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Getting the fish out of the water: Considering benefits and problems of doing research on teacher education at an international level

Sigrid Blömeke & Lynn Paine

Structure and content of teacher education depend on a deeper rationale which is a result of cultural boundaries. At the same time teaching is a cultural practice that differs across countries. Like the water in the fish's tank, such cultural givens are too often invisible as we debate research designs. In this article, we focus in particular on the understanding of three main components of teacher education: mathematics, mathematics pedagogy and general pedagogy, and on juxtaposing two extreme models: Germany and the US. It turns out that benefits and problems of international comparisons are closely related to each other.

Keywords: Teacher education, comparative study, cultural context, social context, international comparisons, mathematics

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It is now a familiar adage to argue that the fish is not aware of the water in which it swims. Thus begins a common, but powerful, argument for comparative work. Today, as many societies turn to teacher education as a problem or a site for reform, it is particularly important to think about the need to move beyond the familiar, or to see with a kind of "peripheral vision" (Bateson, 1994). Structure and content of teacher education depend – as educational questions in general – on a deeper rationale which is a result of cultural boundaries. Stigler and Hiebert (1999) argue that teaching reflects "cultural scripts". It is worth our recognizing that teacher learning is also a cultural practice (Correa, Perry, Sims, Miller & Fang, in press). And like the water in the fish's tank, such cultural givens are too often invisible to our consideration as we debate research designs, in this case, for research about teacher education.

We write as two teacher educators from different countries who, through the course of our research work together and with others, have come to see this "water" in ways we had not before. It is known from other studies that teacher education *students'* understanding of their teaching can increase through teaching experiences in an international context (Willard-Holt, 2001; Pence & Macgillivray, in press). In pursuing what seemed like a common research interest – understanding teacher education comparatively – as a German and US researcher we have regularly been reminded of how much of our understandings of teacher education, our motivations for studying it, and our interpretations of our research – are shaped by our research experiences, too.

The reputation of the teaching profession, its social status, the structure of the labor market, the eagerness of pupils to learn as well as basic characteristics of length and depth of teacher education generally do not vary very much within a country. From an international point of view this is true even in the US – probably one of the countries with the greatest variation in the world. Consider a single example. Across the US, teacher education programs are organized in years and sometimes even in cohort groups; students are taught in classes which meet several times a week; responsibility for the schedule lies with institutions. From a German point of view, this looks very strange (at least as long as the "Bologna process"[1] had not started). Here, the individual students make the schedule on their own by choosing from a broad range of courses which meet once a week: for example, a student may choose an educational foundations course from what might be a set of about 50 such courses. The student composition in every course is different. Individual

students, not some central registrar, have to keep track of their course transcript. A German teacher educator would be hard-pressed to talk about program structure. Within very general outlines and formal definitions even the length of the study depends on the decision of the individual teacher education students.

Research that aims to explore the effectiveness of teacher education is therefore limited if it is restricted to the rather narrow set of possibilities and contexts of a single nation. International comparison offers a much needed set of richer, if more complex, contrasts. In this article, we consider the arguments for comparative research in teacher education, drawing not only on our two countries but on additional countries which form the basis for two studies of mathematics teacher education (Schmidt et al., 2007; Tatto et al., 2008) in which we are participants.[2] We focus in particular on three core aspects of teacher education for which comparative study can be beneficial. We end by considering some of the challenges of trying, in a practice typically so locally constructed, to gain the perspective that international work affords and requires.

1 Approaching teacher education and its policy context in Germany and the US

Germany and the U.S. are both countries with a strong sense of the need for and contentious debates about the possibilities of reform of teacher education. To explain the questions that are framed in each country we consider, albeit briefly, the policy contexts out of which these have grown.

West Germany (FRG) and the US were both deeply affected by the so-called "Sputnik shock" in the 1960s. That the USSR – as the leading nation for the Eastern bloc – was the first to be able to send a satellite into the space raised doubts about the level of technical knowledge in the two countries, followed by inquiries into their educational systems. In the following decades serious innovations were discussed by educational policy people in both countries, with several

[1] All European ministers of Education agreed in Bologna in 1999 to introduce the well-known system of Bachelor and Master university degrees in stead of native degrees like "Diplom", "Magister" or "Staatsexamen" in Germany in order to be able to compete for high-achieving students with English-speaking countries, especially the US.

[2] While researchers from 8 countries – Bulgaria, England, Germany, Italy, Mexico, South Korea, Taiwan, and the US – were involved in the initial design of "Mathematics Teaching in the 21st Century (*MT21*)", additional countries are involved in IEA's "Teacher Education and Development Study (TEDS-M)". The altogether 24 countries which have participated in *MT21* or TEDS-M planning and work cover the range of the TIMSS- and PISA scales. In addition, they represent different cultures and traditions of teacher education. We thank all participants of the conferences during *MT21* and TEDS-M. We are indebted to the insights they offered over the course of the meetings but we take responsibility for whatever errors of interpretation or fact in the reflections we develop here. The views expressed in this article are solely those of the authors.

reforms implemented (see for Germany Führ 1998, Blömeke 2002; see for the US Tanner & Tanner, 1990; DeBoer, 1997; Lappan, 1997).

