

Is there more to Numeracy than Meets the Eye?: Stories of Socialisation and Subjectification in School Mathematics

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In keeping with movements in society generally there has been, over the past several decades, an increasing interest in the social aspects of learning mathematics in school and using mathematics beyond school to meet the demands of life, work and leisure. In this paper I attempt to draw connections between the two; how what is learned in school, and how it is learned, might affect its competent and critical use after school. I argue that classroom practices of *socialisation*, as in social constructivist, Vygotskian and socio-cultural psychological approaches to teaching and learning mathematics do not tell the whole story; stories of *subjectification* must also be told to help us understand how it happens that some school leavers are able to use mathematics to liberatory and powerful ends and others in limited ways that deprive them of choice.

A constant in our world beyond 2000 is that the rate of change is exceptional and accelerating. Diverse aspects of these changes are taken up and selectively represented in the media via information and communication technologies. Our social world is data-rich and dynamic and demands new skills of school leavers who will need to be able to critically interpret and evaluate vast amounts of information and act decisively and justly. The workplace has become a knowledge economy where workers are problem identifiers, problem solvers and strategic brokers who work in small teams on short term projects; workers of the future will need the social skills that will enable them to work productively with others, be able to broker consensus, communicate ideas and give and solicit help as they generate joint products (Education Queensland, 1999).

Mathematically, students exiting the schooling system will need to know the mathematics and have the social adaptability, flexibility and confidence to use this knowledge in dynamic and powerful ways. One's standard of numeracy might be seen as a measure of one's ability to work *with/in* the mathematics discourse in a specific site; *with* the mathematics points to the necessary knowledge of content, the ability to reason, solve problems, communicate, connect mathematical ideas and applications and *in* mathematics points to one's positioning by oneself and others in the discursive field, as agentic and competent in performing the required mathematical tasks. In this paper I attempt to suggest some important features of the social context of school mathematics that might have a bearing on how well school leavers acquit themselves in the world of work and leisure beyond 2000.

Given the emphasis on mathematics as a social practice beyond school, I first of all examine the theoretical assumptions and practical imperatives of the (social) constructivist and Vygotskian inspired classroom practices in teaching mathematics in school. I argue that the notion of teaching and learning as *socialisation* framing classroom activities is useful in orienting students to powerful mathematical ideas and ways of engaging in reasoning and debate. However, in maintaining the psychological individual/society dualism, socialisation theories inevitably though unintentionally turn to notions of individual pathology to explain how it happens that many students do not learn the mathematics, nor manage to establish themselves as agentic and competent users of its powerful ideas. I argue that were we as educators and researchers to open our eyes to processes of *subjectification* also framing and influencing all that happens in the classroom social context, we may be able to take steps to interrupt at least those immediate practices that potentially disenfranchise many learners.

Framing my analysis of theory and practice throughout the paper is an inclination to accept that indeed there is much more than meets the eye to ensuring that all children leave school with the necessary intellectual and social skills needed for the postmodern world. Whereas in the past it was considered enough to know the facts and skills and pass the exams, it is now more widely recognised that these competencies often came at a cost; for example, there are many girls/women who do quite well in the exams yet do not choose careers where higher levels of mathematics are needed (Johnston, 1994), preservice teachers who are anxious and underconfident about teaching mathematics and too many children “who come to school enthusiastic and eager to learn mathematics and ... leave school with quite negative attitudes” (Australian Education Council, 1990, p. 31). Socialisation into the content and reasoning processes is important, but it may be that attendant, often invisible, processes of subjectification selectively position students within the discursive field; each of these factors may be co-constitutive and influential regarding agency with/in mathematics.

Teaching and Learning Mathematics: Socialisation

All contemporary learning theories consider that social interaction, in one form or another, is important to cognitive development. However, the nature, role and importance of social interaction is theorised differently in the various approaches to teaching mathematics in the classroom. In this section of the paper I examine the role of social interaction in Piagetian *social* constructivism where the social context is instrumental in providing challenges and perturbations as a catalyst to individual cognitive reorganisation, and Vygotskian approaches where social interaction in the form of “mediation by materials, tools, peers and teachers is seen to be constitutive of learning” (Lerman, 1998, p. 147). Each of these is premised on processes of socialisation to bring about cognitive and developmental growth.

