Nations adopted the Millennium Declaration in which all participating countries and several international organizations committed themselves towards working together to achieve eight Millennium Development Goals by the year 2015. The goals adopted included three that are relevant to our discussion here:

1. The achievement of universal primary education
2. The promotion of gender equality and empowerment of women
3. The development of a global partnership for development

It is obvious now that these aims remain a challenge for the international community and that equity for many young people from low-income countries remains unmet. Atweh et al 2014 pointed out two challenges in forming such global partnerships to alleviate the disadvantage of students from low income countries. First there is very little research about the need of such students and what is effective in alleviating existing inequality between countries and within low-income countries. Second, the limited resources within these countries imply that effective policies are not likely to be developed and implemented.

Question 8. How can knowledge about achieving equity developed in one context be useful, if at all, for other contexts?

Question 9. Who is responsible for achieving equity in mathematics education around the world?

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