COVER SHEET

Social Justice and Sociocultural Perspectives[1]

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This is the third chapter on "sociocultural perspectives" to appear in MERGA reviews of trends in mathematics education in Australasia. The first chapter (Atweh, Cooper, & Kanes, 1992) considered research reported in the period 1988-1991 while the second chapter (Zevenbergen, Atweh, Kanes, & Cooper, 1996) considered research in the period 1992-1995. This chapter considers research trends in the period 2000-2003. It is perhaps appropriate to commence this review by few words about its context and its scope.

The first review argued that the "[s]ocial context is a growing area of mathematics education research in Australia" (Atweh, Cooper & Kanes, 1992, p.43). Twelve years later, we suggest that those "new" sociocultural perspectives have become "mainstream" interests for many researchers in Australasia. This "coming of age" of sociocultural perspectives of research is best illustrated by MERGA sponsoring an international collection of chapters under the name *Sociocultural Research on Mathematics Education: An International Perspective* (Atweh, Forgasz & Nebres, 2001). The advances and diversification in theoretical perspectives, research methodologies, and research topics are reflected in a huge increase in research reported in the period of this review, necessitating decisions to limit the types of research considered for this chapter. This was a hard decision to make since some topics such as language and mathematics; ethnomathematics, adult learner and non-formal mathematics; and politics in mathematics education, that were discussed as separate chapters in previous MERGA reviews, are not covered in this present volume. Other topics such as classroom interactions, which was reviewed in the previous reviews under this area, will be omitted here due to space limitation. Similarly, research conducted by postgraduate international students studying at universities in Australia and New Zealand is not reviewed here unless the research relate to data from the Australasian region.

Hence, the present volume discusses research under three headings. Like the previous reviews, factors associated with disadvantage such as ethnicity and socioeconomic background are discussed in the first section. Factors associated with the teacher are also discussed here in the second section of the chapter. However, this discussion is limited to teachers' professionalisation and socialisation. Included in this is the area of research on teachers' values because it is an emerging area on the international scene with a significant contribution from Australasian researchers. Finally, like the previous reviews, new theoretical perspectives used by mathematics educators are reviewed in the third section of this chapter. In addition emerging interests in mathematics education in global context are also discussed.

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[1] Atweh, B., Meaney, T., McMurchy-Pilkington, C., Neyland, J., Trinick, T. (2004). Social justice and sociocultural perspectives in mathematics education. In b. Perry, G. Anthony, & Diexmann, C. (Eds.), Research in Mathematics Education in Australasia 2000-2003 (29-52). Brisbane: Post Pressed.

Finally, the terms "sociocultural and "social justice" in the title of this chapter reflect the wide use of these terms today in mathematics education literature to replace the term "context" used in the previous reviews. The two terms here are used in the widest interpretation that signify that the studies reviewed here deal with social or cultural aspects of mathematics education; many use sociological theories and methodologies consistent with the social sciences; and, importantly, most deal with questions of disadvantage, power and social justice. However, as we will note below, not all studies reported here are adopt a critical stance in their design and conclusions.

Factors Associated with Students' Disadvantage

This review notes a continued scholarship and research interest on the problem of low achievement among certain groups of students in mathematics. This problem, being complex and multifaceted, is intellectually and methodologically demanding. It is further hindered by shortage of funds for research and educational change in general. More specifically, the shifting government priorities, in the current political climate at least in Australia, do not place the concern about social justice and disadvantage high on the research agendas. In spite of these hindrances, researchers in mathematics eduction have continued to investigate causes of disadvantage and successful interventions to deal with it. In this section, we will review factors related to social and cultural backgrounds of students and conclude by a critical reflection on this research. Perhaps it is useful to comment on the particular classification of the studies presented here. We acknowledge that the terms "social" and "cultural" factors are contested terms. For the sake of this review, we will use the terms "social factors" to include gender, geographical location and socioeconomic background of the students. Similarly, we will use the term "cultural factors" to represent racial and ethnic backgrounds. Finally, very few studies related to gender are reviewed here. These studies are dealt with under a separate chapter in this volume.

Social Factors

Although social disadvantage in student learning is varied, here we will deal with question of poverty and socioeconomic barriers. We will identify studies that (i) provide evidence of this problem; (ii) represent ways of working with communities to explore new ways of tackling it; and finally (iii) provide theoretical perspectives for the study of disadvantage.

