

PISA, national and regional education policy and their effect on Mathematics teaching in England and Germany¹

Peter Kelly

Plymouth University, Plymouth Institute of Education, UK

Hans-Georg Kotthoff

Paedagogische Hochschule Freiburg (University of Education Freiburg), Institut fuer Erziehungswissenschaft, Germany

Abstract

To consider how processes of education governance linking the work of international organisations and national and regional policymaking in two contrasting policy environments affect policy enactment in schools, we analyse differences in mathematics teaching between English and German secondary schools using Bernstein's account of pedagogic practice. This allows the opportunities for achievement provided to different groups of students to be identified. Our findings suggest that, as a result of hard governance pressures, English higher achievers have more opportunities to make progress than lower achievers; a concern which is consistent with standardised assessment data. Despite policy changes, similarities in the teaching of higher and lower achieving students in Germany remain, and these account, in part, for the narrower gap in achievement there.

Keywords

England, Germany, mathematics pedagogy, educational governance, policy cycle, secondary schools

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Soft and hard governance

The days are long gone – if they ever existed – when education policy was the preserve of national governments. International organisations like the Organisation for Economic Co-operation and Development (OECD), who administer and analyse the Programme for International Student Assessment (PISA) comparative tests, and the European Union (EU), whose education mission has become to support the cross national development of human capital, are highly influential. Whilst international surveys of student outcomes like PISA are used in many countries to justify education reform (Lingard et al., 2013), the influence of the OECD has increased with their providing explanations for national differences in scores linked to policy recommendations (Sellar and Lingard, 2014).

Soft governance approaches rely on information rather than diktat to steer local practice, for example, by publishing research, surveys, guidance and advice and creating various fora where this can be shared and discussed. Ideally, policymakers or practitioners then make use of this information to bring improvement. In reality, however, accountability measures can conspire to harden governance effects by increasing the status of officially endorsed information, leaving policymakers or practitioners unable to choose alternative courses of action, however promising they might believe them to be, without facing disapproval or sanction. Much has been written about the soft governance role of the OECD and the EU (for example, Mundy et al., 2016). Alexiadou (2014), for example, provides an analysis of policy learning through the EU's open method of coordination which challenges more simplistic

accounts of policy borrowing, whilst also showing how the European Commission's governance activities stretch into areas like education for which the EU has no legislative remit. Such developments have led Lingard and his colleagues (2013) to adapt the policy cycle (Ball and Bowe, 1992) to include a level of global governance. As such, education reform agendas often share 'performative' similarities (Ball, 2013).

Our concern here is to elaborate particular versions of this extended policy cycle, identifying how processes of education governance linking the work of international organisations and national and regional policymaking affect policy enactments in schools. We hope to understand this better by comparing different versions of the policy cycle. To explore policy enactment, where the cycle meets students, we analyse interactions between the three 'message systems' of curriculum, pedagogy and assessment (Bernstein, 1975) which constitute pedagogic discourse (Bernstein, 1990). We use an approach which draws on Bernstein to compare mathematics teaching in England and Germany, setting each within their national and regional policy context. As schools in Germany are administered on a regional basis, we focused on one land, Baden-Württemberg, contrasting this with South West England, a region with a similar economic profile in agriculture, industry and tourism and with generally low unemployment. The English teachers all worked in local authority community colleges. The German teachers also taught in public schools within the selective tripartite system, half from the academic *Gymnasien* which focus on preparing students for university entrance and half from the lowest tier *Hauptschulen* which provide a more general education. In all we engaged in sixteen teaching observations of mathematics

lessons for pupils aged 12-13 years in each country, with each participating teacher observed teaching and then interviewed on two occasions.

This study is novel in comparing extended policy cycles in contrasting education governance contexts and, in particular, analysing policy enactment within each policy cycle, something Ball and his colleagues (2012) suggest is crucial in policy evaluation but difficult to do well, by comparing pedagogy which Alexander (2009) also identifies as an important but under-researched area. Methodological rigour is provided firstly by combining the insights of insider researchers in lesson observations with the perspectives of both teachers and students in interviews and from participant validation and secondly by using Bernstein (1990; 1996; 2004) to analyse pedagogy as an emergent sociocultural phenomenon. Significantly, the analysis provided here casts light on the complex relationship between hard and soft education governance and education outcomes for different student groups.

Comparing education in England and Germany

Teaching is closely linked to the societies and education systems in which it takes place (for example, Goodson and Lindblad, 2011) and comparison can help illuminate how the political economies and the systemic and accountability structures within which teachers work give rise to different conceptions of teaching. The neoliberal education reform agenda in England is long established whereas a similar programme has been slow to emerge in Germany for reasons we discuss shortly. Yet both countries draw on humanist education traditions which have long been subject to progressive influence.

