Challenging Task-driven Pedagogies of Mathematics

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Much primary mathematics teachers' work consists of designing, selecting, assigning, and monitoring learning tasks. This paper uses postmodern perspectives to examine task-oriented pedagogies of mathematics, demonstrating how the discourse supporting such pedagogies conflicts both with the discourse embodied in international declarations which advance children's right to participation in decisions affecting their lives, and also with participatory principles espoused within the discourse of 'good governance'. The paper raises issues about children's autonomy, entitlement to control their learning environment, and spontaneous determination of their own educational journeying and considers alternative discourses of participant-determined mathematical learning.

In spite of a shifting emphasis from teacher as transmitter of mathematical knowledge, to teacher as facilitator of students' development of mathematical understandings, and in spite of changing ideals of mathematical learning tasks, a general acceptance as legitimate and effective practice, of traditional task-oriented pedagogies in which the teacher selects or designs learning tasks for students, has changed little. This view is reinforced in a recent mathematics curriculum support documents for teachers, (Ministry of Education, 1997) which states that 'As the professional with expertise in both learning theory and curriculum, the teacher plays a pivotal role…by planning programmes where students' thinking and learning are of prime importance" (p. 21). A critique of task-oriented pedagogies of mathematics may be timely, given recent calls for democratic access through democratic mathematics education e.g. Malloy, (2002) who suggests that "The idea of children having democratic access to powerful mathematics ideas is a human right" and "democratic education is collective in its goals and individual in its opportunities for student participation" (p.18). Skovmose and Valero (2002) argue that "mathematics education becomes powerful in a cultural sense when it supports people's empowerment in relation to their life conditions." (p. 394). Democratic education implies empowerment through participation. At present, the majority of the world's children have little agency in determining the path and nature of their mathematical learning within our compulsory educational institutions (Apple & Beane, 1999; Gates & Vistro-Yu, 2002). The classroom itself may be regarded as a significant element of the *life conditions* of our children, and creating conditions of empowerment within the mathematics classroom must concern those who seek to "democratize" mathematics education.

Drawing upon statements gathered from education policy documents, curriculum materials, teachers, and students (Walls, 2003), this paper examines the ways in which the discourse of mathematics education produces and sustains a task-oriented approach to teaching mathematics. It considers the implications of such pedagogies for young learners of mathematics and contemplates reframed educational discourse in which a *participant-determined pedagogy of mathematics* might more appropriately reflect the discourse of enhanced empowerment for children in the classroom.

What is a "Task"?

In this discussion, mathematical tasks are broadly defined as the kinds of activity that teachers of mathematics assign or *set* their learners. Mathematical tasks are variously

referred to as *questions, activities, problems, practice, new learning, lessons, examples, learning experiences, units, programmes of work, projects, investigations* or *homework*. Tasks take many forms and vary in length and complexity, from oral questions to be answered rapidly, worksheets or pages of the textbook to be completed, open-ended questions to be explored, real life situations to be investigated, or test items to be responded to. The distinguishing features of a 'task' are its compulsoriness and exclusion of the learner from the process of selection or design. Tasks are routinely and universally used by mathematics teachers for a variety of purposes including the introduction of new mathematical ideas, practice of previously learned skills, assessment of learners' mathematical skills, identification and grouping of children according to their mathematical performances, or even to settle the children down.

During an ethnographic study in which ten children were tracked across three years of their middle primary schooling in New Zealand (Walls, 2003) the children were asked what they usually did at maths time. Typical responses from the children in the study spoke of the compulsory and teacher-determined nature of everyday tasks in mathematics.

Jared:	The teacher says, 'Go and get your maths books out.' And she writes stuff on the board for maths. (Late Year 3)
Georgina:	We get into our groups and do the worksheet. (Mid Year 4)
Mitchell:	You have to sit down and do some times tables or pluses or take away. (Late Year 5)

Over the three years of observation, mathematical tasks in the children's classrooms were found to consist predominantly of quick fire tests, teacher-directed group work, and solo seat-bound written exercises from worksheets, textbooks or questions on the board.