Evidence of disadvantage. In this category, five studies are notable in the period covered by this review. Webster and Fisher (2000b), using a secondary analysis of data from the Third International Mathematics and Science Study (TIMSS), and Peard (2002), using questions similar to those used in TIMSS, both confirmed quantitatively that socio-economic status is a dominant variable affecting achievement in mathematics. Fullarton and Lamb (2000) considered some 26 schools, classroom and student background variables as possible predictors of student achievement. The authors used Hierarchical Lineal Modelling techniques where sets of variables are introduced progressively into a mathematical model and their effects in explaining variations in students' results are ascertained. The authors found that girls still achieved slightly, but statistically significantly lower than boys, and consistent with previous research, students from higher socioeconomic variations have higher achievement. Gender effects, as well as socioeconomic background, affected achievement both directly and as mediated by other

factors such as word knowledge and attitudes towards mathematics. The authors commented that the "findings support the view that classroom differences in mathematics achievement are largely due to the students in the classroom rather than their teachers, once again with SES background one of the most determining factors" (p. 361).

Similarly, using the TIMSS data, Webster and Fisher (2000a) compared the opportunities and achievement of rural and urban students in Australian schools. The authors pointed out that rural disadvantage is a consistent theme of many previous research studies. Using LISREL and multilevel analysis techniques, the data showed that student variables contributed a larger amount of variation between student results than classroom and school variables. Gender effects were minimal. Rural students did achieve at a lower level than urban students but the differences were quite small. The study also showed that rural schools were better resourced than urban schools. The authors concluded that "contrary to previous research, students from rural locations had higher career aspirations and more positive attitudes than students from urban locations; but once again, these differences were not very large although statistically significant" (p. 358).

In an interview-based study that focussed on language issues, Perry, Dawe, Howard and Dengate (2000) provided evidence that language is one of the factors that has a bearing on the achievement of socially disadvantaged students. In a similar type of study of the impact of migration, Wotley (2002) indicated that, in the minds of teachers, the culture of the student population affects achievement. In another study focussed around task-based interviews with children Young-Loveridge (2000) found that Mäori and lower socio-economic groups showed less understanding of mathematical concepts. It is noteworthy that one of the four schools she studied achieved higher levels of understanding than would have been predicted by the overall trend. This counter-trend reminds us that there is nothing inevitable about the problem under discussion, and it suggests that future research into the reasons for such exceptions might yield valuable insights.

Intervention studies. The second category is of particular importance because such projects involve working with schools to make concrete improvements, now. We note however, that this type of intervention is rare in the literature of mathematics education. There is one major study reported in the span of this review: the Mathematics Enhancement Project (MEP) in New Zealand, a five year developmental study that began in 1999. Three reports, Alangui, Autagavaia, Barton and Poleki (2001); Alangui, Autagavaia, Barton, Kensington-Miller, Lane, Paterson, Poleki and Van Den Heuvel (2002); and Barton, Autagavaia, Poleki and Alangui (2002) provide background information on the project. The project aims to improve the mathematics achievement of students in a small number of selected low socio-economic schools, and increase the subsequent participation of these students in tertiary courses with mathematical orientations. The project has four interrelated components: a teacher-initiated development program, learning support for students, enhancement of the image of mathematics among students and the community, and ongoing research to monitor and support the project. The teachers and researchers involved in the project are committed to the view that education ought to enhance the cultural component of personal identity.

Theoretical tools. In the third category, the work of two educators presents some theoretical tools to study students' disadvantage. Firstly, Zevenbergen (2000a & 2001) reported on a theoretical orientation—and two supporting empirical studies—that articulates the importance of language and linguistic factors in the under-achievement of students from low socio-economic status backgrounds. The theoretical framework is

broadly informed by Bernstein's study of the socio-linguistic aspects of schooling and Bourdieu's notion of cultural and linguistic capital. In these studies she raises awareness of how some students are disadvantaged through the practices of classroom interaction that are often taken as normal. Students enter the school context with a linguistic habitus (a non-deterministic embodiment of culture which provides a lens through which the world is interpreted) that predisposes them to interact in ways that cause them to be marginalised through the pedagogical practices of the classroom. The underlying argument is that students have limited opportunities to learn other linguistic possibilities because the need for such opportunities are not recognised by teachers and therefore are not provided by them in their teaching of mathematics. Naturally, there is a need to recognise the importance of language - in particular the mathematics register and the way that language is used in schools - in the teaching and learning of mathematics.

