A Poststructuralist Perspective on the Productive Power of *Process* in Mathematics Education: Practical Implications for Pedagogy and Research

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What would it mean for mathematics education in the twenty-first century were teachers and researchers to take even more seriously, to interrogate more carefully, the productive power of the learning *process*? While the importance of the *cognitive* aspects of process in the construction of robust mathematical understandings and relationships is well appreciated and articulated in teaching and research, its *constitutive* force has largely been ignored. In this paper I use the poststructuralist notion of the productive, constitutive force of the process of *coming to know* in mathematics to (a) extend current understandings of how the teaching/learning processes of the classroom influence participation, knowledge growth and mathematical identity, and (b) contemplate the practical implications of this potentially generative force with regard to instructional practice and further research. The paper is framed by the poststructuralist notion that the ability and inclination to engage in mathematical reasoning and inquiry is not a personal attribute or skill but discursively produced.

Introduction

In contemporary mathematics education and research learning processes are taken very seriously; it is generally well accepted that students actively engaged in processes of conjecture, reasoning and the communication of mathematical ideas and relationships will develop robust conceptual understandings and the ability to apply newly constructed knowledge in and beyond school [Australian Education Council, 1990; The National Council of Teachers of Mathematics (NCTM), (2000)]. For example, the NCTM (2000, p. 20) talks about *proficiency* as the ability to use knowledge flexibly, applying what is learned in one setting appropriately in another and sees a close relationship between understanding and proficiency: "One of the most robust findings of research is that conceptual understanding is an important component of proficiency, along with factual knowledge and procedural facility".

There are however, many students who do not reach appropriate levels of understanding, or proficiency, leaving school anxious and nervous about further involvement in any form of mathematical activity. As stated in *A National Statement on Mathematics for Australian Schools* (1990, p. 31) "children come to school enthusiastic and eager to learn mathematics and ...leave school with quite negative attitudes". While it is often assumed that this disaffection is a direct result of a school curriculum that has not concentrated well enough on the development of understanding, pedagogic practices may also be implicated in how they coercively position some learners. Willoughby (cited in Bourke & Curcio, 2000), for example, suggests that much of the mathematics taught in schools has been taught in such a way as to make students dislike both the mathematics and the learning of it; even if school leavers could use mathematics effectively they would be unlikely to do so. Confrey (2000) speaks up on behalf of those regularly marginalised in pedagogic

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practice to assert that certain groups are disproportionately filtered out by instructional practices and experiences that are impersonal and alienating. The task I set myself in this paper is to delve more deeply into the processes of *coming to know* in mathematics; to analyse *how* engagement in learning processes, while ostensibly leading to the construction of mathematical knowledge, is also dangerous because of its constitutive effect on identity and agency.

The Productive Power of Process

While teaching/learning processes are not commonly considered dangerous, poststructuralist theorising suggests that this is so because engagement in discursive practices, while producing intellectual knowledge also constitutes or produces the learner. The learner, "is the effect of a production, caught in the mutually constitutive web of social practices, discourses and subjectivity; its reality is the tissue of social relations" (Henriques et al., 1984, p. 117). For mathematics education this means that as students engage in those learning processes that educators recognise as powerful and productive, they are simultaneously *subject to* positioning within the familiar storylines and practices of the classroom. Subjectivity, in a poststructuralist sense, moves beyond notions of individual consciousness or perception about action, events and ideas to describe a "way of knowing" about ourselves in the world that is both intellectual and emotional; it describes who we are and how we understand ourselves and is both conscious and unconscious (McNaughton, 2000, p. 97). As students take themselves up within discursive practices (transmission teaching, group work) and storylines (females can't do geometry) their very subjectivity, and mathematical identity, is actively constituted. This act of positioning is not merely a psycho-social event but an embodied productive process whereby the learner *comes to know* (unconsciously, perhaps) about mathematics as a potentially powerful avenue of further work and study and about her/himself as a legitimate user of its authoritative ideas. A student's constituted *knowing* about mathematics invisibly influences her/his appreciation and application of it, in and beyond the classroom (Lather, 1991).