Task-driven Mathematics Pedagogies in Times of Change

Traditional pedagogies of mathematics are well-recognised and have been described by many researchers. Brown (2001) describes how changing pedagogies of mathematics have created an *opposition* between transmission (the old) and discovery (the new) conceptions of teaching mathematics and the conflict that seems to exist for teachers between these two seemingly distinct approaches. But although the content and management of tasks may differ between these approaches, the task-bound culture of mathematics classrooms within which learners are similarly produced and positioned, is preserved. The following transcript of a video recording of teacher/pupil interaction during a mathematics learning session in Jared's year 5 classroom illustrates how the role of the teacher is maintained within changing mathematics educational discourse.

Mr Waters: First of all this morning we're going to put up the title *(Writes* 'Problem Solving' *on the board)* Underline it and miss a line. See if you've got your brains into gear. (*Writes the first pattern on the board: (1) 2,4,6,8, , ,)* A nice easy one to start off with. What you're going to do is complete the number pattern. *(Writes: (2) 3,6,9, , ,),* Fill in the numbers and continue it on. Maths is patterning, that's all it is. Complete the whole number pattern. *(Writes: (3) 5, 25, 45, 65, , ,)* They're going to get harder and harder. (*Looking at a child's work)* There's no need to write the boxes, the boxes on the board represent the ones that are in your book. Make sure you have the most important piece and that is the comma between, if you don't, your numbers will represent something else. You must set them out properly. (Jared's teacher, late Year 5)

Although the learning experience is presented as "problem solving", by using the task-oriented expressions "you're going to", "you must", "you don't", "make sure", the teacher positions himself as a taskmaster whose role it is to allocate work and manage learners,

emphasising the compulsory nature of the task and the expectation that all the children are to follow the same very particular procedures.

Task-driven pedagogies such as this were found in every one of the classrooms observed. Teachers in the study displayed an unquestioning belief in and acceptance of their responsibility as taskmasters, as evidenced by the following typical comments:

Mr Loch: At the moment I'm finding it's taking time for some kids to settle down, settle into a routine…kids just don't complete work and they're not used to actually getting through something. Finishing it off. That's something I'm very tough on. I like things to be completed. (Jessica's teacher, interview early Year 3)

Mrs Joiner: (*Writing about Rochelle*) She needs only a few reminders to complete set [mathematics] tasks. (Progress report for parents, early Year 3)

Mr Solomon: Georgina, I had to separate out from the others, for about four or five weeks I think it was. I gave her a desk over there by herself. *(Points to corner of classroom)* She was just far too distracted and didn't finish or get on with her work. (Interview, mid Year 3)

Ms Torrance: I think he [Dominic] would prefer working in a group… I would prefer him to work on his own. Independent tasks, he's not the best; he's very chatty. (Interview, mid Year 3)

In the mathematics classroom, much teacher talk was focused on task-related protocols.

Ms Summers: *(To Peter)* You've finished! Doesn't it feel good when you've done it? (Classroom observation, late Year 3)

Ms Torrance: We have some amazing speedsters who have got on their rollerblades and got their two sheets done already. (Dominic's teacher, classroom observation, late Year 4)

Ms Sierra: You're supposed to do your own work, OK?…I don't want you talking, I want you to concentrate. (Liam's teacher, classroom observation, early Year 4)

Doyle (1988) has described such teacher/learner interactions in mathematics classrooms as a process in which "teachers affect tasks, and thus students' learning, by defining and structuring the work that students do, that is, by setting specifications for products and explaining processes that can be used to accomplish work" (p.169).

The pedagogical tradition of teachers' structuring of mathematical learning through a series of carefully selected and closely managed discrete *tasks*, and the significance of *task* in mathematics educational discourse may be regarded as an entrenched cultural feature of the mathematics classroom. Pedagogies of mathematics have been particularly regulated by a prevailing epistemological view of mathematics as a discipline consisting of a body of specialised procedures based upon unassailable universal principles which are seen to be arranged in hierarchies of increasing complexity. In this view, mathematical truths can best be conveyed to the learner through a process of initiation in which the learner is assigned increasingly difficult tasks by the teacher who has, through a similar process, acquired the same knowledge and skills. Task-setting is thus regarded as the proper, legitimate, and major role of an effective teacher of mathematics.