In both countries reform efforts also focused on teacher education. In Germany, these have produced what has been the structure of teacher education during the past decades. In most federal states the status of elementary teacher education was enhanced by declaring the training institutions part of higher education. Further reforms strengthened the subject-matter preparation of intending elementary teachers, and in the 1970s these programs were finally structurally brought into line with the teacher education system for secondary schools. At the same time secondary teacher education, which had been exclusively subject-matter oriented, introduced coursework in subject-matter pedagogy and general pedagogy. Since that time all future teachers have first enrolled in special teacher education programs at the university where they have academic lectures in subject matter, subject matter pedagogy and general pedagogy. After having acquired a Bachelor- (for elementary school) or a Master- (for secondary school) like degree called the First State Examination, all future teachers must then participate in a practical training with two foci: on subject-matter pedagogy and on general pedagogy. This second phase of teacher education currently lasts for another two years, during which time the future teachers receive a reduced salary by the state. Much time is spent at schools where the graduates teach – partly as assistants to experienced teachers, partly taking full responsibility of their own. The practical training ends, if successful, with the awarding of a second degree based on an assessment called the Second State Examination.

The very length of teacher education and the two high-stakes exams indicate an expert approach as well as an attempt of state-orientated quality control which are typical for occupational regulations in Germany in general. Licensure or at least certification are familiar requirements for access to the labor market. Germany's vocational school system is probably one of the most advanced throughout the world. The expert approach implies a huge financial investment of the federal states, in the case of teacher education followed by further investments into the practicing teaching force if one considers the relatively high teacher salaries. Together with a status as civil servants these mechanisms provide high stability in the teaching force. It is very common that somebody serves as a teacher for 30 or more years.

However, before leaving this seemingly ideal case two downsides have to be mentioned: The expert approach is almost exclusively limited to entrance into professional practice. Once

somebody has a job as a teacher, he/she is relieved from most quality control mechanisms or professional development requirements. In-service training is a deserted and vastly neglected field in Germany. It is as if the states (and the teachers!) assume that 7 years teacher education can make up for a whole professional life. In addition, the extensive training requirements which ensure high quality teaching from the very beginning make the labor market relatively inflexible. Career changes are rare exceptions. Neither do teachers shift from school into other careers nor do academics from outside school move into the teaching profession.

U.S. teacher education came in the 20th century to become regularly located within higher education, but longstanding debates about its content and its relation to practice, coupled with the tremendous diversity of higher education homes in which it occurs, have led to a national landscape of pre-service preparation that can be characterized in part by its variation. In the US following Sputnik, changes in mathematics education had implications for pre-service and in-service teacher education: renewed emphasis on the structure of the discipline and process of problem solving, dramatically increased federal support for professional development of teachers that focused on improving their content knowledge, and investment in the development of innovative curriculum materials. The reforms, small and large, that occurred in curriculum, teaching, and school organization, did not lead to the kind of large-scale structural challenges to teacher education that were found in Germany. Yet there is no doubt that in the decades after Sputnik, teacher education in the U.S. has frequently been a source of concern, a lightning rod for debate, and a target of reform (Labaree, 2004), even if these cycles of debate, as Zeichner and Liston argue (1990), have been characterized by a "historical amnesia" (p. 3). Certainly, the persistent criticisms of US teacher education have contributed to the vulnerability of the enterprise and the low status of institutions which engage in it (Goodlad, 1990). This has also been a factor in the continued lack of consensus about the roles of subject matter and pedagogical knowledge.

In contrast to Germany's situation, U.S. conventions regarding the regulation of teachers after initial teacher education tend to treat pre-service education as the key first step, but not the last, in some continuum of teacher learning (Feiman-Nemser, 2001). There is no national policy related to in-service education or professional development, and states vary in how they recognize and reward professional learning. Yet across all states the two most common criteria used to advance a teacher up the career and pay scale are seniority and professional development.

In spite of their many debates and actual reforms, both Germany and the US since the 1990s have had to face disturbing results on surveys on pupil learning at the lower secondary level. In mathematics, science and reading literacy, neither Germany nor the US was in the group of top-performing countries (Mullis et al., 2004; OECD, 2007). These results added to the arguments for the reform of teacher education.

Germany's media has given much attention to PISA and TIMSS results, leading to heated debate and soul-searching among policy makers, researchers, and lay people with a main focus on the reading literacy of immigrants. The German press is only now realizing that teacher quality and the quality of teacher education could be important aspects to be discussed. In the U.S., a large and varied set of reports, commissions, and recommendations have, despite their diverse institutional origins, reached much the same conclusion. As the Glenn Commission, typical of this set of arguments, proposes: "It is abundantly clear from the evidence already at hand that we are not doing the job that we should do—or can do—in teaching our children to understand and use ideas from …[mathematics and science]." (Glenn & U. S. Department of Education, 2000, p. 4) The earliest contemporary critiques of the US system, most typically represented in *Nation at Risk* (National Commission on Excellence in Education, 1983), were clear about the problem of student performance; yet it is only most recently, in the wake of TIMSS and PISA and new directions in math and science education (NCTM, 2000), that a centerpiece of the current concern is teaching and teachers.