Comparing pedagogy in each of these circumstances allows an improved understanding of the broad relations between teachers, practices and pupil experiences. Together these can inform an understanding of policy implementation and the policy cycle (Ball and Bowe, 1992); concluding an extensive review of comparative education policy research, Busemeyer and Trampusch suggest this is much needed: 'this domain would benefit from theoretical work on the micro–macro problem in understanding outcomes of education policy' (2011: 434).

The English and German policy contexts

Whilst experiences of school mathematics can vary considerably within countries, our concern here is to identify those significant variations between England and Germany which can be attributed to differences in traditions, policies and circumstances including how these mediate international influences. Amongst the most reported features of education in England in recent years are the regular standardised testing of students, publication of tables comparing results at a school level and high-stakes school reviews by a national inspectorate (Ball, 2013). No doubt the consequences of failure for students, teachers and schools combined with the competition engendered by a long tradition of individualism (Goodson and Lindblad, 2011) have exacerbated the influence of testing and inspection, and many have raised concerns about their negative impact on student learning (Stevenson and Wood, 2013; West, 2010).

Until 2010 the significant ongoing educational reform climate in England meant PISA attracted little media attention or direct policy response, despite moderate student

performance. However this began to change when the UK Labour government announced that performance in PISA 2009 would provide an informal baseline from which to measure the success of their reforms, and subsequently Michael Gove's Education White Paper in 2010 mentioned PISA as justification for further reform. However in Germany a concern with student achievement on PISA 2000 (OECD, 2001) stimulated considerable public debate and, some argue, provided impetus to significant policy reform (Ertl, 2006; Waldow, 2009). From the mid-2000s an emphasis on transparency and accountability meant German education reform was increasingly steered by output evaluations. National educational standards in subject specific competencies, similar to PISA, were developed, with *Länder*-based comparative standardised student assessments following in 2009. However these standardised assessments have remained relatively low-stake partly because they receive very little public attention compared to the performance of German schools in the PISA tests; something largely ignored by teachers in England. Curriculum and assessment addressed subject competences by focussing on subject application and everyday relevance, and this led to an increase in cross-curricular pedagogy and in-class student differentiation. Testing a representative student sample in each state was introduced to monitor variations in student achievement of the national standards, thus avoiding high-stakes for students and teachers; national monitoring is summarised in a biannual report on education, *Education in Germany*.

Since 2006, school development has been supported through the regular and systematic evaluation of schools through *Länder*-based school inspections. As reports

are available to school management and the responsible local school administration alone and are not linked to rewards or consequences, compared to England these are also relatively low-stake (Kotthoff, Böttcher and Nickel, 2015). However, greater autonomy for school heads in relation to budget, staffing and teaching programmes has allowed them increased opportunities to respond. Whilst inspections in all schools are now carried out regularly in Germany, the use of such inspections over many years in England has helped build extensive databases of school performance data, and this has led to the development of more targeted school inspections where the results from previous inspections, school self-evaluations and student achievement data are used to visit schools proportional to their need. This means poorly performing schools are inspected more frequently than other schools. Meanwhile other systematic change in Germany has sought to increase heterogeneity, including the introduction of comprehensive *Gemeinschaftsschulen*, ending the tripartite system in some areas, all day schools which extend the school day and preschool services which offer increased language support to children from non-German speaking homes. Interestingly, the underachievement of migrant groups on PISA 2000 came as something of a surprise in Germany, whereas such groups had long been identified and monitored using comparative test data in England. It is important to note that at the time of this study schools in England were just emerging from a period of significant prescription, both of curriculum content and teaching approach through national government strategies. Over this period the focus in England has been on skills rather than competences, with mathematics renamed numeracy to reflect this, and to some extent this side-lined

subject cohesion allowing concerns about fragmentation to emerge. In Germany curriculum content remains regulated by official textbooks, particularly in maths and foreign languages, which are based on educational standards, whilst teachers are left to decide how best to teach.

There are significant differences in how schools in each country relate to what Ball (2013) calls policy technologies. The market focus in England encourages parental choice linked to the performative appraisal of schools through the publication of high-stakes national standardised test and inspection outcomes, as described above. Thus school management is dominated by the surveillance of teachers and students to try to ensure outcomes are met, bringing job insecurity, where teachers are only as good as their students' results allow, and tightly controlled working conditions which combine teachers' pastoral and subject responsibilities. These technologies combine to create climate of relatively hard governance weighted heavily from professional autonomy to accountability.