Secondly, in describing the theoretical background of the MEP project, reported above, Barton (2003) argued that there is a danger of adopting a single theoretical perspective as a base of intervention projects because "its epistemology and assumptions limit what happens" (p.142). Barton identifies at least three theoretical perspectives that informed the design and analysis of the findings in the MEP project. The first theoretical approach is that of cultural conflict discussed by Skovsmose (2002) and his colleagues in Denmark. Skovsmose shifts the focus in studying disadvantage from the students' background to a focus on the foreground. The foreground represents the set of opportunities facing the students at every moment of decision-making. This includes the students' perceptions and constructions of these opportunities. The benefit of a focus on the foreground in mathematics education, Barton argues, is that it is more "amiable to change" (p.138). Similarly, the MEP project is based on the principles of critical mathematics constructed by Skovsmose and Borba (2000) and the French theory of didactic contract developed by Brousseau (1997).

Cultural Factors

Culture is an integral aspect of students' identity as well as opportunity to learn mathematics. Here we argue that ignoring culture in mathematics education is not only poor pedagogy but also a form of social injustice. This section reviews research concerning diverse groups of learners in mathematics education with a major focus on indigenous students. It discusses (i) studies that illuminate cultural conflict faced by indigenous students in mainstream mathematics education; (ii) those studies that report on interventions to alleviate these problems with a focus on professional development of teachers; and finally (iii) comparative studies on cultural differences not restricted to indigenous students.

Cultural Conflict. We argue here that indigenous students are among the most disadvantaged in mathematics education. The social cost of their failure to achieve comparable results in mathematics has been a concern to many educators. At the 2003 MERGA conference, there were 6 presentations which dealt with aspects of different groups of indigenous students learning mathematics. Constructing mathematics as a cultural practice (FitzSimons, 2002) implies that effective mathematics teaching must include learners experiencing social learning processes from their own cultural perspective (Howard & Perry, 2001). After listening to Aboriginal students talk about learning mathematics at the primary level, Howard and Perry concluded that if school environments for Aboriginal children are not reformed, social inequalities will continue. In examining

characteristics of indigenous learners and related pedagogical strategies, Nichol and Robinson (2000) argued that "if you wish to perpetuate inequalities then provide the same education for all" (p. 495). A "fair go" for students does not mean treating all equally but rather changing teacher pedagogy to include the cultural backgrounds of indigenous students. However, Perso (2002) sounded a cautionary note on making assumptions of essentialism about worldviews or pedagogies as many non-Aboriginal people may share worldviews with those acknowledged as being those of Aboriginal people.

Relevant to mathematics curricula written in indigenous languages are questions about the way mathematical ideas are conceived and explored, and how language used in mathematical talk 'can alert us to different conceptual systems' (Barton & Frank, 2001, p. 138). Vocabulary and grammatical constructions can point to different ways of conceptualising quantity, space, or relationships resulting in tensions for indigenous learners and a Western-based curriculum (Barton & Frank, 2001; McMurchy-Pilkington & Trinick, 2002). This issue can increase the mismatch between home and school.

Meaney (2002) discussed the concept of cultural conflict between many indigenous students and the culture of the school in western societies. Cultural conflict need not be conceptualised negatively according to Bishop (2002a). An effective pedagogy in the context of cultural difference is one "that recognizes both conflict and consensus as significant in the learning process" (p. 211). Rather than seeking a resolution to conflict, teachers should consider how they can provide an environment that ensures explicit cultural interaction inclusive of trust and openness.

The focus on taking the students' cultural heritage into account does not imply, however, that alternative more modern pedagogies are not appropriate. For example Northcote, Marshall and Lenoy (2001) demonstrated how online learning technologies that incorporate cognitive tools to scaffold learning and strengthen links between theoretical and practical mathematics were found to be effective in enhancing the learning of indigenous adults, as well as increasing their motivation and enjoyment. In light of research that claims teachers need to incorporate cultural learning pedagogies of their students, questions can be raised whether it is possible to motivate students without necessarily considering their culture. Research by Spielman and Mitchelmore (2000) seems to suggest we can. Perhaps this is an illustration of the advantage of change in focus from the "background" to the "foreground" that we discussed above.

Using the models of cultural conflict to discuss indigenous education inevitably raises question of power. In emphasizing the political nature of curriculum, McMurchy-Pilkington and Trinick (2002) argue that while New Zealand has a national mathematics curriculum written in Maori it is based largely on a western knowledge framework. The writers, both Mäori, question whether teaching in the medium of Mäori from this curriculum will enhance the mathematical thinking and reasoning of Mäori from a Mäori worldview. This claim has implications for ethnocentric mathematics teaching and content. A number of the articles highlight the use of power and control in mathematics education (Bishop, 2002b; FitzSimons, 2002). While learners may have some power in their own learning - who and how they listen and respond - they are also subject to others' power, namely their teachers and their family. While professional development may assist teachers to be more effective in power sharing with their learners, involving their parents in curriculum development (Meaney, 2001; Meaney & Fairhall, 2003) is another way of power sharing with the community.

