Social inequalities, meta-awareness and literacy in mathematics education

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In this paper I take as a starting point social inequalities and pupils' different learning possibilities as a result of their social background, and consider mathematics on three levels: *The level of Discourse,* which primarily encompasses cultural relations and communities of meanings in school; *the level of genre* which concerns recognizable common cultural texts and the frames of reference which support their understanding, and finally, the level of paradigmatic and syntagmatic *modes of thought* which are necessary for learning within mathematics. My argument is that in order to decrease the school's reinforcement of social inequalities, teaching should be based on meta-awareness rather than acquisition through pupils' activities.

Keywords: mathematical discourse; genre; modes of thought.

Introduction

In 2006 a new curriculum reform, The Knowledge Promotion (LK06) was introduced in Norway. The overall goal for this new curriculum was to raise the knowledge level for all pupils in school and to change the school so that the impact of family background on pupils' school results should be less. In Norway, education is a democratic right and social background should no longer be a reason for lack of education. Yet, despite the democratization which has taken place, social inequalities are increasing within the Norwegian educational system, as in many parts of the world: educated parents foster educated children (Bakken 2004; Bourdieu 1995; Zevenbergen 2001).

In taking the increasing social inequalities as a starting point I suggest that a higher meta-awareness of both language and modes of thought will increase all pupils' possibilities for learning. The focus will be on pupils who are characterized as previously low attaining in the school discourse. My argument is based on Bruner (1986) and on other theorists who have developed his theories further. One of Bruner's main arguments is that we learn through the use of language and being aware of the learning situation. The challenges will be addressed by taking a literacy perspective which recognizes that mathematics as a school subject draws on a range of discourses. Olson (1994) emphasizes that school subjects belong to different textual communities, and to master a school subject is to develop the ability to manipulate different texts:

> To be literate it is not enough to know the words; one must learn how to participate in the discourse of some textual community. And that implies knowing which texts are important, how they are to be read and interpreted, and how they are to be applied in talk and action. (273)

Gee (2003) emphasizes the difference between acquisition and learning, reminding us that what many pupils already have acquired before they start school, others have to actively learn. This is a problem which has been neglected in many pedagogical reforms. Teaching which is mainly based on acquisition through pupils' activities and not on meta-linguistic awareness will reinforce the differences which are already there. Thus school can be looked upon as a reinforcement of social inequalities.

Meta-linguistic awareness and literacy competence characterize the “winners” in the Norwegian school (Bakken 2004), as in other countries. Many ‘weak’ pupils find it difficult to distinguish everyday language and school language and these pupils will also have difficulties in mathematics in their meeting with the new and strange in the subject (Zevenbergen 2001).

The main purpose of this paper is to discuss pupils’ learning possibilities in mathematics from a literacy perspective. The argumentation will take place on three theoretical levels: I explore mathematics on the level of discourse, then I turn to the level of genre, and thirdly I examine the implications of Bruner’s (1986) concept of ‘modes of thought’ in terms of ways of thinking and reasoning in the subject. First, however, I start by discussing the impact of social inequalities for pupils’ learning, and the role of their prior understanding about ‘the meaning’ of typical classroom activities, that is, of playing the school game (Olson 2003).

Literacy and primary and secondary discourses

Pupils start school with different prior understandings about its activities and goals. They have different experiences with books, literature and calculation, and different affinities in relation to letters and numbers. These prior understandings, which encompass experiences, language, habits, affinities and feelings, constitute what Gee (2003) calls their “primary Discourse”.

The primary Discourse is a ‘value Discourse’ and is part of different networks of meanings. It may, or may not, support school activities. Some pupils feel comfortable at school because of a match with their primary Discourse, while for others school may be more or less foreign. This is a challenge in a learning context. School is more or less about constant meetings with new and different thinking and texts, what Gee calls “secondary Discourses”. Ideally, the purpose of schooling is to encourage openness to unfamiliar and new secondary Discourses.

Zevenbergen (2001) focuses on the potential difficulties pupils will meet in mathematics classrooms. Like Gee, she emphasizes that pupils enter school and mathematics classrooms with different social backgrounds and correspondingly different language backgrounds. Drawing on Bourdieu, she argues that some pupils are “predisposed” (47) to learn mathematics, not because of innate abilities but rather because of their family habitus. These pupils are better equipped to cope with the mathematical culture and to “position themselves more favorably in the eyes of their teachers” (47). For others the opposite will happen, and success will be more elusive. This initial habitus is also recognizable in Norwegian classrooms (Penne 2006).

