Chapter 1.2.3
First Years of Teaching

Carl Winsløw, *University of Copenhagen, Copenhagen, Denmark*, and
C. Bergsten, D. Butlen, M. David, P. Gómez, B. Grevholm, S. Li, P. Moreira,
N. Robinson, N. Sayac, J. Schwille, T. Tatto, A. White, T. Wood

1. Introduction

A recurring and crucial theme in research on teacher education is the relation between pre-service teacher education and the day-to-day practices of mathematics teachers in schools. As we have seen in previous chapters, this relation appears already when pre-service teachers are engaged in practice periods, which in many cases form part of their teacher education. However, it appears also, and sometimes more acutely, in the experiences of teachers in the first years after completing teacher education. The first years of teaching practice may indeed be viewed as a period of transition at several interrelated levels:

- at an *epistemological* level, for example, when it appears necessary to adapt the (sometimes quite "academic") forms of knowledge acquired in pre-service education to the conditions and requirements of teaching;
- at an *institutional* level, passing from one institutional context (e.g., a university) to another one (a school, usually within a wider system of schools), often with quite different norms and other cultural assets; and
- at a *personal* level, the change from being a student in a community of students to being a professional in a community of teachers. This clearly depends on the previous aspects but also on more contingent conditions and personal beliefs.

In this section we shall take a closer look at the phenomena of transition as they occur and are studied in contributions to the 15th ICMI Study as well as in related literature. As we shall see, the institutional transition is organised quite differently in different countries and educational systems (even within one country), and this clearly is important in understanding different conceptions, in these contexts, of the other two levels. Britton, Paine, Pimm, and Raizen, (2003, p. 16) define a system of induction as a coherent set of policies and practices set up by a country (or another official entity, above the level of single institutions) to help new teachers in their practice. While most of the contributions consider just a single such system, we may also see the effects of different induction systems by looking at the studies together. Indeed, they can be considered a part of teacher education in the broader sense of frameworks for developing teachers' professional knowledge (see Tatto, Paine, & Schwille, 2005).

R. Even, D.L. Ball (eds.), *The Professional Education and Development of Teachers of Mathematics*, DOI 10.1007/978-0-387-09601-8_8,

2. The Epistemological Transition

Several models are proposed in the literature, and also in this ICMI study, to shed light on the complexity of the professional knowledge which teachers need to develop in order to teach mathematics in required (e.g., by official regulations) or otherwise desirable ways. Bergsten and Grevholm (2005) point out two possible "divides" which may occur in the teachers' knowledge: between disciplinary (mathematical) and pedagogical knowledge, and between the practical and theoretical parts of each of these. Drawing on Chevallard's (1999) anthropological theory of didactics (see Barbé, Bosch, Espinoza, & Gascón, 2005, Sect. 2) Bergsten and Grevholm (2005) point out the "ideal" intimate connection between theoretical and practical blocks of knowledge as an organisation system for practice: on the one hand, theoretical blocks of knowledge are needed for explaining, structuring, and giving validity to work in the practical block, while on the other, the theoretical block has no meaning if detached from the practical block (tasks and techniques) it explains, structures, and justifies. They then go on to point out the lack of a unified scholarly based organisation of pedagogical knowledge, in particular the "diverse" and perhaps altogether underdeveloped theoretical block of such knowledge. Without a relation between mathematical and pedagogical knowledge at the level of theory blocks, "teachers are trained to stay at the 'punctual level' (i.e., limited to particular problems and techniques only) at their future work in classrooms, giving way for an instrumental way of communicating knowledge with their pupils" (ibid.). This situation is illustrated, for example, by the case study described in detail by Barbé et al. (2005), where the incoherent punctual organisations of mathematical practice found in the upper-secondary Spanish classroom are also related to more fundamental inconsistencies in the curriculum. Even if the teacher has sufficient knowledge of the academic mathematics behind the curriculum he teaches, the lack of a coherent, corresponding, and articulated pedagogical organisation of knowledge leaves him with few possibilities to avoid this instrumental approach in the classroom.