Intervention and professional development. The importance of professional development (PD) to assist teachers in changing their teaching pedagogy was evident in two studies that report on initiatives to improve numeracy for indigenous students (Callingham & Griffin, 2001; Efthymiades, Roberts, & Morony, 2000). Investing heavily in teachers' professional development was associated with positive gains in students' performance, especially if the professional development was a long term, school wide, site-based project (Efthymiades et al., 2000). A professional development program for Samoan secondary teachers released to attend the National University of Samoa was reported by Afamasaga-Fuata'i (2002). This program included learning to teach meta-cognitive tools that enhance mathematics learning to assist students to overcome a reliance on rote learning. Meaney (2001) describes how a Maori school community developed a mathematics curriculum using a framework she designed for the community. Based on Freire's concept of praxis, the implementation process for the framework included flexibility, reflection and action on the wider macro issues that influence indigenous students' learning in mathematics. Findings suggest that indigenous parents can make a valuable contribution to mathematics curriculum development as well as lessening the gap between home and school. Have parents also a part to play in the professional development of teachers? In a later publication on this project, Meaney and Fairhall (2003) problematised such collaboration by suggesting that although they are very worthwhile, there needs to be careful negotiation of roles and the strategies used in order to make indigenous parents comfortable in working in the foreign structures of the school.

In an interesting study comparing five mathematics education programs that share an aim of improving the mathematics education of indigenous Australian students, Matthews, Howard and Perry (2003) presented criteria for the comparison of the designs of the different programs. The researchers found that while all five reviewed programs share a commitment to social justice and empowerment, there were some variation between their commitment to principles of engagement, relevance and connectedness. Interestingly however, none of the programs contributed to concerns about reconciliation and the self-determination aspirations of the indigenous people involved.

The study of Ethnomathematics has much to offer teachers in classrooms where Western mathematics is valorised (Stillman & Balatti, 2001). Professional development that involves teachers as ethnomathematical researchers can be an important avenue to challenge teachers' beliefs by encouraging them to reflect on the nature of mathematical knowledge.

Other Cross Cultural Research. Both in Australia and New Zealand, there is an increased awareness of the multicultural nature of society and schools. This awareness has lead to several opportunities for comparative studies of student's attributions of success and failure in mathematics (Cao & Bishop, 2001) and teachers' beliefs about the learning and teaching of mathematics (Perry, Vistro-Yu, & Howard, 2002) across a range of Asian countries. Such research often found differences between countries and cultures that may have significant implications for multicultural classrooms. The writers highlight the complexity of attributional differences and urge more comparative research on teachers' and parents' beliefs and values.

A New Zealand study on Asian students (White, Allan-Rae, & Fisher, 2001) challenged the simplistic notion of 'rote learning' as "'parroting' or mindless repetition of facts" (p. 5). Chinese students described repetition as active, requiring a "focused effort". Additional to a Confusian work ethic, the students had an "intrinsic enjoyment of gaining mastery" (p. 6)

resulting in mathematics confidence unlike the anxiety that many other children experience. It is interesting to note that what is referred to as "Asian" in this study include students from a diverse Confucian based cultures including mainland China, Taiwan, Hong Kong and Korea.

In a collaborative cross cultural project Zhao, Mulligan and Mitchelmore (2002) compared mathematics assessment practices in a Chinese primary school and a high Asian population primary school in Australia. Findings suggest that high mathematics achievement of Chinese children in both schools cannot be entirely attributed to the teachers' pedagogical knowledge of culturally appropriate pedagogies. Contrary to studies that urge a change in pedagogy, this research points to other factors like parental help, perception of exams, and motivation as explanations for high mathematics achievement. Clarke and Mesiti (2003) in comparing lessons from Australia and the United States demonstrated difference in patterns between the lessons within each country and with each teacher. The authors conclude that simple between-country differences have necessarily been far too general to inform practice.