While the quality of teachers and teaching became a key concern in Germany and the US, as well as in other countries, in the wake of the international studies of the '90s, teacher quality could not be included in PISA and TIMSS because of its complexity. There is, of course, much evidence that teachers make a difference for pupil learning: Teachers with high knowledge in subject matter and pedagogy, appropriate beliefs about learning and instruction, high verbal skills, significant self efficacy and long teaching experience achieve significantly better results in pupil learning than teachers with low knowledge in subject matter and pedagogy, inappropriate beliefs about learning and instruction, low verbal skills, low self efficacy and short teaching experience (Berliner, 1994; Scheerens & Bosker, 1997; Stipek, Givvin, Salmon, & MacGyvers, 2001).

Unfortunately – and this applies to the US as well as to Germany – there is much less consensus on precisely how to educate our teachers best so that they develop as high-quality teachers

during their professional life. “There are serious disagreements about what it means for teachers to be well qualified and about what it takes to prepare teachers well.” (Wilson, Floden and Ferrini-Mundy, 2001, p. i) This problem is magnified by the relatively thin empirical base of research about teacher education (Darling-Hammond, 2000a, 2000b; Blömeke, 2004; Cochran-Smith & Zeichner, 2005). While there are many anecdotal accounts of teacher education within the U.S. and elsewhere, there is a relatively small set of rigorous, systematic studies that examine teacher education beyond a single program, course, or experience. Research on structural aspects of teacher education for the explicit purpose of creating comparisons has already been carried out by OECD (2004b) and Eurydice (2004). But this is not the feature of teacher education which matters most. Indeed, research focused on formal aspects like degrees shows contradicting results.

Our need to understand teacher education is further reinforced by the increasing demands on and re-conceptualized understandings of what math and science learning in the 21st century requires and the associated demands for corresponding teachers, teaching, and teacher knowledge (National Research Council, 2000). This again applies for both Germany and the US. In both countries research indicates a weakness not only with regard to the general results in TIMSS and PISA but a specific lack of student achievement in more complex and demanding parts of the studies: in reasoning and solving of complex problems as well as in applying the acquired knowledge to every-day situations. The national curriculum standards in mathematics and science, for example, emphasize new kinds of mathematics and science teaching (Stephens, 2003). Similarly, the German curriculum standards formulate goals which go far beyond algorithm-related competencies students only acquire (KMK, 2003). This makes it even more crucial for teaching novices to develop practices that include a rich repertoire of subject matter-specific teaching strategies and an ability to teach to a wide range of learners (Putnam & Borko, 2000).

This heightened awareness of the significance of teacher quality, the lack of consensus about what paths and approaches within teacher preparation produce desired outcomes, and a sense of urgency in the pressure to reform and support new kinds of teaching all point to the need for critical examination of teacher education. Both of us have been participants in *MT21* and TEDS-M. It is through this combination of experiences that we have come to reflect on the benefits and challenges of doing international comparisons of teacher education. These reflections emerged through the messiness of working collaboratively across national and cultural settings

and assumptions; this process has helped us recognize significant justification for such international work.

2 Benefits of international comparisons of teacher education

> Properly done, comparative education can deepen understanding of our own education and society; it can be of assistance to policymakers and administrators; and it can form a most valuable part of the education of teachers. Expressed another way, comparative education can help us understand better our own past, locate ourselves more exactly in the present, and discern a little more clearly what our educational future may be. (Noah, 1986, p. 154).

Unquestionably one of the most important benefits of international comparisons is the variety of manifestations which makes hidden national characteristics visible. Like everyone else, researchers are embedded in their own culture so that they often are not able to recognize matters of culture. This is particularly the case for teacher education, given the unique way in which it incorporates or touches on many different levels of education and stands at the intersection of education and other social, economic and political arenas. This embedded character of the system of teacher education in any one country makes looking beyond that country's experience crucial for recognizing the taken for granted assumptions which drive it. The investigation of another teacher education system in a foreign country, for example, and the discovery that it is possible to organize things differently shed a new light on the system at home. The need for this is particularly great in the case of studying teacher education, since research on teacher preparation implicates the researcher – being at the same time a teacher educator – as an "insider" in a way that research on pupils typically does not. The "peripheral vision" (Bateson, 1994) made possible by international comparison works to reduce the bias of provincialism that the insider (teacher educator/researcher) making claims about the nature, content, or quality of teacher education practices may have.

The internationally comparative perspective and the following reflection process can lead to a deeper knowledge about fundamental cultural concepts behind educational features which had been taken for granted before. The present structure suddenly emerges as an artifact of larger

national structures, systems, and beliefs. In fact, such sudden realizations happened numerous times during our international collaboration on teacher education.

