Positioning of the Teacher in the Improvement of Mathematics Classroom Practice

Eva Jablonka[1] and Christer Bergsten[2]
King's College London[1]; Linköping University[2]

This paper is a hybrid between a discussion essay and a theoretical paper. Our concern is the positioning of teachers in contexts where the reshaping of educational institutions along with the commercialisation and commodification of research carried out at universities, increasingly interferes with the intellectual freedom of both teachers and researchers. Funding of research in these contexts privileges 'findings' with direct implications for developing teachers' classroom work. We discuss examples drawn from a range of studies, including classroom observation, curriculum design, and professional development settings in terms of the subjectivities attributed to the unauthorised position in the relations established in these practices.

Introduction

While "teachers are regarded as key persons of educational change" (Kieran, Krainer & Shaughnessy, 2013, p. 363), they are still commonly construed by researchers and educational stakeholders as "passive recipients" of research outcomes, while at the same time providing the empirical data for the research (ibid., p. 365). With references to research papers from the 1990s, White, Jaworski, Agudelo-Valderrama, & Gooya (2013) noticed that:

> The term "professional development" of teachers has often, in the past, implied a deficit view of teachers, emphasizing elements of knowledge which teachers lack, or ways in which teachers need to be developed (p. 396).

Consequently, researchers in mathematics education are positioned as authors and teachers as unauthorised audience. Amongst many others,

Kieran et al. (2013) address this by suggesting that teachers should be involved as "key stakeholders who co-produce professional and scientific knowledge" (p. 387).

Our concern is the positioning of teachers in contexts where the "remaking of the school as a business" (Pinar, 2004, p. 5), increasingly interferes with the intellectual freedom of both teachers and researchers and implies a "de-skilling" of teachers (Apple, 1990). In England, for example, anti-theoretical vocationalism (e.g. teacher *education* became teacher *training*) substantially narrowed down the knowledge base on which teachers' judgements about curriculum, pedagogy and assessment can be exercised. In addition, sociology, philosophy and history of education have been taken out of initial teacher education programmes in many countries, so that teachers have few resources with which to produce critical responses to policy changes (Lerman, 2014). While research in mathematics education always has been conceptualised as having a face towards practice, the reshaping of educational institutions along with the commercialisation and commodification of research carried out at universities (Radder, 2010), might lead to researchers feeling more obliged to participate in practices with direct implications for developing and evaluating teachers' classroom work. In this contribution, we explore the positioning of teachers in these practices.

Levels of Subjectivity Attributed to Teachers

In most activities, in which researchers are involved in practices with direct implications for developing teachers' classroom work (such as in the role of curriculum designers, didacticians, and teacher evaluators) teachers and researchers are in what Dowling (2009) describes as a "pedagogic relation", as opposed to an "exchange relation". Pedagogic relations can be recognised by the establishment of an author, an audience and a privileged "content", that is, a hegemonising practice/discourse aiming at closure, the evaluation principles of which are controlled by the author. In "exchange relations" the principles of evaluation of performances are located within the audience. Dowling (2009, p. 244) distinguishes three levels of subjectivity attributed to "unauthorised positions" in both relations. For our purpose the levels attributed in pedagogic relations are of relevance. These are

"apprenticeship" (high level), "dependency" (low level) and "objectification" (no subjectivity), which may amount to different hierarchical positions in relation to access to the principles of the hegemonising practice/discourse. We draw on these notions in our exploration.

Observing, Evaluating, and Quantifying Teachers

There is a long tradition of carrying out studies that seek to identify how pedagogy and curriculum systematically relate to students' learning, aiming to evaluate the quality of pedagogic practice. As early as in 1891-92 Joseph Mayer Rice conducted lesson observations in classrooms in primary and grammar schools in 36 US cities, where he also talked to teachers, parents and staff in education authorities and visited teacher education institutions, collected student productions and tested year-3 pupils in arithmetic. He classified schools into levels of excellence, ranging from a mechanical 'antiquated' approach of drill-and-practice to a 'scientific' approach (Rice, 1893). The report is explicitly evaluative, with clear preferences for a 'progressive' (the 'scientific') curriculum and pedagogy. In mathematics education research the activity of evaluation lingers on. As Morgan (2013) observes, "The moralising of the student implicated in the regulative discourse of the classroom is paralleled by the moralising of teachers in the discourse of mathematics education." (p. 61).