Clarke (2003) examines the role of international comparative studies that are prevalent in mathematics education. He examines the design used in many of these studies and their possible benefits. He argues that "central to the effective conduct and utilisation of international comparative research are considerations of 'cultural authorship' and 'adaptive potential" (p. 143). There are dangers in uncritical use of such studies in leading to globalisation (see his definition of globalisation below) of curricular standards. Researchers should consider the potentials for appropriation, imposition and exploitation as well as imperialism of ideas and values. However, when seen as collaborative exercises they can provide "insights into the novel, interesting and adaptable practices employed in other school systems and of insights into the strange, invisible and unquestioned routines and rituals of our own school system and our own mathematics education" (p. 180).

Reflections on Research on Disadvantaged Students

From the various studies reported, research on disadvantaged students remains a concern to the mathematics education community in the Australasian region However as we have argued above, this research remains subject to government funding and priorities. In particular, we noted that there are limited reported projects on interventions. More research is needed on initiatives that raise mathematics achievement levels in disadvantaged groups rather than "quick fix remedies" (Thornton & Blain, 2002, p. 664). The authors warn that "quick fix" remedies, providing good ideas and materials that can be used immediately in teachers' classrooms, are unlikely to make a long-term impact on the beliefs and practices so firmly imbedded in the traditional practice of mathematics classrooms. Active and structured reflection by teachers are key factors in promoting changes in those beliefs and genuine professional development of teachers that can achieve a just outcome to the diverse student population in our schools.

One highly visible gap noted in the literature was the relative absence of research done by indigenous people on indigenous people or people of non-Anglo-cultural-background, (Bishop, 2002b). More resources and academic support for indigenous academics and teachers are needed to enable networking, professional development and writing to occur. Working *with* and empowering communities from socially disadvantaged background to speak for themselves rather than writing *about* them might more effectively close the gap in achievement levels in mathematics.

While research into teachers' beliefs about mathematics has "long and troubled history" (White, 2002, p. 690), there seems to be a paucity of research on teachers' attitudes to ethnically different learners and their mathematical learning. While it might be accepted that teachers need strong pedagogical knowledge and knowledge of mathematics, knowledge of the cultural background of their students is also important to avoid alienating or excluding students, and thus exacerbating the disadvantages (Sullivan, Zevenbergen & Mousley, 2002). Additionally research on community input is also largely absent. Meaney's study (2001, p. 11) attests to indigenous Mäori parents having similar concerns to those of mainstream parents about what mathematics students would need to learn in order to be successful, and given the opportunity to have some input, will do so. More research is needed about what indigenous parents think about how the mathematics' learning environment of their children can be enhanced.

Lastly, although more research on disadvantaged students is needed in mathematics education, it is essential to note a significant danger in which disadvantage may be constructed in, or as a result of, such research. Students' background should not be constructed as a deficit inherent in the students themselves. Disadvantage does not reside in the students themselves or their background. Disadvantage is more relational and depend on the norms and practices within which students from diverse backgrounds have to integrate (Willis, 1998). In commenting on an earlier version of this chapter, Paola Valero (personal communication) points out:

> *It is precisely this sociological, complex nature of students' engagement in mathematical learning what Skovsmose's notion of foreground points to. The definition of foreground as: "the possibilities which the social situation makes available for the individual to perceive as his or her possibilities" (1994, p. 179). This definition highlights the fact that students' intentions to engage in mathematical learning is not psychologically determined, but a sociologically shaped construct. In relation to studies of disadvantage this notion can help moving from the deficit model (e.g., students being poor as a factor of disadvantage) towards a sociological and political movement in which the person's learning possibilities are bounded to the person's perception of his/her context in the present and future.*

Focus on Teachers' Socialisation and Professionalisation

Research on teachers of mathematics is quite diverse in the mathematics education literature. This review on teachers' issues conducted here is necessarily limited. We are interested in this context in the sociocultural dimensions of research and writing on teachers along the lines outlined in the introduction of this chapter. We will limit our discussion into two areas. Firstly we will consider issues related to mathematics teachers as professionals, in particular the problematic relationships between teaching and research. Secondly, we will consider research into the socialisation or induction of the teachers from preservice teacher education into the profession.

Teachers as Professionals

Issues related to the professionalisation of teachers in mathematics education have received considerable attention by mathematics educators in Australasia. Stephens (2003)

has compared four developed countries including the United States, Australia, The Netherlands and Japan in terms of their requirements for preservice teaching education. In concluding he directed attention to the shortage experienced in many countries of qualified mathematics teachers. Regarding "the slowness of governments to respond to mathematics teachers shortages" (p. 791), it is hard to see this trend reversing during the next 10 years. He concludes, "[i]n this future scenario, school based professional development and training will be an essential component of regulating entry into the profession …. Ongoing professional training will be an essential component of the work of teachers and to improving the quality of teaching mathematics" (p.791-792).