Over the past decade, mathematics educators have devoted serious thought to selection and design of tasks, considering both their affective and cognitive impacts upon learners. A growing belief in the value of meaningful contexts and a focus on the processes of thinking and working mathematically is reflected in official curricula of many countries advocating pedagogical approaches based upon open-ended mathematical tasks, problem solving, and even problem posing. Rich Tasks for New Times of Queensland and Realistic Mathematics Education of the Netherlands provide examples of efforts to provide students with mathematical tasks that are meaningful, relevant, and authentic. But recent innovations have continued to support the view that tasks are central to the mathematical learning process and that task selection and/or design should be the primary responsibility of the

teacher-as-expert. Carpenter et al (1997) for example, describe the teacher's role in *cognitively guided instruction* of children's mathematical learning in the following way: "Almost every minute, a teacher makes a decision about what to teach, how to teach, who to call on, how fast the lesson should move, how to respond to a child, and so on…because of the intimate knowledge of students that teachers have, no one else can make these immediate decisions about what to do in the classroom." (p. 95). Similarly, Ernest (2001), in describing a *critical mathematics* says 'Obviously teachers must decide what activities and projects would be best suited to their pupils, how often these kinds of activities can be done…' (p. 289). He provides teachers with examples of possible topics. Although recent pedagogical shifts in mathematics education have strongly encouraged teachers to select or design tasks for interest or relevance, and increasingly expect or even compel children to participate by sharing their thinking as they undertake these tasks, it is seldom considered essential that children are consulted about the *context, content* or *efficacy* of such tasks. Irrespective of how *open* or *closed* the tasks may be, task-oriented pedagogies subtly or otherwise construct mathematical learning as a form of compulsory labour divided into discrete units of work which must be at least attempted and preferably completed by the learners, and by which learners' performances might be judged by the teacher.

International moves toward more expansive and connected mathematics have been tempered by increasing specificity of learning outcomes. Numeracy enhancement projects in Australia, New Zealand and the UK for example are characterised by teacher-directed pedagogies supported by increasingly refined assessment tasks, enabling teachers to better identify children's current mathematical learning stages and detect their weaknesses and strengths. It is believed that armed with the correct training and diagnostic tools, teachers will be better able to make the most significant decisions about what mathematics their pupils will learn, when they will learn it, and how that learning will take place. Such approaches diminish opportunities for learners to select learning contexts and to direct their own learning, and overlook significant learning factors such as children's social networks, first languages, current understandings of the world, sensitivities, interests, passions, and aversions.

Learner-determined Mathematics Education? Considering Alternatives

Although attempts to confer greater autonomy on young learners can be found in the child-centred learning movement of the 1970s, and the learning through play philosophy of early childhood education, task-driven pedagogies of mathematics remain embedded in the life of school and classroom. It is difficult to imagine teaching and learning of mathematics in any other form, but alternative modes of children's learning are not difficult to find. Observations of the kinds of "informal" acquisition of knowledge and skills that occur outside of school settings, such as children learning to ride their skateboards with a group of friends, offer compelling models of learning that are not task-dependent, rather they are *participant* or *learner-determined*. Children can be seen to flourish within these forms of self-selected and self-directed experiential learning. The learning is a form of playing around. It is socially valued and seen as worthwhile. The learners feel supported by a self-selected social group. They learn at their own pace, in their own time, and in a place of their choosing. They are free to make mistakes which they accept as a natural and even humourous part of learning. The learners challenge each other to take risks, and they provide each other with informal feedback, helpful hints, and encouragement. They are free to discover and invent, they can start and stop whenever they like, and they gain intrinsic satisfaction from their growing accomplishments. Above all, the learning is

embodied. It engages the whole child – the cognitive, affective, motor-sensory and social 'self'. Such observations might lead us to consider that the ways in which traditional task-oriented mathematics pedagogies fail to provide for participants, may be a significant factor in the kinds of disaffection, marginalization and alienation that have been widely recognised in young learners' experiences of school mathematics. Some support for participant-determined pedagogy can be found in Pollard (1997) who describes how teachers might provide for negotiated curriculum, arguing that "rather than reflect the judgments of the teacher alone, it builds on the interests and enthusiasms of the class" and noting that, "Children rarely fail to rise to the occasion if they are treated seriously. The motivational benefits of such an exercise are considerable" (p. 182). The children in this study were also asked about how maths time could be better for them. Their answers not only supported Pollard's assertions, but also illustrated how tasks define and constrain mathematics as a subject, and them as learners of the mathematics.