The Social Context Facilitates Individual Knowledge Construction

Although Piaget's name is rarely mentioned in the mathematics classroom, his notions of development and the construction of knowledge have had a significant influence on understandings and assumptions that frame educational practice. Piaget's constructivism holds that learners have to construct their own knowledge; its appeal lies in images of learners actively engaged in knowledge construction and contrasts sharply with prior notions of learning as passive reception and retention of others' preformed knowledge. The knowledge constructed is an internal conceptual structure, or schema, built up piece by piece as the learner reorganises activity on the basis of experience. “*Knowledge*”, says von Glasersfeld (1989, p. 124) who further developed Piaget's work, “refers to conceptual structures that epistemic agents, given the range of present experience within their tradition of thought and language, consider *viable*” (emphasis in original). Thus knowledge is not a *representation* of an independently existing *real world* but is made up of conceptual structures which prove to be adapted to, or fit within, the subject's range of experience.

Piaget did not speculate on how teachers should teach to ensure knowledge growth, though many educators have incorporated a well defined role for social interaction in the negotiation of meaning and *fit* with prior experience. In the literature (Davis, Maher, and Noddings, 1990) there has been an emphasis on establishing a mathematical community that would provide objects to be used in investigations, have lots of teacher-student interaction for purposes of diagnosis and guidance, encourage student talk, model mathematical thinking and promote questions and comments that help community members challenge and defend their own constructions. Cobb, Wood, Yackel, Nicholls, Wheatley, Trigatti, and Perlwitz (1991a, p. 6), who have been instrumental in adapting Piagetian notions of knowledge construction for

teaching, stress the importance of construction and acculturation: "In the course of classroom social interactions, the teacher and students mutually construct taken-to-be-shared mathematical interpretations and understandings".

Regardless of the theoretical adequacy, or otherwise (see Lerman, 1996) of drafting social aspects of knowledge growth onto Piaget's autonomous cognising subject who constructs knowledge from experience, social constructivist approaches such as those of Cobb and his colleagues have developed and emphasised the importance of mathematical content, of having students speak their developing constructions and of student *engagement* in learning generally. However, my argument in this paper centres on the notion that engagement can be empowering or not for students and should not be understood as always a positive force in numeracy development; if the teacher understands knowledge as purely cognitive, and the learner as naturally rational and autonomous, s/he may structure the social context in ways that unknowingly limit personal sense-making and empowerment. For example, Yackel and Cobb (1996) tell the story of Donna, who changes an answer after repeated questioning by the teacher although she was correct in the first instance. The teacher berates Donna for not standing firm on her convictions regarding the answer and tells her "So you should have said, Mr K. Six. And I can prove it to you". He then adds "I've tried to teach you that!" According to the teacher's reading of the situation, Donna has let him down in that she did not behave rationally and autonomously in strongly asserting and reasserting her answer. In remaining blind to the power relationships operating between teacher and student in the social context of the classroom, the teacher is able to blame Donna for not learning what he has *tried* to teach. The effect of interactions such as this could be, even though Donna knows the mathematical content (she has agency *with* the maths), that she also learns to doubt herself and her ability to participate correctly in the discursive field (she lacks agency *in* participation).

Social Life is Primary in the Construction of Knowledge

Jaworski (1994) claims that the move to an *inherently social* view of knowledge construction paralleled a move away from constructivist notions of development centering on internal mental structures developed through experience, to Vygotskian notions of cognitive abilities and capacities formed and constituted in social phenomena. For Vygotsky, a theory of cognition is a social theory where the personal is imbricated with the social and the public such that mental function cannot be considered independent of that interaction. Wertsch and Tulviste (1992, p. 548) state:

Vygotsky's account of culture suggests that humans are never as autonomous and as free of outside interference as it might at first appear. Instead, human mental functioning, even when carried out by an individual acting in isolation, is inherently social, or sociocultural, in that it incorporates socially evolved and socially organised cultural tools.

Language for Vygotsky was fundamentally communicative and social, rather than merely a tool for reflecting cognitive processes (Burman, 1994). Language carries the social and cultural inheritance of the communities in which an individual participates and plays a central role in the development of consciousness.

The idea of consciousness formed and constituted in social phenomena through mediation by cultural tools and communication brings a new dimension to classroom practice in that it makes clear that mathematics education is not a neutral process. Students and teachers bring subjectivities and socio-cultural perspectives and values to bear on educational tasks and so it becomes important to both engage and *embrace* all learners in the classroom community. However, it is one thing to recognise and celebrate difference and quite another to ensure that this recognition leads to teaching practices that support numerate behaviour in the classroom. If we accept that learning is a process of internalisation, then internalisation has produced these differences and we must accept that what we started with, as in constructivist

understandings of the individual, was biological (Henriques, 1984, p. 21). The notion of internalisation of knowledge through social practices is deterministic. As Gee (1995) says, humans use language and other sign systems as social tools in interaction and internalise patterns of tool-within-contexts-of-use as pieces of intra-mental furniture that bears the hallmarks of interactive use, but there is no space for individuals to critique or question the formulations they have swallowed.

