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The three faces of problem solving

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The point of departure in this paper is my previous research in which I analysed how the idea of problem solving is recontextualised into the mathematics curriculum for upper secondary school in Sweden and how this increases the risk for excluding lower SES students from future power. I discuss how this research could be followed up through a suggestion of how problem solving could be viewed in three different ways: as an ideology, a competence and an activity. Bernstein’s pedagogic device and dichotomy of vertical and horizontal discourses are crucial in this suggestion. By seeing problem solving as an activity, and connect this to what Bernstein labels the evaluative field, I thereby tie the whole pedagogic device together by taking an overall view of problem solving as global policy-speak.

Keywords: Pedagogic device, evaluative field, vertical and horizontal discourse, social equity, problem solving.

INTRODUCTION

Certain aspects of our way of life, certain kinds of knowledge, certain attitudes and values are regarded as so important that their transmission to the next generation is not left to chance in our society but is entrusted to specially-trained professionals (teachers) in elaborate and expensive institutions (schools) [...] Different schools may make different priorities, but all teachers and all schools make selections of some kind from the culture (Lawton, 2011, pp. 6–7).

This selection is not only about what kinds of knowledge, attitudes, and values that should be transmitted, but also to whom. Since this selection is often made on socio-economical grounds, school reproduces social inequity (Bernstein, 2000). Instead of ‘school being for all’ (see, e.g., Skolverket, 2012b) there is instead a risk of ‘school being for some’ (Dahl, 2014).

Furthermore, education should not only be the transmission of tools to interpret the world, but also the means to change the world (Atweh & Brady, 2009). Bernstein (2000) suggests that what schools should provide students with for them to become citizens with a stake in society is a sense of, what he calls enhancement, inclusion and participation. According to Wheelahan (2007) this has to do with the form of knowledge that students are given access to:

Unless students have access to the generative principles of disciplinary knowledge, they are not able to transcend the particular context. Students need to know how these complex bodies of knowledge fit together if they are to decide what knowledge is relevant for what particular purpose, and if they are to have the capacity to transcend the present to imagine the future. (p. 10, italics in original)

In the mathematics curriculum for upper secondary school in Sweden (year 10–12) problem solving is emphasised as a main competence that students should develop (Skolverket, 2012a). This emphasis, both on competences and problem solving, is common to other curricula and frameworks, for instance Curriculum and Evaluation Standards for school mathematics (NCTM, 1989), Principles and Standards for School Mathematics (NCTM, 2000) and Adding It Up (Kilpatrick, Swafford, & Findell, 2001) in the USA, the KOM-project in Denmark (Niss, 2007) and PISA (Programme for International Student Assessment) (OECD, 2012). Sweden, in following this international trend without questioning the roles of competences and problem solving can be seen as adapting to, what Ball (2013) calls the global policy-speak (Dahl, 2014). Global policy-speak “produces, or is the effect of, a cutting-off of research in mathematics education from its political responsibility and consequences and from its philosophical and political roots” (Gellert, Barbé, & Espinoza, 2013, p. 303).
I have in previous research (Dahl, 2014) investigated how the need for problem solvers is expressed in the Swedish mathematics curriculum, where Sweden is seen as an exemplar of a wider trend in mathematics education. I have also suggested that, with the new curriculum in Sweden, launched in 2011, there is a greater risk of reproducing inequity through school compared to the older curriculum; mainly due to the greater division between vocational education and academic preparatory education that is more solidly build in to the system with the curriculum (Dahl, 2014). These different types of programmes attract students with different social background with vocational education attracting to a greater extent from lower SES groups (Broady & Börjesson, 2005).

The curriculum is here defined as the official documents that address teachers and in Sweden these are the same for all upper secondary schools and includes the national tests since one purpose with these tests is to concretise the curriculum (Skolverket, 2012b). Together, these documents inform teachers and students of what should be taught/learned, in some sense how it should be taught, but also what should be assessed and how. Questions that arise from this are about what really happens in schools and in the classrooms in regard to competences, and especially problem solving competence. Is there a difference, as the curriculum suggests that there should be, between different educational tracks? If so, how does this intended difference affect students' foregrounds?