An increased market focus in Germany has begun to allow some parental choice of school in some states leading to an increased movement between schools; in some metropolitan areas of Baden-Württemberg more than half of students now transfer from primary schools to *Gymnasien* which have therefore become the main secondary school type. However, standardised testing and inspection results are not made available to support parental choice; these perform a soft governance role instead. Indeed, the job security which accompanies their civil servant status coupled to teachers' relative autonomy allows teachers much greater control over their working

conditions than in England and provides a restraint on pedagogic reform. Thus in some *Länder* other structural restraints on teachers remain, including the emphasis on teachers' academic roles in *Gymnasien* and combined pastoral and subject roles in *Hauptschulen*.

In mathematics, the mean PISA performance at age 15 for Germany in 2012 (OECD, 2014) was better than previously. At about 17.5% each, both low and high achievers performed significantly better than English students. Amidst this overall picture, however, despite slight improvements in PISA scores for average and weak pupils in Germany, the high impact of social class and migration status remains; as yet, the impact of the education reforms described above on classroom activity and student performance is not clear. Since 2006 the performance of English students overall has been fairly consistent, but within this the share of low achievers has increased to 22% in 2012 whilst that of high achievers has declined to just over half of that. This appears to contrast with a slight increase in 2012 in the proportion of pupils in English state schools achieving five or more GCSE (the principal subject examinations which mark the end of compulsory schooling) or equivalent passes. But whilst four out of every five students with higher prior attainment made the progress expected of them between the ages of 11 and 16, only one in five of those with lower prior attainment did so (DFE, 2013). Thus, despite the complexity of comparing different assessment outcomes, it seems higher achievers respond much better to mathematics teaching than low achievers in England, whilst the response is more even in Germany.

Mathematics teaching

Rather than seeing pedagogy as an idealisation, a set of recommended teaching practices, for Bernstein pedagogy is a phenomenon which emerges from the activities of teachers and students together, each subject to a number of competing factors and influences as they negotiate and pursue their various goals (Bernstein, 1990; 1996; 2004). But not only do teachers face many demands, as Ball says, 'teaching has always involved making decisions within a complex and rich field of contradictions, dilemmas and priorities' (2006: 83), they do so in social situations where the consent of students to act in accordance with their teachers' expectations is not guaranteed; it has long been understood that pupils can withdraw their cooperation in overly challenging lessons (Doyle, 1983; 1986). Hence we can regard classroom activity as constructed by teachers and students together (Dowling, 1998) in sites of competing influences and goals (Ball, 2006; Kelly et al., 2013). As such, some like Apple (2012) suggest these processes allow low achievers to become complicit in their own marginalisation.

In order to analyse pedagogy within this complex picture, Bernstein (1990; 1996) separates discursive practice working towards instructional goals, largely those associated with the subject being taught, from that concerned with regulatory goals including activity which promotes students' willingness to accept responsibility for their actions and to behave in a sociable manner. For him, power is embodied both in the way boundaries between the different objects of these discourses are established and policed, something he calls classification, and in who has control over decision making which he calls framing. For example, the ways in which mathematics as a subject is

defined and differs from other subjects is a matter of classification as are the roles adopted by teachers and students respectively. When classification is high, each of these is clearly separated, but in cross curricular work or when teachers and students engage in problem solving together this lessens. Similarly framing is high when teachers determine the content, sequence and pace of teaching but appears to lower as students become more involved.

Clearly the nature of mathematics as a subject is central to the formation of pedagogy. Bernstein separates subject discourses into vertical and horizontal (1999); the vertical discourse is concerned with increased subject specialisation and complexity (Hazzan and Zazkis, 2005) whilst the horizontal links subjects to their presence and use in other contexts. It is the understanding and ability of students to work with abstract ideas which ultimately leads to exam success (Cooper and Dunne, 2000). In mathematics, particular difficulties have been identified for the vertical development of some students, particularly lower achievers, as they first encounter algebraic ideas at around the age of 13 (Malisani and Spagnolo, 2009), the age of students in this study. Hernandez and his colleagues (2011) point to such occasions as when the stratification of achievement widens alarmingly. However Knipping and her colleagues (2008) place more emphasis on how mathematics teachers contribute to this widening gap by, for example, working too hastily and assuming low expectations. As a way of helping children better understand mathematical ideas, teachers often link them to everyday examples, thereby adapting the horizontal mathematics discourse. Indeed, this can be in response to student disquiet when challenged. However such an

emphasis can limit students' vertical subject engagement, supporting Apple's argument above; especially as Bernstein (1975) identifies that many pupils, particularly those from working class backgrounds, favour mathematics which is grounded in concrete examples and emphasises relevance.

With this account of mathematics teaching in mind, the focus of this study is to explore differences in mathematics teaching, as emergent practices in sites of policy negotiation and enactment, analysed using Bernstein's account of pedagogic practice, between the English and German schools who participated. In part, our analysis of each context concerns the nature and development of the vertical mathematical discourse and its relation to both adapted horizontal discourses and mathematical success. We then relate identified differences to the dominant influences on each context, thereby elaborating two particular versions of the extended policy cycle described earlier; one relatively hard in educational governance terms compared to the other.