A similar divide between academic mathematics and school mathematics (the latter being understood as validated knowledge specifically associated with the development of school education in mathematics) is pointed out by Moreira and David (2005), who study the particular case of the construction of rational and real numbers as they are conceptualised within these two organisations of knowledge. According to them, the formal presentation of rational numbers found in "academic mathematics courses is ultimately dissonant with the forms of knowledge about real numbers found in school teaching practice since it ignores many important pedagogic issues, such as the rationale for extending . . . the notion of number". In case the beginning teacher has mainly been presented to the academic mathematics knowledge organisation—which seems to be the case in the teacher education programme the authors describe—she may then be left to construct such rationales as she best can or to resort to an instrumental approach to teaching in which rationales and coherence are more or less absent.

In fact, the balance—and possible integration—between "academic" mathematics and "school mathematics" in various forms seems to be a concern in several papers presented in this ICMI study. It can be more or less left to the beginning teacher depending on the organisation of her pre-service education and the system of induction (see the next subsection).

Ball, Bass, Sleep, and Thames, (2005) present what they call a "practice-based theory of mathematical knowledge for teaching", consisting of:

- common content knowledge, the mathematical knowledge of the school curriculum (essentially what is aimed at for students);
- specialized content knowledge . . . mathematical knowledge that teachers use in teaching that goes beyond the mathematics of the curriculum itself (and could be needed, e.g., to analyze errors made by students);
- knowledge of students and contents, for instance, about what mathematics students find interesting or challenging and about what students are likely to do with specific mathematical tasks; and
- knowledge of teaching and contents, such as knowledge about instructional sequencing of particular contents, about useful examples for highlighting salient mathematical issues, and about advantages and disadvantages of representations used to teach a specific content idea.

In their session, the authors invited participants to analyse how these knowledge components were needed in classroom teaching, based on video material, and how they differed. They also recognize that the mathematics knowledge it takes to teach it is inadequately understood at present and, one may speculate, accordingly difficult for teachers to develop in their first years of practice, as it would presumably also be taught inadequately in teacher education.

In several studies (e.g., Ma, 1999; Stevenson & Stigler, 2000) the practices of East Asian teachers—such as collaborative "lesson study"—have been pointed out as ways in which teachers, and in particular new teachers, may develop these and similar forms of school mathematics knowledge during their professional lives, through collaborative design and discussion of individual mathematics lessons (with concrete mathematical target knowledge). Teacher development through the Japanese model for lesson study is the topic of several contributions to this ICMI study, such as the work session by Robinson (2005) on lesson study in Israel and the work session by White on lesson study in Malaysia and Australia.

In his paper, Li (2005) describes Chinese teacher education as being largely focused on academic mathematics, in this sense, similar to the Brazilian case described by Moreira and David (2005) and adds, towards the end of his paper, that "Chinese teachers . . . develop profound understanding of fundamental mathematics during their teaching careers". It seems from this contention, as well as from studies such as those by Ma and Stevenson & Stigler, that initial training may not have to take full responsibility for new teachers' development of the elements of school mathematics knowledge described above. This seems to concord with Butlen's conclusion in his contribution on the specialised knowledge which is required to teach

mathematics in disadvantaged areas in France: “Initial training cannot tackle all the specific issues that might pose problems for new beginners; it must therefore be resumed and developed during the early years in post” (Butlen, 2005).

However, perhaps because the opportunities for doing so in pre-service education are typically less developed in most Western countries (see the next subsection), he also says that it is “indispensable to integrate them [knowledge components related to mathematics teaching in schools with many children from disadvantaged backgrounds] into a specific initial training which includes arrangements adapted to analysis of teaching practices”. The distribution of responsibilities between pre-service education and induction during the first years of teaching seems to be a crucial issue for resolving some of the problems for beginning teachers, and it cannot be considered solely as a question of improving our understanding of the problem from an epistemological point of view. It involves, in a salient way, the institutional transition.

3. The Institutional Transition

In the anthropological theory of didactics (Chevallard, 1999; Barbé et al., 2005), teaching and learning are viewed as an activity situated in an institutional setting (Bergsten & Grevholm, 2005), that is, the corresponding practical and theoretical knowledge is fundamentally anchored in institutions as an institutional ecology of knowledge (Chevallard, 1992). In particular, knowledge about mathematics teaching tends to take on more theoretical and disciplined forms when developed, taught, and learned within an academic institution than when it is developed and used within a school.