Before moving in to the theoretical background and framework, I need to describe what I mean with the problem-solving citizen, a term I introduced in my previous research. The problem-solving citizen is a citizen who is flexible, employable and one who gives his/her "best in responsible freedom" (Skolverket, 2012b, p. 4). Drawing on OECD in defining the problem-solving citizen, I add that he/she also has to be(come) an intelligent consumer (OECD, 2006, p. 72). With this view on the citizen, which is the dominant view in the curriculum, the citizen is one with duties to the country rather than rights (Dahl, 2014). As a contrast, with Bernstein's view on the citizen, the rights of a citizen are emphasised.

THEORETICAL BACKGROUND AND FRAMEWORK

Bernstein (2000) described the pedagogic device as illustrating how education acted as a filter for ensuring that class distinctions were reproduced. The pedagogic device consists of three sets of interdependent rules: the distributive rules regulate the power relationship by distributing different forms of knowledge to social groups; the recontextualising rules regulate the formation of pedagogic discourse; the evaluative rules constitute pedagogic practices that are realised in instructional and regulative texts (Bernstein, 2000). In relation to the problem-solving citizen, the distributive rules can be considered as controlling how the discussions of politicians, education bureaucrats and educational researchers are relayed to those formulating the curriculum. The recontextualising rules control how the distributed knowledge about problem solving is incorporated into the curriculum and national tests which in turn control the ways that educators in schools and the wider education sector come to discuss problem solving. The evaluative rules control how teachers teach problem solving in classrooms. Within this field, the regulative discourse is dominant over the instructional discourse (Bernstein, 2000). The regulative discourse "refer[s] to the forms that hierarchical relations take in the pedagogic relation and to expectations about conduct, character and manner" (p. 13). The instructional discourse "refer[s] to selection, sequence, pacing and criteria of knowledge" (p. 13).

From a Bernsteinian perspective, the "generative principles of disciplinary knowledge" mentioned above in the quote from Wheelahan, could be equated with knowledge forms in a vertical discourse, which is context-free or generalisable, in this case, from the world of mathematics. The opposite is forms of knowledge in a horizontal discourse which includes mundane or common sense knowledge. According to Bernstein (2000), this latter form of knowledge is context-dependent and not easily used outside the given context, thus not generalisable. The difference between knowledge from the horizontal and vertical discourse is not a matter of abstract or concrete; rather, it is a matter of reference to a specific material base, that is, to a context outside mathematics (Bernstein, 2000). For instance, in school mathematics, a task or problem that is situated in a context outside mathematics can be regarded as within a horizontal dis-
course. These contexts could be domestic areas, such as best-buy strategies, or vocational settings, but also other school subjects, such as economics or chemistry. Knowledge from the vertical discourse is context-free and can be realised in mathematics tasks that make no reference to the outside world, such as find the greatest area of a triangle with a given perimeter. Due to their context-independency, tasks such as this are generalisable to different contexts or can give access and insights to the esoteric world of mathematics. From the point of view of social equality, access to the vertical discourse is crucial.

In her small study, Lubienski (2000) raises questions about NCTM’s (1989) suggestion that problem solving should be a means for developing other mathematical skills or competences. Drawing on Bernstein, Lubienski (2000) states that “contextualised mathematics problems seem to align nicely with lower-class students’ preferred ways of thinking” (p. 457) and “one might expect that if lower SES students tend to have a contextualised orientation to ideas, they would benefit from contextualized problems” (p. 467). However, she concludes that this is not the case. Lubienski draws the conclusion that the lower SES students in her study were not able to transcend the context of the problems and had greater difficulties learning from solving contextualised tasks than their higher SES peers. Her conclusion was that by putting mathematical problem-solving tasks in a context, some students, particularly students from a lower socio-economical background, are hindered in their mathematics learning.