Method

To analyse teaching we explore practice by identifying teacher and student goal-directed behaviours, conceptualised as roles. Roles indicate a division of labour and carry an assumption of reciprocation; generally speaking, by acting as a teacher I expect others to act as students. Constructed thus, roles provide a social unit of analysis: they can be assigned, adapted or resisted by the actions of others. Teacher roles are situated within a particular subject, classroom, school culture, and so on. And

they are the visible outcomes of mediations across many, sometimes contradictory, influences, including responding to the roles adopted by students. Hence teacher roles characterize the act of teaching whilst acknowledging its situated and reciprocally defined nature.

We categorise roles using Bernstein's model of pedagogic discourse (1990; 1996). This comprises an instructional discourse about curriculum content and assessment and the sequencing and pace of teaching, and a regulatory discourse concerned with managing the division of labour and promoting appropriate conduct in the classroom. By linking roles to pedagogic discourse we describe pedagogy and by contrasting our analysis in and across national groups we compare pedagogy, finally relating this to national socio-political educational debates.

Context of the study

The study within which this paper is set is a comparison of two cases – England and Germany – chosen for their contrasting education policy contexts. We recognise there are many influences on the construction of teaching and that inevitably our account is tied to the contexts in which the study was carried out, although our findings might resonate with the experiences of others more broadly, allowing naturalistic generalisations (Stake, 1995) to be made, and indicate worthwhile avenues for future research. An earlier paper, which reported on just two teaching episodes taken from this larger study, utilised the same method to explore elite mathematics education in both countries (Kelly and Kotthoff, 2016). Mathematics was chosen as a focus for this

study because, as a core area of pupil learning with wider social significance and status, it has been the site of much reform and contention over the past twenty five years in England and fifteen years in Germany. Local advisors identified the schools involved as those recognised in external evaluations as having been particularly successful in mathematics teaching. We sought such schools to avoid clouding comparisons with issues of competence.

The eight English teachers worked in four local authority community colleges. There were two in each school, one of whom taught a higher set and the second a lower set. The eight German teachers also taught in public schools within the selective tripartite system; four worked in two *Gymnasien*, more academic schools which focus on preparing students for university entrance, and the remaining four worked in two *Hauptschulen*, schools which provide a general education to students whom it is expected will not attend university. The English community colleges included two city schools, one in a seaside town and one in a rural town; likewise one *Gymnasium* and one *Hauptschule* were located in a city whilst a second of each was in a smaller town. We engaged in sixteen teaching observations of mathematics lessons in each country, with each participating teacher observed teaching and then interviewed on two occasions. Classes for pupils aged 12-13 years old were chosen to allow subject teaching beyond basic level to be considered whilst avoiding a focus entirely on school leaving examination preparation. The profile of the participating teacher group in each country was similar, both groups being equally divided between men and women and containing three teachers with between 3 and 5 years, three with between 5 and 10

years and two with more than 10 years teaching experience; all were identified as promoting high student attainment by their school managers.

The lessons observed in each country were divided equally between high and low achieving groups. Two lessons were observed for each teacher (in Germany these lasted 45 minutes and in England 60 minutes) and audio recorded during a three week period (in week 1 and again in week 3), during the summer term (when classroom norms and routines were fully established) by insider researchers who were native speakers of English or German. Each lesson related to a slightly different content area, and on each occasion both the teacher's planning and samples of the pupils' work were collected. Following each lesson the observer's notes, audio recording of the teacher in the lesson, planning and children's work provided the basis for lesson analysis. Immediately following each lesson a detailed interview was used to explore and illuminate the varied goals and broader expectations which orientated teachers' work, how they made sense of them and what they did to achieve them. Three boy-girl pairs of students, selected by their teachers as above, at and below average attainment for the class, were also interviewed to explore their understanding of and response to the lesson.

Data analysis

The analysis presented below results from our categorisation of lesson observations, teacher interviews and student group interviews. We began by looking in our observations of lessons (using the audio recordings alongside the observation notes)

for the varied goals and broader expectations (including those implicit in what teachers said and did) which orientated teachers' work, how they made sense of them and what they did to achieve them. This was also done in the interviews, in response to the researcher's recalled observations, teacher planning and examples of student work, and related to the student interviews. In the later part of the second interview, teachers' values and beliefs were explored. The initial coding was carried out individually for each teacher before comparisons were made across teachers. Participant validation tested the verisimilitude of our resultant findings; their resonance with the lived experiences of teachers.