Clearly teachers (and the wider educational community) hope that all students will come to know mathematics as a potentially powerful and useful tool and themselves as competent and confident in its many applications. However, just how this might be realised in the classroom is a difficult and contentious issue. Where historically educators have taken for granted a rational individual able to act autonomously on constructed knowledge, poststructuralist theorisations, recognising the constitutive force of power relations in all discourses including mathematics education, render this a contentious issue. Proficiency, in the way it has been defined by the NCTM (2001) implying an easy relationship between understanding and application, is provisional and dependent on the extent to which learners have access to discursive practices that positively impact on their developing mathematical identities.

While the ability to apply constructed knowledge in new contexts is always provisional and problematic, a sense of agency with (the intellectual knowledge) and in (the discursive practices) can be constituted in teaching/learning interactions that celebrate the student's presence and ways of making sense of mathematics and (the pedagogic) experience. Power/agency/autonomy is not an attribute but a relation; to be able to act in powerful ways the student must be capable of, respected and valued in speaking/writing the accepted 'truths' of a discourse, in enacting established 'ways of being' and in going beyond these to forge something new (adapted from Davies, 1991). Thus the teacher cannot 'give' power to students but can make spaces for them

to establish themselves in powerful ways in teaching/learning interactions as they construct mathematical ideas. Significantly for educators, this notion of the operation of power suggests that it can have libratory and/or limiting effects; for example, while a student is always *subject to* relations of power in the classroom s/he also constructs intellectual knowledge and is constituted as a speaking subject who may be able to act powerfully in that, and/or related discourses.

In this paper I rely on a compilation of recent research to demonstrate how power/knowledge/identity relationships render the classroom a productive though coercive space; here learners are *coming to know* about mathematics and themselves as learners as the teacher's already constituted *knowing* influences the extent to which they are able to realise themselves as competent and confident. While the teachers discussed in the analyses below clearly value inquiry-based, investigative learning processes that should lead to robust mathematical constructions, in most cases the ways in which they interact with students appear to render positive outcomes unlikely. This is because, in basing practice on humanist, psychological understandings of learners as essentially rational and autonomous they take agentic participation for granted and do not recognise the extent to which their uses of language and classroom practices tend to have a limiting effect on engagement. How classroom relationships of power/knowledge/identity intersect and operate to constitute identities, as constituted identities simultaneously shape the learning context (Walkerdine, 1988), is the object of analysis and speculation in the following sections of this paper.

Coming to Know...

Over the past several years I have worked extensively in classrooms, teaching and researching the ways in which mathematics education operates in a variety of contexts. One thing I have learned is that the operation of the mathematics education discourse is never innocent; it comprises discursive practices which maintain "socially organised frameworks of meaning that define categories and specify domains of what can be said and done" (Burman, 1994, p. 2). Unfortunately many students *come to know* a mathematics of low intellectual demand, and discursive practices insensitive to constituted socio-cultural identities that rob them of the possibility of making sense of mathematical experiences in personally meaningful ways (Willoughby, 2000). Such students may merely take up "the available discursive position of subordination and (in)difference" (Kelly, 1997, p. 43).

I (Klein, 1999; 2001a), for example, have analysed inquiry-based instructional practice from a poststructuralist perspective to show that *how* inquiry is realised in the classroom can have questionable effects on students' mathematical identity and their ability to (want to) apply constructed knowledge in new contexts. Indeed, the claim to inquiry is merely rhetorical in that it is commonly the case that the students do not engage fully in investigating the mathematical ideas and relationships but rather question whether or not they have undertaken the correct mathematical procedures and whether their answer is correct (Lave, 1997). Similarly, in 'problem-solving' lessons (Klein, 1999) several teachers maintained traditional authority relationships while actively engaging the children in low-level 'busy' work around mathematical ideas of mass, space and number. Though students eagerly engage in these teaching/learning processes, they come to know a mathematics of disparate facts and skills and themselves as dependent always on the teacher. This was also the case in a Year 6 classroom (Klein, 2001a) where the common assumptions on which inquiry based practice is based (Gregg, 1995) were not realised in the classroom; for example, there was no less teacher control, many students did not 'freely' engage in