In this paper, sociocultural differences in mathematics classrooms in Norway are recognised. According to Gee (2003), literacy for pupils is a question of mastering secondary Discourses. Pupils meet them in school and in mathematics. A precondition is meta-awareness in the learning process incorporating contextual understanding and interpretation.

Discourses, genres and modes of thought- three levels in the teaching/learning process

In order to discuss the challenges sociocultural differences play for mathematics teaching and learning, I consider mathematics on three levels: *The level of Discourse*, which primarily encompasses cultural relations and communities of meanings in school; *the level of genre* which concerns recognizable common cultural texts and the frames of reference which support their understanding, and finally, the level of paradigmatic and syntagmatic *modes of thought* (Bruner, 1986) which are necessary for learning within mathematics. Developed by Olson as "modes of apprehension" in the school context, these are "the frames of reference in terms of which children and adults formulate their experience, the major modes in which they define the discourses or disciplines that are the concern of schooling" (2003, 156). Thus one learns to reason or think as a mathematician.

The level of discourse

A Discourse is a kind of 'community of meaning', of ways of thinking to understand the world or a part of the world. Discourse gives meaning, a feeling of inclusion and identity, for example in the profession of teaching. Within a Discourse, some frames may be obvious while others are in motion, formulated by Gee (2001) as follows:

> We can think of Discourses as identity kits. It's almost as if you get a tool kit full of specific devices (i.e. ways with words, deeds, thoughts, values, actions, interactions, objects, tools, and technologies) in terms of which you can enact specific activities associated with that identity. (720)

Mathematics teachers are located within a Discourse or "identity kit" as is the textbook in the subject. To mathematics teachers the Discourse is creating an implicit world of knowledge or experience. However, from some pupils' point of view, what is obvious to teachers may not be certain. Some have a background providing them with access towards unfamiliar Discourses or secondary Discourses, but others will not recognize these without support from the teacher. Thus Solomon (2009) emphasizes the teacher's role in supporting mathematical literacy, and I agree that this can only be facilitated through intervention from the teacher which makes rules, language and nature of arguments in the subject more explicit. The only way pupils can become party to what is frequently implicit knowledge is through awareness of mathematics as a secondary Discourse.

According to Dowling (2001) formal mathematics is often projected onto a practical task for the less able pupils, for example shopping, in the public domain. As Walkerdine (1988) pointed out, the use of numbers in shopping is not the same as studying number relationships in mathematics in the esoteric domain. Thus mathematics presented in an everyday discourse may be embedded in practical tasks and 'less able' pupils will not gain the desired access to the subject. As a result pupils' predispositions for mathematics, or lack of such, will be reinforced at school.

Similarly, Kleve (2007) reported that perceived low-attaining pupils were taught mathematics differently from high-attaining pupils in Norway. Low-attaining pupils were confronted with more rote learning and focus on methods and procedures, in comparison with pupils who were perceived to be more able. Furthermore the low-attaining pupils were not challenged in the same way to make connections between different areas of mathematics.

The genre level and pupils' prior understanding

Although there is much discussion in the literature about the relationship between discourse and genre, I will adhere to Hyland's (2003) definition of genre as follows:

> Genre refers to abstract, socially recognised ways of using language. It is based on the assumptions that the features of a similar group of texts depend on the social context of their creation and use, and that those features can be described in a way that relates a text to others like it and to the choices and constraints acting on text producers. Genres, then, are the effects of the action of individual social agents acting both within the bounds of their history and the constraints of particular contexts, and with a knowledge of existing generic types. (21)

Although a variety of genres are expressed in our curriculum, and teachers themselves draw on these genres, research suggests that genres are rarely made clear for pupils, who may lack the same control of genre. The challenge for teachers is to be explicit about their use of genres and teach genres explicitly. Successful pupils come to school with sufficient pre-understanding. Less successful pupils need the teacher's assistance to understand the implicit rules of genre in the subject (Solomon 2009). For Hyland (2003), an approach which is sensitive to genre offers

> … the most effective means for learners to both access and critique cultural and linguistic resources … The provision of a rhetorical understanding of texts and a metalanguage to analyze them allows students to see texts as artifacts that can be explicitly questioned, compared, and deconstructed, so revealing the assumptions and ideologies that underlie them. (125)