Measuring the Quality of Mathematics Teachers' Practice

Scales based on ratings of a range of aspects of teacher performance are increasingly used in the USA for formative teacher assessment, evaluation of curriculum policy and professional development (Hill et al., 2012). One such scale is the Mathematical Quality of Instruction (MQI) score that aims at "independent estimates of the mathematical quality and the pedagogical quality of instruction" (Learning Mathematics for Teaching Project, 2011, p. 27). The separation does

not seem to be feasible, as it turns out that the "conceptualization is deeply disciplinary, but coordinates mathematical and pedagogical perspectives" (p. 31).

The scales (each with several codes marked as present/ absent and appropriate/ inappropriate) comprise *Richness and development of the mathematics, Responding to students, Connecting classroom practice to mathematics, Language, Equity, and Presence of unmitigated mathematical errors*. The framework is an ad-hoc construction of categories (as opposed to being informed by an analytical framework) and the criteria for the code marking are not discursively available; hence they require 'expert rating'. The expert is either a researcher of the Learning Mathematics or Teaching Project team or some apprentice, who might have been introduced into this practice through observing the lesson observers and learning how they marked the codes. The observed teachers are in a non-negotiable unauthorised position in a hegemonic discourse of good teaching, if this evaluation is not embedded in some form of professional development.

Even though measures of instructional quality originate in the idea that students' scores on mathematics tests are an inappropriate measure of the quality of teaching and hence classroom teaching needs to be looked at, correlations with some measures of student outcomes are still often incorporated in studies that use such measures or are used as an argument for their validity. In discussing the MQI measure, the authors write that "it is unclear whether and how well the various elements of this instrument correlate with student outcomes. Ideally, a next validation study would also compare student outcomes with both teacher scores on the MQI instrument and on more pedagogically focused instruments." (Learning Mathematics for Teaching Project, 2011, p. 44). What the observers engage in, is an evaluation of teaching practice with largely implicit criteria for the 'good' teacher. The performance criteria could possibly be acquired by the teachers through observing a 'master teacher' who gets full score on the MQI scale.

Measuring the Efficacy of Mathematics Teaching

Quantitative measures of teaching are most prominently used in the USA. One example is 'value-added' modelling (VAM):

> Value-added modeling has been widely accepted as a more objective approach to estimating the value of teachers than other methods since it expresses a teacher's unique contribution to student learning in precise, quantitative terms (Wei, Hembry, Murphy, & McBride, 2012, p. 25).

In this statistical apparatus, teaching *as such* is essentialised as a quantifiable teacher attribute (their 'value') that exists to a variable degree in teachers, who are producing gain scores in students, conceptualised in terms of profiles with differing quantifiable characteristics (such as gender, ethnicity, language) that amount to differences in speed when their teachers steer them in a race through a curriculum that leads to their achievement gains on standardised tests. The students' characteristics can be accounted for as 'noise' in the model in order to get to the essence of the teacher 'value'. This is their 'unique' contribution.

When looking at table 3 in Wei et al. (2012, p. 14 ff), one sees that different more or less complex versions of such models amount to very different rankings of the same mathematics teachers. Hill, Kapitula and Umland (2011, p. 826), amongst others, offer some internal critique, but appear to sympathise with the form of the accountability procedure:

> Although we do recommend the use of value-added scores in combination with discriminating observation systems, evidence presented here suggests that value-added scores alone are not sufficient to identify teachers for reward, remediation, or removal.

These procedures establish accountability relations, which include both standards and standardised procedures for monitoring the standards that are defined and developed without involvement of the party made accountable (and become punished or rewarded). Researchers are obviously involved in developing the procedures for monitoring the standards and funded by those who purchase their research.

Teachers as Operators of Proprietary Curriculum Schemes

The increased amount of studies of *instructional effectiveness* of different teaching approaches by means of randomised controlled trials (RCT) mark a comeback of experimentalism. The UK government has recently recruited proponents of RCT for promoting their use in evaluating education and public policy, with the intention to identify interventions with large effects for low cost. Examples include the Department for Business, Innovation and Skills's (BIS) new project about the relative effectiveness of different approaches to 'delivering' adults' English and mathematics learning.

Experimental curriculum development studies occasionally include classroom observations in order to check the fidelity of the teachers' 'dispending' of the intervention (the 'treatment'), or to complement measurement of gain scores with scores from classroom observations (e.g. Clements et al., 2011; Ross & Bruce, 2007). Teaching is only relevant in relation to the statistical regularity the black box of classroom practise produces as its achievement outcomes. The teacher is then clearly objectified.