For example, various members of our international group were surprised that significantly different numbers of subjects can be required for future teachers. In all German federal states, for instance, it is required that secondary teachers are prepared to teach two subjects, and this is reflected in the assignment of teachers to classes. The German system reflects both administrative/institutional concerns (making timetabling easier and avoiding having out of field teaching) and a deep philosophical mentality in schooling and teacher education that favours breadth over depth ("Allgemeinbildung"). The high degree of subject specialization in England, in contrast, means that an intending teacher in the quite popular PGCE or other post-BA routes takes no further content work. For a German teacher education expert – intuitively characterizing the English system as a "narrow" and "functional" idea of teaching in contrast to the German idea of "Bildung" – the challenge of seeing that other systems might opt for an alternative arrangement was educative; one comes to see that depth of preparation in one field could also be defensible – and due to several reasons may even be desirable. At the same time the US colleagues noted this reaction and were impressed that their out-of-field-teaching "problem" may not just be an administrative dilemma; it could also be seen as a reflection of philosophical traditions and a challenge to teacher education.

Another surprise happened around issues of selectivity. Our group had one of its many strong reactions when the rest of the participants learned that in Taiwan only the highest performing mathematics students within the math department are allowed to enter teacher preparation. For many countries, including the US, the assumptions and reality this suggests are very unfamiliar.

Through our many meetings together, we (re)discovered that the social reputation of the teaching profession can be completely different, that the teachers' role at school can be bounded more or less expansively, that the delineation of teachers' work affects teacher preparation differently, and so on. Over weeks of face to face collaboration, intense conversation, and repeated occasions where project members tried to provide a description of teacher education--the system and assumptions driving it--in their country, we have continued to confuse or startle each other. Often we were unaware how our preconceptions shaped our interpretations. Through conversation we assumed we had understood the other's teacher education systems. Yet as soon as we tried to repeat our understanding of what our colleague had explained, it became obvious that this in fact was not the case. Hence, we have had, in each meeting, to repeatedly check our understandings of what each other's systems entail, emphasize and value. We came to recognize that we were operating on very different assumptions about the goals, structure, content, meaning, values, and conflicts of teacher preparation.

The differences culminate in different understandings of particular, and often regarded as key, parts of teacher education: subject-matter preparation (in the case of our project, mathematics), math pedagogy and general pedagogy, as well as notions of approaches to theory and practice. It is these differences that we believe are both important to explore and fruitful for informing a richer, more complex understanding of the opportunities to learn in teacher education and the structural arrangements which can support them.

- *Mathematics in teacher education*

If teacher education is examined comparatively, it has more often been at the policy and structural level. There might be recognition that the system is different, requirements vary, or even that the contexts are unique. Yet what the content of teacher education entails, particularly the content of subject-matter preparation, has been assumed, left unexamined.

What is to be gained through an international comparative study of teacher education which looks closely at the subject-matter knowledge expectations and learning opportunities afforded pre-service teachers? Our collaboration points to a diverse range that makes it problematic simply talking about subject-matter knowledge as if it is a known category for which we have shared understanding of the term.

With regard to mathematics as part of teacher education, some countries restrict themselves to the learning of school mathematics, whereas others expect a learning of advanced school mathematics (also called “school mathematics from a higher point of view”). Others still demand the learning of scientific mathematics. School mathematics can be understood as the use of mathematics as a tool for appropriation and discovering of the world; it is literally that mathematics which is taught in K-12 schooling. Advanced school mathematics explains background, rationale and applications of school mathematics (like a meta-theoretical approach). Compared with these, scientific mathematics is completely different given its appropriation and discovering mathematics as an academic system. Even if the terms of a lot of topics are the same (e.g. Linear Algebra) the differences between scientific and school mathematics are fundamental. That is why school mathematics neither is part of scientific mathematics nor can be derived out of it. In many countries intense controversies exist how far beyond school mathematics teacher education has to go, yet the different positions are often strongly emphasized without anybody having real evidence for them.

Math teacher education in Germany builds onto a school education in mathematics which tries to assure a certain level for *all* high-school graduates. Areas like Trigonometry, Calculus, Analytic Geometry, Algebraic Structures and Probability are already a required part of mathematics instruction at secondary school. According to a broad understanding of “Allgemeinbildung” (only insufficiently translated as “all-round education”) it is impossible that those who enter university have not had at least the basics of these mathematical areas at school. They are requirements for the high-school exam, set on the national and the states’ level with giving no choices to local authorities or students. Basic courses focus on fundamental topics of mathematics, giving exemplary insight into working methods and interdisciplinary aspects but also into differences between knowledge in everyday life and scientific knowledge. At upper secondary level advanced courses in mathematics at the “Gymnasium” offer students a broad insight into complex mathematics topics and require independent and reflective mastery of mathematical methods. Of the advanced courses, mathematics is the second most frequently chosen subject among pupils, with roughly one third of the pupils choosing mathematics (twice as many males as females).