Teaching mathematics in England

At the time of this study, the common curriculum in England was principally utilitarian and accompanied by detailed guidance. But as the primary aim was preparation for employment, the curriculum was not entirely focussed on the concrete and practical; progression towards symbolic representation and manipulation was also included. For the four lower set teachers we interviewed in this study, mathematics represented a box of tools which could be used to solve various, mostly calculation, problems deemed relevant to everyday life. In addition, these teachers generally believed students whose parents or carers' work was mostly unskilled and manual came to school disposed towards learning things they saw as practical, useful and linked to their everyday experiences rather than abstract and esoteric ideas (Hatcher, 2012). This performance focus on utility, comprising both a notion of numeracy as a set of

skills or procedures and an assumed linear route from learning to application, and the need to do well in high-stakes standardised tests and exams dominated instructional discourse. Here it was assessment rather than the curriculum which drove pedagogy; despite the apparent skills focus, the way the subject was tested had a greater effect on how it was taught. In the four higher sets the emphasis was more on mathematics as a highly classified subject, a set of assumptions and specific practices which worked together and were then applied, particularly on past exam questions at the end of the lesson. Hence, vertical development preceded horizontal application in past exam questions for higher achievers, to some extent paralleling the linear relation between basic learning and application in assessment exercises for low achievers.

Pedagogy in English lower mathematics sets coupled this utilitarianism to a strong individualism and, broadly speaking, all four teachers focussed on the progress of individuals in the lessons observed, often supporting them independently of each other and emphasising the importance of test success to all. Whilst for the most part children were taught procedures through whole class instruction, this was followed with students working individually - although grouped with others tackling the same exercises - practicing using these procedures whilst their teachers supported them. The focus on highly individualised teaching providing differentiated tasks to groups based on mathematics test scores meant that children had to rely on teacher support alone, and peer support was not encouraged so there was little opportunity for students to learn from each other, be scaffolded by more knowledgeable others working alongside them, make links through serendipity, see alternative approaches, hear

alternative accounts and explanations, see and use multiple representations or talk about their work. Setting, which collected weaker students together in classes, exacerbated this. Coaching fitted this procedural emphasis well and a horizontal focus on real world examples attempted to make learning relevant; throughout, teachers emphasised making mathematics relevant and meaningful to students and in this learning always led to application. The stress on utility and focus on relevance meant teachers often started with the familiar to help students make sense of ideas, brought everyday examples into lessons and used concrete representations to support the understanding of abstract ideas with low achievers. But the main emphasis remained on test achievement, and there was reference to this and what was demanded throughout; here usefulness implied useful in achieving grades, and national test strategies were sometimes emphasised over focussing on mathematical development. As such, relevance was used as an aid to understanding mathematics so it could then be applied in tests and exams rather than used in students' everyday lives. But this limited vertical mathematical development to procedural and instrumental understanding (Bernstein, 1996; Skemp, 1976). Teachers explained students' dislike of the uncertainty engendered by problem or learner-centred approaches to teaching (Apple, 2012) by suggesting such work was too challenging and led to frustration. Instead, and because teachers wanted to control pupil learning to ensure they did well, they used highly classified and framed teaching, allowing pupils little freedom to decide for themselves. Finally, groupings meant difficulty dominated the atmosphere, without the keenness of brighter students, and there was a critical mass in each class who

resisted when responsibility moved from teachers supporting whole class instruction to students engaged in individual work. In this, students resisted challenging work including abstraction and closed down tasks; student resistance involved distracting activities, where they misbehaved or created social crisis involving disputes with their peers until the teacher reduced or eliminated the demands placed on them.

The four teachers in higher sets supported student engagement and helped them think about problems mathematically, so framing was apparently weak. In this, students assumed responsibility for their mathematical work and were expected to monitor their own understanding and progress. However by emphasising mathematical thinking, teachers aligned students with the structure of mathematics and used this to frame their engagement. In contrast to lessons for low achievers, student pairings provided lots of time for them to discuss their thinking with each other and so engage with a strongly vertical mathematical discourse, exploring problems within the structure of mathematics and looking for patterns and generalisations, relationships and reciprocity. Together, these led to increasingly sophisticated levels of abstraction, whilst teachers scaffolded the precise use of a range of mathematical terms. However, links were also made to examination questions and this provided a difficulty for teachers; that between encouraging student choice in thinking things through and working towards specific curriculum aims using examination questions to evaluate learning. The former was weakly framed whilst the second demanded stronger framing and we often found teachers began by asking apparently open questions but quickly closed these down and sought specific answers. Interestingly, in the higher sets we observed, students all

engaged in identical work with little support for those experiencing difficulty, but this was countered by the many openings for pupils to learn from each other.