Researcher:	If you were the maths teacher what sorts of things would you have at maths time?
Jared:	Easy work…Playing games. (Late Year 3)
Jessica:	I'd like it if we did it together (Late Year 4)
Georgina:	Have more time, like we have half an hour on maths and we don't hardly have any time to do it. (Georgina, Mid Year 5)
Jessica:	Well, long enough for me to get stuck into it and start enjoying it. And then once I've started getting a bit bored, I think 'I want to finish this.' (Mid Year 5)
Dominic:	Just playing a bit more games. (Late Year 5)
Liam:	I wouldn't really do it [maths work] I'd just play the games. (Late Year 5)
Peter:	Um, probably more maths games and, um, more drawing things. (Mid Year 5)

In the nexus between the discourse of task-driven pedagogies of mathematics and the discourse of participation, efforts to increase learners' ownership can be discerned. The New Zealand Ministry Education (1997) for example encourages "allowing students to have some control over their own learning and assessment by involving them in planning learning and assessment activities" (p. 21) Hiebert et al, (1997) advocate learners' *adjustment* or *shaping* of mathematical tasks their teachers have previously selected while continuing to support the teacher's primary role in task selection. They advise teachers to "select tasks with goals in mind", and state that "although the selection of tasks does not require wildly creative or clever ideas, it does require careful thought about the mathematics landscape and about the way in which a series of tasks might lead students across a landscape" (p. 163). Community participation and negotiation in shaping curriculum content has also been suggested within the discourse of ethnomathematics as an effective approach for culturally distinct and marginalised groups (e.g. Lipek, 1994).

The works of Apple and Beane (1999), Cotton (2001), Skovsmose and Valero (2002) and Gates and Vistro-Yu (2003) explore the intersecting discourses of democratic process and mathematics education, probing the dilemma that has challenged mathematics educators in recent times: valuing learners' right to freedom and independence on the one hand, and increased accountability for learners' progress by means of tighter control of the what is to be learned and how, on the other. At the root of the dilemma lies educators' unwillingness to entertain the notion that young learners have a legitimate role in determining *what* they learn and *how*. Davis (1996) captures this when he states that "a mathematical task should impose 'liberating constraints' which are intended to strike a balance between 'complete freedom' (which would seem to negate the need for schools in the first place) and no freedom at all" (p. 97).

Discussion

Children's lack of participation within task-oriented mathematics pedagogies may be challenged on several fronts: (1) as a *human rights* issue; (2) as a *governance* issue, and (3) as a *learning* issue. I will briefly consider each of these in turn.

(1) The United Nations Charter of Universal Rights of 1947 represents collaborative international thought about how human beings should treat one another. It identifies the rights of each human individual in terms of *needs*, including the need to belong, to feel safe, to be accepted and respected, and to be fully included in all community activities. These rights have been further refined and articulated for children. The UN Convention on the Rights of the Child (CRC) of 1990, now ratified by 191 countries, upholds children's rights to participate. Article12 confers 'the child who is capable of forming his or her own views the right to express those views freely in all matters affecting the child', and Article 13 states 'the child shall have the right to freedom of expression' (UNICEF, 2002, pp. 63-64). In their statement to the UN General Assembly's Special Session on Children in 2002, representatives from the Children's Forum issued a vision statement of a world in which children's rights are protected. It states "We see the active participation of children: raised awareness and respect among people of all ages about every child's right to full and meaningful participation, in the spirit of the CRC, and children actively involved in decision-making at all levels and in planning, implementing, monitoring and evaluating all matters affecting the rights of the child" (UNICEF, 2002, p.11). Such statements suggest that the rights of children as self-determining citizens to participate in all areas that affect their lives must include their education. Compulsoriness and lack of learners' participation in decision-making within task-driven mathematical learning cultures fails to recognize these principles.