Similarly, when it comes to assessing through problem solving tasks, Cooper and Dunne (1998) found that sometimes students, in solving contextualised tasks draw too much on the real world and, at other times, too little. They further suggest that there is a relationship to students’ socio-economic background wherein students from lower socio-economic backgrounds struggle more often to bring in the appropriate knowledge form.

Bernstein (2000) states, “to make specialised knowledge more accessible to the young, segments of horizontal discourse are recontextualised and inserted in the contents of school subjects” (p. 169). Following Lubienski (2000) this is problematic when it comes to teaching or learning through problem solving. Following Cooper and Dunne (1998) it is also problematic when it comes to assessing problem-solving competence. This means that problem solving is problematic both when it is seen as a means for developing other mathematical competences and as an end in itself, both views highlighted in the mathematics curriculum in Sweden (Skolverket, 2012a). As Bernstein suggests, segments of the horizontal discourse can be brought into school mathematics as hooks, but “using horizontal discourses other than as a ‘hook’ to entice pupils into vertical discourses is to destroy what is distinctive about pedagogic communication” (Whitty, Rowe, & Aggleton, 1994). From a categorisation of school mathematics tasks in a textbook series with tracks for different ability levels, Dowling (2005) concluded that students who are labelled low-ability, mainly from working class are denied access to, what Dowling calls the esoteric domain. This is another way of saying that the students are denied “access to the generative principles of disciplinary knowledge” (Wheelahan, 2007, p. 10).

Thus, although the purpose of using contextualised problems is to develop mathematical awareness and competences, it may have the opposite affect, especially if students from low socio-economic backgrounds are the students given these tasks more often, as suggested by for instance Dowling (2005), Lubienski (2000) and in my analysis of the mathematics curriculum in Sweden (Dahl, 2014). Contextualised problems, including those based on the students’ own experiences, can be used to hook students and promote mathematics, but can be problematic if, in solving them, students never leave the horizontal discourse and enter the vertical discourse.

FitzSimons (2008) suggests “these complementary discourses, vertical and horizontal, need to converge in formal education settings in order to enable richer forms of knowledge construction by learners” (p. 3). In order to see and understand the boundaries that exist between them, students need access to both discourses. Access to the vertical discourse may be denied to certain groups of students. In particular, low achievers from low socio-economical areas (Dowling, 2005; Lubienski, 2000; Wheelahan, 2007) may be restricted access into the vertical discourse. In order to gain equal outcomes and ensure that social differences are not reproduced, all groups of students need access to the vertical discourse in order to “transcend the present to imagine the future” (Wheelahan, 2007, p. 10). Therefore, a way of ensuring equality becomes
a question of ensuring equal access to the vertical discourse. My analysis of the mathematics curriculum in Sweden (Dahl, 2014) suggests that there is a risk this is not the case. Instead there is a risk that lower SES students are hindered from access to the vertical discourse.

Sjöstedt (2013) draws the same conclusion, but adds Bernstein’s ideas about visible pedagogy (Bernstein, 2003). In viewing pedagogic practice as a cultural relay, Bernstein (2003) discusses some criterial rules about “criteria which the acquirer is expected to take over and to apply to his/her own practices” (Bernstein, 2003, p. 64). Visible pedagogy has to do with whether or not these rules are explicit in the pedagogic practice. If the criterial rules are visible, students see the connection between pedagogy and evaluation; that is, they know what is expected of them. The syllabus in Sweden is divided into core content (what should be dealt with in the classroom) and competences (what should be assessed and graded). If there is a difference in what happens in the classroom and what is assessed, then there is a risk that the pedagogy becomes invisible, meaning that the students will not know what is expected of them. According to Bernstein (2003), this is problematic for lower SES students. For a more equitable outcome, there is, besides being given all access to the vertical discourse, also a need for the pedagogy to be visible.