Teaching mathematics in Germany

Based on common *Bildung* standards, originally written to reflect PISA expectations but since then subject to ongoing discussion and revision, the core curriculum applied to all schools within *Länder* and, for those in this study, was *Hauptschulen* or *Gymnasien* specific; both emphasised the structure of mathematics and, to some extent, logical thinking. Curriculum goals, although often not shared with students, were largely regulated by the exercises provided in *Länder* authorised textbooks.

Teachers, for the most part, held a relatively formal view of mathematics as an abstract, unified and true body of knowledge, which needed to be passed on to students as rules. In *Hauptschulen* the focus was mostly calculation rules and effective procedures needed for everyday life and there was no abstraction beyond calculation to algebraic manipulations. The four teachers there combined their instructional concern for students' mathematical development to allow them to function in society with a more regulatory concern for their personal development as sociable and consensual citizens, a role which also took teachers into supporting students' wider social relations. *Gymnasium* teachers also expressed the strongly classified view that mathematics becomes more powerful as its abstraction from everyday contexts and concrete and enactive representation increases. In both school types, textbooks shaped the content and sequence of pedagogy - although teachers determined the

pace of teaching - and included regular test preparation exercises which reflected the *Bildung* standards. Periodic class tests, set and marked by teachers but based on textbook material, were used to monitor student progress. In this, the curriculum, pedagogy and assessment were closely aligned.

As such, mathematics was considered best passed on to students as rules and pedagogy was largely teacher-led. Highly framed whole class instruction, comprising explanation and questioning, led to the identification of clearly classified rules and procedures which students, particularly in *Gymnasien*, were required to think through logically using their knowledge of the structure of mathematics. The use of these rules and procedures was then practiced individually with teacher support, in textbook exercises, which often included routine application problems, until the process was fluent. Mathematically there was a strong emphasis on order, provided by sequential progression through state standards and approved textbooks. In *Hauptschulen*, relevance came from linking basic calculation to everyday contexts. Here the focus of mathematics teaching was almost entirely on horizontal development as students learnt rules and to use correct approaches accurately. In all this the teacher was very much in control, making decisions about lesson pace and monitoring and correcting student work. Hence both subject and role classification and the framing of the lesson were high. Whilst the expectation was for students to work individually on textbook exercises, in practice they supported each other within their groups as well as receiving individual support from their teacher. As such, in terms of regulation there was some sharing of responsibility between teachers and students within clearly defined roles.

Nevertheless, throughout lessons there was a lack of challenge and this seemed to be the price of consensus between teachers and students; students cooperated so long as they were not overly stretched. Finally, when there was a higher than usual proportion of students with migrant backgrounds, teachers' first propriety was often to ensure children could understand the language by introducing and supporting student use of relevant vocabulary and linguistic structures, and this tended to side-line mathematics teaching. For example, in one lesson we saw, the teacher introduced the topic money to the whole class for the first 20 minutes, and this had very little mathematical content as she linked money to the everyday experiences of children and their families; the teacher's aim was to introduce and explain new language as the children provided suggestions of themes related to money.

Similarly, the high degree of classification and teacher framing continued in *Gymnasien* following whole class instruction as students practiced using rules and procedures correctly in specific exercises with teacher support. The tasks provided for students by the teacher throughout were closed with single solutions largely requiring the accurate use of rules or procedures. As lessons progressed, tasks increased in complexity and abstraction, and teaching was thereby highly oriented towards a vertical discourse. Students internalised an unchanging set of mathematical ideas as rules and procedures through argumentation and challenge, and practiced using these until they achieved fluency. Simple examples were used to support this process, as with cutting cakes to understand fractions, but this was the extent to which a horizontal discourse applied; unlike in England, mathematics was not reduced to transferable skills or

similar. Instead, rules and procedures were mostly used in routine application textbook exercises.

Discussion

Whilst in the teaching observed in both countries the curriculum was highly classified, for the lower achievers, those in those English lower sets and German *Hauptschulen* participating in this study, it was concerned with mostly routine calculations and simple geometric problems which could be solved using known rules and procedures, and was therefore set within a largely horizontal discourse with only limited vertical development involving small, incremental movements towards increased complexity or abstraction. However, for the higher achievers in the English higher sets and *Gymnasien* we worked with, the curriculum was almost entirely focussed on students' vertical mathematical development, although the emphasis differed slightly. A concern that students engaged in processes of seeking and identifying generalities as well as making use of known rules and procedures was combined in England, whereas the focus in Germany was mostly on students' facility in efficiently using rules and procedures of ever increasing generality in solving problems. As an aside, the valorisation of theoretical over practical knowledge originated with Aristotle and is central to humanist views about education; that it was taken for granted in the mathematics curricula of both countries underlines the continuing humanist influence. And so, underpinned by this hierarchy whilst also considered socially important, the vertical mathematics discourse provided a legitimate means by which student

achievement became stratified, explaining its gatekeeper role for post-school education and employment.