investigative processes nor develop powerful mathematical structures. Although teachers clearly value student engagement in mathematical inquiry with regard to the construction of mathematical knowledge, they are often unaware of the constitutive effects of all teaching/learning processes. Where autonomous action is taken for granted and the conditions of inquiry are not met, students do not come to know the richness and regularity of mathematics, nor are they constituted through discursive practices where they can engage on their own terms to powerful ends.

Zolkower (1996, p. 59), in a paper titled *Math Fictions*, shows how supposedly investigative classroom learning processes, while championing the 'open ended', 'realistic' and 'multicultural' operate in ways that deprive the students of the possibility of making sense of the mathematical situation or of acting in any sense autonomously. With reference to a low-income, multicultural , Latino neighbourhood, Zolkower (1996) demonstrates how a teacher's ignorance of her own cultural assumptions impacts with disastrous effects on her instructional practice and throws into question the possibility that the classroom could ever be free from the operation of relationships of power. More specifically, though the children have to place sense-making on hold to engage at all with the problem (where a person's pay doubles each day and s/he works every day), the teacher blames the students for lack of attention, poor knowledge of facts, confusion and difficulties in implementing problem solving strategies. While one reading of this situation could be that at least the children engaged in some 'doubling' activities, another could interrogate the pedagogic interactions for their constitutive force. Because the process of getting to the answer is teacher led, because the problem itself is 'not real' for the children, and because the teacher blames the students for lacking attention participation is likely to be superficial. As well, it might be assumed that the existing order will be maintained because students are unlikely to challenge a teacher's actions where they are positioned (have come to know themselves) as deficient, having only themselves to blame for imperfectly playing the game of classroom mathematics.

Knowing...

Lather (1991) makes the important point that in our action is our constituted *knowing*. She does not refer to the intellectual thoughts that guide our actions, nor the skills we have learned to implement these actions but the constituted knowledges that have invisibly formed us over the years and coercively, unconsciously influence our every action. In the classroom, a teacher's constituted *knowing* about learners and learning influences the qualitative status of the teaching/learning interactions where intellectual and social knowledges are produced. For example, in the past I (Klein, 2001,b) have framed my teaching on 'constructivist' principles assuming that preservice teachers actively engaged in investigative learning processes would construct robust mathematical ideas and easily implement similar instructional strategies in their classrooms. However, over time, I came to realise that in my teaching I maintained conventional power relations that, to some extent at least, create the mathematics teachers of the future. Preservice teachers come to know ways of being a student that (are constitutive of and) reflect the power relationships of previous schooling rather than interrupt or change them. I now find it surprising that I continued in my 'constructivist' practice without realising that as I encouraged them to construct their own mathematical ideas and relationships, I also positioned them as dependent learners. This may have serious implications for their ability to establish themselves as competent and generative teaching professionals in the future, given that how they are positioned, and are able to establish themselves as reflective

learners, has implications for their developing professional identity.

There is also the problem of how socio-cultural assumptions about what is important and how things should be done permeate interactional relationships, leading to disaffection and alienation for some students. For example, I had an Aboriginal student in my class (Klein, 2001b) who came to tell me that she was extremely nervous and anxious about the work we were doing and her participation in my subject generally. Like all teachers, I acted from my constituted *knowing* of learners and learning (Lather, 1991). I set up an extra tutorial for her and other students who were having 'problems' and asked her to keep a journal documenting these problems. I deferred to humanist understandings of the individual, as essentially rational and autonomous, to classify the student as in need of help and 'remediation'. At no time was anything about my motives or instructional practice questioned – I was blind to the White, middle-class European appropriation of the 'real world' in the way I interacted with students and the Anglo-European genesis of journal writing as a means of making sense of experience (Klein, 2001b). Classroom teachers, too, can find themselves confronted by students such as Lenny (Klein, 2000a, p. 75) whose actions in the classroom do not make him recognisable as a legitimate student; Lenny sits awkwardly on his chair and calls out to the teacher who ignores him because of is inability to 'do' school properly. The teacher's constituted *knowing* about how students must disport themselves makes Lenny unrecognisable as a learner in this classroom. In a similar situation, a boy works out answers to mathematical problems in his own way, and then does them the teacher's way, so that he can get a mark (Klein, 2000a, p. 74). As educators we may not be sensitive enough to the alienating effect it can have on students' identity when they have to put sense-making on hold to be able to achieve themselves as legitimate students in the mathematics classroom.