A shift from seminar (non-academic college) to university-based teacher education has taken place in many countries over the past thirty years in some form and at some levels at least. Bergsten and Grevholm (2005) point out that this may have entailed a widening of the gap between practice and theory blocks of teacher knowledge while on the other hand enabling a more systematic, if not scientific, approach to the knowledge underlying the teaching profession.

> The seminar tradition, by its experience-based mode of reference, is both oriented and constrained to practical blocks, in the disciplinary as well as in the pedagogical realm . . . It is normally only within mathematics and pedagogy as university disciplines that the theoretical levels of its knowledge are discussed . . . These disciplines live in different departments at the university with normally little or no interaction.

After examining briefly how this division has developed in Sweden, the authors conclude that

> didactical research is needed to develop a relevant theoretical block to merge the didactic divide . . . one of the major goals for research in mathematics education is . . . the development of a body of educational knowledge in mathematics, to make teacher education an institution able to work in line with the professional competence paradigm for what it means to be a mathematics teacher in school.

The authors thus call for better alignment of the knowledge development that takes place within universities and schools, and this is set out as a special task for the didactics of mathematics, or mathematics education research, as a third disciplinary component besides mathematics and pedagogy. It must be noted here that this third discipline, as an academic one, is relatively new and has developed in different ways in different institutional contexts. Many mathematics educators are, or have been, active teachers within a primary or secondary school, as is evidenced by the broad range of professional experiences and background that are evidenced by the contributions to this study.

In fact, the direct implication of mathematics education researchers in development projects within schools could be one important venue for creating the institutional alignment mentioned previously and hence to construct a smoother transition for beginning teachers as they move from university to school. The contribution of Wood (2005) is an example of such a project which had as its goal to investigate how primary-school teachers learn to develop their classroom teaching in accordance with reform schemes in the United States. It involved six primary-school teachers in their second year of teaching. Following the suggestions of a researcher, the teachers adopted a three-step model for collegial development devised by Jaworski (1988) involving reflection upon video recordings of their teaching and comparing these to a written record of their plans and expectations prior to the lesson. They were then to devise a "plan of action" to carry out in the classroom based on the results of their reflections. Notice that the elements of the reflection procedure implemented by Wood and her co-researchers bear at least some resemblance with the long-established format of lesson study in Japan (e.g., Stevenson & Stigler, 2000, Chap. 9). However, in lesson study, teachers only occasionally interact with researchers, and more importantly, the design, reflection, and redesign is done collectively rather than individually.

Wood's paper focuses on how each of the teachers learned from this process. While all of the primary teachers began by relying on two models for instruction, a model of students' behavior during instruction and a model of themselves as teachers of mathematics, only some of the teachers were able to create more complex forms of practice, in line with the constructivist views of learning set out by the American reform scheme. These students were characterised by building essentially new models of the ways students made sense of mathematics and then realising a need to transform their ways of teaching. On the contrary, other teachers focused extensively on students' behaviors and external factors and continued to

use the same form of teaching. The experiment thus confirms the need for teachers to go beyond pedagogical schemes for student behaviour, to reflect systematically on students' mathematical thinking in the specific context of a teaching situation. The study also seems to suggest that explicitly asking them to do so may not in itself suffice. However, clearly the existence of frameworks for engaging in such reflections in connection with professional practice could be important, not least for beginning teachers, and they seem to be lacking in many environments (see also the case of Sandra at her rural school in Australia, reported on in the previous chapter).

More generally, there is a huge variation, among systems of education, when it comes to official regulations for the institutional transition from university to school—if they exist at all. In some cases (like that of Sandra) the new teacher is left practically on her own in her practice right after graduation, while in other countries (like China; see Ma, 1999, 137f, as refered to in Li, 2005) a system of mentorship is set up to accompany the new teacher during the first years of teaching. Britton et al. (2003) present study-induction systems in different geographical sites (France, Japan, New Zealand, Shanghai, and New Zealand). In all of these places, they found comprehensive and official frameworks for supporting new teachers in their first years of teaching. There are many and striking differences between these induction systems. In particular, the university of graduation assumes quite different roles within induction processes. For instance, in France, induction is highly standardised (see Sayac, 2005): teachers take up a part-time teaching job along with finishing their last year of teacher education and receive visits and guidance at their school from a designated university-employed mentor. In New Zealand, a variety of support providers are available to the beginning teacher, mainly within the school of employment; the authors mention that some schools achieve the goals of the national induction policies better than others (Britton et al., 2003, p. 191). It appears from the studies in Britton et al. (2003) that induction systems could be very important for the experiences and development of teachers in their first years. However, it seems to be work for the future to undertake a more extensive international comparative study of induction systems.