Developing and evaluating curriculum schemes may attribute some level of subjectivity to the involved teachers in the form of dependency. We looked at an example from the USA (again), which included a large scale study that used a cluster randomized trial with data from 1305 pre-school children for the evaluation of a curriculum based on mathematics learning trajectories (Clements et al., 2011); the children in the 'treatment group' "outperformed those in the control group on the total mathematics test score, with an effect size of 0.72" (ibid., p. 153). As the control group consisted of schools introducing other pre-school curricula, the explanation provided for the effect size emphasised that the teachers enrolled for the experimental treatment were not only trained to use the material appropriately but also introduced to the principles of its construction. The authors argue that the requirement of fidelity of implementation does not imply that teachers "should implement curricula in routinized ways" (p. 157). However, the teachers were not apprenticed into the theoretical and empirical base for the learning trajectories assumed in the scheme and had no influence on the design of the materials with respect to the principles for their construction.

In this project, development of teaching quality (in recruiting William James as authority) is constituted as based on "the science of learning and instruction" which "continues to lay down increasingly specific and useful guidelines" (p. 158). Curriculum is then a technology derived from this 'science' involving teachers who will never have full access to it, except a singular short professional development and access to a website with exemplary teaching activities along with some explanations. This approach is opposed to "focusing primarily on teachers' autonomously inventing individual curricula" or "idiosyncratic 'creativity' that does not build on extant science, and learning and instruction is less likely to serve either the profession or the classroom's students" (p. 158).

The importance of early-years intervention is argued from a "human capital perspective" (p. 128). In the RCT-part of the study of this curriculum, the teachers are objects to the same exact science (of teaching), measuring 'fidelity of implementation' and other variables, including 'teacher personal attributes'. The project is based on the assumption of relatively unskilled teachers, "especially those in early childhood, [who] have limited time and knowledge of mathematics and mathematics education research (Sarama, 2002; Sarama & DiBiase, 2004) required to plan, research, and write truly research-based curricula (as defined in Clements, 2007)." (p. 158). The production of the curriculum material is perpetuating the de-skilling of teachers. The teachers remain dependent on using the proprietary material.

Teachers and Researchers as 'Collaborators'

Kieran et al. (2013) claim that teachers are the key stakeholders in educational research in three "important dimensions": "reflective, inquiry-based activity with respect to teaching action; a significant action-research component accompanied by the creation of research artefacts by the teachers (sometimes assisted by university researchers); and the dynamic duality of research and professional development" (p. 361). The following examples have been selected to illustrate some of these dimensions.

Hatch and Shiu (1998) discuss several types of what they call *practitioner research*, which is an example of 'empirical action research' in

mathematics education. This is conceptualised as a division of labour between researchers and teachers, either in the form of a virtual collaboration across time and space, or as in one setting (e.g. professional development). They explain, amongst other things, how transcripts from a teacher's audio recording of their own classroom might serve as a source for both "personal knowledge" and "general knowledge" when analysed and discussed from the perspective of both a practitioner and a researcher. They note that "vivid accounts of the particular […] speak more directly to a practitioner" (ibid., p. 311) and are offered "to the research community for replication and response" (ibid., p. 314). This statement points to a potential distributive mechanism; teachers produce exemplars of pedagogic activities and student work (e.g., published in professional journals), while researchers produce generalised accounts. The status differentiation between researchers at universities and 'practitioner researchers' is not challenged by this move, even though this might have been intended.

A learning study, which has become a common activity in professional development in Sweden, is "a form of action research made by teachers with the specific goal of finding out what matters for student learning of a particular capability" (Runesson & Kullberg, 2010, p. 308). Teams of teachers (often in collaboration with a researcher) design, conduct and discuss lessons in iterative cycles, with pre- and post-tests of student's achievement, based on principles from 'variation theory'. They note that experiences from many learning studies indicate that "by deeply investigating the particular", teachers can also gain knowledge of "general character". Teachers' potential subjectivity here is apprenticeship into variation theory.

Kieran et al. (2013) illustrate 'the dynamic duality of research and professional development' by a range of examples, including 'Learning Communities in Mathematics' (LCM). In the following we refer to Jaworski (2006) in our discussion of the LCM project, which involved collaborations between researchers in mathematics education ('didacticians') and mathematics teachers at project schools (that volunteered to participate), underpinned by 'community of inquiry' as a general guideline for the work. 'Community' might suggest a sense of solidarity arising from a shared aim or signify informal relationships between the participants. The communities of inquiry are formally established. They include mutual obligations and are constructed as mutually beneficial for both categories of people involved, the teachers and the

researchers, through establishing a 'co-learner partnership' between them. "[P]articipants grow into and contribute to continual reconstitution of the community through critical reflection" (Jaworski, 2006, p. 202). Activities within the project took place both at the schools and at the university, including workshops with researchers introducing inquiry tasks and teachers reporting from classroom activities. In the work with mathematics tasks (mostly designed by the didacticians), the 'inquiry stance' points to an openness of the tasks, which affords cooperation, but does not imply it. The agenda was set by the researchers, positioning the teachers as apprentices into a pedagogic action with "inquiry as a fundamental theoretical principle" (ibid., p. 187). The establishment of a community of inquiry implies an acceptance of a social order where an inquiry stance "is a form of social positioning taken in a community of teachers in which inquiry has become one of the social norms in practice" (ibid., p. 201).