THE CONNECTION BETWEEN THEORY AND METHOD

The term problem solving is ambiguous and my suggestion is that problem solving can be seen to have three different faces: 1. Problem solving as an activity, that is, when someone, for instance a student, solves a problem. 2. Problem solving as a competence, that is, an interpretation and a description of problem solving in, for instance the curriculum, and 3. Problem solving as an ideology, that is, how problem solving is a part of the global policy-speak. I further suggest that these three faces can be connected to the evaluative field (EF), the recontextualising field (RF) and the distributive field (DF) respectively.

Bernstein (2000) distinguishes “between an official recontextualising field (ORF) created and dominated by the state and its selected agents and ministries, and a pedagogic recontextualising field (PRF). The latter consists of pedagogues in schools and colleges, and departments of education, specialised journals, private research foundations” (p. 33, italics in original). In Table 1, I add this division of the recontextualising field but also suggest that the ORF is the bridge from the DF to the RF and the PRF is the bridge from the RF to the EF.

Furthermore, within the recontextualising field, Bernstein (2000) distinguishes between two different discourses: the instructional discourse (ID) and the regulative discourse (RD). RD is dominant over ID and “refer[s] to the forms that hierarchical relations take in the pedagogic relation and to expectations about conduct, character and manner” (p. 13). Those students become and act as genuine problem solvers is seen as the main goal of mathematics education, the end in itself.

To summarize and put things in different words: Problem solving as an ideology is when politics, following a global policy-speak, talks about and uncritically assume that problem solvers is something all need to become. Within the RF this is transformed into competences and goals of the school. In the classroom (the EF) problem is an activity, used both to develop other mathematical competences but also for assessment, that is, to assess if the students “have the competence”, if they have become problem-solving citizens. That the RD is dominant over the ID means that the actual goal of problem solving as an activity in the classroom is to make the students behave as problem solvers (problem solving as a competence) because it is assumed what the country needs (problem solving as an ideology).

In my previous research, it is the operation of the distributive and recontextualising rules that are in focus around the construction of the problem-solving citizen and this project was an analysis of the curriculum, including the national tests. In order to see the whole
picture, an investigation of what happens in schools and in the classroom needs to be added. By moving the analysis into the classroom would mean an investigation situated within the evaluative field which would cover the whole pedagogic device because “[t]his is what the device is about. Evaluation condenses the meaning of the whole device” (Bernstein, 2000, p. 36). The issue on the level of evaluative rules (the classroom) could be transformed to be an issue about how the instructional discourse (about problem solving) supports or hinders access to the regulative discourse (the problem-solving citizen). My suggestion is that this is an investigation of problem solving seen as an activity but also that it connects back to the other views on problem solving.

INITIAL THOUGHTS FOR A METHOD

To investigate the evaluative field there is not only a need to investigate how problem solving is reused as an activity. There is also a need to investigate why from the teachers’ points of views. And also what the effects could be from the students’ points of views. This would give indications of the influence that the global policy-speak (problem solving as an ideology) and the curriculum (problem solving as a competence) have on teachers and students and will hence tie the whole pedagogic device together.

The investigation should have as it aims to find differences and similarities between vocational programmes and academic preparatory programmes. Further, it should be based on access to the vertical and horizontal discourses. That is, how do teachers within the different types of programmes interpret problem solving as an activity?

It is also important to address another dichotomy that I used in the analysis of the curriculum (Dahl, 2014): if problem solving is seen as a means for other competences or areas or if it is seen as an end in itself. This categorisation is important because of the issues that arise when problem solving is seen as a means for learning mathematics highlighted by, for instance, Lubienski (2000) and Dowling (2005). Together with the why question, this dichotomy is also important in order to investigate how the instructional discourse supports or hinders access to the regulative discourse.

Finally, the visibility of the pedagogy is important to take into consideration. With an assumed risk of more recontextualisation for the lower SES students there is also a greater risk of the pedagogy being invisible. The risk of the lower SES students “looses” is then doubled.

REFERENCES