From Humanist Agent to Subjection...

While contemporary research and teaching is based on notions of a humanist individual able to act rationally and autonomously in 'supportive' contexts, poststructuralist thought juxtaposes a timely interrogation. Through analyses such as those briefly sketched above, poststructuralists make visible the mutually constitutive force of individual and context. Teacher and students in the mathematics classroom weave threads of power/knowledge/identity that constitute or create the context while simultaneously they are (re)created in the discursive matrix. Thus pedagogic imperatives must not concentrate on the teacher alone, and how s/he can make teaching more investigative and effective, but rather they must be concerned that the conditions of agentic participation are met. In mathematics education, this means that the students are respected and valued as authors of their own constructions and meanings and ways of making sense of experience, that the mathematical knowledge fostered is robust and connected and that the skills needed for agentic participation are met (adapted from Davies, 1991). This does not imply any particular teaching method, but values highly students' ability to access the discursive threads of power/knowledge/identity in ways that support their collaborative participation and developing identities.

In the examples depicted above, the teacher in each case tends to act in ways that limit students' ability to establish themselves as knowledgeable participants in the mathematics classroom. From a poststructuralist perspective I take it that teachers act in these ways according to their already constituted *knowing* about how mathematics education is done and how they have come to know learners and learning; their

instructional practice reflects psychological theories of socialisation that take agency and autonomy for granted and regard interaction as merely representative of the knowledge constructed rather than constitutive. These theoretical perspectives, in assuming 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. However, on the other hand there are many teachers who appear to have a clear appreciation of the productive potential of pedagogic encounters; these teachers make explicit the regularity and pattern of mathematics, they make spaces for students to establish themselves as active participants in the classroom and they authorise student voice and ways of making sense of the mathematical experience. 'Gina' is one such teacher (Manouchehri & Goodman, 2000) who enlivens the interactional processes in ways that appear to invite participation and robust knowledge growth. Gina does not classify or coddle students but works with them in a collaborative partnership that facilitates the construction of mathematical knowledge and student authorship of the sense-making process. Gina works with her students in ways that suggest she sees them, and the knowledge they are constructing, as always evolving and *in process*, not static and set in stone as can often be the case, especially in mathematics education.

Implications for Practice

No doubt many educators and researchers are surprised to find an argument for the practical worth of poststructuralist theory in mathematics education (Constas, 1998). Here data do not stand as evidence of what is true but look to the ways in which sense is being made...and to the possibilities of personal sense making available . Interested in processes of subjection, and the position that can be taken by the speaking subject, poststructuralist theorising is profoundly sceptical of appearances and common sense, making visible the productive power of interactional patterns in classrooms and teacher education, working at the margins to challenge and disrupt dominant views. As Kilpatrick and Silver (2000) suggest, mathematics educators need to consider very carefully the unexamined and unexpressed assumptions that guide their work. In the section below I contemplate some of the practical implications a view of the discursive production of knowledge and identities might hold for mathematics education. New forms of research able to draw attention to previously unseen aspects of practice can be of interest (and constitutive) even though they may not sit comfortably with previously constituted subjectivities.