In another example provided by Kieran et al. (2013), "teacher researchers collaborated with university researchers in reflecting on their own teaching and in conducting cycles of action research that focussed on improving the mathematical discourse of their classrooms" (p. 369). In the project, a group of teachers were guided through carrying out analyses of their own classroom discourse, with a particular focus of their own choice. The group shared the goal of learning, reflecting upon and changing mathematical discourse in classrooms. The project had as a main goal "to give teachers the opportunity to find their own research voice" (p. 370). Quantitative and qualitative discourse analytical methods were introduced by the researchers, using data from the teachers' classrooms. The project amounted to a publication including teachers' analyses and contributions by the researchers leading the project (Herbel-Eisenmann & Cirillo, 2009). Teachers also presented at meetings and conferences. In this project, the teachers were apprenticed into a particular mode of research, and eventually became subjects of the activity.

Discussion

The different positions in relation to access to the principles of a particular hegemonising discourse of 'good teaching' in pedagogic relations between teachers and researchers relate to different

constellations in professional development settings. One question arising from the outline of these examples pertains to modes of involvement in the discourse constituted in the projects where teachers are positioned as apprentices or dependent. All aim at improving teaching practice and assume commitment to both aims and means by the teachers. The means appear to be handed over to the teachers by the researchers and might not be open to critique; pursuing a shared educational project is assumed. A reflection on how discourses of 'good teaching' relate to projects of education in the political and economic contexts of the settings is deferred, as the focus is on improving classroom practice *as such*, based on a projection of what researchers aim to achieve on teachers, who are constructed as the key "stakeholders […] who *can affect to the greatest extent the achievement of one of the main purposes of the research enterprise, that is, the improvement of students' learning of mathematics*" (Kieran et al., p. 365; italics in original). Coherence in the group and commitment to the means might not be established by this deferment. As Gellert, Becerra Hernández and Chapman (2013 p. 346) note, action research is dominated by professional development programmes for teachers aiming to further their personal knowledge, and a search for "a deeper ecological validity" of their practice, while the "transformative potential of action research in terms of emancipatory educational, cultural and political processes" has not been much pursued.

In the curriculum trial the participation of teachers was not voluntary (schools were selected randomly). The aims of this curriculum to increase pre-school children's achievement gains in numbers, shape and measurement and the increasing use of computers were not negotiable. With respect to access to the means, the teachers were positioned as dependent on the 'scientific' underpinnings of this particular approach, although they were expected to use their professional knowledge as pre-school teachers to adapt their interaction with the children, according to what they were taught in the introduction to the learning trajectories and the mathematical concepts involved. They were not provided with any means or resources with which to critically reflect on the economic context in which the activity took place. It was assumed that they had not acquired the competencies for developing their own curriculum approaches in their teacher education. Their status as teachers is one of a skilled operator of proprietary curriculum schemes. In this context, one might envisage some

teachers continuing to work with and discuss this particular curriculum scheme connected via a website to a virtual community of its users, and others picking up another curriculum package, which they get for free as an exchange for participating in another randomised controlled trial.

While classroom observations might all envelope an evaluative component, the objectification of the teacher is evident in disembedded observation studies concerned with gap-gazing in teachers' knowledge and skills, whose classrooms might exhibit impoverished, undeveloped mathematics (in contrast to *Richness and development of the mathematics*), who do not interpret student productions and do not use student errors (in contrast to *Responding to students* appropriately), and do not correct their mathematical errors (*Presence of unmitigated mathematical errors*) etc. (categories in the MQI). When such observational categories are quantified and linked to student scores on standardised achievement tests, the ground is laid for the objectification of teachers and students in the bureaucratic accountability machinery based on quantified standards and standardised measurement procedures for monitoring the standards. Mathematics is implicated in this social technology, as 'mathematicoscience', which represents the 'bureaucratic public voice' (Dowling, 2009, p. 142). Researchers producing observation scales and other quantitative measures of teaching quality are allies in this process of increasing bureaucratisation, while alternative modes of classroom research are at risk of being "written off for their alleged 'ideological posturing'" in the hegemonic discourse of neo-classical experimentalism (Howe, 2004, p. 57).

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