In two consecutive years, there were keynote presentations at MERGA conferences which addressed the gap between "theory" and "practice" in mathematics education. Malone (2000) argued that this has its roots in the technical rationality or the positivist epistemology that dominated early research in mathematics education. Malone went on to critique the demarcation between theory generation and theory application and called for a new research paradigm involving the teachers themselves. On the other hand, Sowder (2001) maintaining the traditional paradigms, called for changes in research in mathematics education to make it more effective. First she argued that it has to be more authoritative and persuasive. She also argued for research that is relevant to practice and communicated in a manner accessible to teachers.

The obstacles to the dissemination of research findings to policy making, curriculum reform and practice of the teachers were further discussed by Begg, Davis and Bramald (2003). The authors concluded with three principles that researchers need to consider. Firstly, they called for better communication between researchers and teachers: "Research needs to be anchored in the immediate realities of the classrooms – it is working in the classrooms and with teachers that informs publications that are relevant to teachers" (p. 627). Secondly they called for the replacement of the traditional models for the "development of policy, curriculum, resources, assessment and teachers by being more democratic … where teachers become involved in all stages of development and decision making" (p. 628). Finally, they called for broadening the understanding of research to include "giving more recognition to scholarship that involves literature studies instead of data collection" (p. 629). Lastly, Atweh and Arias (2001) argued that concerns about the relative failure of many reform programs in education have refocused the attention on the role of teachers in the educational equation. They called for the use of action research for the continuous professional development of teachers. The authors put forth an argument that through action research, not only do teachers learn to improve their practice but also such involvement increases their professionalism.

Induction of Teachers

Sparrow and Frid (2001b) argued that national and international reports and reforms on the teaching of mathematics have not been as effective in changing mathematics teaching in the classroom because "teacher education courses do not appear to be effective in changing the traditional beliefs and images about teachers and teaching that students bring to their pre-service education" (p. 451). Here we will consider different approaches to assisting teachers' transition and socialisation into the profession.

Mentoring. Sparrow and Frid (2001a) discussed the use of the concept of a "fellow worker" to assist teachers in their transition. A fellow worker becomes a "hybrid of critical friend, colleague, listener, mentor, resource support and interested person" (p. 4). In this

study the fellow worker was not part of the school or employment authority hence had no evaluative role. Rather their function was to assist the teachers to reason about and learn from experiences. Likewise, they provided support to the teacher in their self-image as professionals balanced with providing some critical evaluation. The authors concluded that, in the first year of teaching, often described as the survival year, the "existence of the 'fellow worker as a successful catalyst for reflection upon ones' beliefs and pedagogical practices highlights the need for further research into the value of such a person" (p. 12). A similar project using the concept of a fellow worker was reported by Howard, Perry, Lowe and Ziems (2003) with a group of indigenous teachers.

Learning communities. Goos (2002) presented another model to study teacher development. She uses sociocultural theories based on the work of Vygotsky to study the experiences of students in the practice teaching component of their pre-service course. In addition to the widely familiar concept of Zone of Proximal Development (ZPD), Goos uses the concepts of Zone of Free Movement (ZFM) and Zone of Promoted Action (ZPA) to study the development of student teachers. The ZPD is defined as "the novice teacher's emerging skills that have not yet developed fully, but which are taking shape under the guidance of other people" (p. 310); the ZFM refers to "environmental constraints that limit freedom of action and thought" and the ZPA "represents the effort of a teacher educator, supervising teacher, or more experienced colleague to promote particular teaching skills or approaches" (p. 310). Goos and Bennison (2002) report on a study concerned with the impact on beginning teachers' professional learning in the context of specific classroom and school environments. The authors demonstrated how through working in a community of practice the beginning teachers have demonstrated shifts in beliefs towards a more open and constructive view of mathematics and mathematics teaching and learning. Further, through the interactions with older teachers, the self-identity of the beginning teachers was shaped as a member of community of practice.

A different theoretical stance used to study the socialisation of teachers involves the concept of identity formation (Walshaw & Savell, 2001). The authors pointed out that the traditional wisdom that teachers learn how to teach from experience is a simplification because it does not take experience as acting with a social context that sanctions some and prohibits other experiences. The authors asserted that "knowledge of oneself is to be understood in relation to evolving relationships between people and the setting in which activities are conducted" (p. 516). The study draws on theories of subjectivity and power of knowledge production as important constituents of meaning of student teacher experiences.