In the teaching observed in both countries, a largely vertical learning discourse preceded a horizontal assessment discourse, as Bernstein (1999) suggested it might, and nationally important tests in each country provided the focus for the horizontal discourse. In England, the limited vertical classroom discourse with lower achievers quickly proceeded to a horizontal one, where mastering test-like problems became the focus of teaching. As such, the horizontal discourse became, in practice, the testing discourse. This was also partially the case in German classrooms and English higher sets, where assessment mirrored the curriculum and provided the main arena for application, requiring students to use identified rules and procedures to solve formalised problems; routine application tasks of the form used later in tests in textbook exercises in Germany and past GCSE exam questions or similar in England. It would therefore be reasonable to link this explicit and specific assessment focus in mathematics classrooms in each country to improvements in German PISA results and English GCSE and national tests results respectively. PISA results were not important in England where GCSEs were highly significant for pupils, teachers and schools; the teachers we observed strived to adopt approaches effective in maintaining expected progress from earlier assessments and this seemed to work well with higher achievers. However PISA results were more significant at the national level in Germany. Here it is possible that PISA-like exercises in textbooks contributed alongside other factors towards improving national results. In this, national standards shaped the *Länder*

standards and the content of *Länder* approved textbooks, something which appears to have exerted a greater influence on classroom teaching than low-stake *Länder*-administered assessments and inspections, although this is a complex relationship deserving further study. In any case, we must be careful not to overstate the influence of PISA in the German classrooms as this was not a consideration for teachers in their everyday practice.

But whilst in both English lower sets and German *Hauptschulen* in this study the focus was explicitly on teaching students how to tackle routine calculations and simple geometric problems set in everyday contexts, in reality pedagogy for all learners in England and with higher achievers in Germany was often more concerned with decontextualised calculations and the like; as mentioned above, use was only in the context of past and similar test and exam questions. Meanwhile for lower achievers in Germany straightforward mathematical exercises were often unambiguously set in commonplace contexts, and for all learners in Germany there was a consistency between teaching and assessment. This highlights one difference between the skills discourse which underpinned thinking about the usefulness of mathematics and took transfer for granted in England and the PISA competencies model which dominated in Germany; the former tended to separate learning from application but assumed this to be unproblematic, whilst the second did not differentiate between learning and application. Yet whilst on occasion everyday examples were used in the German lessons we observed to contextualise new ideas and support learning, such as by explaining equivalent fractions using a visual illustration of cake slices, in England and

particularly with lower achievers, slightly more complex and abstract mathematics was often made accessible using concrete similes and relevant examples to aid understanding. One example of this we saw was the use of a visual representation of a balance scales to illustrate how both sides of an algebraic equation should be treated equally. However, tying mathematical understanding so closely to concrete examples could limit opportunities for vertical progression which depended much on students' confidence in moving away from the concrete towards abstraction. This distinction between the English skills and German competencies discourses would benefit further elaboration.

Remaining with instructional discourse, in the participating *Hauptschulen* and *Gymnasien* textbooks played a strong role in framing and regulating the content, sequence, pace and assessment and helped ensure curriculum and assessment paralleled and consolidated each other, as described above; they included PISA-like routine calculations for *Hauptschulen* and more sophisticated and abstracted algebraic and geometric rules and procedures in PISA-like tasks in *Gymnasien*, some in everyday contexts, in textbooks and subsequent class tests. However, given its weight, in England, again, as described above, assessment more than curriculum framed pedagogy with lower sets, although the curriculum had slightly more influence with higher sets where teachers adopted a less direct approach. Meanwhile in both *Hauptschulen* and *Gymnasien* the focus was on the application of rules and practicing procedures. Clearly the hard governance climate in England which gave the highest significance to test results meant all was mobilised towards maximising student

performance on these. In the soft governance environment in Germany, both the federal separation of powers and continued teacher autonomy mitigated against direct top-down reform of the kind seen in England. Here textbooks, as guides and resources to support teachers, provided a better way of shaping teaching.