The Learner in Context

Theories of socialisation are based on the notion of a rational humanist individual who acts according to constructed knowledge. The individual learner is an *epistemic agent*, *naturally* striving to resolve cognitive conflict, and a state of equilibrium (von Glasersfeld, 1989). In the classroom context it is taken for granted that learners behave rationally as Cobb (1986, p. 303) states: “it is assumed that children's behaviour is rational” and they are “expected to show intellectual and social autonomy in the classroom”. Cobb et al. (1991b, p. 174) emphasise that: “The teacher trusted the children to resolve their problems and they trusted her to respect their efforts”. Practice is based on humanist understandings of the individual and the environment or context of learning is assumed to be challenging yet supportive of all learners.

In many such classrooms reference is made to communities of collaborative practice where learning through doing, argument, experimentation and risk-taking are highly valued; they are valued because involvement in these processes is seen to be constitutive of students with inquiring minds who seek and find resolutions to meaningful problems. For example, the Australian Mathematics Education Program (1982) was based on the understanding that students who learn mathematics in challenging and problem solving contexts will be able to apply constructed knowledge and skills in practical ways, have a deeper understanding of the mathematics involved and show significantly increased ability to recall or reconstruct the mathematics. Again, such proclamations take for granted that active engagement is necessarily an *enabling* experience for students; they ignore how problem solving and investigations as commonly practised in schools may merely reinforce traditional binaries of correct/incorrect answers and successful/unsuccessful students.

A poststructuralist view of the social construction of knowledge holds that all knowledge is discursively constituted, that the learning context can be empowering or not, and that individuals are not essentially rational nor autonomous. All learners are constituted through discourses wherein relationships of power/knowledge position them as agentic or not; agency is thus problematic, it is fragmentary and transient, because it is discursively produced. Weedon (1987) makes clear that the use of the word discourse in poststructuralist theory infers more than ways of thinking and producing meaning as often used in psychological discourses: “Discourses”, states Weedon (1987, p. 108) “constitute the 'nature' of the body, unconscious and conscious mind and emotional life of the subjects they seek to govern”. This notion of constituted subjectivity goes against that of the rational choosing individual of socialisation theories. That is, persons will choose to do things, but always within the bounds of their discursive production; for example, it is unlikely that the young Aboriginal girls playing across the road in the park will choose to run for Prime Minister of Australia or become an airline pilot as such possibilities, for them, have probably not been discursively produced. As Henriques et al. (1984, p. 117) state: “The subject itself is the effect of a production, caught in mutually constitutive web of social practices, discourses and subjectivity; its reality is the tissue of social relations”. This theorisation of the learner has important implications for numeracy beyond 2000.

Teaching and Learning Mathematics: Subjectification

Theories of subjectification provide useful analytical tools for making clear the coercive power of all discourses, including school mathematics. The tools of subjectivity and positioning with/in discourses enable teachers and researchers to examine teaching-as-usual for its constitutive effects. Theories of subjectification do not hold that teachers are shaping the *internal* beings of their students but rather that students, and teacher, are *subject to* relationships of power/knowledge within the discursive matrix. Poststructuralism does not allow the external/internal nor the passive/active divide. People are always learning, through positioning in overlapping discourses, to know themselves at times in powerful and liberatory ways, and at other times in ways that deprive them of choice and the possibility of operating in powerful ways (Davies, 1994). This has important ramifications for teaching school mathematics and numeracy in school and beyond, though it does not carve a linear and seamless link between the two.

Agency, or power, in a poststructuralist sense, is always spoken of as “relationships of power” (Foucault, in Bernauer and Rasmussen, 1987, p. 11). Power is not possessed, it is not a commodity or gift. It is sustained in relations not persons. As Applebaum (1995) suggests, it is perhaps helpful to think of a physics of power instead of an economics of power; power is in all relationships, similar to gravitation among physical bodies. The imperative becomes not to establish who *has* power, but rather *how does power operate?* In all contexts, including the classroom, power operates to structure the possible field of action of others. Foucault (1982, p. 789) states: “It is a total structure of actions brought to bear upon possible actions; it incites, it induces, it seduces, it makes easier or more difficult; in the extreme it forbids absolutely; it is nevertheless always a way of acting upon an acting subject or subjects”. Power relations in the classroom are constitutive of learners and degrees of agency with/in school mathematics.