One implication has to do with the qualitative nature of pedagogic interaction. A first step might be to abandon the eternal search for that one best teaching 'method' to suit all children in all contexts; methods are based on essentialist notions of identity and take for granted rational teachers and learners able and willing to act autonomously. From a poststructuralist perspective it may be propitious to focus on the qualitative nature of all interactional processes; to ensure that they are as productive as possible for all learners. A coalition of many ways of interacting with students can be valuable as long as it is sensitive to the need for students to learn in ways that are personally meaningful and satisfying, that value and respect their voices and encourage them to go beyond the given to explore relationships and new ideas. Thus there is a need to de-emphasise stipulated practices in the classroom (doing worksheets, problem solving, uses of technology) to examine more carefully the productive nature of the interactions and relationships that mediate and produce meaning; group work and other technologies are only as useful as their ability to

enhance the qualitative status of the teaching/learning partnership. Teaching is no longer something 'done' to students; rather any instructional act always comprises a teaching/learning relationship where relations of power/knowledge/identity constitute, and are constituted by, the teacher and students. In this way relevance, motivation and agency are seen to be discursively constituted rather than personal attributes or attitudes.

In the examples above, most teachers based their instructional practice on essentialist, humanist notions of individuals as capable of choosing to act rationally and autonomously, or not. For example, in the Zolkower (1996) article the teacher blames the students for lack of attention, for not engaging enthusiastically in the mathematical activities; the teacher does not recognise the coercion in her instructional practices that may lead to student disaffection with mathematics and the learning of it. In my teaching I, too (Klein, 2001b) categorise students into binary pairs (motivated/unmotivated; competent/incompetent) which diverts attention from my teaching and blames the student for non-performance. Similarly, socially constructed notions of 'ability' infiltrate classroom practices and support or suppress students' disposition to act in powerful ways in the classroom. This deferral to 'ability' and 'attitude' talk by educators traps them into a crippling stasis that they are trying to move beyond; in attributing blame to students for not learning or having the correct attitude, teachers remove any blame from themselves and are content and able to continue with teaching-as-usual. As Kilpatrick and Silver (2000, p. 225) state:

> As long as ability is taken as rock-solid property of the individual...it undermines a commitment to ensuring that all students receive an optimal education in mathematics.

Within poststructuralist thought students (and teachers) do not *have* 'ability' and 'attitude'; rather these are social constructions that are discursively produced and so could be (produced) otherwise. This is a second area with implications for further research in mathematics education.

Practical implications also pertain in the area of preservice teacher education. It has historically been taken for granted that preservice teachers, given new theoretical, disciplinary and pedagogical insights, could implement new, inquiry-based instructional practices in the classroom. Such notions were based on humanist notions of the agentic, freely choosing individual. An alternative poststructuralist reading of this situation might be that teachers do what they do in classrooms (they interact with students in certain ways), not because of theories and pedagogic knowledge they have constructed in teacher education programs, but largely because of what they have *come to know* of learners and learning mathematics through their formative years. A special effort has to be expended in teacher education to focus less on the thinking individual, and more on the operation of discourses and the implications for changed practice. It would appear that much more research needs to be carried out in this area towards a re-culturing of teacher education (at the moment students probably experience the same power relations they knew at school) as teacher educators come to recognise the productive potential of pedagogic relationships (Klein, 2000a). .

Conclusion

In this paper I attempt to reveal the intellectual and constitutive processes of mathematics education. I suggest that these processes are not separate but intersect and intertwine to support or suppress students' qualitative experience of mathematics and their ability to establish themselves as competent and confident users of its

powerful ideas (NCTM, 2000). While many teachers and researchers will lament poststructuralist's troubling of knowledges that for so long have been known to be certain and true, and perhaps mourn the interrogation of the rational, autonomous agent of humanist thought, they might also consider its many possibilities. As Davies (2002, p.14) states:

> Poststructuralist theory, in its openness to meanings not yet thought of, and in its dedication to not getting stuck in old clichés and explanations, is often surprising, joyful and energising, bringing life to research and to teaching by breathing life into the educational institutions in which we are (always becoming) subjects.

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