Use of action research. Lastly, Ginns, Heirdsfield Atweh and Watters (2001) have used action research to study the socialisation of a group of women teachers in primary mathematics and science. Three action research cells have been formed to investigate teachers' learning about how to make mathematics more inclusive, their assessment practices and catering for the gifted and talented. The study demonstrated how through action research, not only were the teachers able to gain confidence and overcome the sense of isolation, but how they were able to develop a theoretical understanding of some of the issues that they were dealing with in their projects. For example, Atweh and Heirdsfield (2003) reported that through action research, the beginning mathematics teachers were able to challenge their views on the meaning of inclusive curriculum.

Emerging Contexts and Perspectives

In the introduction to the Sociocultural Research on Mathematics Education (Atweh, Forgasz & Nebres, 2001), the editors discussed some significant changes in mathematics education theory and research methodologies during the past 25 years. In addition to the shifts from the heavy reliance on theories and constructs borrowed from psychology to sociological constructs and perspectives, research in mathematics education has witnessed a diversification in research methodologies from quantitative/experimental to qualitative/naturalistic to critical paradigms. Here we discuss further new perspectives that appeared in the mathematics education literature within the scope of this review – such as poststructural/postmodern analysis.

Similarly, during the period covered in this review, we note a steady increase in reflexivity in mathematics education literature and scholarship. Mathematics educators around the world have directed their attention to examining the effect of their own practice. One example of this self examination is the emerging role that the discipline plays in globalisation. Atweh (2001) argued that while mathematics educators have been aware of the international status of their discipline, it is only recently that a few have commenced to direct a critical gaze on their discipline in terms of voice, assumptions and effects at the international multicultural scene. This section will consider recent areas of research by Australasian researchers (i) using recent constructs from postmodern writers and philosophy of ethics; and (ii) globalisation of the discipline.

Recent Theoretical Tools

Poststructural ideas have been used in many discipline areas to tease out the assumptions which are inherent in interactions between people. Klein analyses her own work with preservice teachers (Klein, 2000a, 2001b); classroom interactions (Klein, 2001a); concept of involvement by students in their learning (Klein, 2000a) and the research done by others (Klein, 2000b & 2002b) from a poststructuralist perspective. In these, she illustrated how teacher or lecturer beliefs about learners which are based on humanist assumptions of "a rational, autonomous human essence allow the teacher to classify non-participants according to demeaning binaries (good/poor student; motivated/unmotivated; autonomous/dependent learners) and remain ignorant of pedagogical relationships that limit engagement and knowledge growth" (Klein, 2002a, p. 395) which thus reduced the agency of students. Klein (2000b, p. 74) suggested that a student described by Yackel and Cobb (1996) who after questioning by her teacher changed her answer, much to the disappointment of the teacher, had "agency *with* maths" (original emphasis) as she knew the answer but lacked agency in participation because of the power relationship between teacher and student. Agency is a recurring theme within Klein's work. Quoting Davies, Klein (2000b, p. 76) described agency as the positioning of oneself so that one has a voice within and beyond discourses. The value that she sees in the poststructuralist perspective is that it reveals how these binaries are determined and cause damage to students.

Similarly, Walshaw (2001b) used poststructuralist ideas to critique research methodologies used in mathematics education. By re-examining her own research, Walshaw suggested that the seduction of traditional research methodologies to deliver one coherent *truthful* account of classroom needs to be overcome by using a poststructural approach which enables the complexity of the experience as a result of 'particular historical

trajectories and sociocultural contexts' to be more fully examined (Walshaw, 2001b, p. 513). Walshaw (2001a) differentiates between poststructuralism and postmodernism, two concepts at times used interchangeably. For the author, postmodernism is a way of living today as a reaction against the project of modernism. Poststructualism on the other hand is a group of theoretical and epistemological positions that are helpful for examining our work as researchers. Poststructuralists question the blind faith in the ability of rational thought to illuminate "truth" that is objective and independent of historical contexts.

Neyland (2002), investigating the problems experienced by teachers and students, considered how scientific management theory affected mathematics curriculum development. He used the ideas of the ethical philosopher Emmanuel Levinas to describe how the primordial relation between people was being eroded through the "rationalised processes of change, the meeting of targets, standardisation, the specification of outcomes and the disciplined observance of protocols" (p. 517).