Building on this (somewhat common) basis, everything else with respect to amount and content of lectures in mathematics during teacher education varies a lot across federal states or institutions. Future teachers of grade 1 through 4 are not required to take a lot of math lectures

even if they will have to teach mathematics later at school. In some federal states teacher education programs neglect the mathematics part if students take German as a subject. In contrast to this, a teacher-education program for future teachers in lower secondary can consist of exactly the same lectures a Master's level student concentrating in scientific mathematics has to take (e.g. including Topology and Mathematical Logics). Coursework in school mathematics and advanced school mathematics therefore takes place only in the very first few weeks of the 5-year university programme.[3]

The depth and breadth of mathematics preparation for future teachers in the U.S. has been a subject of much recent debate. Reports suggest that there is little coherence in the preparation of mathematics teachers in many US teacher education programs (National Research Council, 2001). In part this may reflect the broader US tradition of decentralization in education. Specifications for what a mathematics teacher must know or what their teacher preparation must include are made not at the national level but reflect a complex interaction between state policy, non-governmental accreditating agencies (such as NCATE), and institutions of higher education. Diversity is in some ways a hallmark of U.S. teacher preparation.

Certainly, compared to German students, US students preparing to become teachers of mathematics come with quite varied mathematics backgrounds. US university education builds on a high school education with many choices for pupils. Thus, mathematical knowledge and skills can vary a lot already at entry to university, to teacher education, or even at the conclusion of teacher education programs. Variation exists as well in the content of mathematics that is offered -- in terms of the level, its justification, its location within the university (offered, for example, by mathematicians or math educators, to all students studying mathematics or only to those intending to be teachers), not to mention how it is taught. Yet, despite this real variation, in contrast to German intending secondary teachers, the vast majority of US prospective teachers would have far less extensive and a comparatively briefer period of academic study of scientific mathematics than the German counterparts, who, if intending to teach middle or high school, spend 5 years in the university studying mathematics, among other areas, before two further years in a second institution to support their "practical" knowledge.

[3] At this point it is important to repeat that a German maths teacher never is a maths teacher only – not even at the high school level. In all teacher education programs at least a double major is required. Future teachers of elementary schools have to complete a minimum training in three subjects to be qualified to take on the role of form teachers.

One might hypothesize that the differences in the German and the US concepts of subject matter in teacher education, which go along with different institutional levels on which future teachers gain their subject-matter knowledge, would result in different knowledge and performance of future teachers. Unfortunately, empirical data on this important question about the effectiveness of teacher education does not exist. A German critique of teacher education is that teacher education in the subject matter emphasizes a very (perhaps too?) high level in scientific mathematics and a very traditional instructional perspective on mathematics (i.e. linear-systematic procedure and orientation on algorithms without strengthening of real-world modelling, use of heuristics and reasoning, self-determined and co-operative learning, discovering the dynamic character of mathematics and self-evaluation) for future secondary teachers and offers only a low-level knowledge of advanced school mathematics. In contrast to this, the public as well as teacher educators are more or less confident with the teacher education for future primary teachers – perhaps with the exception of those programs that neglect math coursework entirely.[4] Interestingly, the concerns in the U.S. regarding the mathematics preparation of future primary and secondary teachers are quite different: perhaps the most common complaint is that neither group has sufficient knowledge of mathematics (even though what that knowledge should be, as suggested earlier, is still the subject of controversy).

Through comparison of teacher education's mathematics learning opportunities and the acquired knowledge of future teachers, as *MT21* did and TEDS-M is currently doing, we can begin to explore these lines of questioning. Too often in comparisons of teacher-education programs internationally, there has been no emphasis on the specific nature of the subject-matter component. Most comparisons are simple ones that attend only to length of preparation (see, for example, the reporting available on teacher preparation and background in TIMSS.) A more nuanced analysis of what is subject matter content, how it is conceptualized, and how it is located within teacher preparation is important to inform debates about reforming and improving the subject matter preparation of teachers. As Ball and Bass (2000, pp. 94-95) argue, often "subject-matter knowledge" is measured simply by the proxy of course attainment, yet if we are to think about "usable mathematical knowledge" for teaching, we must look far deeper than the name or number

[4] But even with respect to these programs the displeasure is limited because these teachers usually do not teach mathematics at school. Due to the requirement of several majors it is mostly possible to coordinate the allocation of the teaching staff in such a way that at least regarding core subjects like German or mathematics and subjects with special requirements like music or sports teachers mostly teach in those subjects in which they have majored.

of courses. The very challenge of trying to describe and make sense of another country's mathematics curriculum expectations for future teachers forces us to do just that.

- *Math pedagogy in teacher education*

Within the discussions of mathematics pedagogy in the U.S., some of the most influential advances have focused on what could be seen as efforts to conceptualize mathematics pedagogical knowledge, mathematics pedagogy, and/or professional knowledge for mathematics teaching (Ball & Bass, 2003; Ma, 1999). In many countries math pedagogy is seen as a core element of teacher education, though it is conceptualized completely different there – and in some countries it is even missing.