4. The Personal Transition

Case studies of individual teachers' experiences during their first years of teaching can be used to study more deeply the effects of institutional and epistemological constraints in the teacher profession and in particular the way into it. Small-scale qualitative studies of individual teacher experience are reported on in several contributions to the ICMI study, and some of the cases are about beginning teachers. However, given the short format for contributions, we have only outlines of the details. For instance, the vignettes of the case of the teacher Sandra, which were presented in the previous chapter, are obviously a quite condensed version of her experiences: a lack of opportunities for professional development in a community of practice.

The phenomenon of isolated teacher practice is found in many other studies of beginning teachers, such as Skott (2001), who studies the school mathematical beliefs and practices of a Danish novice teacher who seems to develop these in a similar state of isolation. This may not necessarily be viewed as a problem by the "culture" of teaching:

> Traditionally, Danish teachers have been allowed a considerable degree of freedom with regard to their choice of teaching methods. Combined with loose descriptions of the mathematical contents in the national curriculum . . . and with a weak tradition for collaboration among teachers in each subject, individual teachers are given and left with considerable influence and responsibility in their classroom (Skott, 2001, p. 9).

Stigler and Hiebert (1999, p. 123) mention "the often described isolation of U.S. teachers". The independence of the individual teacher is seen as positive by many teachers, but the authors contend that collaborative research-and-development systems for American teachers—such as those found in Japanese lesson study—would be required to achieve "steady, continuous improvement of teaching" in the United States (p. 127).

Skott (2002) studied another case of how a young teacher may experience a fundamental gap between the ideals and modalities adopted in teacher education, and the constraints and opportunities found (or perceived) in a real-life school. "Here, not only the relative isolation in which the new teacher works, but also the pressure he is under . . . to ensure that the students perform well in the next test" (p. 215) contributes to the teacher's experience that a number of the ideas learned and adopted in pre-service education are just not viable in teaching. This in particular seems to affect possibilities for enacting constructivist principles for teaching.

It seems obvious that the needs for collaborative frameworks are particularly important for the beginning teacher. Teacher students in a university will often be treated to collaborative forms of work, both on theoretical and practical projects, as evidenced by several chapters of this volume. For instance, Gómez (2005) describes how a methods course promoted collective learning for teaching by aiming at constituting a kind of community of practice among the students. One may imagine the disenchantment of new teachers who, after graduation and being hired at a school, are to face the "influence and responsibility" of teaching their classes without substantial interaction with other teachers on how to do so.

5. Concluding Remarks

The first years of teaching can be seen as a transition with many interdependent components: from being a teacher student in a university environment, where mathematics and teaching is often considered in more theoretical ways, to a (more or less autonomous) status of being a professional in a school, in charge of a number of practical problems related to teaching and school mathematics. We have considered a mosaic of studies from different parts of the world which, in various ways, shed light on these transitions. The international perspective seems very important

here, as it may help us to reject the fatalism that often results from a perspective which is confined to a single system of education—where, as one says, "It has always been like that". Needless to say, systems of schooling—including teacher education—display a surprising level of inertia. Looking beyond them may help us recognize that their defaults are not inevitable. This seems in particular to be the case for some of the problems faced by beginning teachers, including isolation and lack of resources for professional growth as a mathematics teacher.

References

Ball, D., Bass, H., Sleep, L., & Thames, M. (2005). *A theory of mathematical knowledge for teaching*. Paper presented at the conference of the 15th ICMI Study on the Professional Education and Development of Teachers of Mathematics, Águas de Lindóia, Brazil.

Barbé, J., Bosch, M., Espinoza, L., & Gascón, J. (2005). Didactic restrictions on teachers practice—The case of limits of functions at Spanish high schools. *Educational Studies in Mathematics, 59*(1–3), 235–268.