In the past we have understood agency to lie in teachable attitudes and skills, and ultimately to be an individual attribute or quality. We have become used to speaking in psychological terms of motivated/unmotivated, autonomous/dependent learners of mathematics. If, on the other hand, we see agency as discursively determined, we are obliged to take more seriously the extent to which classroom practices actually foster numerate behaviour in students. Numerate behaviour reflects a certain agency with mathematics and comprises intellectual and social aspects of knowing mathematics. An important issue here is that agency with/in mathematics is closely tied to having authorship of constructions and meanings and signifies “the capacity to speak/write and be heard, to have voice, to articulate meanings from within the collective discourses and beyond them” (Davies, 1991, p. 52). Teachers then need to examine very carefully whether classroom practices, for example completing a blackboard of *sums* or another page in a textbook, position the students as appropriately numerate for a world beyond 2000.

Interestingly, the extent to which students can establish themselves as numerate in the classroom has no certain relationship with particular teaching methods, resources or grouping arrangements a teacher chooses to use. Rather, the question is always how a discourse operates to positively position as many students as possible; all teaching methods and resources have empowering or oppressive potential. In the end, it is important that students exiting school for a postmodern world have come to know doing mathematics as a social practice, in school and beyond, and themselves as competent and agentic users of its powerful ideas. Educators and researchers over the past score of years have emphasised the importance of embracing and engaging students in learning mathematics, though in taking agency for granted they have neglected to examine the many ways in which classroom activities and processes limit the extent to which students are able to establish themselves as competent. For example, many teachers seek to make learning mathematics more enjoyable for students by

taking them outside the classroom to, let's say, measure objects and complete graphs, though it is not at all clear that traditional power relationships between teacher and taught are interrupted. If not, students are in no real sense able to establish themselves as competently agentic and thus continue to come to know mathematics as comprising disconnected bits of information and skills, and themselves as passive receptacles of this arguably limited and limiting notion of mathematical knowledge.

Agentic numerate individuals, lifelong learners with inquiring minds, live out their apprenticeships, partly at least, in school. I would argue that inquiring, investigative, problem-solving minds are discursively constituted – they are not physiological or psychological attributes of individuals. To have agency, even if only for a moment, is to be recognised by oneself and others as one who can and should have voice within the discursive community, and also to be positioned as one who can interrupt and question taken-for-granted ways of operating. In school, learners need to experience such ways of operating with/in mathematics and to articulate how well classroom activities facilitate their developing mathematical understandings and ways of making sense of experience. The teacher might engage with students in making the operation of the discourse problematic; in this way school mathematics is recognised as a social practice and this recognition may be constitutive of inquiring and questioning mathematicians of the future.

Conclusion

Usher and Edwards (1994, p. 25) explain the foundations on which theories of socialisation are based:

The very rationale of the educational process and the role of the educator is founded on the humanist idea of a certain kind of subject who has the inherent potential to become self-motivated and self-directing, a rational subject capable of exercising individual agency. The task of education has been understood as one of 'bringing out' of helping to release this potential.

I have argued that this particular understanding of the human subject is dangerous in that it takes the ability to be agentic as given; it diverts attention from all manner of educational and other social pressures that render this problematic.

I have used the poststructuralist notion of individuals constituted through discursive practices to suggest that many invisible, and at times oppressive, features of teaching interactions can variously position learners in school classrooms. While it is important that learners of mathematics construct powerful mathematical ideas and are socialised into ways of reasoning and conjecturing in mathematics, these observable features of learning conceal their constitutive powers. I am referring here to countless elements of interactions that might affect whether or not students come to know themselves, viscerally, as mathematically competent and agentic; for example, if the teacher always defers to the Question-Response-Evaluate questioning sequence, or always works from a textbook, the students are positioned as dependent and having to reproduce others' knowledge. In such cases, there is little room for student authorship of ways of making sense of mathematics and coming to appreciate its inherent integrity, nor of realising themselves as competent and agentic in its articulation. Although teachers are in no position to defer to student input regarding *what* mathematics is learned, there may be much to be gained from students' invaluable insights regarding the often unseen and unrecognised power relations affecting *how* it is learned.

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