(2) Teaching institutions may be regarded as systems of management (e.g. Foucault, 1977). As such, should be expected to adhere to the principles of good governance: *transparency*, *fairness*, and *participation* (UNDP, 2000). Viewed in these terms, many schools fail to provide good governance since opportunities for learners to determine or participate in the design of either the scope and structure of compulsory curriculum, or the content form, pace or assessment of localized learning tasks, are non-existent in all but the most "alternative" schools, or the experimental classroom.

(3) The social constructivist learning theories widely espoused by mathematics educators, suggest that optimal learning occurs as a socially interactive process operating within the learners' zones of proximal development, and scaffolded by others (not necessarily adults) within a supportive group. *Participant determined learning* such as the example of friends on their skateboards, offers a vision of social constructivism at its best. In providing students with genuine and significant opportunities to choose *what* mathematics they will learn and *how* they will learn it, teachers might, in collaboration with children, help to create optimal learning conditions that build upon and work with significant elements of their students' social worlds – their passions and joys, the things they view as valuable, and ways in which they prefer to learn. Failure to do so may significantly limit learning opportunities for children.

A revisioning of schools as inclusive sites can be found in the UNICEF (2003) report on the state of the world's children which describes international efforts to establish child-friendly schools, particularly in developing countries. One of the listed characteristics of a child-friendly school is that it "involves children in active *participatory* learning" (p. 89). It argues that a *human rights approach* is needed in all efforts to improve conditions for children, in which "people are recognized as key actors in their own development, rather

than passive recipients of commodities and services," and where "participation is both a means and a goal" (p. 93).

The ways in which teachers select and 'set' tasks for learners, manage learners' engagement with the tasks, and use such tasks to determine what the learners know and can do, says much about traditional relationships between adults and children in our societies. In most communities around the world, children have little say in what happens in their lives, their education included. A changing relationship between the teacher and learner of mathematics is suggested by rights-based discourse. As Neyland (2004) argues, a postmodern ethical orientation to mathematics education "will shift the focus away from procedural compliance and onto direct ethical relationship between teachers and their students." (p. 69). From a postmodern view, it is within discursive formations that such relationships are produced and maintained. Reframing the teacher/student relationship is therefore both contingent upon and made possible by changing educational discourse. In focusing upon a discourse of *participant-determined* pedagogy, we might shift our gaze from learner as *educational product* to learner as *growing and valued member of a local community*, or learner as *global citizen*. Within such a discourse, a participant-determined mathematics education might embrace some of the following principles:

- mathematics curriculum is locally negotiated between schools, parents, and children
- flexible *learning situations* are collaboratively shaped between teachers and children
- learning situations are not constrained by specific learning outcomes – rather their broad goals are mutually recognized as part of a *mathematical* landscape
- children engage in learning situations at their own pace and in a manner of their choosing
- children choose with whom to engage in the learning situations
- children seek information and assistance from a variety of sources, not just the teacher or textbook, recognising that *working mathematically* is a part of all cultures
- children assess their own learning according to collaboratively constructed assessment criteria
- all learning and assessment operates to enhance the physical and social well-being of children

Conclusion

The concept of child-friendly learning environments in which children's participatory rights as *global citizens* are acknowledged, obliges us to re-examine widely practiced pedagogies of mathematics. The place and nature of task-setting in mathematics education must be reconsidered within the discourse of children's right to participation. Although some writers (e.g. Dowling, 2001; Vithal, 2003), caution that the rhetoric of participative mathematics education - emancipation and empowerment of children – may be little more than *myth* since interventions merely reinforce existing inequities, within international discourses that are both increasingly recognizing the vulnerabilities of children and their need for greater protection, and valuing the contribution children can and should make to the development of local and global communities, the right of children to be substantially involved in determining their own learning has significant implications as a growing ethical expectation and legal requirement of education. As Osler and Starkey (2001) state in the World Yearbook of Education, 'if schools are to ensure the greater participation of

young people in decision making in line with the Convention on the Rights of the Child, schools must not only provide structures for participation, but also equip children with the skills to participate' (p. 100). Further research is needed in this area.

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