In German teacher education math pedagogy is expected to bridge subject matter knowledge and general pedagogy and to do this on a generalized, academic (scholarly) level. The relationship between content and learning is reflected and how to teach the content is discussed. Over the past two decades math pedagogy has developed into an academic discipline with an academic specialisation for which university professors are responsible. Within German teacher education, practical training in teaching takes place in a second phase at separate institutions. It is not expected that students gain performance skills at university, but they are, in the first phase, exposed to and expected to develop competence in theories and concepts about pupils' learning of mathematics at school as well as about its teaching. The future teachers acquire knowledge about the contribution of mathematics to the development of children, about the structure and different philosophies of mathematics curriculum, the history of mathematics at school, about methods and media in teaching mathematics, the cognitive demands of mathematical problems and students' difficulties with these as well as results of instructional research on mathematics learning. The conception of knowledge of math pedagogy appears very similar in Taiwan and Korea where future mathematics teachers participate in extensive theoretical work related to pedagogical aspects of mathematics, though they place significantly less emphasis on a subsequent practical training than does Germany. In Taiwan, a student will have 26 credits for math pedagogy and pedagogy, with both required and elective courses in subject-specific pedagogy, such as the psychology of mathematics learning.

In contrast to this scholarly idea of math pedagogy, the conventional US understanding of subject-specific pedagogy often implies a bridge between subject-matter knowledge and practical

teaching skill, one that occurs on an individual, situated level. We make the distinction here between what might be seen as typical approaches to subject-specific teaching methods, which tend to be discussed at a highly practical level, and what Shulman and colleagues (Shulman, 1987; Wilson et al., 1987) termed pedagogical content knowledge. As Westbury et al. (2000), Gundem and Hopmann (1998), Bromme (1995), and Ball and Bass (2000) suggest, European approaches to pedagogy, as understood in the tradition of didactics, includes a highly theorized set of ideas about the teaching of content. While pedagogical content knowledge, " is a special form of knowledge that bundles mathematical knowledge with knowledge of learners, learning, and pedagogy," (Ball and Bass, p. 88), its very presence in the discourse of U.S. teacher education is a reminder that most approaches to teacher education have not fully developed this kind of conceptual approach to the teaching of subjects. Rather, math pedagogy traditionally has more often been an opportunity, typically closely linked to sites of practice, for intending teachers to develop knowledge of a repertoire of instructional approaches in mathematics.

A somewhat similar interpretation of this US idea of math pedagogy exists in Italy where laboratories play an important role in teacher education. Here students develop lesson plans or assignments. This approach to math pedagogy as closely linked to the practical contrasts not only with Germany's and East Asian traditions of teacher education, but with experiences elsewhere as well. England, in the wake of dramatic reforms in teacher education, is an example for countries in which math pedagogy as a field of study for intending teachers almost does not exist anymore. After having received a Bachelor’s degree independent of possible professions, future teachers take a practically oriented one-year teacher training in which only a few theoretical dimensions are covered in the field of math pedagogy; this is more (and deliberately, by those who designed the national reforms in teacher education) constrained in time and hence depth than in most other countries (Jaworski and Gellert, 2003; Furlong, 2002; Judge et al., 1994).

It appears that math pedagogy is a shared concern in several countries. In Germany the low amount of maths pedagogy is criticized as its weak empirical foundation. Similarly, much of the debates regarding the preparation of future math teachers in the US revolves around the relative balance and appropriateness of the course preparation in what we might think of as math pedagogy. Such debates in England eventually led to the dramatic reduction of their presence in today's teacher education. Yet what any of these national discussions means by math pedagogy is often not deeply explored. One small glimmer of this need for distinction occurred as our US and

Australian colleagues in our project meetings were stumped by the assertion that math pedagogy in the German university is a "theoretical subject". One of our colleagues, clearly baffled by this, asked, "but what is math pedagogy without a practical dimension?" Each side could not imagine the other's perspective. These (recurring) discussions reminded us that we could even use the same terms—like math pedagogy—but mean very different things. Comparative and international work affords an opportunity to investigate more deeply different approaches and conceptualizations of math pedagogy, their contributions to teacher knowledge, and, as Noah suggests above, locate ourselves in a far more complex range of possibilities than we often recognize.

- *General pedagogy in teacher education*

If mathematics and mathematics pedagogy offer fertile areas for study, so does general pedagogy, in Germany known as "Erziehungswissenschaften", or what in the US has become the little researched residual categories often called educational foundations and generic teaching methods. It is clear that there are dramatic variations in general pedagogy. Looking across the countries represented in *MT21*, we recognize that there is significant variation in the relative place of general pedagogy, as well as in what constitutes this domain. If one only considers Bulgaria and Italy, at the level of their attention to math pedagogy, they do not look so different, with the former allocating 30% of teacher preparation time to that and the latter 20%. Yet in terms of general pedagogy, Bulgarian teacher education students have only 7% of their course time in this area, in contrast to 20% for Italian teacher candidates.

General pedagogy represents another important component of teacher education that, like mathematics and mathematics pedagogy, reflects institutional instantiations of differing conceptions of teacher education. In this case the concepts are strongly linked to different ideas of teachers' work, knowledge, and teacher learning.