Prior understanding opens up the text's meaning as linked to a cultural community of meaning. It is the same issue in mathematics. Solomon (2009) emphasizes the importance of awareness of genre in all subjects, also in mathematics. Despite not being evident in mathematics classrooms, a wide range of genres are being used. Graphs, for example are means of communicating information and express meaning. Also mathematical definitions, proofs, equations, algorithms and statistical tables are considered as expressions of genre. In the mathematical part of the curriculum in Norway (Kunnskapsdepartementet 2006) these are integrated as competence aims, which encompass a variety of genres in line with the description presented by Marks and Mousley (1990):

> In solving problems, writing reports, explaining theorems and carrying out other mathematical tasks, we use a variety of genres...Events are recounted (narrative genre), methods described (procedural genre), the nature of individual things and classes of things explicated (description and report genres), judgments outlined (explanatory genre), and arguments developed (expository genre). (119)

Genres may be discursively expressed, but they will always be more than this. On one hand they represent different textual traditions. On the other hand genres are part of successful pupils' prior understanding; they are frames for understanding, necessary for academic development and may be used as interpretive lenses (Bruner 1986; Feldman and Kalmar 1996). Many pupils need a specific prior understanding to decode the genre signs necessary for a relevant interpretation of the text (Cochran-Smith 1994).

The research reviewed here demonstrates the importance for pupils to gain awareness of mathematics discourse as well as learning about genre in the subject. Discourse and genres make mathematics what it is.

Awareness of different modes of thought in mathematics

As a last point, awareness of different modes of thought as a prerequisite for learning is discussed. Suggesting that it is necessary, but not sufficient, to work on the level of discourse and genre, and building on Bruner's (1986) distinction between paradigmatic and syntagmatic modes of thought, I argue that working with mathematics requires both modes of thought, or 'modes of apprehension'.

For Bruner, the paradigmatic mode of thought is linked to a scientific way of thinking that requires arguments based on *decontextualized generalizations and explanations* (as in the case of mathematics). It requires the acknowledgement of an unchangeable, permanent, abstract system. The syntagmatic mode of thought is primarily narrative and requires hermeneutical ways of reasoning, and as such *contextualized interpretations.* Bruner (1986) writes:

> Let me begin by setting out my argument as baldly as possible, better to examine its basis and its consequences. It is this. There are two modes of cognitive functioning, two modes of thought, each providing distinct ways of ordering experience, of constructing reality. The two (though complementary) are irreducible to one another. Efforts to reduce one mode to the other or to ignore one at the expense of the other inevitably fail to capture the rich diversity of thought. (11)

The syntagmatic mode communicates an 'experienced' world, and is more or less subjectively based and therefore cannot communicate absolute truth but, rather, verisimilitude. We therefore have to *interpret* within contexts, within which parts can be explained in the light of wholes and vice versa. In communicating and thinking in the syntagmatic mode, the narrative structure is the most pervasive cognitive schema (Bruner 1986). For Bruner it is unrealistic to suppose that the two modes can be separated and that we can choose the one over the other.

Although, as Mason and Johnston-Wilder (2004) point out, people deal with generalizations and abstractions all the time, in mathematics generalizations are expressed in a succinct notation from which further conclusions, particular or general, may be drawn: "Mathematics deals with relationships per se, and so *context is of the least importance*; hence the prevalence of abstractions in mathematics" (132, my emphasis). Oatley (1996) refers to Bruner's 'two modes of thought' claiming that objects expressed in the narrative or syntagmatic mode slips easier into the mind whereas the mind is more resistant to objects expressed in the paradigmatic mode. He refers to how Newton's third law can be explained either narratively (syntagmatic) or with a mathematical equation (paradigmatic mode of thought). He thus emphasizes the need for both modes of thought in physics.

Meta-awareness in the learning process, why is it so important?

In this paper I have argued for meta-awareness for all pupils. The starting point was social inequalities and pupils' different learning possibilities as a result of their social background, which forms their primary Discourse. Meta-awareness and literacy competence characterize the winners in school. However, meta-awareness should not be reserved for those whose social background, or 'value Discourse' supports school activities. To decrease the school's reinforcement of social inequalities, teaching should be based on meta-awareness rather than acquisition through pupils' activities. My argument has been on three levels; discourse, genre and modes of thought. On the level of Discourse, I have argued that the only way pupils can become party to implicit knowledge is through awareness of mathematics as a secondary discourse. The teacher plays a crucial role in this work. Also, it is important that the 'less able' pupils not only should be presented mathematics in an everyday discourse, because then they will not gain the desired access to the subject. On the level of genre, it is important for the teachers to be explicit about genres and to help pupils establish sufficient pre-understanding. Finally, the argument has been that both modes of thought, paradigmatic and syntagmatic are necessary for all pupils in the mathematics learning process.

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