Bergsten, C., & Grevholm, B. (2005). *The didactic divide and educational change*. Paper presented at the conference of the 15th ICMI Study on the Professional Education and Development of Teachers of Mathematics, Águas de Lindóia, Brazil.

Britton, E., Paine, L., Pimm, D., & Raizen, S. (2003). *Comprehensive teacher induction. Systems for early career learning.* Dordrecht: Kluwer.

Butlen, D. (2005). *From an analysis of actual teaching practices of new teachers appointed to schools in education priority zones to teacher training strategies*. Paper presented at the conference of the 15th ICMI Study on the Professional Education and Development of Teachers of Mathematics, Águas de Lindóia, Brazil.

Chevallard, Y. (1992). Fundamental concepts in didactics: Perspectives provided by an anthropological approach. In R. Douady, & A. Mercier (Eds.), *Research in didactique of mathematics, selected papers* (pp. 131–167). Grenoble: La Pensée Sauvage.

Chevallard, Y. (1999). L'analyse des pratiques enseignantes en théorie anthropologique du didactique. *Recherches en didactique des mathématiques, 19*(2), 221–265.

Gómez, P. (2005). *Learning in secondary preservice teacher education from the communities of practice perspective*. Paper presented at the conference of the 15th ICMI Study on the Professional Education and Development of Teachers of Mathematics, Águas de Lindóia, Brazil.

Jaworski, B. (1988). Investigating your own teaching. *Unit 5 of ME234, using mathematical thinking.* Milton Keynes: The Open University.

Li, S. (2005). *Two features of teacher preparation in China*. Paper presented at the conference of the 15th ICMI Study on the Professional Education and Development of Teachers of Mathematics, Águas de Lindóia, Brazil.

Ma, L. (1999). *Knowing and teaching elementary mathematics: Teachers' understanding of fundamental mathematics in China and the United States.* Mahwah: Lawrence Erlbaum.

Moreira, P., & David, M. (2005). *Mathematics in teacher education versus mathematics in teaching practice: A revealing confrontation*. Paper presented at the conference of the 15th ICMI Study on the Professional Education and Development of Teachers of Mathematics, Águas de Lindóia, Brazil.

Padilla, M., & Raley, J. (2003). Guiding the new teacher: induction of first year teachers in Japan. In Britton et al. (Eds.), *Comprehensive teacher induction. Systems for early career learning* (pp. 194–260). Dordrecht: Kluwer.

Robinson, N. (2005). *Lesson study: an example of its adaptation to Israeli middle school teachers*. Paper presented at the conference of the 15th ICMI Study on the Professional Education and Development of Teachers of Mathematics, Águas de Lindóia, Brazil.

Sayac, N. (2005). *A scheme for the initial education of teachers: analysing practices during professional workshops*. Paper presented at the conference of the 15th ICMI Study on the Professional Education and Development of Teachers of Mathematics, Águas de Lindóia, Brazil.

Skott, J. (2001). The emerging practices of a novice teacher: The roles of his school mathematical images. *Journal of Mathematics Teacher Education, 4*, 3–28.

Skott, J. (2002). Belief research and the actual and virtual communities of a novice teachers' practice. In A. Cockburn & E. Nardi (Eds.), *Proceedings of the 26th annual conference of PME* (Vol. 4, pp. 209–216). Norwich: University of East Anglia.

Stevenson, H., & Stigler, J. (2000). *The teaching gap. Best ideas from the world's teachers for improving education in the classroom.* New York: The Free Press.

Stigler, J., & Hiebert, J. (1999). *The teaching gap. Best ideas from the world's teachers for improving education in the class room*. New York: The Free Press.

Tatto, T., Paine, L., & Schwille, J. (2005). *Analyzing the relation between theory and practice in three country case studies*. Paper presented at the conference of the 15th ICMI Study on the Professional Education and Development of Teachers of Mathematics, Águas de Lindóia, Brazil.

White, A. (2005). *Lesson study in two countries: What can we learn?* Paper presented at the conference of the 15th ICMI Study on the Professional Education and Development of Teachers of Mathematics, Águas de Lindóia, Brazil.

Wood, T. (2005). *Developing a more complex form of mathematics practice in the early years of teaching*. Paper presented at the conference of the 15th ICMI Study on the Professional Education and Development of Teachers of Mathematics, Águas de Lindóia, Brazil.