In Germany teachers' tasks are not only to instruct pupils in several subjects to reach cognitive and subject matter-related motivational learning goals but also to support their social and moral development. Engaging in activities like travelling with students or setting up musical, theatre or sports events is a teacher task that requires a significant amount of time. In addition teachers have to take part in school-management tasks as well as carry out assessments and counsel students and parents. In general, teachers are seen as having broad autonomy to design their

lessons within general state guidelines (Westbury, Hopmann & Riquarts, 2000). Textbooks require permission of the state authorities but the teachers of a school are relatively free in choosing one out of a rich supply of very different editions with regard to themes, methods and social values or creating additional material for instruction. Only recently, the federal states have started to try trough standards for student achievement on several levels (mainly grade 4 and 10) and partly centralized exit exams at the end of lower and higher secondary to balance this freedom and the need of comparable outcomes.

But still the effects of the long-lasting tradition are highly visible and affect teacher education. Teacher performance is regarded as a continuous linking of pupils' needs to content and social needs. The German concept of "Bildung" proclaims a balance of goals and content, with content seen as a way to reach goals related to "Bildung" (e.g. citizenship; Klafki, 1963). It is mostly up to the teacher to decide how to balance these two dimensions and to explain why a specific topic is relevant to reach the broader goal. In addition, German teachers are civil servants. The associated job security offers the possibility to teach freely according to one's values. Against this backdrop professional ethics and a capacity of high-level reflection become very important. Their development is a foundational piece of general pedagogy. Hence, history, philosophy and sociology of education have had a very strong position (compared with the US, where psychology and teaching methods are more dominant) in the program of preparation of Germany's teachers.

The autonomy and professional status of teachers determine part of the purpose for and content of "general pedagogy". This means at the same time that with changes in the teacher status the character of "general pedagogy" changes, too. And this is what happens at present. As a consequence of the Bologna process and of a stronger focus on outcomes, general pedagogy becomes more skill-related and less elective. This is equivalent to a loss of meaning of philosophy, history and sociology of education – while psychology and teaching methods become more important. The ministries of education have enacted standards for teacher education which reflect this change, and with the switch to Bachelor and Master degrees they require the new programs undergoing an accreditation process.

In the US, the diversity in the nature of teacher's work, social assumptions about schooling, demographic pressures, and traditional conventions about instruction have created a diversity of institutional configurations responsible for much of the knowledge base that Germany's gen-

eral pedagogy attends to. Like Germany, one can argue that general pedagogy in teacher education reflects ideas about schooling, its purposes, and the responsibility of teachers. One outside observer to US schools of education described the dominant approach as one that puts "head over heart", with the stance of pedagogy content encouraging a vision of child-centred schooling and teaching (Judge et al, 1994).

Unlike Germany, however, there is no single category in the US entitled general pedagogy. Depending on the institution and program approaches, some of this content falls within what is often considered educational foundations (of sociology, history, philosophy and psychology of education) and some in generic methods/instructional design courses. In the U.S. pedagogical preparation both means many different things and "varies considerably across institutions" (Wilson et al., 2001, p. 12). Despite this diversity, general pedagogy in the US has not been organized with the sharp and widely recognized distinctions of theoretical aspects of pedagogy and practical aspects that are found in Germany.

State control of public teacher education programs, accreditation schemes such as those of NCATE or TEAC, and INTASC standards for initial teacher education all create bins in which components of general pedagogy get located or require programs to prepare teachers to develop particular kinds of general knowledge—about learners and learning, instruction, curriculum, and assessment (Darling-Hammond, 2000a). But how this is arrayed, and whether this knowledge is represented as theoretical or practical is very much a reflection of the orientation or tradition of institutions and their faculty (Zeichner & Liston, 1990). Nevertheless, as Labaree (2004, 2005) argues, this body of knowledge is often devalued and seen as taught by those lacking true expert knowledge and occupying a "lowly status" (2005, p. 187). In fact, this situation is not new. Conant in 1963 dismissed foundations in teacher education programs as "patching together scraps of history, philosophy, political theory, sociology and pedagogical ideology" taught often by faculty "frequently not well trained in any one of the parent disciplines" (p. 127). Echoes of Conant's criticism remain today (see, for example, Kramer, 1991, and the American Enterprise Institute's 2003 conference called "Can Education Schools Be Saved?").

We see even greater challenges to the role and contribution of formal instruction in general pedagogy in England, where the entire teacher preparation curriculum occurs for PGCE students in 36 weeks, but only a third of which are university-based. There, the attack on teacher

educators as “woolly headed” reflects criticism of general pedagogy and real debate about what professional education means (Judge et al., 1994; Furlong, 2002).

These complexities hint at the variation in notions of and approaches to general pedagogy across different countries. Such variation can be revealing and important to explore, yet the complexity also adds to what makes such research conceptually and methodologically challenging.

3 Concluding reflections: problems raised by benefits of international comparisons of teacher education and the need to start working on them

Benefits and problems of international comparisons are closely related to each other. A benefit of international comparisons often turns out to be (or cause) simultaneously a problem and vice versa. The examples above remind us how much teacher education is a cultural practice. As such, problems of language and meaning become important and are far more demanding to resolve than “simple” translation of instruments or responses (National Research Council, 2003; Broadfoot & Osborn, 1991; Schmidt et al., 1996). Of course, at one level, this is a common, familiar, and well-studied aspect of cross-national studies, for which there are now widely used conventions of translation, back translation and the like (Hambleton, 2002). In teacher education, we would argue that there are even more language-related challenges that require attention.