Framing by teachers in participating higher sets in England was apparently weak because they relied on student reasoning to provide structure for their thinking, directing this towards curriculum outcomes. This contrasted with the greater emphasis on instruction rather than exploration in both English lower sets and Germany, although reasoning was also central to German teaching. The difference for English higher achievers was that tasks were often open, with a variety of solutions pursued; students were encouraged to seek patterns or generalities and recognise the process they had done this by, whilst teachers facilitated this process in relatively informal ways. In this sense, the introduction of examination questions was also done in an exploratory way as often a number of alternative approaches and solutions were sought. In contrast, teachers employed direct instruction with closed questions to strongly frame work in lower sets. In the German lessons observed this was also the case, the object being reliable and efficient use of fixed rules or procedures in textbook exercises. Rules were built systematically, and the emphasis on them may have contributed to an unchanging but also rather routine view of mathematics as a subject by students. Teachers were instructors, ensuring understanding and accuracy within similarly structured and regulated classrooms. Hence there were clear differences in pedagogy between the two countries, although, with higher achievers, both focussed on mathematics as a

strongly classified subject and encouraged student responsibility for their own learning. Interestingly, teaching in English higher sets reflected a long tradition as did more authoritative teaching across student groups in Germany. Both endured in each country, regardless of reform, perhaps because they afforded strong affiliations and had deep roots (operating, as they did, at the philosophical level described by Schmidt, 2011); this is an area which would be an interesting focus for further research. On the other hand, English lower sets appeared to have been those most affected by two decades of policy reform.

With this in mind, and turning finally to the regulatory discourses seen, for the English lower sets observed in this study, roles were clearly defined with teachers often assuming responsibility for student learning within a highly framed pedagogy; an inevitable consequence of evaluating teachers on the basis of their students' exam success. They also received highly individuated teaching, leaving little opportunity for peer support and the like, reflecting a long held suspicion in English schools that collaboration amongst lower achievers rewarded laziness and, in any case, constituted a form of cheating. The resultant lack of opportunities for social support was exacerbated by the division of students into sets as this created a climate of difficulty and dependence; it also allowed small groups to gain enough influence within classrooms to resist challenge, denying this challenge to the whole class and thereby privileging mediocrity and preventing any engagement with vertical discourse. There was also a lack of challenge in *Hauptschulen* which helped to maintain student cooperation, and lessons in *Hauptschulen* were sometimes very contextual and social,

particularly when there were a large proportion of migrant students. For English higher sets and *Gymnasien*, despite differences in teacher framing, lessons in both countries were structured to allow students to work as a class, in groups and individually which provided for informal peer and teacher support. Pupils were expected to talk to each other about their mathematics and, at times, make decisions. As such, both positioned students as responsible for their own learning whilst emphasising the importance of students thinking things through for themselves, thereby providing cultures of challenge and student choice, promoting student independence and facilitating their engagement with vertical discourse.

All in all, then, the analysis above is congruent with standardised assessment data indicating that English higher sets provided more opportunities and fewer obstacles to student achievement than lower sets; the approaches used were quite different between these two groups. In this regard, the similarities we observed in teaching higher and lower achieving students in Germany might in part account for the narrower gap in achievement between these two groups. However, both of these conjectures are in need of a fuller exploration.

Conclusion

The relationship between education governance processes resulting from the work of international organisations, national and regional policymakers and elsewhere and mathematics teaching in English and German secondary schools is complex. However, our analysis of a relatively small number of rich and detailed qualitative cases has

allowed us to explore the outcome of this process in terms of the opportunities for achievement provided to different student groups. We contend that, as a result of hard governance pressures PISA data was appropriated to defend national policy initiatives. As a result of these pressures English higher achievers were better supported in their vertical mathematical development than lower achievers, and this was reflected in the widening gap between these groups in standardised assessment data. However, the softer policy change environment in Germany was shaped in direct response to PISA data, and afforded a number of similarities in the teaching across groups of students, some established and some new. These similarities provided some indication of why the achievement of lower achievers was closer to that of higher achievers. However, given the limitations of this research, it is clear that these contentions would benefit from further substantiation.

What is also clear is that intricate interactions between international, national and local influences are not served well by simple representations such as that of a policy cycle. We suggest a somewhat looser model is in order; one which recognises the fluid, emergent and sociocultural nature of social activity and which thereby better accounts for processes of governance and the formation of pedagogy.

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Authors:

Peter Kelly

Plymouth University
Plymouth Institute of Education
Drake Circus
Plymouth, Devon, PL4 8AA
UK

email: peter.kelly@plymouth.ac.uk

Peter Kelly is Reader in Comparative Education and Convenor of the Comparative Social Policy Research Group in the Institute of Education at Plymouth University, UK, where he has worked since 2003. His work focusses on comparing social policy and pedagogy and their effects on educational inequality in Europe.

Hans-Georg Kotthoff

Institut fuer Erziehungswissenschaft
Pädagogische Hochschule Freiburg
Kunzenweg 21
79117 Freiburg
Germany

email: hg.kotthoff@ph-freiburg.de

phone: +49 (0)761 682 393

Hans-Georg Kotthoff is Professor of School Pedagogy and Comparative Education at the University of Education Freiburg, Germany. His research interests include comparative education, European educational policy, educational governance and evaluation and teacher education.