Klein and Walshaw's research provides insights into mathematical teaching events which may otherwise remain hidden. However, one criticism of these approaches is that they do not provide alternative solutions. With poststructuralist approaches which connect problems back to their social, historical and political roots (see Gore, 1998, p. 233 and Walshaw, 1999), there is a sense of inevitability. Neyland (2003) also suggested that the current scientific management approaches harmed teachers and students without discussing how this could be overcome. However, in a subsequent development of his research Neyland (2003) argues that what he calls the 'jazz metaphor' ought to take increasing prominence in mathematics education, thus diminishing the dominance of the 'forensic metaphor' and the 'cult of expertise' which were the targets of his earlier critique. For the situations to change, teachers need to be able to make use of their new understandings. Klein (2002a, p. 395) herself acknowledged the need to move beyond providing explanations of situations to nominating ways of acting which may lead to improvements in student learning. The suggestions that she made were, however, no more than loose ideas based around investigating more carefully 'the productive nature of the interactions and relationships that mediate and produce meaning'. Given that what poststructuralism does well is provide explanations, it may in fact be inappropriate to insist that it provide solutions. Instead investigations which use this approach remind all who are involved in mathematics education that it is a complex issue and what is needed are reflective practitioners who should be encouraged to move beyond simple explanations for improving students' learning. The reality of the situation with the marginalising of teaching practice into teacher-proof recipes and the increase of administration will not support this reflexiveness in teachers (see Smith, 2000; Zevenbergen, 2000b for an extended discussion of these issues).

Global Context

The field mathematics education is arguably one of the most internationalised fields of higher education. During the past hundred years the discipline of mathematics education has witnessed a great rise in number of international organisations, conferences and journals. It is long been acknowledged that studying the patterns of curriculum content and reforms around the world, one is more impressed by their similarities than their differences (Oldham, 1989, cited in Clements & Ellerton, 1996). In the area of research in mathematics education, Bishop (1992) argued that similarity is a feature of many research traditions evolving in different countries around the globe.

Using theoretical constructs from the sociological literature, Atweh and Clarkson (2001) and Atweh, Clarkson and Nebres (2003) made a distinction between the concepts of internationalisation and globalisation and point out that, while "efforts at internationalisation ... [are] seen by ... [many] authors as activities that improve higher education institutions without diminishing their autonomy. ... There is some evidence, however, that the processes of globalisation are compelling rather than invitational, and therefore require careful scrutiny" (McGinn 1996, p. 78). This research project consisted of interviews with mathematics educators from Latin America (Atweh, 2001, Atweh & Clarkson, 2002a), East and Southeast Asia (Atweh, 2003) and Australia (Atweh & Clarkson, 2002b). It also included a survey of selected mathematics educators from these countries (Clarkson & Atweh, 2003) as well as case studies in collaborative projects between different nations (Atweh, 2003).

Arguably, there are many discourses on globalisation in education. For example, Atweh, Clarkson and Nebres (2003) discussed the concept globalisation as awareness of "the world as one" but made a distinction between globalisation and homogenisation. They argued that globalisation consists of contradictory pattens of differentiation and integration. On the other hand, Clarke (2003) presented a conception of globalisation as "the reduction of mathematics education in all countries to a single common denominator" (p. 147). French's (2002) description of the role of aid agencies in mathematics curriculum change in the Cook Islands would support this later view. Obviously, these alternative conceptualisations have to be taken into account when debating the merits or otherwise of patterns of globalisation in their discipline.

Similarly, on the theme of globalisation and the politics of mathematics education, Thomas (2001) argued that mathematics educators cannot afford to neglect the political context of their discipline at local and international levels since decision making affecting mathematics education is increasingly influenced by global economic considerations rather than educational and equity considerations.

Concluding Remarks

In this review we have noted a healthy growth in issues as well as theoretical developments in sociocultural research in mathematics education in the Australasian region during the past four years. However, we argue that there remain issues that are under-researched and under-theorised. In the area of student disadvantage we have argued that research should move from identifying factors of disadvantage into considerations of solutions to problems. Further, while qualitative small scale studies have provided significant knowledge, there is also a need for large scale projects and knowledge that can inform practice on a policy level. The challenge for mathematics educators is to continue with this interest in the area of disadvantage in spite of government shifting of priorities and agendas. Moreover such research should be conducted *with* the teachers and communities to assure its relevance and better implementation. In the case of indigenous communities there is a need for more indigenous educators to be involved in research and an encouragement for them to publish their results widely. The emerging paradigms within mathematics education in the use of participatory research should be encouraged. Here we argue that not only would this lead to better research but also to more useful research. Lastly, we note that the question of disadvantage is constantly shifting and new arenas

emerge. In the age of globalisation, the question of disadvantage by developing countries and dominant western paradigms raises new concerns for research and action.

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