Descriptions of teacher educations systems, the experience of experts, and the results of research work are mostly available only in the particular native languages. Teacher education serves local (sometimes understood as national) needs, and the language of it has significant local/national character. To be able to be examined internationally a first translation step into some shared language (in this case, English) is necessary. Yet the data collection itself can only happen in the native language. So, a second translation step has to be done for field tests followed by feedback on the results and possible problems in English and so on.

The resultant language problem is not only one of costs (which we do not intend to minimize). Rather, it is more fundamentally a problem of cultural boundaries. A lot of terms from native languages cannot be translated because adequate English terms are missing and vice versa. In the field of education, this problem arises often. It is even difficult to name the process in which future teachers learn their profession: Is it teacher education, is it teacher training or is it perhaps teacher preparation? The questions are not simply literal but instead relate to deeper and

often tacit assumptions about schooling, teaching and teacher learning. Because these terms connect to broadly shared cultural beliefs, most often the uniqueness of their meaning is not explicit and can easily escape scrutiny unless, as happened in our *MT21* conversations, outsiders to the cultural community stumbled over and began to inquire about them. Behind the apparently simple choice of whether to refer to the practice as teacher training, teacher education, teacher preparation, or some other term, lie other questions of history, policy, social values and cultural norms.

The recognition of the cultural nature of teacher education argues for approaching a comparative study of it in ways that maximize the possibility for cross-cultural communication and direct examination of terms (LeTendre, 1999). To inquire into the education of teachers in different national settings requires the participation of insiders from these settings as well as sufficient and sustained dialogue across these individuals. There have to be many different people around the table, so to speak—not just those representing substantive expertise in mathematics education, psychometrics, and research design, but people with the knowledge of the practices in teacher education in each setting.

Of course, the challenge then becomes, if we extend the metaphor, of how to have a table big enough to guarantee the needed expertise yet small enough that researchers can, face to face or virtually, engage in a real dialogue in which each can hear others when they talk. The need to look deeply within a country's institutions, policies, and implicit theories and values, and at the same time look across early and often enough to sharpen design, analysis and interpretation has important design implications for any cross-national teacher education study that intends to go beyond surface indicators. How to balance a desire for greater cross-cultural dialogue and reflection with the problem of unwieldy logistics is a challenge.

Recognizing the diversity of cultural frames of teacher education also encourages us to recognize that we do not necessarily share the same interests in undertaking such a study. Why do countries want to take part in a study on teacher education? It could be – and in the case of teacher education one can be sure about this – that these interests sometimes contradict each other. We know already that this is the case with regard to the importance of content knowledge, for example. Whereas Germany has traditionally privileged this part of teacher education and may have more or less failed in connecting this part of teacher education to other parts and to specific teacher tasks, the US has struggled with the opposite: high amount of skill-related pedagogy for most future teachers and lack of sufficient content knowledge. Consequently, if we were

to offer a caricature of the rationale for each country's participating, we see a strong subject-matter bias runs through the motives of the US for conducting international teacher education work, as if only mathematics counts in the preparation of future maths teachers. In contrast, a strong task-related bias runs through the German demands as if a strong declarative knowledge base were negligible. For both countries, the disturbing national results on TIMSS and PISA have been a not insignificant part of what persuades them to want to understand the development of mathematics teachers' knowledge cross-nationally. Coming from two extremes this may be the perfect starting point of developing a useful study – when they succeed in getting the fish out of the water or at least in filtering the water in a way that the fish is seen in an appropriate way, un-biased and in its full shape.

Our image of getting the fish out of the water seems especially apt when we recall how commonly, in research debates about teacher education, we treat it—the practice, institutions, and purposes—as if they are universal, when most frequently writers are arguing about teacher education in their particular national context. Grossman and McDonald (2008), for example, make a persuasive argument for the need for teacher education research to move beyond its "adolescence" (185) by identifying common factors that allow shared and more precise language, engaging in "sustained inquiry about the clinical aspects of practice and how best to develop skilled practice" (189), recognizing teacher education as contextualized (192), and drawing on organizational perspectives and understandings. They suggest the "progress…will require researchers…to reach outside their immediate communities, to look over their backyards to see and learn from what their neighbors are doing" (199). We are struck that the notions of neighborhoods, divisions, contexts and fields all appear tacitly bounded by U.S. discourse and experience.

In U.S. press and educational research, it is now not uncommon to see how international comparison becomes part of a rhetorical move to advocate change (Darling-Hammond, 2007). We too see the benefit of international perspectives and argue here that they are very needed not necessarily as a yardstick against which to measure ourselves, but as a way to deepen our understandings and possibilities for improvement. As we try to argue here, the challenge to teacher educators is to take Grossman and McDonald's point seriously, yet to recognize that moving beyond the familiar is not only imperative but forces us to see how easily we fall into the trap of thinking only in locally bounded ways that restrict the development of our theories and the reform of our practices.

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